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**Coherence of Conservation and Development Policies of Coastal and Marine
Protected Areas in West Africa**

**Cohérence des politiques de conservation et de développement des aires
protégées marines et côtières en Afrique de l'Ouest**

**Coerência das políticas de conservação e de desenvolvimento das áreas
protegidas marinhas e costeiras na Africa Ocidental**

BIBLIOGRAPHY ON MARINE PROTECTED AREAS

General and West African references

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6. CORAL REEF

Boudouresque, C. F. et al. (1975). Végétation marine de Île de Port-Cros (Parc National). 10. La régression du récif-barrière de posidonies. *In: Travaux Scientifiques Du Parc National De Port-Cros*, (1), 41-46.

Abstract: This study is based on critical examination of old photographs, recent aerial photographs to which were added fishermen memories and underwater observations. An attempt to map the barrier-reef of *Posidonia oceanica* (L.) Delile at the beginning of the century, and a comparison with its present time area makes it clear that it has considerably regressed

Rubeli, K. et al. (1976). Special symposium issue on role and management of national parks. *In: Malayan Nature Journal*, 29(4), 213-343.

Abstract: A series of papers given at the symposium held in July 1976 in Malaya, including: Rubeli, K. Taman Negara [National Park] - present demands and future pressures. [1 ref.]; Lim, W. C. Why have national parks or nature reserves? [16 ref.]; Jenkins, D. V. National parks in Sabah - for whom and for what? [5 ref.] An official policy statement; Lampie, E. Problems in the second century of United States national park management; Musa bin Nordin Walking trails in Taman Negara; Stone, B. C.. A proposal for a Malaysian National Park Service; Jenkins, D. V. Present and future national parks in Sabah. [14 ref.] Notes on the origin of the Kinabalu National Park (as a war memorial) and the Tunku Abdul Rahman National Park (coral reefs), and on several proposed new parks; Langham, N. P. E. The need for marine parks and reserves in Malaysia. [18 ref.]; Ong, J. E.; Dhanarajan, G. On a national park for Pulau Pinang; Ding, C. H. Proposal for an integrated plan of a national park in Perak. [12 ref.]; Rubeli, K. The Tembeling hydro-electric project from the Taman Negara viewpoint. [4 ref.]; Jacobs, M; Wilde, W. J. J. O. de Botanical exploration in the Gunung Leuser Nature Reserve (Acheh, Indonesia). Notes on high-montane moors in N. Sumatra.

Dustan, P. (1977). Besieged reefs of Florida's Keys. *In: Nat. Hist. N.Y.*, 86(4), 72-76.

Abstract: In the early 1960's the first underwater park in the USA was opened encompassing >100 square miles of sea floor off Key Largo, Florida. Within its boundaries are 35 species of coral and >500 species of fish. The collecting of corals and fish is forbidden within the park, but line fishing, lobstering and commercial fishing are permitted. The coral reefs in the area are now threatened by scuba diving, snorkeling and leisure boating especially the anchoring of small boats. One possible solution is to affix permanent moorings to the sea bottom. Another possibility is to mark the reef with a circle of bouys and forbid anchoring within that circle. Whatever the scheme some effort should be made to protect the reefs now, for these delicate ecosystems cannot long endure man's continuing pressure

Werding, B., & Koster, F. (1977). The Coral Formations of the Northern Coasts of Columbia. A Conservation Problem ? International Seminar On The Present Problems Of Marine Ecology And The Future Of Man.. Seminario Internacional Sobre Problemas De La Ecologia Marina Actual Y El Futuro Del Hombre Santa Marta Colombia : Inst. Invest. Mar. Punta Betin

Abstract: A general description is given of what is known and of the investigations being carried out on the coral reefs of the northern part of Columbia. The contamination and destruction that these are subject to is discussed. The Tayrona National Park has already been established in this area, but the conservation of the coral reefs is still a considerable problem

Wilkinson, W. A. (1977). Marine conservation in Tonga. *In: SPC Fish. Newsl.*, (15), 54-56.

Abstract: The needs of an increasing population, coupled with changed fishing methods, have placed excessive pressures on the resources of the reefs and lagoons of Tonga. In some areas destruction of reef habitats and over-exploitation of fish-stocks has resulted. A large marine reserve has been established in Fanga'tua Lagoon. Two outlying islands, Malinoa and Monuafe have also been declared reserves and a destructive form of reef fishing called tu'afeo has been banned

Augier, H., & Boudouresque, C. F. (1978). Végétation marine de l'île de Port-Cros (Parc National). 16: Contribution à l'étude de l'épiflore du détritique côtier. *In: Travaux Scientifiques Du Parc National De Port-Cros*, (4), 89-100, Incl. bibliogr.: 53 ref.

Abstract: One hundred and six species of Bryopsidophyceae, Chlorophyceae, Phaeophyceae and Rhodophyceae are listed from these bottoms. Some of these are characteristic of the *Phymatolithon Mesophylletum phytocenosis: Phymatolithon calcareum, Mesophyllum coralloides, Cryptonemia tunaeformis, Peyssonnelia rosa marina fa. rosa marina, Sebdenia dichotoma, Kallymenia spathulata, etc. Vidalia volubilis, Rytiphloea tinctoria and Peyssonnelia rosa marina* are often abundant

Hay, L. (1978). The Great Barrier Reef Marine Park. *In: Australian Parks and Recreation*, 21-25.

Abstract: The Park Authority was established in 1975. Its duties include recommending areas for inclusion in the Park, preparing zoning and management plans. A study is being made of the current uses of the Great Barrier Reef Region. It is particularly concerned with the Capricornia Section containing reefs and shoals forming a distinct geographical unit, and which is subject to the most intense recreational and tourist use. There is widespread support for setting aside areas for 'non-extractive' (passive) recreation and for research, while managing the majority of Reef areas by rotational zoning.

Leung, A. (1978). Post-harvest handling of live marine fish in Hong Kong. *In: Proc. IPFC*, 18(3), 128-135.

Abstract: In 1976 the annual production of live marine fish in Hong Kong was estimated at 2,070 tonnes and valued at US -dollar-10.62 million. Three quarters of these fish are produced by the capture fishery sector and the remainder by the culture fishery sector. The capture fishery sector consists basically of longliners and gill-netters and exploits fish from the accessible coral reef areas. The culture fishery sector produces live fish mostly by cage culture. The pattern of post-harvest handling and marketing is similar for both capture and culture fish although the former involves more elaborate handling procedures. At present, the mortality due to post-harvest handling of the capture fish is substantial. Improvement of the fishing methods, the design of vessels and, in particular, the seawater circulation system used on board such vessels can reduce handling and transport mortalities. The condition of the seawater in which fish are kept alive for wholesaling should be favourable to the survival of the fish. The possible use of a tranquillizer to avoid excessive injury to the fish during handling should also be studied.

Saunders, G. W. (1978). National Parks in the area and adjacent areas. Workshop on the northern sector of the Great Barrier Reef. Papers and proceedings of a workshop held in Townsville, Australia 20 and 21 April, 1978 Great Barrier Reef Marine Park Authority *Workshop Series GBRMPA: Vol. 1.*

Abstract: The region adjacent to the Great Barrier Reef contains widespread and diverse natural areas which on present world standards must be regarded as almost pristine. The history, flora and fauna of existing and proposed national parks and their significance for nature conservation purposes are set out. Management of these areas cannot be divorced from

management of the surrounding waters, reefs and submerged lands.

Wilkinson, W. A. (1978). Marine conservation in Tonga. *In: Tigerpaper*, 5(2), 14-15.

Abstract: Brief descriptions are provided of the marine reserves and parks recently established in Tonga. Visitors are required to observe basic rules of conservation and observe fish and coral formations in their natural habitat.

Wilson, J. (1978). Tourist and recreation activity in the northern section of the Great Barrier Reef. Workshop on the northern sector of the Great Barrier Reef. Papers and proceedings of a workshop held in Townsville, Australia 20 and 21 April, 1978 [s. l.]: Great Barrier Reef Marine Park Authority *GBRMPA Workshop Series: Vol. 1*.

Abstract: The impact of tourist and recreational activities on the region and future trends are briefly considered. Much of the tourist appeal is attributable to the Great Barrier Reef, but the impact on the reef is, at present minimal because the number of persons is fairly small, ships and boats on passage are confined to the main shipping channels, and most people fall within the control of charter boat operators or the management of a resort, both of whom take a generally responsible attitude towards reef use.

Winterbottom, R. (1978). Range extensions and additions to the South African marine ichthyofauna, with the description of a new species of congrogadid from Kwazulu. *In: Zool. Afr.*, 13(1), 41-56.

Abstract: Range extensions for 17 species of marine fishes are recorded, and a new species of congrogadid is described. Of the new records, 12 are new to South Africa or are here reported to have a greater range within South Africa than previously recorded, and 4 have not been reported from the Indian Ocean before (*Plectroglyphidodon phoenixensis*, *Gymnothorax fuscomaculatus*, *Samariscus triocellatus* and *Synodus engelmani*). *Halimuraena shakai* sp.nov. is described on the basis of 23 specimens taken in 12-15 m of water from the reef off Sodwana Bay, Kwazulu. *Emmelanthias stigmapteron* is redescribed on the basis of 2 additional specimens (previously only known from the holotype), and 3 more specimens of *Batrachthys felinus* are reported (previously known from 4 specimens).

[Anon.]. (1979). Census of existing coral reef parks. *In: Newsletter, Coral Reef Group*, (2), 8-15.

Abstract: Coral reef parks arranged according to geographical area are listed

Feeley, M. T., Filer, D. L., & Schwartz, L. (1979). Zooplankton emerging from a Philippine coral reef: a preliminary study. *In: J. Asian Ecol.*, 1, 51-56.

Abstract: Plankton samples were collected by means of a special plankton trap every 6 h over a period of 48 h from 4 substrates in a marine reserve area. The substrates examined were rose coral, branching coral, coral rubble, and coral sand. Different groups of organisms differed in vertical migration patterns and substrate preferences. More taxonomic groups migrated into the water column at night, although the total number of organisms was greater during the day over all substrates except rose coral. The largest total number of plankton for day and night samples was collected over rose coral. Copepod nauplii constituted a significant portion of all day samples. Although copepods formed the greatest number of organisms over all substrates at all times, they constituted a much lower percent of the samples. The three different developmental stages of copepods occupied special and temporal niches, an arrangement which may reduce or eliminate competition and/or predation.

Palmer, H. D. (1979). Georges Bank attracting industry interest. *In: Pet. Eng. Int.*, 51(12), 108.

Abstract: Georges Bank is once again scheduled for sale. Sale 42, to be held in Providence,

R.I., Oct 30, will offer 128 tracts consisting of 728,728 acres from 63 to 157 miles off southeastern New England. Water depths range from 117 to 1,190 ft. Continuing concern is evident in recent reports by the Department of Commerce which stress the need to delete certain tracts, and various proposals establishing marine sanctuaries within the lease area have been made by NOAA. In spite of the uncertainty surrounding Sale 42, interest in this area is believed to be high. Unlike the Baltimore Canyon region to the south, Georges Bank structure consists of numerous faulted basins in Triassic and Carboniferous bedrock. Jurassic age sediments within these depressions may be as thick as 6,500 ft, and geophysical studies suggest these materials are limestones and dolomites in the central and southeastern portions with shales and sandstones in the northwest. The most promising prospects for production are believed to lie in an equal thickness of Lower Cretaceous sandstones, shales, and limestones. Data from the two COST wells (G-1 and G-2) drilled on the bank still are classed as proprietary, and only shallow coring operations have been published by USGS. Potential traps include major unconformities, buried reefs, and stratigraphic traps. Farther to the north, pay zones have been drilled on the Canadian Scotian Shelf, and similar structures in that region (plus traps above salt domes) lend support to optimism regarding Georges Bank.

Salvat, B. (1979). Trouble in paradise. Part 2. Coral reef parks. *In: Parks*, 4(1), 1-4, 5 ref.

Abstract: The development of underwater recreational activities gives growing importance to coral reefs but also brings the threat of over-exploitation of the stocks of economically interesting species as well as a degradation of the environment. The advantages of establishing marine parks and reserves are examined, including the development of recreational activities, and the use of the parks as a source of recruitment for naturally restocking exploited surroundings. The objectives and planning of coral parks are discussed.

Sodero, D. E., & Hobson, J. P. Jr. (1979). Depositional facies of lower paleozoic Allen Bay carbonate rocks and contiguous shelf and basin strata, Cornwallis and Griffith Islands, Northwest Territories, Canada. *In: Am. Assoc. Pet. Geol. Bull.*, 63(7), 1059-1091.

Abstract: Allen Bay and overlying Read Bay shelf carbonate rocks and their lateral northward transition to basinal clastic rocks of the Cape Phillips are well exposed on Cornwallis and Griffith Islands. Allen Bay carbonates (1830 m thick) consist of dolomite. Brachiopods suggest a Silurian age for the middle and upper Allen Bay. Detailed outcrop studies recognised 5 main depositional facies and 15 lesser facies. Facies changes are described in terms of transitional depositional stages. Deposition environments ranged from restricted interior algal flats and sabkha islands to unrestricted basins. Normal marine deposition on the carbonate shelf and shelf edge occurred in both high- and low-energy environments. During lower Allen Bay deposition slopes were low between shelf and basin, but may have been more pronounced through middle Allen Bay deposition when a dolomitized shelf-edge reef complex provided an effective barrier. The sedimentation rate of basin and slope kept pace with that of the shelf throughout deposition. The thermal alteration of organic matter in the Allen Bay and transitional Allen Bay-Cape Phillips facies appear to have been optimum for oil and gas generation. Allen Bay porosity values are greater at the shelf edge and in dolomitized carbonate sands and patch reefs of the interior shelf. Porosity reduction shelfwards is related to transition from dolomitized sand to finer, protected-shelf and algal-flat facies. Dolomitization is related to interstratal mixing of marine and hypersaline water with fresh water.

Boudouresque, C. F., Giraud, G., & Panayotidis, P. (1980). Végétation marine de l'Île de Port-Cros (Parc National). 19: Mise en Place d'un Transect Permanent. *In: Travaux Scientifiques Du Parc National De Port-Cros*, (6), 207-221.

Abstract: The 150 m transect runs over a *Cymodocea nodosa* lagoon, a barrier-reef of *Posidonia oceanica*, a dead mat of *Posidonia* and *Posidonia* herbier. Every 20 or 100 cm along

the transect, accurate measures of depth, *Posidonia* shoot densities and shoot barings were carried out, in addition to identification of the dominant species.

Jones, R. S., & Cotterell, C. C. (1980). Recreation, wildlife and nature conservation. (p. 18pp.; 2 maps.). [s. l.]: [s. n.].

Abstract: Prepared for the Eleventh Commonwealth Forestry Conference, the pamphlet outlines the most important facilities available in the country for recreation, wildlife and conservation enthusiasts and describes the proposed national parks including the mountain ranges and lowland areas of unique, dry scrub and limestone forests. It further deals with beaches, marine parks, scenic roads and trails, botanical gardens, caves, spas, rivers, coral reefs, and nature preserves. The existing problems of management of the resources are discussed and some solutions outlined. The latter include the training of personnel, planning and implementing development strategies by both government and private individuals, advertising, rationalizing of a single development agency and a more authoritative government land use policy.

Ormond, R. (1980). Management and conservation of Red Sea habitats. Proceedings Of The Symposium On The Coastal And Marine Environment Of The Red Sea, Gulf Of Aden And Tropical Western Indian Ocean, Khartoum, 9-14 January 1980

Notes: Incl. 10 refs.

Abstract: The findings of a project concerning the development of recommendations for long-term conservation of shallow waters, littoral and maritime habitats of the Red Sea are presented. Following a discussion of various factors having environmental impact on coral reefs and other communities in the Red Sea, a rationale for marine conservation is given. Management considerations and conservation strategies for the Red Sea are described. Potential sites for marine parks and reserves are outlined. (Publ. in coop. with: UNESCO Div. of Marine Sciences, Paris (France); Saudi-Sudanese Red Sea Joint Comm., Jeddah (Saudi Arabia)).

Risk, M. J., Murillo, M. M., & Cortes, J. (1980). Observaciones Biologicas Preliminares Sobre el Arrecife Coralino en el Parque Nacional de Cahuita, Costa Rica. *In: Revista De Biologia Tropical*, 28(2), 361-382.

Abstract: Preliminary investigation at Cahuita National Park, Costa Rica suggests that the reef is in a state of decline. The number of coral species is less than half that recorded for other Caribbean areas. Growth rates of individual coral heads may be, however, as high as in other areas. Boring sponges are ubiquitous, but only 4 species were found. A series of descriptions and sketches are given of the various reef habitats represented in the park. Evidence from coral growth habits and species composition, direction of longshore drift, and sediment studies suggest that heavy sediment loading may be responsible for the present state of the reef.

Shinn, E. A. (1980). Geologic history of Grecian Rocks, Key Largo Coral Reef Marine Sanctuary. *In: Bulletin of Marine Science*, 30(3), 646-656.

Abstract: Grecian Rocks Reef is composed of five major ecologic zones: (1) a deep seaward rubble zone ranging in depth from 6-8 m; (2) a poorly developed spur and groove zone composed of massive head corals and *Millepora*- (4-6 m water depth); (3) a characteristic high-energy oriented *Acropora palmata*- zone extending from the surface down to 4 m; (4) a distinct broad reef flat composed of in situ *A. palmata*- and coral rubble, followed by (5) a narrow low-energy back-reef zone of unoriented *A. palmata*- thickets of *A. cervicornis*-, and various massive head corals in water 0-3 m deep. An extensive grass-covered carbonate sand flat 3-4 m deep extends in a landward direction from zone 5. Cores revealed that all the zones except the massive coral head zone are superficial coatings over a carbonate sand and rubble accumulation. A thin 1-m thick layer of lime mud and peat was found 11.5 m below sea level

on the Pleistocene bedrock beneath the sand and rubble in the reef flat core hole. Carbon-14 analyses of coral from 7 m below the reef surface indicate that the reef began growing approximately 6,000 years before present

Akimichi, T. (1981). Perception and Function: Traditional Resource Management in Three Pacific Islands. *In: Resource Management and Optimization*, 1(4), 361-378.

Abstract: Traditional marine resource systems in the tropical Pacific are described with reference to three selected islands: Palau, Satawal (Micronesia) and Malaita (Melanesia). A generalized resource model in coral habitats is compared functionally with the perceived models to understand congruency. Strategic use of time and space, and cognition of food as resources, are the major interests concerned. Ecological diversities and cognitive similarities in the use of resources are an important element in the study of traditional resource systems.

[Anon.]. (1981). Great Barrier Reef Marine Park zoning plan implemented. *In: Aust. Fish.*, 40(9), 24-26.

Abstract: The zoning plan and regulations for the first section of the Great Barrier Reef Marine Park - the Capricornia Section - are described

Bryceson, I. (1981). A Review of Some Problems of Tropical Marine Conservation With Particular Reference to the Tanzanian Coast. *In: Biological Conservation*, 20(3), 163-171.

Abstract: The productivity, diversity and susceptibility to stress of tropical marine communities are compared with those of temperate marine communities. The question of the importance of conservation is raised. The applicability of island biogeographical theories in relation to the design of marine reserves is briefly reviewed. It is suggested that the contention that conservation areas should always consist of the largest possible single area is not necessarily correct for the tropical marine environment. Conservation problems of particular habitats within Tanzanian coastal waters are detailed with special reference to the following: coral reefs, rocky intertidal platforms, cliffs, sandy beaches, sandy-muddy tidal flats, seagrass beds, mangroves, estuaries and small islands. The plight of some endangered species is discussed. Conclusions are drawn regarding the present status of marine conservation in Tanzania.

Castaneda, P., & Mclat, R. I. (1981). The municipal coral reef park in the Philippines. Proceedings of the 4th International Coral Reef Symposium

Abstract: The importance of coral reefs to an archipelagic country like the Philippines cannot be overemphasized. Coral reefs provide shelter, spawning, nursery and feeding grounds for various edible and commercially important marine organisms, thus providing an important source of protein. Presently, Philippine coral reefs are subjected to various stresses and perturbation and over-exploitation. Marine parks are now being established to give protection to significant portions of our coral reef areas. Because of the geographical and socioeconomic situation of the country, management of marine parks on conventional modes is rendered difficult if not impossible. It is in this context that a municipal coral reef park was conceptualized. The system calls for the establishment of small protected areas managed and protected by the local government which will complement the national marine park system being envisioned for the country.

Davis, G. E. (1981). On the role of underwater parks and sanctuaries in the management of coastal resources in the Southeastern United States. *In: Environmental Conservation*, 8(1), 67-70, 1 fig., 1 tab., 25 ref.

Abstract: This paper reviews the current state of protection that is accorded to marine resource parks, national monuments and sanctuaries in the southeastern United States. Coral reefs

provide most of the examples cited, but the discussion has broader applications to most, if not all, coastal resources. Aquatic resources in parks and reserves are not as well protected as comparable terrestrial resources. Their value as genetic material and 'emotional' reserves is therefore diminished. There is a wide variation between parks in the degree of protection according to aquatic resources. The consequences of permitting consumptive uses of aquatic resources in parks and reserves need to be objectively evaluated.

Done, T. J., Kenchington, R. A., & Zell, L. D. (1981). Rapid, large area, reef resource surveys using a manta board. The Reef And Man. Proceedings Of The Fourth International Coral Reef Symposium. Volume 1. (pp. 299-308). [s. l.]: [s. n.]

Abstract: Visual survey techniques originally developed for studies of crown-of-thorns starfish have been further developed to provide a technique of resource assessment for the Great Barrier Reef Marine Park Authority. The technique has been applied to 82 reefs of the Great Barrier Reef and has recorded descriptions of substrate, live and dead hard coral cover, soft coral and algal cover, hard coral mean colony size, and species diversity. The relative abundance of the visually dominant organisms in the benthic community has also been recorded.

Eiseman, N. J. (1981). Algae . Key Largo Coral Reef National Marine Sanctuary Deep Water Resource survey Washington, DC: NOAA/OCZM NOAA tech. Rep.:

Gore, R. H. (1981). Decapod crustaceans. Key Largo Coral Reef National Marine Sanctuary Deep Water Resource survey Washington, DC: NOAA/OCZM NOAA tech. Rep.:

Hudson, J. H. (1981). Growth Rates in *Montastraea annularis* : A Record of Environmental Change in Key Largo Coral Reef Marine Sanctuary, Florida. In: Bulletin of Marine Science, 31(2), 444-459.

Abstract: Annual growth rates of *Montastraea annularis* over the last 50+ years were determined for inshore, midshore, and offshore reef areas within the Key Largo Capra; Reef Marine Sanctuary, Florida. In this study, 144 massive heads of *M. annularis* were sampled by coring and their growth history examined, using X-radiography to facilitate accurate measurement of more than 7,000 individual annual growth increments. Key elements affecting growth and survival of *M. annularis* in the sanctuary appear to be water depth, turbidity, and temperature. *Montastraea annularis* from offshore fore-reef areas grew most slowly, averaging only 6.3 mm of vertical growth per year from 1928 to 1978. Many cores at this location reveal a long history of environmental stress indicated by numerous healed-over "die-off" voids excavated by various boring organisms, principally boring sponges

Jaap, W. C. (1981). Stony corals (Milleporina and Scleractinia). Key Largo Coral Reef National Marine Sanctuary Deep Water Resource survey Washington, DC: NOAA/OCZM NOAA tech. Rep.:

Jameson, S. C. (1981). Archaeology. Key Largo Coral Reef National Marine Sanctuary Deep Water Resource survey Washington, DC: NOAA/OCZM NOAA tech. Rep.:

Jameson, S. C. (1981). Biological zonation. Key Largo Coral Reef National Marine Sanctuary Deep Water Resource survey Washington, DC: NOAA/OCZM NOAA tech. Rep.:

Jones, R., & Clark, M. K. (1981). Fishes. Key Largo Coral Reef National Marine Sanctuary Deep Water Resource survey Washington, DC: NOAA/OCZM NOAA tech. Rep.:

Kelleher, G. G. (1981). Research needs for coral reef management planning. The Reef And

Man. Proceedings Of The Fourth International Coral Reef Symposium. Volume 1. (pp. 231-236).

Abstract: The Great Barrier Reef Marine Park Authority is a coral reef management planning body. One of its statutory functions is the conduct of research relevant to the Great Barrier Reef Marine Park. The Authority conducts the majority of its research by contract with other agencies. In developing its research program the Authority has had to develop a means of assessing research priorities. This paper discusses the role of research in marine park planning and management related priorities in coral reef research.

Mikkelsen, P. M. (1981). Mollusks. Key Largo Coral Reef National Marine Sanctuary Deep Water Resource survey Washington, DC: NOAA/OCZM NOAA tech. Rep.:

Miller, J. (1981). Echinoderms. Key Largo Coral Reef National Marine Sanctuary Deep Water Resource survey Washington, DC: NOAA/OCZM NOAA tech. Rep.:

Newton, E. C., & Hof, T. v. (1981). The distribution of black corals along Bonaire. 16th Meeting Of The Association Of Island Marine Laboratories Of The Caribbean Vol. 16 (p. 14). [s. l.]: [s. n.].

Notes: Summary only.

Abstract: A survey of black coral around Bonaire was conducted for resource management. In 49 vertical transects 10 m wide, from the surface to 60 m, the number of colonies belonging to 2 species has been counted per 5 m depth interval, distinguishing 6 size classes. The 2 species are a possibly undescribed bushy species with resemblance to *Antipathes dichotoma* Pallas as redescribed by Brook and *A. pennacea* Pallas as redescribed by Opresko, a flabellate species. The former species is most used in jewellery manufacture. The total number of *A. cf. dichotoma* is considerably lower than that of *A. pennacea*, but generally they have similar fluctuations in the horizontal distribution. The windward side of the island has far less numbers of these species and *A. cf. dichotoma* is often absent. The optimal depth for *A. pennacea* is deeper (40-45 m) than for *A. cf. dichotoma* (25-30 m), with a maximum depth of 60 m for *A. cf. dichotoma*.

Pichon, M., & Morrissey, J. (1981). Benthic Zonation and Community Structure of South Island Reef, Lizard Island (Great Barrier Reef). Second International Symposium On Biology And Management Of Tropical Shallow Water Communities Coral Reefs, Bays And Estuaries, 20 July 2 August 1980, Papua New Guinea Miami, FL USA: Rosenstiel School of Marine and Atmospheric Science

Abstract: South Island Reef is a coral reef extending over 1.8 km between South Island and Bird Islet, immediately south of Lizard Island. The reef is exposed to southeast trade winds but is protected from heavy swell by the outer Barrier Reef lying some 12 miles offshore. Benthic zonation and community structure of South Island Reef were studied, with special reference to two of the most conspicuous benthic groups, which are also two of the most important primary producers, scleractinian corals and algae. Quantitative information was obtained for scleractinian corals by the use of the line transect intercept method. Numerical analysis of the data collected indicates that the coral assemblages of the slopes are markedly different from those of the reef flat. A zonation pattern is defined on the reef flat. The various coral assemblages show very unequal development, and most of the reef flat corresponds to a unit in which the subdivisions suggested by the numerical analysis do not represent drastically different coral communities.

Pomponi, S. A. (1981). Sponges. Key Largo Coral Reef National Marine Sanctuary Deep Water Resource survey Washington, DC: NOAA/OCZM NOAA tech. Rep.:

Robinson, A. et al. (1981). Progress in Creating a Marine Reserve System in Indonesia. Second International Symposium On Biology And Management Of Tropical Shallow Water Communities Coral Reefs, Bays And Estuaries, 20 July 2 August 1980, Papua New Guinea Miami, FL USA: Rosenstiel School of Marine and Atmospheric Science

Abstract: Indonesia, the world's most heavily populated archipelago, has begun to take steps toward understanding and managing its substantial marine resources. As one part of an integrated program of marine conservation, a system of marine reserves is in the preliminary planning stage. This system will include recreational marine areas, such as the proposed Pulau Seribu Conservation Area near Jakarta, as well as areas suited to special interest international tourism, such as Pulau Menjangan in Bali. The system will also involve integrating adjacent marine ecosystems into existing or proposed terrestrial reserves, where such marine resources are an important ecological component themselves, or where they may provide a significant buffer to the terrestrial reserve. The Komodo National Park is an example of such an island sea complex.

Shinn, E. A. (1981). Geology. Key Largo Coral Reef National Marine Sanctuary Deep Water Resource survey Washington, DC: NOAA/OCZM NOAA tech. Rep.:

Soegiarto, A. (1981). The development of a marine park system in Indonesia. Proceedings of the 4th International Coral Reef Symposium (pp. 288-291).

Abstract: For centuries the Indonesian people have used the marine environment for many purposes: transportation, trade and communication, recreation, sources of food and minerals. Unfortunately, however, the Indonesian marine environment is under heavy stress due to pollution and other destructive forces. In order to ensure the quality of the marine environment as a whole, a master plan for a marine park system is being developed in Indonesia. This master plan is an integrated part of the Nature Conservation Program in Indonesia. Basic criteria to develop marine parks and conservation areas have been established. Currently, more than 40 potential sites are under study to evaluate the feasibility of establishing them as marine parks and conservation areas. A national commission on Marine Park Systems has been formed for this purpose. International organizations and UN specialized agencies, such as World Wildlife Fund, Food and Agriculture Organization, UNESCO, and UNDP, cooperate and assist with this program. This paper briefly reviews the plan, the implementation and constraints of the marine park development in Indonesia.

Wheaton, J. (1981). Octocorales (Octocorallia: Gorgonacea). Key Largo Coral Reef National Marine Sanctuary Deep Water Resource survey Washington, DC: NOAA/OCZM NOAA tech. Rep.:

Alcala, A. C., Gomez, E. D., & Alcala, L. C. (1982). Survival and growth of coral transplants in central Philippines. In: Kalikasan , 11(1), 136-147.

Abstract: Fragments of scleractinian corals, hydrocorals, and octocorals in Sumilon Marine Park and in Bantayan, Dumaguete, central Philippines were transplanted in denuded portions of shallow coral reefs in these localities in 1979 and 1980. Their survival and growth rates were observed. Yearly survival rates for species ranged from 18 to 100%; overall rates were 40% for the Sumilon transplants and 71% for the Bantayan transplants. Yearly growth rates of the survivors were also variable; the fastest growers increased from 10 to 20 cm in diameter

Busch, W. S. (1982). Marine science laboratories move into the sea. Proceedings Of The Sixth Meeting Of The United States Japan Cooperative Program In Natural Resources Ujnr. Panel On Diving Physiology And Technology, Menlo Park And Catalina Island, California, October 20-26, 1981 (pp. 241-251).

Abstract: Research opportunities in tropical island waters, on a mid-Pacific archipelago, amidst temperate water kelp forests, and on the Atlantic continental shelf have been opened up with the aid of the National Oceanic and Atmospheric Administration's Undersea Research Program. The facilities are as diverse as the marine ecosystems they serve - a submersible which will allow two scientists to explore the depths to 1200 feet....a habitat sitting on the seafloor within a giant kelp forest and functioning as a home and laboratory for six aquanauts....a habitat in tropical waters allowing four scientists to monitor the life of a coral reef....a research ship supporting scientific divers tethered to a depth of 120 feet along the U.S. continental shelf. Research areas include studying the effects of pollution and ocean dumping, devising methods of extracting energy from the oceans, protecting marine mammals, answering questions about marine geology and the composition of the continental shelf, and using bioactive substances in drug development. One habitat, the HYDROLAB, located in St. Croix, U.S. Virgin Islands has supported over 152 scientists from 35 universities and institutions

Goeden, G. B. (1982). Intensive fishing and a 'keystone' predator species: ingredients for community instability. *In: Biological Conservation*, (22), 273-281.

Abstract: A series of surveys of demersal fish stocks were carried out along the Great Barrier Reef in order to assess their condition and to investigate the effects of fishing on the large-predator community. Results from the surveys indicate that a significant relationship exists between the abundance of a keystone predator species and the distance from major human population centers. Removal of this predator through fishing has the effect of bringing about changes in the relative abundance of other large predatory species including several that do not comprise part of the usual catch. Although the changes in community structure are apparently unpredictable, it is possible to calculate a measure of community flux which reflects the rate of this change relative to variations in the abundance of the keystone species

Kelleher, G. and Kenchington, R. A. (1982). Australia's Great Barrier Reef Marine Park; Making development compatible with conservation. *In: Ambio*. (11):262-267.

Miller, J. W. (1982). The use of recreational divers for the collection of marine resource data. Proceedings Of The Sixth Meeting Of The United States Japan Cooperative Program In Natural Resources Ujnr. Panel On Diving Physiology And Technology, Menlo Park And Catalina Island, California, October 20-26, 1981 (pp. . 267-273).

Abstract: The Florida Institute of Oceanography (FIO) has developed a program (SEAWATCH) that will utilize supervised volunteer recreational divers, trained by qualified marine scientists, to collect data on the aquatic environment. The SEAWATCH Program will offer the opportunity for public agencies, local administrations, private enterprises, and research institutions to obtain, in a cost-effective manner, data essential for making informed administrative and technical decisions affecting marine resources. Examples of the data that can be acquired by recreational divers include: (1) early detection of environmental changes and trends, (2) stock assessment of finfish and shell fish, (3) surveys of plants and animals, (4) monitoring of natural and artificial reefs, (5) water samples, (6) measurements of water clarity, (7) assessment of the effects of pollution on the marine environment.

Ryland, J. S. (1982). Introduction to the Coral Reefs of Fiji. Proceedings Of The Seminar Workshop On Utilization And Management Of Inshore Marine Ecosystems Of The Tropical Islands, November 24 30, 1979, University Of The South Pacific, Suva, Fiji (pp. 13-22).

Abstract: The Fiji islands are surrounded by a maze of reefs, the physical importance of which cannot be over-estimated: as barriers to the ocean they provide protective ramparts, harbors and anchorages; as traps they retain detritus from the land, provide productive lagoons supportive of various fisheries, and facilitate the formation of the alluvial coastal plains. Fringing reefs are

narrow and skirt the margins of continental lands and "high" islands. They are within the shelter of barrier reefs where the shore itself is protected from wave action. The barrier reefs may be considered as of two basic types: first, the oceanic ribbon reefs such as the Great Sea Reef, Beqa Barrier Reef, Great Astrolabe Reef and some of the Lau Group barrier reefs. These enclose lagoons or sea areas of normal salinity and their entire character is oceanic. They are biologically almost unknown and offer an exciting challenge for the future. The second category comprises barrier reefs that may be exposed, as off Suva, with well developed spurs and grooves, or more sheltered as off Ba. The final category of reef important in Fiji is the platform reef. Restricted to shelf waters, platform reefs are of oval outline, lengthened in the axis of the prevailing wind, and with a low island of white coral sand, the cay, at the leeward end.

Salm, R., & Robinson, A. (1982). Moorings for marine parks: design and placement. *In: Parks*, 7(2), 21-23, 5 fig., 3 tab.

Abstract: Anchoring poses a serious problem for managers of protected marine areas: visitors need safe anchorages, both overnight and for short periods at the reefs they visit, however, anchoring can directly or indirectly destroy the very value of the area. The assembly, placement, maintenance, and problems of moorings are discussed.

White, A., & Wells, S. (1982). Coral reefs in the Philippines. *In: Oryx*, 16(5), 445-451.

Abstract: With 44,000 sq km of coral reef surrounding its many islands and an ever-increasing population that depends heavily on fish for protein food, the damage being done to the Philippine reefs is of serious concern. Silting of the water (the results of erosion following forest clearing), modern fishing methods and the collecting mania all contribute to this. A long list of suitable areas for marine reserves has been compiled, and thanks to education programmes some communities are taking conservation measures for themselves

Baker, J. T. (1983). Research for management. Proceedings Of The Inaugural Great Barrier Reef Conference, August 28 September 2, 1983 (pp. . 473-474). [s. l.]: [s. n.]

Notes: Summary only

Abstract: Research for management has several distinctive characteristics as compared with research in the pure academic sense. An example of research for management within the Great Barrier Reef region lies in the operation of the Great Barrier Reef Marine Park Authority. The Authority is constrained in the types of research it may conduct or support by reason of the objects of the Great Barrier Reef Marine Park Act of 1975

Bannerot, S. P., & Bohnsack, J. A. (1983). An overview of visual techniques for censusing reef fishes and their applications, with emphasis on a random point technique. *In: Proceedings Association of Island Marine Laboratories of the Caribbean*, 17, 8.

Notes: Summary only

Abstract: Non-destructive visual techniques for the collection of quantitative data on reef fishes by divers working in shallow water are usually designed to produce information about species diversity, community structure, relative abundance, or density of individuals. Demand for these data has been growing with the advent of new marine sanctuaries and increased interest in the analysis of exploited reef resources. Methods are discussed in terms of the efficiency of data collection and the quality and quantity of data collected. A random point visual technique is presented which minimizes bias due to diver movement, is rapid, efficient, repeatable, and objective; and produces data on frequency occurrence, indices of abundance, fish size, density of individuals, and community composition

Bell, J. D. (1983) Effects of depth and marine reserve fishing restrictions on the structure of a rocky reef fish assemblage in the north-western Mediterranean Sea. In: Journal of Applied Ecology. (20):357-369.

Bohnsack, J. A. (1983). Resiliency of reef populations after a spearfishing ban at Looe Key National Marine Sanctuary: Progress report. In: Proceedings. Association of Island Marine Laboratories of the Caribbean, 17, 24.

Notes: Summary only.

Abstract: Looe Key National Marine Sanctuary was established and a ban on spearfishing was initiated in 1980. Enforcement began in the summer of 1981. Visual fish surveys conducted prior to sanctuary establishment demonstrated significantly smaller piscivorous predator populations, differences in prey species composition, and differences in predator composition compared to control reefs (Molasses and French Reefs) in the Key Largo Coral Reef Sanctuary which had been protected from spearfishing since 1960. Predator populations have increased at Looe Key Reef since the establishment of the sanctuary. In particular, the observed frequency of grey snapper, *Lutjanus griseus*, has increased dramatically although population levels remain well below those on the control reefs. *Thalassoma bifasciatum*, the most abundant prey species, showed a drop in abundance correlated with increased predator populations. *T. bifasciatum* population levels at Looe Key Reef prior to sanctuary establishment had been double those on control reefs.

Bowmaker, A. P. (1983). Coral reefs of the north-east South African coastline. Fifth National Oceanographic Symposium. 24-28 January 1983. Rhodes University, Grahamstown. Abstracts South, Africa: Council for Scientific and Indust. Res.; SANCOR

Bradstock, M., & Gordon, D. P. (1983). Coral-like bryozoans growths in Tasman Bay, and their protection to conserve commercial fish stocks (17), 159-163.

Abstract: Mounds of coral off Separation Point, Tasman Bay, which have recently been protected to conserve ecologically associated commercial fish species, are predominantly growths of bryozoans. Two species make up the bulk of these structures. Trawling through the coral grounds has affected the fish populations to the extent that an area has been closed to trawling to conserve stocks.

Frazier, J. (1983). Conservation of sea turtles of the Red Sea. Marine Science In The Red Sea. The Proceedings Of The International Conference On Marine Science In The Red Sea Celebrating The 50th Anniversary Of Al Ghardaqa Marine Biological Station

Notes: 25 ref.

Abstract: This paper reports all 5 species of pantropical marine turtle from the Red Sea, but documents only *Chelonia* and *Eretmochelys* as nesting there. Available feeding habitat is suitable mainly for these 2 and especially for *Eretmochelys*, which is associated with active coral reefs. If the situation in the Red Sea is similar to that in the rest of the world, the animals represent a valuable renewable natural resource that must be conserved. However, the lack of baseline data makes rational management impossible.

Gourlay, M. (1983). Accretion and erosion of coral cays and some consequent implications for the management of marine parks. Proceedings Of The Inaugural Great Barrier Reef Conference, August 28 September 2, 1983 (pp. . 475-482).

Abstract: The numerous coral cays of the Great Barrier Reef are the product of complex physical, geological and biological processes. As geologically temporary features they are subject to considerable instability as they respond to fluctuations in the conditions imposed upon them. Wave action is the dominant agent governing this response and its effects are

illustrated in this paper by the accretion and erosion behaviour of cays in the Capricorn region.

Great Barrier Reef Marine Park Authority. (1983). Annual report 1982/83. *In: Annu. Rep. Great Barrier Reef Mar. Park Auth*, 128.

Abstract: The annual report of the Authority is presented. Information includes administrative details and reports of research funded during 1982/83.

Hay, M. E. (1983). Patterns of fish and urchin grazing on Caribbean coral reefs: are previous results typical? *In: Ecology*, (65), 446-454.

Hof, T. v. (1983). The influence of dredging on a coral reef in Bonaire, Netherlands Antilles. *In: Proceedings. Association of Island Marine Laboratories of the Caribbean*, 17, 18.

Notes: Summary only.

Abstract: Mortality of hard corals was monitored photographically and sediment movement was determined on a fringing reef off the construction site of a large resort development project in Bonaire. This project included the excavation of a limestone terrace by means of blasting to create waterfront building sites and dredging to connect the resulting canal system to the open sea. The average sediment load of the water off the canal entrance (139.6 g.m super(-2).d super(-1)) was significantly higher than at the control (25 g.m super(-2).d super(-1)) and other stations. The variation in the amount of sediment released was clearly correlated with construction activities. A high mortality in the 35 m quadrat in comparison to the more shallow quadrats is accounted for by the relative high percentage by sediment-sensitive *Agaricia lamarcki* on the lower reef slope. The mortality observed is almost exclusively correlated with the high sedimentation caused by the pre-dredge filling.

Kelleher, G. (1983). Informational needs for managing the Great Barrier Reef Marine Park. *Proceedings Of The Inaugural Great Barrier Reef Conference, August 28-September 2, 1983*

Notes: 25 refs.

Abstract: Information needs for managing the Great Barrier Reef Marine Park are discussed. Information requirements are grouped into the following areas: resource analysis, analysis of use and information management. Bathymetry and survey, physical oceanography, marine geosciences, marine chemistry and marine biology are also considered.

Mahadevan, S., & Nayar, K. N. (1983). National Marine Parks (Gulf of Mannar). *In: Journal of the Marine Biological Association of India*, 25(1-2), 71-77.

Abstract: There is an immediate necessity for the conservation of marine flora and fauna in the islands of Gulf of Mannar. The situation as it is to-day needs the establishment of a National Marine Park in the area. A survey of 20 islands during 1977-81 revealed the extensive destruction of fauna and flora by human interference. The island system is unique in that it serves as a habitat for many endangered species like the marine turtles, the dugong, the *ptychoderan Balanoglossus*. Extensive destruction of the fringing coral reefs around islands is noted and it is imperative that this destruction should be totally stopped. The paper outlines measures for the establishment of a viable National Marine Park system in this area and also indicates the need for a national policy for establishing Marine Parks elsewhere along the coast.

Mailer, S. R. (1983). A survey of black coral on the north coast of Jamaica. Should harvest be allowed?. *In: Proceedings. Association of Island Marine Laboratories of the Caribbean*, 17, 20.

Notes: Summary only.

Abstract: The distribution and abundance of black coral on the Jamaican north coast was assessed to make recommendations of harvest feasibility. The total estimated mass of the standing crop was 3,800 km. A fisheries model was constructed to examine harvesting

feasibility. This model, adapted from Beverton and Holt Dynamic Pool Model. By applying mortality losses against gross production a plot of net yield is obtained. Fishing mortality can be applied to the model to evaluate harvesting strategies. To protect recruitment, a minimum harvestable age of 23 yrs was chosen, allowing time for reproduction. The model provides a maximum harvestable yield of 137 kgannum.

Ortiz-Sotomayor, A., & Ortiz-Corps, E. (1983). Preliminary aspects on seasonality of littoral marine algae in Puerto Rico. Proc. of the Association of Island Marine Laboratories of the Caribbean 1983 Vol. 17, Chap. 9.). [s. l.]: [s. n.].

Notes: Summary only.

Abstract: Rocky substrate, protected from heavy wave action by an offshore fringing coral reef in Fajardo and rocky shore exposed directly to wave action in Humacao were observed for species composition of the littoral algal communities. During heavy seas, a considerable amount of sand is transported along the littoral zone causing abrasion and suffocation of algae in this region. Wave regime in this coast may determine the permanence of algal species and cause seasonal appearance of species of littoral algae. In Fajardo, 75 species of littoral algae (34%) Chlorophyta, 26% Phaeophyta and 40% Rhodophyta) and in Humacao 48 species (29%, 27%, and 44%) have been identified. Monthly observations in these 2 stations will be continued and temperature, salinity, and wave action recorded. Colonization of natural and artificial substrates after heavy seas will be studied throughout the year.

Russell, B. C. (1983). Annotated checklist of the coral reef fishes in the Capricorn-Bunker Group Great Barrier. (p. 184). Townsville: Great Barrier Reef Marine Park Authority.

Thompson, R., & Munro, J. L. (1983). The biology, ecology and bionomics of the hinds and groupers, Serranidae. Caribbean coral reef fishery resources (pp. 59-81). Manila: ICLARM

Van't Hof, T. (1983). The economic benefits of marine parks and protected areas in the Caribbean region. Proceedings of the 5th International Coral Reef Congress (pp. 351-556). [s. l.]: [s. n.]

Abstract: Most of the marine parks in the Caribbean are associated with coral reef and found in developing countries. As exploitation of marine resources for short-term profits has often prevailed over careful management ensuring lasting returns, it is important that marine biologists and conservationists use all available arguments to convince administrators and politicians of the need to establish marine parks as a means of marine resource management. Although the benefits of resource management in connection with fishing and other collecting at sustainable levels are fairly well known, the economic benefits of marine parks in relation with marine tourism have been less well documented. The economic benefits of marine parks are a direct result of management actions. Firstly, marine parks aim at protection of the resource base and hence, guarantee a certain quality of the environment to park users. Secondly, marine parks regulate use so as to ensure sustainability of uses and to avoid conflicts between users groupers with different interests. Finally, marine parks provide services and facilities to users. These factors are believed to cause an increase in tourism compared with the situation where no management is existing. From the survey of marine parks in the Caribbean and adjacent regions, it appears that marine parks are generally considered economically beneficial, but hardly any data exist to substantiate this assumption Two studies have focused on the economic benefits of marine parks with a substantial marine component: Virgin Islands National Park at St. John and Cahuita National Park in Costa Rica. Analysis of the costs and benefits of the existence of the parks demonstrates a high benefit to cost ratio for both parks. In order to make marine parks economically beneficial or to increase their benefits, it is recommended that active, ongoing management is ensured, that adequate user facilities and

services are provided¹ and that the promotional value of the existence of a park be fully exploited.

Vanderbilt, H. C., & Clark, E. (1983). A scientific and economic conceptual endeavor for the development of coastal marine parks and mariculture. Marine Science In The Red Sea. The Proceedings Of The International Conference On Marine Science In The Red Sea Celebrating The 50th Anniversary Of Al Ghardaqa Marine Biological Station [s. l.]: [s. n.]

Abstract: A plan to protect the north Red Sea coastline while developing the economic potentials of mariculture, tourism, and industry is urgently needed. A project is proposed to help develop marine parks and reserves while providing a nondestructive alternate to fishing on reefs through mariculture.

Vermeij, G. J., Kay, E. A., & Eldredge, L. G. (1983). Molluscs of the northern Mariana Islands, with special reference to the selectivity of oceanic dispersal barriers. *In: Micronesica*, 19(1-2), 27-55.

Abstract: The shelled molluscan fauna of the northern Marianas, a chain of volcanic islands in the tropical western Pacific, consists of at least 300 species. Of these, 18 are unknown from or are very rare in the biological better known southern Marianas. These northern-restricted species are over-represented among limpets and in the middle to high intertidal zones of the northern Marianas. At least 22 gastropods which are common in the intertidal zone and on reef flats of the southern Marianas are absent in the northern Marianas. The northern Marianas lie within the presumed source area of the planktonically derived part of the Hawaiian marine fauna. The ocean barrier between the northern Marianas and the Hawaiian chain appears to select against archaeogastropods and against intertidal species but is unselective with respect to adult size and to other aspects of gastropod shell architecture. These findings are consistent with those for other dispersal barriers.

Alcala, A. C., & White, A. (1984). Options for management. *In: R. A. Kenchington, & B. E. T. Hudson. Coral Reef Management Handbook* (pp. 31-40). [s. l.]: [s. n.].

Abstract: The development of a management plan for coral reefs is discussed, indicating the following 6 basic approaches to consider; 1) zoning - to set aside different parts for different levels of use; 2) closure during a part of the year (e.g. breeding season); 3) closing and opening parts for periods greater than a year in alternation allowing for recovery; 4) determining a permitted level of use, harvest or access within a specified season; 5) prohibiting or limiting unacceptable equipment; and 6) size limiting

Claasen, D. v. R., & Pirazzoli, P. A. (1984). Remote sensing: A tool for management. *In: R. A. Kenchington, & B. E. T. Hudson. Coral Reef Management Handbook* (pp. 63-80). [s. l.]: [s. n.].

Abstract: The important role that remote sensing plays in compiling and revising resource maps for use in resource planning and management is discussed with particular reference to coral reefs.

Claringbould, R., Deakin, J., & Foster, P. (1984). Data review of reef related tourism 1946-1980. (pp. 120, 41 ref.). [s. l.]: [s. n.].

Abstract: A study of reef-related tourism within the Great Barrier Reef Region of Australia, of which there has been a tremendous growth over the period 1946-80, and, in some cases, exceeding the Queensland and Australian averages. Recommendations are that research is required into the following areas: (1) economic impact of tourism, specifically day visitors and usage and impact of boat and aircraft charters, and pleasure boats; (2) the present and likely future market segments and suitability of accommodation; (3) adequacy of transport; (4) visitor

experiences of the Reef, to help develop an environmental consciousness; (5) annual update of the database review.

Cocks, K. K. (1984). A systematic method of public use zoning of the Great Barrier Reef Marine Park, Australia. *In: Coastal Zone Management Journal*, (12), 359-383.

Abstract: This paper is an abridged version of a report on the application of a land-use planning method developed by the Commonwealth Scientific and Industrial Research Organization to the task of providing a zoning scheme for a portion of the Great Barrier Reef Marine Park. The approach involves the development of guidelines for making zoning decisions, the development of methods for measuring whether a scheme satisfies these guidelines, and the use of a computer-aided technique to create successive schemes for evolution against these guidelines

Genolagani, J. M. G. (1984). An assessment on the development of marine parks and reserves in Papua New Guinea. *In: J. McNeely, & K. R. Miller (eds), National Parks, Conservation, And Development. The Role Of Protected Areas In Sustaining Society. Proceedings Of The World Congress On National Parks, Bali, Indonesia, 11-22 October 1982* (pp. 322-329). [s. l.]: [s. n.].

Abstract: The Papua New Guinea National Parks Service has tried since the early 1970s to establish marine protected areas. This development, however, has made very little progress in establishing additional reserves due to the traditional ownership systems, limited manpower and finance, and lack of enforcement and training. This account is an assessment of the problems in establishing marine parks and reserves, while discussing preliminary needs, actions and future developments and support that is needed. Within this framework, a case study on the proposed Horseshoe Reef-Tahira Marine Park is presented. The experience of the Horseshoe Reef Marine Park is then discussed to identify appropriate actions and support that is needed for marine conservation on a national scale.

Great Barrier Reef Marine Park Authority. (1984). Annual report 1983-84. Townsville, Qld. (Australia): Great Barrier Reef Marine Park Authority.

Abstract: The report covers activities undertaken by the Great Barrier Marine Park Authority in 1983/1984. The following areas are considered in particular: 1) planning; 2) park management; 3) education and information; 4) research and monitoring; and 5) administration.

Habibullah-Khan, M. (1984). Marine intensive tourism in ASEAN countries. *Proceedings Of The Pacific Congress On Marine Technology, Honolulu, Hawaii, April 24-27, 1984*, Chap. 10, (p. MRM5). Manoa, HI USA. Hawaii: Marine Technology Soc.

Notes: Summary only.

Abstract: This study intends to make a survey of the various tourist resorts in the coastal areas of ASEAN countries with particular attention to Sentosa and St. John's islands in Singapore, Phuket, Samui and Pattaya in Thailand, Penang in Malaysia, Sombbrero Park in the Philippines, and Bali in Indonesia. Demand for marine-based tourism in this region depends on a number of factors. These include tourist's income, volume of sea-borne trade in relation to total trade, cost of travel by sea in relation to airfare, relative prices in different countries, degree of marine pollution, etc., as well as various other social, political and demographic factors. A marine intensive tourist industry depends on a well-preserved environment and is therefore often in conflict with other marine resource users. The introduction of pollutants into seas by petroleum hydrocarbons and other sources is disastrous for water-based tourist resorts. The recreational activities (sports diving, collection or aquarium fish, shells, corals, etc., dumping of non-biodegradable rubbish) of tourists have caused ecological damage in many countries. Expanding tourist centers in coastal belts have had adverse effects on fisheries, aquaculture, mariculture and mangroves as well. The proposed study will attempt to uncover these conflicting uses of marine resources with special reference to ASEAN countries.

Heslinga, G. A., Orak, O., & Ngiramengior, M. (1984). Coral reef sanctuaries for Trochus shells. *In: Mar. Fish. Rev.*, 46(4), 73-80.

Abstract: The authors conclude that marine sanctuaries can contribute to trochus conservation efforts and are of potential economic benefit if properly sited and patrolled. Guidelines are suggested for sanctuary selection and assessment of trochus distribution and abundance. Population densities are shown to be influenced by reef orientation, degree of exposure to surf, substrate type, and water depth.

Kelleher, G., & Lausche, B. (1984). Review of legislation. *In: R. A. Kenchington, & B. E. T. Hudson. Coral Reef Management Handbook* (pp. 41-45). [s. l.]: [s. n.].

Abstract: Issues to be taken into account regarding effective legislation in coral reef management are indicated.

Kenchington, R. A. (1984). Large area surveys of coral reefs. Comparing Coral Reef Survey Methods. Report Of A Regional Unesco Unep Workshop, Phuket Marine Biological Centre, Thailand, 13 17 December 1982. (p. 92 103). Paris France: Unesco Div. Of Marine Sciences Notes: 8. ref.

Abstract: Problems involved in the detailed study of large areas of coral reefs are discussed. Manta tow and satellite imagery techniques are described. These methods can provide the means to relate detailed study of small areas to the broader context for environmental studies and management.

Kenchington, R. A. (1984). Making a plan. *In: R. A. Kenchington, & B. E. T. Hudson. Coral Reef Management Handbook* (pp. 115-121). [s. l.]: [s. n.].

Abstract: The development of a management plan for coral reefs is discussed, indicating contents of the plan and documentations, establishing goals and objectives, taking into account of activities and plan development.

Kenchington, R. A. (1984). Overview: Consultancies, expert advice and international assistance. *In: R. A. Kenchington, & B. E. T. Hudson. Coral Reef Management Handbook* (pp. 181-184). [s. l.]: [s. n.].

Abstract: The planning and supervision involved in a consultancy in order to ensure effectiveness are discussed, with reference to coral reef management.

Kenchington, R. A. (1984). Review of plans and of management. *In: R. A. Kenchington, & B. E. T. Hudson. Coral Reef Management Handbook* (pp. 179-180). [s. l.]: [s. n.].

Abstract: The importance of reviewing reef management and zoning plans is discussed, considering re-assessment of goals and objectives and procedure to follow for plan review.

Kenchington, R. A. (1984). Scientific investigations for planning. *In: R. A. Kenchington, & B. E. T. Hudson. Coral Reef Management Handbook* (pp. 53-62). [s. l.]: [s. n.].

Abstract: Surveying coral reefs as a means of obtaining data for use in development and management is discussed.

Kenchington, R. A. (1984). Surveillance. *In: R. A. Kenchington, & B. E. T. Hudson. Coral Reef Management Handbook* (pp. 161-165). [s. l.]: [s. n.].

Abstract: Surveillance often provides the most effective and objective data for assessing the adequacy of a management plan and the adequacy of management in enforcing a management plan. Techniques involved are outlined.

Kenchington, R. A., & Hudson, B. E. T. (1984). Coral reef management handbook. (p. 281).

Jakarta: Unesco.

Abstract: Abstracts of the 22 papers presented in the handbook are cited individually.

Kenchington, R. A., & Salvat, B. (1984). Man's threat to coral reefs. *In:* R. A. Kenchington, & B. E. T. Hudson. Coral Reef Management Handbook (pp. 23-28). [s. l.]: [s. n.].

Abstract: The impact of man's exploitation of coral reefs is discussed, considering fishing and collecting, pollution and other commercial and recreational activities.

Moore, J. G., & Moore, G. (1984). Deposit from a giant wave on the island of Lanai, Hawaii. *In:* Science Washington, 226(4680), 1312-1315.

Abstract: Limestone-bearing gravel, the newly named Hulopoe Gravel, blankets the coastal slopes on Lanai. The deposit, which reaches a maximum altitude of 326 meters, formerly was believed to have been deposited along several different ancient marine strandlines, but dated submerged coral reefs and tide-gauge measurements indicate that the southeastern Hawaiian Islands sink so fast that former worldwide high stands of the sea now lie beneath local sea level. Evidence indicates that the Hulopoe Gravel and similar deposits on nearby islands were deposited during the Pleistocene by a giant wave generated by a submarine landslide on a sea scarp south of Lanai.

Oakley, S. G. (1984). The effects of spearfishing pressure on grouper (Serranidac) populations in the eastern Red Sea. Proceedings of the Symposium on Coral Reef Environment of the Red Sea Jeddah, Saudi Arabia:

Abstract: Grouper populations were observed using SCUBA on the fringing reefs in the Jeddah area of the Red Sea. A series of transects at sites with different human usage showed clearly the effects of sport fishing on grouper populations. Large and medium sized fish were much less frequent in areas where spear and line fishing were common. Small fish, however, showed an increase in frequency at sites with high human usage. Small fish were also more frequent in shallow transects, while medium and large were found predominantly on the deeper transects. Attempts were made to quantify the timidity of the groupers and to assess the relative effects of spearfishing or hook and line fishing.

Phillips, P. C., & Perez-Cruet, M. J. (1984). A comparative survey of reef fishes in Caribbean and Pacific Costa Rica. *In:* Revista De Biologia Tropical, 32(1), 95-102.

Abstract: Fishes from five transects in Manuel Antonio National Park (Pacific) and seven transects in Cahuita National Park (Caribbean), Costa Rica were censused using a rapid visual technique from February to April 1982. Cahuita, with 49 species, had a higher overall species diversity, whereas more individuals were usually seen on the Manuel Antonio transects, where 39 species were counted. Transects with similar habitat complexity showed highest PS values (approximately 60%). Wrasses (Labridae) and damselfish (Pomacentridae) dominated in both the Pacific rock reef and the Caribbean coral reef study areas. Individuals up to 7.5 cm usually dominated on transects, but an increase in size was observed as the habitat complexity increased. Diversity was low at Cahuita in relation to other Caribbean reef areas, probably due to the declining state of the coral reef. The species diversity values at Manuel Antonio are within the range of values found in Central American Pacific estuarine and tidepool studies.

Robinson, A. (1984). Staff training for coral reef and other marine area management. *In:* R. A. Kenchington, & B. E. T. Hudson. Coral Reef Management Handbook (pp. 131-145). [s. l.]: [s. n.].

Abstract: The need for specialized coral reef management training is discussed, summarizing various existing systems by which staff can obtain such training, and also how to choose between them, indicating their cost-effectiveness.

Salm, R. (1984). Ecological boundaries for coral-reef reserves: principles and guidelines. *In: Environmental Conservation*, (11), 20-215.

Abstract: As marine conservation activities intensity, planners and managers of protected areas are finding themselves with few guidelines or tools that are specific to the marine realm. Consequently, the principles, criteria, and practices of terrestrial protected areas tend to be transferred to the marine environment, where they are often inappropriate. In contrast to the situations with all comparable sites on land, there is a paucity of published material on the application of ecological principles to the design and management of marine protected areas. Sing examples of coral reefs, guidelines are presented in this article in the hope that they will elicit comment and stimulate the publication of similar guidelines for different marine environments. Coral reef protected area boundaries must fulfill two requirements: they must include appropriate coral reef, confluent and neighboring habitats, and a sufficient area of each. The first requirement defines the type, and the second the quantity of habitats to be included in a protected area. Studies in the Chagos Archipelago, Indian Ocean, indicate that the core zone of a protected coral reef area should encompass 300 hectares of diverse reef habitats if preservation of biotic diversity is the principle objective. The buffer-zone size needed will vary according to activities planned within the area, the extent of neighboring coastal habitats, and the proximity of up-current sources of potential contamination.

Salm, R. (1984). Man's use of coral reefs. *In: R. A. Kenchington, & B. E. T. Hudson. Coral Reef Management Handbook* (pp. 15-21).

Abstract: The exploitation of coral reefs by man is discussed in detail, considering food production (fish, turtles, spiny lobsters, octopus, giant clams, and squid), ornaments, aquarium fish trade, building and industrial materials. Non-extractive uses of coral reefs are also examined, such as recreation and tourism development, national parks, education and research, natural breakwaters and harbours and waste disposalsewage treatment.

Sindiyo, D. M., & Pertet, F. N. (1984). Tourism and its impact on wildlife conservation in Kenya. *In: Industry and Environment*, 7(1), 14-19, tab., pl., ref.

Abstract: Tourism brings both blessings and curses to Kenya. Tourism earns the country a good proportion of its foreign revenue, second only to coffee and tea. National parks and reserves have benefited directly from receipts of gate and guide fees. The publicity associated with tourism has also benefited the parks as well as the country. Some parks/reserves owe their origin to touristic demand, but tourism has had some adverse effects on wildlife conservation and in particular in national parks and reserves. Certain tourist activities have brought negative effects such as crushing of vegetation by vehicles and harassment of predators. Meanwhile uncontrolled shell and coral collection coupled with physical damage to coral reefs is contributing to the decay of marine parks on Kenya's coast. Furthermore the agricultural and industrial sectors which are interlocked with tourism have a certain negative impact on conservation. For instance, the desire for more land for agricultural production to sustain tourism is posing a threat to park and reserve land. Fertilizers and insecticides used to improve agricultural production end up in rivers, contributing to water pollution. The majority of the rivers traverse important national parks and reserves while two, the Tana and the Sabaki, empty into the Indian Ocean close to the marine parks. Hydropower dams pose a different kind of problem to wildlife conservation.

Sybesma, J. (1984). Nature conservation is business. *Proc. 18. Meet. of the Association of Island Marine Laboratories of the Caribbean, St. James (Trinidad), 13 Aug 1984* Vol. 18 (p. 4). *Notes: Summary only.*

Abstract: Coral reefs are threatened by the development of countries and islands they surround. They are misused by overfishing, coral mining, anchor damage, spearfishing,

collecting for ornament trade, and domestic, industrial and agricultural pollution. Guidelines with step by step information for the establishment of legislation and sound management procedures have been made to protect coral reefs, but knowledge, money and the country's support are not considered. Biologists living in developing countries must focus attention on nature conservation and attempt to preserve coral reefs. A business approach only considers money making projects, therefore coral reefs must be re-examined as money making propositions. Coral reefs can be a great source of income as recreational and tourist developments. Legislation established in this way will become the base for management strategies. Consequently coral reefs will be protected as a new source of income. Biologists do not have to become or to act like businessmen but must achieve their goals by thinking like businessmen. The Curacao Underwater Park is an example.

White, A. (1984). Vulnerable marine resources, coastal reserves, and pollution: A Southeast Asian perspective. *In: J. McNeely, & K. R. Miller (eds), National Parks, Conservation, And Development. The Role Of Protected Areas In Sustaining Society. Proceedings Of The World Congress On National Parks, Bali, Indonesia, 11-22 October 1982* (pp. 170-174). [s. 1.]: [s. n.].

Abstract: The distribution of vulnerable marine resources, coastal reserves and pollution sites in Southeast Asia as compiled for the Marine Policy Atlas of Southeast Asian Seas (Morgan and Valencia, eds. in press) are presented by brief description to accompany the display of maps of scale 1:16,000,000. The vulnerable marine resource distributions include estuaries, beaches, mangroves, coral reefs, sea turtles, crocodiles, seabird colonies, dugong, whales and dolphins. Coastal reserves included all the various designations of marine reserves in the region which border on the coast or have jurisdiction over marine areas. Priority sites for management of marine resources are determined by particularly strong aggregations of vulnerable marine resources, productive fisheries and the presence of marine reserves. This paper focuses on geographical distribution and aggregations which have implications for national and regional marine reserve selection and management programmes.

Bell, L. A. J. (1985). Coastal zone management in Western Samoa. Report Of The Third South Pacific National Parks And Reserves Conference Held In Apia, Western Samoa, 1985. Volume 2. Collected Key Issue And Case Study Papers Noumea New Caledonia: South Pacific Reg. Environment Programme

Abstract: Following an account of the geography and history of Western Samoa, details are given of the country's fisheries. Sea tenure, limited access and traditional management are considered. Pressures on the coastal resources include: dynamite fishing, fish poisoning, manual destruction of corals, soil erosion, industrial and waste disposal and pesticides, crown of thorns starfish, over fishing, cutting of mangrove trees, and dredging. A brief examination is made of fisheries related regulations, marine reserves and mariculture

Champ, M. (1985). NOAA's scientific support coordinators (SSC) and hazardous materials response project. Workshop on Response to Hazardous Chemical Spills in the Great Barrier Reef Region, Townsville (Australia), 3 Aug 1984 Townsville-Australia: Great-Barrier-Reef-Marine-Park-Auth.

Abstract: An account is given of the role and functions of NOAA Scientific Support Coordinators in the field of hazardous materials spills. The following activities are discussed: 1) rapid assessment of adverse effects and mitigation strategies; 2) assessment of damage; 3) hazardous substance assistance and research; 4) notification and activation; and 5) contingency planning assistance.

Champ, M. (1985). United States experience with oil and other hazardous chemical spills. Workshop on Response to Hazardous Chemical Spills in the Great Barrier Reef Region,

Townsville (Australia), 3 Aug 1984 Townsville-Australia: Great-Barrier-Reef-Marine-Park-Auth.

Abstract: Following a brief outline of relevant events since 1967 regarding oil spills, in particular the Argo Merchant, Amoco Cadiz and Ixtoc 1, details are given of the Environmental Protection Agency-NOAA hazardous materials response team and activities conducted. Effects on the marine environment and economic costs are examined.

Dahl, A. L. (1985). Protection and conservation of the reef environment, a gamble on the future: Conclusion. Proceedings of the fifth international coral reef congress, Tahiti 27 May - 1 June 1985, Vol. 4: Symposia and Seminars (A) (p. 285). Moorea (French Polynesia): Antenne Museum-EPHE

Abstract: In reviewing all the papers presented in this symposium, a certain pattern emerges. There were depressing reports of reef damage and destruction; not that this is particularly new or unusual, but the evidence was now more quantitative and world-wide in scope. Figures for damaged reefs such as the 80% of reefs surveyed around Okinawa, and 65% of the reefs visited in Tonga showed that these problems were not just limited to isolated localities, but may affect a major part of a country's reef resources. The new Directory of Coral Reefs being prepared by IUCN documented for the first time that such reef problems were widespread and that the situation was similar around the world. Other contributions described some of the causes of reef damage, such as turbidity and sedimentation caused by construction, dredging and soil erosion on the land. Another frequently-cited cause was pollution by pesticides, chemicals, and nutrients causing eutrophication and the overwhelming growth of green algae. Overfishing and destructive fishing with explosives or by smashing corals were also considered important. Some of the mechanisms for these destructive effects were illustrated, including the variable long-term toxicity of certain pollutants, and the reactions of corals, including mucus secretion, various coral diseases, and the rapid shut-down or death of whole coral colonies. A few natural causes of coral destruction were described, including the effects of scoria from a volcanic eruption, and the abnormal ocean warming during the severe "el Nino" of 1983 which caused extensive coral death on the Pacific Coast of Central America, and total death of many corals in the Galapagos Islands. Occasionally there were surprises, as in the case of the thermal pollution from a Hawaiian power plant that actually encouraged coral settlement. Much of the symposium was devoted to solutions to the problems described, such as the treatment or elimination of waste discharges in coral reef areas, requiring expensive control and monitoring programmes in some cases of heavily impacted coastal areas. The creation of marine protected areas, such as parks, reserves and sanctuaries was also discussed, as were closures and other measures more directly intended for fisheries management. Frequent reference was made to the public education in support of reef conservation, with examples cited from Australia, Sudan and the South Pacific. National legislation, regional conventions and international conventions such as CITES were also discussed, as were broad coastal or environmental management programmes with a coral reef component, such as the South Pacific Regional Environment Programme. The outstanding example of comprehensive management of a major coral reef area is the Great Barrier Reef Marine Park, and several papers described approaches there to zoning, public information and consultation, surveillance and monitoring. The question was raised in discussion as to how this example could be applied in developing countries with much heavier pressure on reef resources. New technologies such as remote sensing may well help to solve some reef management problems, but it was clear that there was still a lack of many solutions appropriate to the tropics. A few papers on the results of reef protection and conservation measures provided some encouragement. While recovery of damaged reef areas may seem slow at first, the site of the classic example of reef eutrophication, Kaneohe Bay, Hawaii, showed extensive coral recovery six years after pollution input had been removed. Australian fishermen had even begun to request controls on their fishing activity in certain vulnerable

areas. An economic evaluation of parks created to protect coral reefs show that, the benefits from the park far outweighed the cost. The overall impression from this symposium on the protection and conservation of the reef environment was of the awesomeness of the problem and of how far we still have to go.

Dinesen, Z. D. (1985). Day-to-day management of Capricornia, the first section of the Great Barrier Reef Marine Park. Proceedings of the fifth international coral reef congress (pp. 253-258). Moorea (French Polynesia): Antenne Museum-EPHE

Abstract: Following the passing of the Great Barrier Reef Marine Park Act by the Australian Commonwealth Government in 1975, the first section of the Marine Park to be zoned for management was the Capricornia Section, at the southern extremity of the great Barrier Reef region. Capricornia includes some 30 reefs and shoals, plus a number of vegetated coral cays associated with 13 of the reefs, the majority of these islands being Queensland National Parks. Day-to-day management of the Great Barrier Reef Marine Park is carried out by the Queensland National Parks and Wildlife Service, under a special arrangement whereby the Commonwealth Government provides initial capital funding, and 50% of operating costs. The day-to-day management requirements are outlined in the Management Guidelines formulated jointly by the Commonwealth and Queensland Governments. Day-to-day management of Capricornia has been in operation since 1982. Management operations include: (1) Education/information activities to increase public awareness of the marine park concept, and of the natural history of the area, and to inform park users of details of the Zoning Plan and Regulations relevant to their activities within the Section; (2) Surveillance of the area using aerial and surface patrols; (3) Deterrence, detection of infringements, and law enforcement of the Great Barrier Reef Marine Park Act and various Queensland State legislation such as the Marine Parks Act, the National Parks and Wildlife Act, and the Fauna Conservation Act; (4) Monitoring of the natural resources of the park and of human usage patterns within the park; (5) Resource management activities including the issue of permits, provision of public facilities, and pest and weed control. Aspects of these day-to-day management operations are discussed with reference to specific examples.

Gilmour, A., & Craik, W. (1985). A framework for monitoring the Great Barrier Reef Marine Park. Proceedings of the fifth international coral reef congress (pp. 265-270). Moorea (French Polynesia): Antenne Museum-EPHE

Abstract: The current position in the development of the Great Barrier Reef Marine Park is briefly outlined noting a proposed completion by 1988. Monitoring is defined and the conceptual background reviewed in the light of some recent literature. The legislative basis for a monitoring program is noted. The Great Barrier Reef Marine Park Act 1975 defines the Great Barrier Reef Region and a process for the development of zoning plans, and associated regulations, for sections of the Marine Park which provide the underlying framework for its management. The zoning plans provide a number of zones which have defined objectives, provisions for entry to, and use of each zone which may include a requirement to apply for a permit for particular uses in a zone. In developing a monitoring program for the Great Barrier Reef Marine Park four specific objectives have been defined related to effectiveness of zoning plans, health of the reef, impact of the zoning plan on the reef, on users and on the local economy. Through a series of matrices each objective has been considered and techniques identified to enable measurements of parameters relevant to the objective. The technique is described and the outcome is discussed in the context of the Great Barrier Reef Marine Park.

Gray, J. E. (1985). Norwegian experience with oil spills: Scientific response. Workshop on Response to Hazardous Chemical Spills in the Great Barrier Reef Region, Townsville (Australia), 3 Aug 1984 Townsville-Australia: Great-Barrier-Reef-Marine-Park-Auth.

Abstract: A brief account is given of research conducted in Norway regarding oil analysis, effects of oil spills and procedures to be taken in the event of an oil spill. The Norwegian Ecological Action Plan is outlined.

Great Barrier Reef Marine Park Authority. (1985). Annual report 1984-85. *In: Annu. Rep. Great Barrier Reef Mar. Park Auth*, 90.

Abstract: The ninth annual report of the Great Barrier Reef Marine Park Authority is presented for the year ended June 1985. Amongst the topics discussed were: planning, park management, education and information, research and monitoring, administration and Great Barrier Reef Wonderland.

Halas, J. C. (1985). An unique mooring system for reef management in the Key Largo National Marine Sanctuary. Proceedings of the fifth international coral reef congress (pp. 237-242). Moorea (French Polynesia): Antenne Museum-EPHE

Abstract: A unique mooring buoy system, tested at French Reef in the Key Largo National Marine Sanctuary in 1981, has been modified and expanded to help mitigate coral anchor damage on other reefs in the Key Largo National Marine Sanctuary and at Looe Key National Marine Sanctuary. This extended mooring buoy system has been improved in order to increase its durability and to reduce maintenance time and material costs. A smaller hydraulic drill, the Stanley IX06, is now used for installation, and both the buoy and attachment lines have been modified resulting in a simpler and more cost effective mooring system. A stainless steel eyebolt is cemented into a hole drilled into the substrate. A 3/4 inch polypropylene downline is attached with a stainless steel shack and extends upward through the center of the buoy to a pick-up line. The downline is lightly weighted near the top to prevent excess scope at the surface. The pick-up line is protected with a length of rubber hose to prevent chafing damage from boat gunwales. Mooring buoys have been enthusiastically accepted by the diving community at Key Largo and Looe Key and have greatly reduced anchor damage. Observations of deployed boat anchors on high use days when all the buoys were occupied confirm that coral anchor damage, varying from minor chain contact to severe tissue abrasion and colony breakage, can be expected when mooring buoys are not used. Increased visitation and accompanying anchor damage to corals are the basis for further increasing the number of mooring buoys in the Key Largo National Marine Sanctuary. 1985

Harrison, C. S. (1985). A marine sanctuary in the northwestern Hawaiian Islands: An idea whose time has come. *In: Nat. Resour. J.*, 25(2), 317-348.

Abstract: The Northwestern Hawaiian Islands (NWHI) are a series of emergent rocks, coral reefs, and sandpits atop submarine volcanos in the North Central Pacific. Far removed from public awareness, these islands are an unlikely setting for serious conflict concerning the management of marine resources. The fishery resources there are substantial, and have been receiving increased attention from fishermen, both domestic and foreign. The wildlife resources of the NWHI are unique and vulnerable. Hawaiian fishermen want to develop the fishery resources of the NWHI, whereas wildlife managers want to protect the wildlife. This conflict has resulted in a state-federal confrontation concerning jurisdiction over certain waters in the NWHI.

Hay, M. E., & Taylor, R. (1985). Competition between herbivorous fishes and urchins on Caribbean reefs. *In: Oecologia*, (65), 591-598.

Holland, R. (1985). Coral reef research and the Wellwood incident. *In: Sea Frontiers*, 31(1), 28-35.

Abstract: Molasses Reef off south Florida was hit by the 400-foot grain freighter Wellwood on

August 4, 1984. The incident, which occurred within the Key Largo National Marine Sanctuary, necessitated adhoc efforts to repair/rescue the coral reef from the damage done by the freighter

Hundloe, T. (1985). Fisheries of the Great Barrier Reef. *In: Spec. Publ. Ser. Great Barrier Reef Marine Park Authority*, (2), 158.

Abstract: The purpose of this book is to describe the economic significance of the major fisheries in the Great Barrier Reef, and hence provide one element of the data required for management. These fisheries can be categorised into 3 major groups: 1) a commercial fishery; 2) a recreational fishery based on individuals using private motor boats; and 3) a recreational game fishery based on the use of charter boats. In a geographical context, the Great Barrier Reef fisheries are adjacent to approximately 85% of the Queensland east coast. In terms of fishermen, boats and value of product landed, the Great Barrier Reef commercial fisheries account for about one half of the Queensland total. The recreational fisheries are also significant at a state and national level.

James, M. K. (1985). Risk assessment of shipping accidents in Great Barrier Reef waters. Workshop on Response to Hazardous Chemical Spills in the Great Barrier Reef Region, Townsville (Australia), 3 Aug 1984 Townsville-Australia: Great-Barrier-Reef-Marine-Park-Auth.

Abstract: The concepts, motivation and limitations of the objective assessment of risk are discussed, with reference to the problem of planning a response to marine spills of dangerous chemicals in the Great Barrier Reef region. The role to be played by an assessment of the probabilities and geographical distribution of shipping accidents is outlined. A method is discussed, based on the Monte Carlo simulation of fault-trees, for the estimation of these probabilities.

Jourde, J. L. (1985). Marine reserves in New Caledonia. Report Of The Third South Pacific National Parks And Reserves Conference Held In Apia, Western Samoa, 1985. Volume 2. Collected Key Issue And Case Study Papers Nouméa New Caledonia: South Pacific Reg. Environment Programme

Abstract: Details are given of the establishment of various different types of marine reserves in New Caledonia: 1) "Yves Merlet Reserve"; 2) special marine reserves around islands of tourist interest in the Noumea area; 3) special rotating reserve on the Barrier Reef opposite Noumea; and 4) specific fishing zones.

Kay, D. (1985). The national plan to combat pollution of the sea by oil. Workshop on Response to Hazardous Chemical Spills in the Great Barrier Reef Region, Townsville (Australia), 3 Aug 1984 Townsville-Australia: Great-Barrier-Reef-Marine-Park-Auth.

Abstract: An outline is given of the Australian National Plan to combat pollution of the sea by oil, which represents a combined effort by Commonwealth and State governments. Some data are presented regarding hazardous chemicals, indicating the nature of chemicals travelling around Australia. A definition is made as to the various authorities responsible for combating the pollution. Funding, legislation and training activities are described.

Kelleher, G., & Dutton, I. M. (1985). Environmental effects of offshore tourist development on the Great Barrier Reef. Report Of The Third South Pacific National Parks And Reserves Conference Held In Apia, Western Samoa, 1985. Volume 2. Collected Key Issue And Case Study Papers Noumea New Caledonia: South Pacific Reg. Environment Programme

Abstract: There is an increasing level of commercial interest in providing tourist facilities at various locations on the Great Barrier Reef. The potential environmental effects of such

facilities are likely to vary significantly, according to the proposed scale of the structure, its design, location and operating regime. The Great Barrier Reef Marine Park Authority, which is responsible for the care and development of the Great Barrier Reef Marine Park, uses a system of initial classification of offshore tourist facilities when determining their potential environmental effects. The paper notes some of the special problems of environmental assessment posed by these types of development.

Kelleher, G., & Kenchington, R. A. (1985). Australia's Great Barrier Reef Marine Park: making development compatible with conservation. National parks, conservation, and development. The role of protected areas in sustaining society. Proceedings of the World Congress on National Parks, Bali, Indonesia, 11-12 October 1982

Abstract: The Great Barrier Reef is the largest system of coral reefs and associated life forms in the world, covering an area of some 300 000 sq km off Australia's northeast coast. The Australian government has established a management regime over the area which provides for multiple use of this great system while ensuring that its natural qualities are protected. The paper describes the management regime, which is based on scientific research, public involvement, and zoning of areas to separate incompatible activities and to reserve areas for the uses to which they are best suited.

Pichon, M., & Dahl, A. L. (1985). Protection and conservation of the reef environment, a gamble on the future: Introduction. Proceedings of the fifth international coral reef congress, Tahiti 27 May - 1 June 1985, Vol. 4: Symposia and Seminars (A) (pp. 163-164). Moorea (French Polynesia): Antenne Museum-EPHE

Abstract: The recent rapid advances in coral reef science marked by this series of international coral reef symposia have underlined the importance of coral reefs as ecosystems and as geological structures. Unfortunately, this growing appreciation of reef environments has been paralleled by the increasing pace of reef destruction with human pressure on the biosphere around the world. Damage to coral reefs may be direct, or more often the indirect result of other development activities. The causes vary from country to country, and range from the pressures of a growing population on subsistence food resources to luxury hotels for wealthy tourists. The result, however, is that a major productive resource of particular importance to the poorer tropical countries is in danger of being lost. This symposium brings together papers treating the various aspects of the protection and conservation of the reef environment which must become a major preoccupation of coral reef science in the years ahead. The pressures on coral reefs, as on all the world's resources, are very great, and little can be done to prevent many more reef areas from being degraded or lost. However, a major effort now in reef protection and conservation may still save many important sites, and in this sense our efforts are an essential gamble on the future. We need to know how to slow and stop the degradation of coral reefs by the many causes and through the many processes of which we are often still woefully ignorant. We need better methods for evaluating the damage done and for understanding the effects on the complex coral reef ecosystem. We also need to learn how to restore a damaged reef to full productivity, and even how to recreate healthy functioning coral reef ecosystems where they have disappeared. Our situation is not unlike that of modern medicine, faced with the challenge of identifying the illnesses of the human body and developing treatments that will restore the patient to full health. This effort will require the breadth and experience of all the scientific disciplines represented at this Congress, and not just the still small number of those working specifically on problems of coral reef management and conservation. The artificial distinction between basic and applied research is a luxury the world can no longer afford. Many basic problems can be addressed through useful actions or manipulations. Creating a marine reserve may not only protect a reef, but also create an opportunity to study the response of the reef ecosystem to the reduction of certain pressures. Only a concerted effort by everyone interested

in coral reefs can help to stem the tide of reef destruction. The papers in this symposium both describe the tide and examine some of the solutions.

Russ, G. (1985). Effects of protective management on coral reef fishes in the central Philippines. Proceedings of the fifth international coral reef congress, Tahiti 27 May - 1 June 1985, Vol. 4: Symposia and Seminars (A) (pp. 219-224). Moorea (French Polynesia): Antenne Museum-EPHE

Abstract: This study has collected information on the species richness and abundance of coral reef fishes at three study sites in three locations in the central Visayas, Philippines. The locations were Sumilon Island near Cebu, Apo Island near Negros, Balicasag Island near Bohol. A modified combination of two techniques of visual census were used to make assessments of both the overall community structure of the assemblage of fishes and the abundance of fishes considered as favoured 'targets' of fishermen. Only one of the study sites has had effective, long-term protective management in the forest of total absence of fishing. This site, the steep slope reserve on the western side of Sumilon Island, had a significantly higher abundance (number) of fishes than all other sites, the highest species richness of all the sites and the highest abundance of many species considered to be highly favoured 'targets' of fishermen including a significantly higher standing crop of serranids (groupers) than all of the other sites. The latter result is of interest because the abundance of serranids is considered to be a good indicator of fishing pressure on coral reefs. It cannot be claimed that protective management is the cause of the high abundance and species richness of fishes at this site. In fact, the area was chosen as the site for a marine reserve because it possessed such characteristics. However, considering the very high fishing pressure on most Philippine coral reefs it could be argued strongly that protective management has been very important in maintaining the high abundance of many of the species of fishes

White, A. (1985). Marine parks and reserves: Management for Philippine, Indonesian and Malaysian coastal reef environments. *In: Diss. Abst. Int.* 46, Pt A Hum. and Soc. Sci. (2), 295. Notes: Order No.: FAD DA8508782.

Abstract: Seven reserve management and two control areas in the Philippines are discussed in detail and compared with two similar management areas in Indonesia and two in Malaysia. This study undertakes three objectives: to document the status of various reefs in the Philippines, Indonesia and Malaysia in terms of reef biology, management approaches, patterns of human exploitation, and the larger environmental settings of reefs; to examine the effects of formal management schemes, human exploitation, and general setting on the reef environments; and to investigate generalities between sites in terms of environmental conditions, management and use by humans.

Wood, E. (1985). Exploitation of coral reef fishes for the aquarium trade. (p. 121). Ross On Wye Uk : Marine Conservation Society.

Abstract: The great majority of ornamental marine fish in the trade, and all marine invertebrates, are collected from the wild. Data on mortalities are not readily available, but it is probable that on average, about 15% of fish die prior to export, and a further 10% in transit to the importing country. Another 5% of fish die while being held in wholesale retail premises, prior to sale. A survey of survival of fish in home aquaria showed that half had died within six months, and 66% within a year, but that some specimens went on to live for four years or more. This report makes several recommendations, among them: the setting up of captive-breeding programs; assessment, by exporting countries, of the status of their reef fish populations, in order to manage this resource properly; licensing of collectors, exporters, importers, and retailers; the setting up to protected areas, species protection and controls on the fishery in the exporting countries

Woodley, S. (1985). The Great Barrier Reef Marine Park: the management challenge. Proceedings of the fifth international coral reef congress (pp. 259-264). Moorea (French Polynesia): Antenne Museum-EPHE *Symposia and Seminars (A)*: Vol. 4.

Abstract: By 1988, it is expected that the Great Barrier Reef Marine Park, an area of approximately 450,000 km² which allows multiple resource use consistent with conservation of those resources, should be completed and under management. The size of the management task, management methods, potential problems and solutions are discussed, where possible with relevance to South Pacific nations. Management of traditional hunting and fishing by Australian Aborigines and Torres Strait Islanders within the Marine Park is examined.

Yap, H. T., & Gomez, E. D. (1985). Coral reef degradation and pollution in the East Asian Seas Region. *In: Environment And Resources In The Pacific*, (69), 185-207.

Abstract: This paper updates knowledge on the status of coral reef resources and the causes of reef damage in South-East Asian waters. It summarizes recent data on the condition of coral reefs in each ASEAN country. Natural causes of reef degradation include water movement, geological dynamics, and biological interactions such as recently reported destruction by *Acanthaster* and *Drupella*. Among human activities causing destruction, siltation and damaging fishing techniques are still the most important, although extraction of building materials, tourism, collecting of reef invertebrates, and pollution are becoming increasingly significant. The establishment of marine reserves is one concrete response to these threats.

Alongi, D. M. (1986). Population structure and trophic composition of the free-living nematodes inhabiting carbonate sands of Davies Reef, Great Barrier Reef, Australia. *In: Australian Journal of Marine and Freshwater Research*, 37(5), 609-619.

Abstract: Population structure and trophic composition of free-living nematodes from carbonate sands within different functional zones (reef crest, reef flat and lagoon) of Davies Reef in the Great Barrier Reef were examined. At the reef crest (station C) and at a shallow lagoon area unprotected by the back wall of the reef flat (station G), sediments were subjected to intense wave action and supported significantly ($P < 0$ multiplied by 05) lower mean nematode densities (< 60 individuals per 10 cm super(2)) than sands within the other reef zones (100-400 individuals per 10 cm super(2)). Mean nematode densities and numerical species richness were highest ($P < 0$ multiplied by 05) in a shallow lagoon habitat protected from hydrodynamic-induced disturbances by the back wall of the reef flat (station H). Differences in population densities among the reef zones were not related to water depth or sediment granulometry. Nematode community structure from the reef crest to the shallow lagoon appears to be determined primarily by sediment granulometry as controlled by reef hydrodynamics, whereas in the deep lagoon nematode communities are negatively affected by the presence of thalassinid ghost shrimps

Anderson, M. et al. (1986). Ecological community type maps and biological community descriptions for Buck Island Reef National Monument and proposed marine park sites in the British Virgin Islands. *In: Res. Rep. Virgin Islands Biosphere Reserve*, (4), 276.

Abstract: Tropical marine ecosystems are an important segment of the Lesser Antillean Biosphere. Knowledge of the location and structure of these ecosystems in the region is necessary to ensure a representative selection of sites within a Biosphere Reserve. During the last decade tourism has increased in both the US and British Virgin Islands. A major component of this increase consists of the sailing fleet, resulting in greater impacts on the marine ecosystems through anchoring, litter and sewage disposal, and more coastal construction to support the boating public. The report mapped and described the coastal areas comprising the present and proposed marine park sites of the British Virgin Islands (BVI) and of Buck Island Reef National Monument, St. Croix, USVI.

Anderson, M. et al. (1986). Virgin Islands Biosphere Reserve. Research report no. 4. Ecological community type maps and biological community descriptions for Buck Island Reef National Monument and proposed marine park sites in the British Virgin Islands. (p. 276). Virgin Islands: Biosphere Reserve.

Abstract: Tropical marine ecosystems are an important segment of the Lesser Antillean Biosphere. Knowledge of the location and structure of these ecosystems in the region is necessary to ensure a representative selection of sites within a Biosphere Reserve. During the last decade tourism has increased in both the US and British Virgin Islands. A major component of this increase consists of the sailing fleet, resulting in greater impacts on the marine ecosystems through anchoring, litter and sewage disposal, and more coastal construction to support the boating public. The report mapped and described the coastal areas comprising the present and proposed marine park sites of the British Virgin Islands (BVI) and of Buck Island Reef National Monument, St. Croix, USVI.

Bombace, G., & Rossi, V. (1986). Effets socio-économiques consécutifs à la réalisation d'une zone marine protégée par des récifs artificiels dans la zone de Porto Recanati. *In: Report Of The Technical Consultation of the General Fisheries Council for the Mediterranean on Open Sea Shellfish Culture in Association With Artificial Reefs, Ancona (Italy), 17 Mar 1986.* (Report No. 357). Rome Italy: FAO General Fisheries Council for the Mediterranean.

Abstract: During 1974-75 artificial reefs were constructed off Porto Recanati in order to protect the area and enable repopulation. Economic effects regarding increased production and aquaculture potential are considered briefly and details given of a fishery cooperative formed in 1981 and its activities.

Boulon, R. H., & Dammann, A. E. (1986). Virgin Islands Biosphere Reserve. Research report No. 8. Map of fishery habitats within the Virgin Islands Biosphere Reserve. Research Report No. 9. Fisheries habitat of the Virgin Islands region of ecological importance to the fishery resources of the Virgin Islands Biosphere Reserve. Research report No. 10. Assessment of fish and shellfish stocks produced in the Biosphere Reserve. *In: Res. Rep. Virgin Islands Biosphere Reserve*, (8-10), 46.

Abstract: 19 Naturally occurring and one man-made benthic community habitat types are described in terms of the commercially important fish species assemblages found occurring there. Marine habitat types were mapped for all of St. John from National Oceanographic Survey aerial photographs and groundtruthed by divers from Jan to May 1984 to determine accuracy of mapping and to describe each habitat in detail. Fish species assemblages are determined using a random point, visual census technique which appears to be quite accurate. Results indicate that each benthic habitat type can be distinctly described in terms of its unique fish species assemblage and life history function. The life history function is viewed as a continuum primarily related to distance from shore and depth with habitats like mangrove shoreline and back reefs. Habitats with greater structural complexity tend to contain a greater number of species

Claasen, D. V. R., & van Ravenswaay, D. B. (1986). The Application of digital remote sensing techniques in coral reef, oceanographic and estuarine studies : report on a regional Unesco. (p. 151). Paris: Unesco.

Craik, W. (1986). Monitoring in the Great Barrier Reef Marine Park. Oceans '86 Conference Record: Science Engineering Adventure. Vol. 3. Monitoring Strategies Symposium Washington, DC USA: IEEE

Abstract: The Great Barrier Reef Marine Park Authority (GBRMPA) is establishing a monitoring program in the 345,000 sq. km. Great Barrier Reef Marine Park. The program is

broadly designed to test the effectiveness and the biological, social and economic effects of the zoning (management) plans which regulate the multiplicity of uses of the Park to ensure conservation of the Reef, and to evaluate the "health" of the Reef.

Dutton, I. M. (1986). Environmental management of the proposed floating hotel at John Brewer Reef. 1. Australasian Port, Harbour And Offshore Engineering Conference Australia. Coll. Civ. Eng. Institution of Engineers

Abstract: Proposals have emerged for the development of major accommodation facilities stationed on the Reef proper. The largest of these proposals to date is the Four Seasons Great Barrier Reef floating hotel which is a hybrid structure, adapted from the Consafe "Coastel" design. It is proposed that the floating hotel will be moored in the lagoon of John Brewer Reef, offshore from Townsville, and will be capable of accommodating some 450 persons overnight (including 100 staff), and up to 200 day visitors. The placement of the Coastel in a coral reef lagoon, which is part of the Great Barrier Reef Marine Park has required, and will continue to require careful attention to environmental, health and safety matters. This paper describes the proposal and the environmental assessment and management procedures employed to minimise adverse impacts and ensure long term, sustainable use of the facility in that location.

Foster, N. (1986). National marine sanctuaries - saving offshore ecosystems. *In: Sea Technology*, 27(11), 25+ vp .

Abstract: The current list of sanctuaries consists of: Key Largo National Marine Sanctuary, Looe Key National Marine Sanctuary, Gay's Reef National Marine Sanctuary, Channel Islands National Marine Sanctuary, Point Reyes-Farallon Islands National Marine Sanctuary, the Monitor National Marine Sanctuary, Fagatele Bay National Marine Sanctuary, Cordell Bank, Flower Garden Banks, and Norfolk Canyon. The seven existing sites were designated pursuant to Title III of the Marine Protection, Research and Sanctuaries Act of 1972, 16 U.S.C. 1431 et seq. The act represents a significant piece of legislation since it provided the first opportunity to designate and manage discrete offshore areas as ecosystems rather than managing individual marine resources such as mammals or fish.

Geat Barrier Reef Marine Park Auth. (1986). Annual report 1985-86. *In: Annu. Rep. Great Barrier Reef Mar. Park Auth.*, 106.

Abstract: The 10th annual report of the Great Barrier Reef Marine Park Authority is presented, describing operations of the Authority for the year ending June 1986, under the following headings: the Great Barrier Reef Marine Park Authority; the Great Barrier Reef Ministerial Council; the Great Barrier Reef Consultative Committee; 1985-86 highlights in review; planning; park management; education and information; research and monitoring; administration; and aquarium.

Guilcher, A. (1986). Coral reef environment: Damage through man action, efforts for better management. *In: Thalassas*, 4(1), 57-61.

Abstract: On most shores where they exist, coral reefs have recently experienced increasing damage due to human action. In order to prevent damage coral reefs, the main effort has so far been the creation, in 1975, of the Great Barrier Reef Marine Park in Queensland, Australia; its organization is expected to be completed in 1988, covering over 344,000 km super(2). Smaller marine parks or sanctuaries exist in 16 countries. Efficient improvements in reef protection are recorded or planned in several places. However, major difficulties are encountered in the developing nations because of the lack of adequate education, and, even more, the heavy human pressure on reefs which makes the regulations inefficient. A general strategy is needed, involving international co-ordination and help to prevent or lessen reef destruction.

Jokiel, P. L., Richmond, R. H., & Rogers, R. A. (1986). Coral reef population biology. *In: Sea Grant Coop. Rep. Hawaii Univ. Honolulu, Hi Usa : Hawaii Univ., Sea Grant Coll. Program.*

Notes: Also as: Hawaii Inst. Mar. Biol. Tech. Rep. No. 37.

Abstract: This volume is the result of research done by a group of highly motivated scientists and students who gathered at the Hawaii Institute of Marine Biology on Coconut Island in Hawaii during the summer of 1983 to participate in a program titled "Coral Reef Population Biology". This was officially labeled as a graduate course in zoology, but it was actually much more. The setting on Coconut Island contributed greatly to the success of this program. The island is in a protected bay with a variety of biotopes and is surrounded by a fringing coral reef that is protected as a marine sanctuary. The format for this program consisted of lectures presented by a group of outstanding scholars with a broad spectrum of approaches to the subject. Next followed intensive research through small group and individual projects. Because of the enthusiasm of the organizers for the high quality and intense interest of the applicants, the program surpassed the original expectations.

Langham, N. P., & Hulsman, K. (1986). The breeding biology of the crested tern *Sterna bergii*. *In: EMU*, 86(1), 23-32.

Abstract: The breeding biology of the crested tern *Sterna bergii* was studied on One Tree Island, Capricornia section of the Great Barrier Reef Marine Park, Australia. The dense nesting habit with its associated adaptations resemble those found in related species of terns. Clutch size was 1.01 with a mean incubation period of 28 days. Laying was spread over 53 days, but individual subcolonies were more synchronised (18 plus or minus 11.5 days). Hatching success in 1979/80 was 69%, most failures being attributed to predation by the silver gull *Larus novaehollandiae*. Smaller subcolonies with proportionally more nests on the perimeter were subjected to greater predation of eggs than were large subcolonies. Overall, there was a decline in hatching success with season. Fledging success was high (85%) with most mortality in 1979/80 being the result of a tropical cyclone. Gulls stole from a third to half of the fish brought to the colony in January 1982.

Lanyon, J. (1986). Guide to the identification of seagrasses in the Great Barrier Reef region. *In: Spec. Publ. Ser. Great Barrier Reef Marine Park Authority*, (3), 54.

Abstract: The guide gives a general account of seagrass morphology and then provides individual species identification, being grouped together according to genera. Identification keys are also included.

Muldoon, J. (1986). Report on field trip to Taylor, Beaver, Farquarson and Eddy reefs Cairns section. The Offshore Effects Of Cyclone Winifred. Proceedings Of A Workshop Held At The Townsville International Hotel, Friday, June 20, 1986 Townsville (Australia): Great Barrier Reef Marine Park Auth.

Abstract: A brief account is given of a field trip conducted in the Mission Reef area to observe the damage caused by Cyclone Winifred to the reef, to survey sites for Quick Cat operation pontoon semi sub, and to assess crown of thorns starfish damage.

Salm, R. (1986). Coral reefs and tourist carrying capacity; the Indian Ocean experience. *In: Industry and Environment*, 9(1), 11-14, 3 fig., 15 ref.

Abstract: Diving is an important commodity in the tourism based economies of the island nations of the Indian Ocean. Although these influxes of diving tourists bring tangible economic benefits, they are not without costs in terms of reef damage and conflicts with local culture and fishermen. The paper reviews types of damage to the Indian Ocean coral reefs caused specifically by underwater tourism, discusses some determinants of reef carrying capacity for

recreation, and proposes means to increase this by managing the use of coral areas and reef resources. It is concluded that increased public awareness, regulation of activities, creation of alternatives, such as strategically placed wrecks to attract divers, and the establishment of marine parks and protected areas, are necessary to protect the coral reefs.

Santavy, D. (1986). A blue pigmented bacterium symbiotic with *Terpios granulosa*, a coral reef sponge. In: P. L. Jokiel, R. H. Richmond, & R. A. Rogers (eds), Coral Reef Population Biology (pp. 380-393).

Abstract: Symbiosis between a blue-pigmented bacterial symbiont and its marine sponge host, *Terpios granulosa* Bergquist, was examined. Sensitivity to ultraviolet and full spectrum solar radiation of different intensities indicated a requirement for a cryptic habitat as occurs on Hawaiian coral reefs. Exposure to 50% ambient ultraviolet radiation resulted in mortality of bacterium and, ultimately, sponge cells. Separation and isolation of the bacterium was achieved using sponge and echinoderm blastula dissociation protocols. The gram negative, extracellular symbiotic bacterium possessed multicellular trichomes containing hi-refractile inclusions of blue pigment and unique terminal cells.

Savina, G. C., & White, A. (1986). A tale of two islands: Some lessons for marine resource management. In: Environmental Conservation , 13(2), 107-113.

Abstract: A comparison of two island fishing communities in the Visayas, Philippines, shows significant differences in coral-reef habitat and in diversity of selected reef-fishes, as well as important differences in fishing customs and catch composition. During the sampling months of April-May 1985, fishermen on the 72-ha Apo Island, Negros, caught more than two-thirds of their total fish-catch on the reef during the same period. Past efforts to manage APO and Pamilacan through local marine reserve systems have not been effective. Different biophysical features at the two sites, and differences in fishing customs, mean that the management needs of the islands are not alike. Effective management should weigh many factors.

Topalian, T. (1986). The role of science and scientists in marine environmental policy and management. In: Diss. Abst. Int., 47, Pt B Sci. and Eng.(4), 147.

Abstract: The objective of this study is to determine how science and scientists interact in environmental policy formation and management and how science is or could be used in the development of policy which can ultimately be used as a basis for effective resource management plans. This study attempts to evaluate the general hypothesis that "Scientists do not play a role in promoting or encouraging science as a means of changing attitudes and opinions of management and the public so as to influence public policy and ultimately environmental management." The use of science in establishing well developed management plans for coral reef areas in Australia's Great Barrier Reef; Jamaica's Ocho Rios Marine Park System; St. Croix's - Buck Island; Anguilla; the Netherlands Antilles - including Bonaire and Curacao Marine Parks; Puerto Rico's - La Parguera National Marine Sanctuary; and several of Florida State reefs such as Key Largo and Looe Key Marine Sanctuaries were examined through analysis of management plans.

White, A. (1986). Marine reserves: How effective as a management strategy for Philippine, Indonesian and Malaysian coral reef environments ? In: Ocean Management, 10(2), 137-139.

Abstract: This study evaluated the effectiveness of marine reserves as an approach to coral reef management in southeast Asia and isolates the most effective management techniques. Seven reserve areas in the Philippines were compared with two similar management areas in Indonesia and two in Malaysia. Two control areas in the Philippines were also considered. Comparison of the areas included the following: 1) documentation of the status of various reefs in the three countries, in terms of biology, management approaches, patterns of human use, and

the larger environmental setting; 2) examination of the effect of various factors, including formal management schemes, human exploitation, and general setting, on the reef; and 3) a summary of those generalities found among sites in terms of environmental conditions, management and use by humans. The following coral reef parameters were used to evaluate reef condition: substrate cover, density of coral genera, *Acanthaster* and *Tridacna* abundances, chaetodontid diversity, topographic relief, and noticeable damage. Sites were ranked in terms of reef quality and compared to remoteness, human exploitation, destructive uses, and management types. Municipal and national management approaches were contrasted and the effects of local education, scientific and tourist interest were noted at each site. Those sites with active local participation in management showed the greatest potential for environmental maintenance and improvement. At other sites where some form of management exists, except one, the management showed a positive impact and a potential for sustainable use. Control sites and those proposed for management without protection show some form of degradation.

White, A. (1986). Philippine marine park pilot site: Benefits and management conflicts. *In* : Environmental Conservation, 13(4), 395.

Abstract: Sumilon Island reef was the first nationally-protected marine park in the Philippines. A municipal marine reserve was established there in 1974 and it was designated nationally in 1980 by the Bureau of Fisheries and Aquatic Resources (BFAR). Its longevity makes it a unique case of marine reserve management in the Philippines. From 1974 until January 1980, Sumilon was managed by Silliman University in cooperation with the municipality of Oslob, Cebu, as a marine reserve. Fronting the 750 m shoreline on the west side was a strictly-protected area designated as a marine sanctuary and marked "RESERVE". No fishing or collecting was allowed there, though non-destructive fishing was allowed in the remaining waters surrounding the island. The privately-owned terrestrial portion of Sumilon was not included in the agreement, although the University leased several parcels of land from the owners.

Baldwin, C. (1987). Fringing Reef Workshop. Science, Industry and Management. Proceedings of a Workshop Held at Arcadia Resort, Magnetic Island, Australia, October 23-25, 1986. Great Barrier Reef Marine Park Authority's Fringing Reef Workshop, Magnetic Island (Australia), 23 Oct 1986 Townsville (Australia): Great Barrier Reef Marine Park Auth.

Abstract: Abstracts of the 31 papers presented at the workshop are cited individually

Cortes, J. (1987). Los parques marinos de Costa Rica. *In*: Parks, 12(1, Supplement, 3-4).

Abstract: Around 8% of the national territory of Costa Rica is devoted to reserves which protect a variety of marine environments and resources. Marine areas face environmental problems caused by man and nature, amongst which are the uncontrolled collection of organisms and sedimentation on the reefs. Recovery of reefs is always slow, and is exacerbated by human intervention. The collection of organisms could be regulated through legislation, but sedimentation of the reefs is very difficult to control as the sediment may come from outside the protected area. It is recommended that, when declaring a marine zone as a reserve, adjacent areas, river basins and nearby forests are also considered. However, the success of this type of project will only be achieved through environmental education and conscience of the people.

Craik, W. (1987). Monitoring of fringing reefs. (pp. 246-255). Townsville, (Australia): Great Barrier Reef Marine Park Auth. *GBRMPA Workshop ser.:* Vol. 9.

Craik, W., & Dutton, I. M. (1987). Assessing the effects of sediment discharge on the Cape Tribulation fringing coral reefs. *In*: Coastal Management, 15(3), 213-228.

Notes: 3 tab., 4 fig.

Abstract: In 1984, a new road was constructed through the coastal rain forest north of Cape Tribulation in North Queensland. Strong concerns were expressed at the time about the potential effects of runoff from the road on the adjacent fringing reefs. The Great Barrier Reef Marine Park Authority responded by developing a comprehensive research and monitoring program to determine what effect (if any) runoff from a new unsealed road through the coastal rain forest between Cape Tribulation and Bloomfield in North Queensland, Australia, has had, or is having on the adjacent fringing coral reefs. This paper describes the complex biophysical and management settings in which the program has been introduced, the program objectives and content, and its importance to management of the Great Barrier Reef Marine Park

Dinesen, Z. D. (1987). Key issues for day to day management of fringing reef areas in the central section of the Great Barrier Reef Marine Park. Fringing Reef Workshop. Science, Industry And Management. Proceedings Of A Workshop Held At Arcadia Resort, Magnetic Island, Australia, October 23 25 1986. Townsville Australia: Great Barrier Reef Marine Park Auth.

Abstract: Key management issues relating to fringing reef areas in the Central Sector of the Great Barrier Reef are examined briefly. The need for greater awareness of the importance of fringing reefs in the region and more information on the reefs themselves and their tolerance to environmental stresses is indicated.

Great Barrier Reef Marine Park Authority. (1987). Annual report, 1986-87. In: Annu. Rep. Great Barrier Reef Mar. Park Auth, 92.

Abstract: The 11th annual report of the Great Barrier Reef Marine Park Authority describes the operations of the authority for the year ending June 1987, under the following main section headings: 1) The Great Barrier Reef Marine Park Authority; 2) the Great Barrier Reef Ministerial Council; 3) the Great Barrier Reef Consultative Committee; 4) planning; 5) park management; 6) research and monitoring; 7) education and information; 8) aquarium; and 9) administration.

Hopley, D., & Partain, B. (1987). The structure and development of fringing reefs off the Great Barrier Reef Province. Fringing Reef Workshop. Science, Industry And Management. Proceedings Of A Workshop Held At Arcadia Resort, Magnetic Island, Australia, October 23 25 1986. Townsville Australia: Great Barrier Reef Marine Park Auth.

Abstract: A structural classification is given for fringing reefs, as follows: 1) simple reefs formed from the foundation on the lowest portion of the rocky foreshore during the Transgression; 2) reefs developed over more gently sloping substrate, particularly where older foundations of Pleistocene reefs may be present; and 3) reefs developed over pre existing positive sedimentary structures. Comparative growth rates of fringing reefs and surface features of fringing reefs are also discussed.

Hunnam, P. (1987). Management of anchorages in marine parks. Fringing Reef Workshop. Science, Industry And Management. Proceedings Of A Workshop Held At Arcadia Resort, Magnetic Island, Australia, October 23 25 1986. Townsville Australia: Great Barrier Reef Marine Park Auth.

Abstract : Anchorages are the aquatic equivalent to car parks, showing problems associated with the concentration of activities conflict between users, overcrowding, pollution, habitat destruction and wildlife disturbance yet at the same time providing managers with positive opportunities for contacting users, monitoring and regulating impacts, and supplying facilities and services to enhance the site's use and enjoyment. A preliminary analysis is given of anchoring and mooring within the Cairns Section of the Great Barrier Reef Marine Park. The concluding sections outline a strategy for the management of anchorages in the Marine Park,

including the active promotion of CARE, a Code for Anchoring on the Reef, and propose a set of guidelines for Low Impact Moorings.

Kenchington, R. A. (1987). Zoning fringing reefs in the Great Barrier Reef Marine Park. Fringing Reef Workshop. Science, Industry And Management. Proceedings Of A Workshop Held At Arcadia Resort, Magnetic Island, Australia, October 23 25 1986. Townsville Australia: Great Barrier Reef Marine Park Auth

Abstract: A discussion is presented on zoning as a management planning approach forming the basis for establishment, control and development of the Great Barrier Reef Marine Park. Characteristics of fringing reefs relevant to zoning and jurisdictional issues are examined.

Newale, R. (1987). Providing a better reef experience. Fringing Reef Workshop. Science, Industry And Management. Proceedings Of A Workshop Held At Arcadia Resort, Magnetic Island, Australia, October 23 25 1986. Townsville Australia: Great Barrier Reef Marine Park Auth

Abstract: An examination is made of the tourism industry of the Great Barrier Reef and areas requiring further development in order to provide an improved presentation of the reef environment to the tourists, who are now becoming more educated and thus more demanding. Activities conducted by the Great Barrier Reef Marine Park Authority in the area are discussed briefly.

Randall, J. E. (1987). Collecting reef fishes for aquaria. *In:* B. Salvat (ed.), Impacts Des Activites Humaines Sur Les Recifs Coralliens: Connaissances Et Recommandations (pp. 29-39). [s. l.]: [s. n.].

Notes: 16 ref.

Abstract: An examination is made of the development of the aquarium fish industry and effects on the stocks of various fish and their marine environment, the coral reef. In the Philippines most aquarium fish are taken using sodium cyanide; this method results in heavy mortality both to the captured fish, which may die up to 1 month later, and also to the local coral reef population. Other noxious compounds used include organophosphate insecticides, rotenone and quinaldine. In Hawaii the most common method is the barrier net, which may result in damage to the coral reefs. The importance of marine reserves to protect such environments is discussed.

Roe, P. A., Zahnleiter, P. R., & Zigterman, R. F. (1987). Management issues identified from assessment of state proposals for marine park declaration. Fringing Reef Workshop. Science, Industry And Management. Proceedings Of A Workshop Held At Arcadia Resort, Magnetic Island, Australia, October 23 25 1986. Townsville Australia: Great Barrier Reef Marine Park Auth

Abstract: A study undertaken on behalf of the Queensland Government to identify areas suitable for declaration as Marine Park under the Queensland Marine Parks Act 1982 has revealed several significant management issues. Key among these is the apparent conflict between fishing, both commercial and recreational, conservation and preservation. In seeking conservation, the overriding management factor has been found to be accessibility to the fringing reef areas.

Saenger, P. (1987). A reconnaissance account of the Rodney Island fringing reef and associated marine communities, Shelburne Bay. Fringing Reef Workshop. Science, Industry And Management. Proceedings Of A Workshop Held At Arcadia Resort, Magnetic Island, Australia, October 23 25 1986. Townsville Australia: Great Barrier Reef Marine Park Auth

Abstract: Field work and Landsat imagery data show 4 distinct marine communities to exist

around Rodney Island: 1) shoreline mangroves; 2) coral fringing reefs; 3) intertidal sandflats; and 4) soft bottom benthic communities. Each of these communities is described briefly.

Schroeder, R. E. (1987). Effects of patch reef size and isolation on coral reef fish recruitment. *In: Bulletin of Marine Science*, 41(2), 441-451.

Searles, R. B. (1987). Phenology and floristics of seaweeds from the offshore waters of Georgia. *In: Northeast Gulf Sci*, 9(2), 99-108 .

Abstract: Seaweeds were studied from rock outcrops in two areas on the Georgia continental shelf, Gray's Reef National Marine Sanctuary on the inner shelf and an area known as the "Snapper Banks" on the outer shelf. The seaweeds observed are seasonal; only a few plants persist through the winter. In this study a gradual increase in number and size of plants and number of species was observed through June; by July-early August, when all 68 species reported were present, the quantity of plants also appeared maximal. Of the 68 species, 43 are species not previously reported from Georgia; eight additional taxa are identified only to genus, but are also new to the region. Sixty-five of the species were collected at Gray's Reef and 22 at the Snapper Banks; three of the latter did not occur at Gray's Reef.

Yamazaki, A., & Ishiwata, N. (1987). Population ecology of the spiny turban shell *Batillus cornutus*. 2. Habitat of juvenile shell. *In: UMI Mer*, 25(4), 184-189.

Abstract: The habitat of spiny turban shell juveniles *Batillus cornutus* was investigated 7 times during the period of November 1981 to January 1985 in both intertidal and subtidal zones of marine reserves on the Pacific coast of Chiba Pref., Japan. Juvenile shells of less than 10 mm in shell height were frequently found living with a related species of small turban shell *Marmarostoma stenogyrum* (Fischer) in a symbiotic connection especially with association of articulated coralline algae (Corallinoideae) in the subtidal zone

Alcala, A. C. (1988). Effects of marine reserves on coral fish abundances and yields of Philippine coral reefs. *In: Ambio*, 17(3), 194-199.

Australian Institute of Marine Science. (1988). Australian marine research in progress 1988. (p. 865). Melbourne Australia: Isu, Csiro.

Abstract: A comprehensive data base of research in marine science and technology in Australia produced by a consortium of Australian research and management agencies: the Australian Institute of Marine Science, the Great Barrier Reef Marine Park Authority, the Commonwealth Scientific & Industrial Research Organization, and the Victorian Institute of Marine Sciences. The 1988 edition contains 1,267 entries indexed according to subject (using the ASFIS Thesaurus), organization, investigator, geographic location and taxonomic identity. It describes objectives, methods and preliminary outcomes of research, with contacts listed for each project

Baldwin, C. (1988). Management of dugong: An endangered marine food species of traditional significance. The need for user involvement in an integrated program of research, management and education. Traditional Knowledge Of The Marine Environment In Northern Australia. Proceedings Of A Workshop Held In Townsville, Australia, 29 And 30 July 1985 Townsville (Australia): GBRMPA

Abstract: An examination is made of the problem of extinction regarding the dugong in Australian waters. Based on its inherent value as a food item, the dugong has a significant role in the life style of northeast Queensland indigenous people. Most of the northeast coast habitat is within the Great Barrier Reef Marine Park. Information gaps in the field of dugong management are identified, and include population dynamics, recruitment, annual removal,

habitat and cultural anthropology. It is concluded that only by "user" involvement in the development of an integrated research, management and education programme will the dugong population of northeast Queensland be able to be used on a sustainable basis

Bojos, R. M. Jr., & Vande Vusse, F. J. (1988). Artificial reefs in Philippine artisanal fishery rehabilitation. Report Of The Workshop On Artificial Reefs Development And Management. Penang, Malaysia, 13 18 September 1988 Manila (Philippines): ASEAN/UNDP/FAO Reg. Small Scale Coastal Fisheries Development Proj.

Abstract: Philippine coastal fishery harvests have been declining because of overfishing by 900,000 artisanal and commercial fishermen and coastal fish habitat destruction. The Central Visayas Regional Project I(CVRP I) seeks to address this problem with community organization and a series of resource management activities carried out by the fishermen. These activities included: artificial reefs constructed and placed by fishermen; mangrove reforestation and management; coral reef management with establishment of marine sanctuaries; small scale sea ranching and farming of valuable native species; and deep water fish attracting devices harvested only with handlines. The fishermen who have been blamed for much of the coastal resource degradation can become effective managers of that resource. Key elements needed for the transition are: community development workers willing to live and work in fishing villages; simple, low cost technologies that are profitable, equitable to the majority of fishermen and sound from a resource management standpoint; and a flexible regulatory framework within which communities may make equitable resource allocation decisions.

Dinesen, Z. D. (1988). Complementary management of marine parks and island national parks in the Great Barrier Reef region. Proceedings Of The Sixth International Coral Reef Symposium, Townsville, Australia, 8th 12th August 1988. Volume 2: Contributed Papers Mini Symposium 1 To 10 14

Abstract: The Queensland National Parks and Wildlife Service (Q. NPWS) carries out the day to day management of the Great Barrier Reef Marine Park on behalf of the federal government agency, the Great Barrier Reef Marine Park Authority (GBRMPA). Increasing usage of the islands and associated marine park areas is resulting in numerous new developments such as jetties and marinas adjacent to rapidly expanding coastal settlements and island resorts. The main issues faced by the Q. NPWS in complementary management of island national parks and marine parks are examined with particular reference to the heavily used inshore areas of the Townsville Whitsunday region.

Gittings, S. R. et al. (1988). The recovery process in a mechanically damaged coral reef community: Recruitment and growth. Proceedings Of The Sixth International Coral Reef Symposium, Townsville, Australia, 8th-12th August 1988. Volume 2: Contributed Papers (Mini Symposium 1 to 10/14) (pp. 225-230). [s. l.]: [s. n.]

Abstract: Coral recruitment and tissue regeneration were studied for 27 months following a freighter grounding on Molasses Reef, Key Largo National Marine Sanctuary (Florida, USA). At the end of the study, hard coral and gorgonian populations in a 1500 m super(2) area of nearly complete destruction were 13% and 10% of pre-impact populations. Recruitment was by species dominant in surrounding communities and was highest in damaged areas that contained surviving adult colonies. Therefore, coral transplantation into heavily damaged areas may increase the rate of recovery. Some transplanted corals should be those displaced by the ship into sand flats. In the 2 years following displacement these corals showed substantial tissue deterioration. Factors delaying recovery include the presence of fine sediment and large amounts of rubble. The removal of such sediment and debris from areas of mechanical impact may enhance recovery by expediting successful recruitment.

Great Barrier Reef Marine Park Authority. (1988). Annual review 1987-88. *In: Annu. Rep. Great Barrier Reef Mar. Park Auth. Townsville, Qld. (Australia): Great Barrier Reef Marine Park Authority.*

Abstract: The report describes the activities of the Great Barrier Reef Marine Park Authority during the year 1987-88, and is presented under the following main section headings: Great Barrier Reef Marine Park Authority; Great Barrier Reef Ministerial Council; Great Barrier Reef Consultative Committee; Planning; Park management; Research and monitoring; Education and information; Aquarium; Administration; and Appendices.

Hudson, J. H., & Diaz, R. (1988). Damage survey and restoration of M/V Wellwood grounding site, Molasses Reef, Key Largo National Marine Sanctuary, Florida. Proceedings of the Sixth International Coral Reef Symposium (pp. 231-236).

Abstract: Grounding of the M/V Wellwood on Molasses Reef in the Key Largo national Marine Sanctuary on August 4, 1984, resulted in massive destruction to living corals and underlying reef framework. A precision survey of grounding damage to the reef was done. The survey revealed that a 1,282-m super(2) area of the reef had sustained a 70-100% loss of live coral cover as a result of the grounding. Within this major damage zone, 644 m super(2) of underlying reef framework had been fractured by the great weight of the 400-ft- long (122 m) ship. Pilot studies were undertaken at the grounding site to test the feasibility of transplanting hard and soft corals, stabilizing widespread fracturing, and rebuilding reef topography with dislodged, massive corals. All 3 mitigation experiments have proven to be a practical means of restoring a coral reef area severely damaged by a ship grounding.

Jaap, W. C., Halas, J. C., & Muller, R. G. (1988). Community dynamics of stony corals (Milleporina and Scleractinia) at Key Largo National Marine Sanctuary, Florida, during 1981-1986. Proceedings Of The Sixth International Coral Reef Symposium, Townsville, Australia, 8th-12th August 1988. Volume 2: Contributed Papers (Mini Symposium 1 to 10/14) (pp. 237-243). [s. l.]: [s. n.]

Abstract: Four reefs were sampled annually from 1981 through 1986 in Key Largo National marine Sanctuary (KLNMS), a coral reef area that is used intensively for snorkeling, diving, and fishing by local residents and tourists. The dynamics at one site, Molasses Reef, is reported. The site was located on a spur with buttresses of *Montastraea annularis* and thickets of *Acropora palmata*. Some 17-19 species and 266-355 colonies were counted annually. *A. cervicornis*, *A. palmata*, *M. annularis*, and *Millepora alcicornis* constituted 66%-90% of all colonies. Incidence of *A. cervicornis* declined 96% between 1981 and 1986. *A. palmata* varied from 2.3 to 5.4 colonies/m super(2), and *M. annularis* varied from 0.9 to 2.3/m super(2)

James, P. S. (1988). Recent observations on marine fisheries resources of Lakshadweep. *In: M. M. Joseph (ed), The First Indian Fisheries Forum, Proceedings. December 4-8, 1987, Mangalore, Karnataka.* (pp. 191-197). [s. l.]: [s. n.]

Abstract: A recent survey conducted in Lakshadweep made an overall assessment of the various types of fishery resources, their potential and the impact of environmental damage on the ecosystems. The skipjack and yellowfin tunas caught in pole and line formed the mainstay of economy of the islanders. The catch increased from 571 t in 1970 to 5000 t at present. The demand for live-baits, essential for pole and line fishing has also increased. Environmental damage, both natural and otherwise, has affected their availability in some islands. The lagoons and the surrounding sea abounds in a variety of food fishes like goatfishes, silver biddies, perches, barracudas, carangids, seerfishes, sharks, rays, etc. Fairly good resources of marine ornamental fishes were observed in various islands indicating potential for export market. A variety of echinoderms occur and some of them are considered to be good for Bache-de-mer industry. The corals and coral reefs are integral part of the islands. They are partially devastated

in some islands due to human interference or natural causes causing not only sea erosion but upsetting the ecosystems with far reaching effects on fisheries resources. The scope for mariculture as well as the possibilities of establishing marine parks are indicated. The prospects for further development of fisheries in Lakshadweep are discussed.

Kozlowski, J., Rosier, J., & Hill, G. (1988). Ultimate Environmental Threshold (UET) method in a marine environment (Great Barrier Reef Marine Park in Australia). *In: Landscape and Urban Planning*, 15(3-4), 327-336.

Abstract: The article concentrates on problems which result from tourism development in attractive and fragile natural environments and presents a planning method which may assist developers and managers to reduce the possible environmental damage to a realistic minimum. The method, based on the Concept of "Ultimate Environmental Thresholds" (UETs), has been recently tested in a marine environment on a group of islands in the Capricornia Section of the Great Barrier Reef Marine Park (GBRMP) in Australia.

Lassig, B. et al. (1988). Monitoring the Great Barrier Reef. Proceedings Of The Sixth International Coral Reef Symposium, Townsville, Australia, 8th 12th August 1988. Volume 2: Contributed Papers Mini Symposium 1 To 10 14

Abstract: The Great Barrier Reef Marine Park Authority (GBRMPA) has initiated a number of specific monitoring programs while continuing to develop an easily accessed, integrated, broad scale data base to gauge the effectiveness of the Great Barrier Reef Marine Park zoning and management. Several other issue oriented, but broader scale and baseline programs have been instigated by the GBRMPA in conjunction with other organisations. The specific monitoring programs are based on key sites and events with potential for management problems in the short term. Examples discussed include: the crown of thorns starfish; monitoring key sites at John Brewer, Norman and Cape Tribulation Reefs; and coral trout surveys. Aspects of the GBRMPA's database development, as a critical element of the monitoring process, are also included. Methodologies, results and difficulties associated with these, and other, monitoring programs are highlighted.

McClanahan, T., & Muthiga, N. (1988). Changes in Kenyan coral reef community structure and function due to exploitation. *In: Hydrobiologia*, (166), 269-276.

Abstract: A comparison of Kenyan reefs of different historical and observed levels of fishing exploitation showed that more exploited reef lagoons had greater sea urchin densities and sizes, fewer and smaller fish, and less coral cover. In the most exploited lagoon the biomass of the burrowing sea urchin, *Echinometra mathaei* increased five-fold during the previous 15 years. An ecological study of the three most common omnivorous sea urchin species inhabiting hard substrate within these reef lagoons suggests that they are ecologically separated by predation and avoid predators and competitors by occupying different size burrows or crevices within the lagoon. Predator removal through fishing activities may result in ecological release of the sea urchins and result in competitive exclusion of weaker competitors. The most exploited reef had a nearly mono-specific barren of *F. mathaei* living outside burrows; this result suggests that this species may be the top competitor. Its ecological release appears to lead to a decrease in live coral cover, increased substrate bioerosion, and eventually a loss of topographic complexity, species diversity, fish biomass and utilizable fisheries productivity

Mcmanus, J. (1988). Coral reefs of the ASEAN region: Status and management. *In: Ambio*, 17(3), 189-193 .

Notes: Special issue: East Asian Seas.

Abstract: Coral reef provide a substantial part of the protein intake in Southeast Asia. Reefs and nonreef coral communities within 15 km of shore are generally overfished, while offshore

subsurface atolls and pinnacle reefs are often beyond the reach of small-scale fishermen. Major destructive forces include excessive sedimentation, related to deforestation, and various forms of destructive fishing, especially blast fishing. Current attempts to manage these areas through coastal-zone plans, fishery restrictions, and the development of marine parks have been effective in only a few isolated cases.

Mcmanus, J., Ferrer, E. M., & Campos, W. L. (1988). A village level approach to Coastal Adaptive Management and Resource Assessment (CAMRA). Proceedings Of The Sixth International Coral Reef Symposium, Townsville, Australia, 8th 12th August 1988. Volume 2: Contributed Papers Mini Symposium 1 To 10 14

Abstract: Success with village based marine reserves in the Philippines indicates that local coastal management may be more realistic than that based solely on national regulations. A village based adaptive management system is proposed wherein environmental community organizers (ECO's) are assigned to villages to evaluate the fishery, environmental, sociological and economic factors, educate villagers in appropriate management options, organize for the formulation of local regulations, and network with national agencies for assistance with particular problems. The fact that many fisheries may be evaluated in a two year period indicates that a 2 to 3 year cycle of implementation and adaptation may be usefully incorporated into local management strategies.

Parnell, K. E. (1988). The hydrodynamics of fringing reef bays in the Great Barrier Reef Marine Park. Proceedings Of The Sixth International Coral Reef Symposium, Townsville, Australia, 8th 12th August 1988. Volume 2: Contributed Papers Mini Symposium 1 To 10 14

Abstract: Results of a hydrodynamic study using Lagrangian techniques in 6 fringing reef bays within the Great Reef Marine Park are presented. Bay circulation is shown to be a response to the interaction of the regional tidal stream with the bay morphology, with eddy circulation being established if there is a high incident angle between the tidal stream and the leading bayhead. Once established, velocities within the eddy are independent of tidal stream velocities. The fringing reef bays are well flushed with greater than 90% water renewal on each tidal cycle. Bay circulation causes flushing times to be shorter than predicted using a volume exchange model.

Samoilys, M. A. (1988). Abundance and species richness of coral reef fish on the Kenyan coast: the effects of protective management and fishing. Proceedings of the 6th International Coral Reef Symposium (pp. 261-266).

Abstract: Underwater censuses were used to measure species richness and abundance of coral reef fish at nineteen study sites on the Kenyan coast. While species richness was highest in marine parks where no fishing or collecting was allowed, the same was not true for fish abundance or biomass of commercially important species. Some of the highest densities and weights of fish were found in the marine reserves where traditional fishing, was allowed. Areas with higher fishing intensity had smaller standing crops of fish, but not comparably smaller abundances. This suggests that the average fish size is lowered by more intense fishing. Two factors, siltation from rivers and dynamite fishing, have a major impact on the fish assemblages. Reels badly damaged from dynamiting, including Mako Kakwe in Kisite marine park were characterized by low species richness and a low biomass of commercially important species. At Malindi, densities and biomass of fish were of a similar magnitude to dynamited reefs, despite the prohibition of all fishing and collecting for the last 20 years. The reef has been subjected to a heavy influx of sediment from the Sabaki River since the early 1970's. Thus, the effects of protection and fishing on reef fish assemblages were confounded by other major impacts on Kenya's reefs, namely siltation and dynamiting.

Simmons, D. (1988). Coastal conservation and marine parks. Report Of The First Oecs Workshop On Fisheries Management And Development. St. Vincent And The Grenadines, 24 27 August, 1987

Abstract: The development of the agricultural, tourism and manufacturing sectors in the OECS has led to the depletion and mismanagement of a number of the critical natural resources of the region (forests, soil and coral reefs). This paper provides an introduction to the concept of marine parks as an element of a coastal conservation strategy and notes the role which they may play in safeguarding coastal resources

Smale, M. J. (1988). Distribution and reproduction of the reef fish *Petrus rupestris* (Pisces: Sparidae) off the coast of South Africa. *In: South African Journal of Marine Science, 23(4), 272-287.*

Abstract: The red steenbras (*Petrus rupestris*) is endemic to the south and south-east coasts of South Africa and is the largest member of the family Sparidae. Morphometric relationships between length and mass are given for whole and eviscerated fish. The size distribution of *P. rupestris* is related to locality and water depth. The development of the functional sexes, and the occurrence of sexual dichromatism, are described. Sexual maturity is attained at about 575 mm fork length in those fishes in the spawning areas. Reproductively ripe fishes were taken from Transkei, East London and a small collection was made from the Agulhas Bank. Peak spawning is between August and October. Current management regulations are discussed and advantages of large marine reserves in conservation of this mobile apex predator are outlined.

Smith, A. (1988). The usage of marine resources by the people of the Hopevale aboriginal community on the east coast of Cape York peninsula. Preliminary results. Traditional Knowledge Of The Marine Environment In Northern Australia. Proceedings Of A Workshop Held In Townsville, Australia, 29 And 30 July 1985 Townsville (Australia): GBRMPA

Abstract: A discussion is presented on a study conducted by the Great Barrier Reef Marine Park Authority to document marine resource usage in the area between Lookout Point and Jeannie River in Cape York peninsula, Queensland, Australia. The major objectives of the study were to document the marine hunting and fishing practices of the Hopevale aboriginal community, to acquire indigenous knowledge of the biology and behaviour of tropical marine food resources of the Great Barrier Reef Marine Park and to provide recommendations that could be used in the development of a management programme.

Tisdell, C., & Broadus, J. M. (1988). Marine reserves: relevant policy and management issues with examples from the Great Barrier Reef Marine Park, Australia, and the United States. Australia: Department of Economics, University of Newcastle.

Abstract: With particular attention to social science considerations, two aspects of marine reserves are examined: establishment decisions and general management decisions once they are established. Economic reasons are given as to why governments should establish marine reserves and a formal cost benefit framework is outlined for determining the optimal size of reserves. Four main aspects of marine reserve management are discussed. First, the objectives applicable to marine reserve management are considered, focusing particularly on the Great Barrier Reef Marine Park, Australia, and the importance of taking account of political sustainability. The degree to which Australian and US legislation provide guidance about objectives is assessed. Secondly, the comparative difficulty of managing land-based parks and marine reserves are considered and natural factors identified which make it relatively more difficult to manage marine reserves. Thirdly, the multiple use of marine reserves and the desirability of zoning are considered. Fourthly, the importance of the social sciences in marine reserve management is emphasized. A social sciences/economics perspective is provided, which differs in a number of respects from the approach adopted by natural scientists.

Van' t Hof, T. (1988). Management of coral reefs and associated systems and resources in the western Atlantic: A status review. Proceedings Of The Sixth International Coral Reef Symposium, Townsville, Australia, 8th 12th August 1988. Volume 1: Plenary Addresses And Status Reviews [s. l.]: [s. n.]

Abstract: A review is made of the current situation regarding coral reef resource management in the western Atlantic, considering various threats to the coral reef environment. Management activities in the different countries in the region are detailed and the role of marine protected areas examined.

Wheaton, J., & Walters, C. (1988). Corals and other prominent benthic cnidaria of Looe Key National Marine Sanctuary, Florida. (p. 25). St. Petersburg, Fla.: Florida Dept. of Natural Resources, Bureau of Marine Research.

Abstract: Octocoral and stony coral (Milleporina and Scleractinia) species composition, abundance, density, and diversity were determined at six sites (to 11 m depth) within Looe Key National Marine Sanctuary, Monroe County, FL. Other prominent benthic cnidarians (Palythoa caribaeorum, Zoanthus sociatus, and Ricordia florida) were noted. Fifty-nine cnidarian species were recorded during the survey, including 23 octocorals, 31 scleractinians, and 2 hydrocorals. Species composition and abundance increased markedly between zones of increasing depth at sites within the spur and groove formation. Diversity values were moderate to high among both octocorals and stony corals and resembled those obtained at other south Florida reefs.

White, A. (1988). The effect of community-managed marine reserves in the Philippines on their associated coral reef fish populations. *In: Asian Fisheries Science*, 2(1), 27-41.

Abstract: This study measures changes over 2 years in the species richness and abundance of fish on 3 coral reefs associated with new community-managed marine sanctuaries in the Visayas, Philippines.

Yamazaki, A., & Ishiwata, N. (1988). Population ecology of the spiny turban shell *Batillus cornutus*. 3. Early growth and change of density. *In: UMI Mer*, 26(1), 12-18.

Abstract: The early growth and change of density of the spiny turban shell *Batillus cornutus* were studied during the period from November 1981 to August 1983 from size-frequency analysis of the natural population in a subtidal zone of marine reserves on the Pacific coast of Chiba Pref., Japan. In these waters the animal reaches a mean shell height of 12 mm at 1.0 year, 33 mm at 2.0 years, and 50 mm at 3.0 years. Juvenile shells of less than 12 mm in shell height live densely inside the association of articulated coralline algae (Corallinoideae), and they move from this habitat to the outside of the association when they attain a size of 12 to 33 mm. They stay in this area for early growth and move gradually to the waters of more than 10 m depth before the third summer

Zann, L., & Moran, P. J. (1988). A coordinated research program on the Acanthaster phenomenon on the Great Barrier Reef. Proceedings Of The Sixth International Coral Reef Symposium, Townsville, Australia, 8th-12th August 1988. Volume 2: Contributed Papers (Mini Symposium 1 to 10/14) [s. l.]: [s. n.]

Abstract: The Acanthaster phenomenon is one of the most serious management issues in the Great Barrier Reef Marine Park. The Great Barrier Reef (GBR) has experienced 2 series of outbreak of the crown of thorns starfish in the past 25 years. In 1985 the Crown of Thorns Starfish Advisory Committee recommended, inter alia, that a coordinated research program be conducted over a 4-5 year period at a cost of \$A3 million. A total of \$A2.5 million has been granted by the Australian government for this research since late 1985. Substantial support also has been given by a number of other agencies. These funds have been allocated to some 58 projects involving 70 scientists from 23 Australian and overseas research institutions. The

Crown of Thorns Starfish Advisory Review Committee, was established to review the development of the program and the progress of research. The research program's major achievements are broadly outlined. A longer-term, coordinated research program is now proposed

Zann, L., & Weaver, K. (1988). An evaluation of crown of thorns starfish control programs undertaken on the Great Barrier Reef. Proceedings Of The Sixth International Coral Reef Symposium, Townsville, Australia, 8th-12th August 1988. Volume 2: Contributed Papers (Mini Symposium 1 to 10/14) (pp. 183-188). [s. l.]: [s. n.]

Abstract: Attempts to control *Acanthaster planci* are reviewed and the cost/benefits of trials undertaken by the Great Barrier Reef Marine Park Authority (GBRMPA) are evaluated. On the GBR, attempts to preserve small areas of reef for coral-viewing at Green Island during both episodes of outbreaks were unsuccessful. At Beaver and John Brewer Reefs about half the coral in 2-4 ha areas was saved by volunteers and tourist operators in sustained programs over 3-4 years. At Cormorant Pass a small, isolated aggregation was successfully eradicated by GBRMPA. About 12,200 starfish were injected in trial controls by GBRMPA. Military divers were provided at no charge but support costs were high. Financial costs to GBRMPA for each starfish injected ranged from A\$0.50-7.00

Alevizon, W. S., & Gorham, J. C. (1989). Effects of artificial reef deployment on nearby resident fishes. *In: Bulletin of Marine Science*, 44(2), 646-661.

Andrews, G., & Holthus, P. (1989). Marine environment survey: Proposed Aleipata Islands National Park, Western Samoa. (p. 68). Noumea New Caledonia: South Pacific Commission.

Abstract: The Aleipata area surveyed includes the south-eastern coast of Upolu Island, Western Samoa. The survey consisted of general descriptive ecology and morphology for the Aleipata coastal fringing reef and the fringing reefs of the two detached islands, Nu'utele and Nu'ulua. The Aleipata area reefs supply the local population with much of their food resources, and a survey of resource use and techniques was conducted. The survey revealed that the Aleipata marine environment supports typical coral reef habitats and associated plant and animal communities, and does not contain particularly unique or spectacular organisms, communities or morphologic features

Baldwin, C. (1989). Water quality and management in the Great Barrier Reef Marine Park. *In: Water Science and Technology*, 21(2), 267-272.

Abstract: Use of the Great Barrier Reef Region for tourism, the economic value of Reef tourism to Queensland, and the value placed by society on natural settings has been increasing rapidly during the 1980's. The Great Barrier Reef Marine Park Authority has the role of providing for reasonable use of this valuable resource. The concern for reefal water quality is discussed in terms of enhanced nutrient levels in the inshore GBR and the low tolerance of corals to nutrients. Findings of a recent Workshop on Nutrients in the Great Barrier Reef Region are described. This paper summarises the Authority's role in ensuring information exchange, appropriate research, and management in the area of water quality management and tourism

Buxton, C. D., & Smale, M. J. (1989). Abundance and distribution patterns of three temperate marine reef fish (Teleostei: Sparidae) in exploited and unexploited areas off the southern Cape coast. *In: Journal of Applied Ecology*, 26(2), 441-451.

Abstract: Visual underwater census was used to determine the abundance and size structure of three conspicuous marine reef fish species on the southeast Cape coast, South Africa, during 1984-86. Sites inside the Tsitsikamma Coastal National Park and outside the reserve at Cape

Reef were compared to evaluate the effectiveness of the reserve as a management option for the fish. Three sparids were studied: *Chrysoblephus laticeps*, *C. cristiceps*, and *Petrus rupestris*. Transect techniques suggested that point counts were best suited for mobile species, while line counts were best suited for more sedentary species. Distribution of the target species within an area was correlated with depth and substratum relief, both factors reflecting feeding and habitat preferences. Fewer fish were found in shallow water and on flat reefs. During cold upwelling, fish moved away from the study area, presumably following warmer water. Seasonal differences were observed in the abundance of *C. laticeps* abundance was greatest in summer. Sampling showed that the abundance and size of fishes was greater within the reserve. The data suggested that the reserve is providing effective protection for species vulnerable to line-fishing.

Clark, J. R., Causey, B., & Bohnsack, J. A. (1989). Benefits from coral reef protection: Looe Key Reef, Florida. Coastal Zone '89: Proceedings of the 6th Symposium of Coastal and Ocean Management

Abstract: By 1988, there were approximately 135 protected coral reef areas in the Caribbean and 123 in Southeast Asia. Major reasons for reef protection are enhancement of tourism, conservation of fish stocks, and prevention of shore erosion. This paper addresses conservation of fish stock in the United States (Florida Keys) and the Philippines (Central Visayas). Changes in fish abundance on study reef in both regions were determined by quantitative before-and-after, studies of fish abundance at protected coral reef areas. Four Philippine projects to increase fish yields by creating inviolate replenishment zones, or reserves, are compared with one project in the United States to protect an intensively used coral reef for ecological, tourist, and fishery purposes. In all cases, a marked increase in desirable species was observed after strict protection was applied. For example, snappers (Lutjanidae) increased by an average of 47, 213, and 2850 percent in the Apo, Pamilacan, and Balicasag island projects in the Philippines, respectively. Snappers increased by 93 percent and grunts by 439 percent in the Looe Key National Marine Sanctuary. The success of these management experiments is most welcome now when the world's coral reefs are suffering increasing exploitation and diminishing faunal resources.

Dutton, I. M. (1989). Workshop on the Role of Scientific Support Coordinator (SSC) in Oil Spill Response. Proceedings of National Workshop Mackay, Australia, November 22-25, 1988. Workshop on the Role of Scientific Support Coordinator (SSC) in Oil Spill Response, Mackay (Australia), 22-25 Nov 1988 Townsville Australia: Great Barrier Reef Mar. Park Auth. *Workshop Ser. Great Barrier Reef Mar. Park Auth.:* Vol. 12.

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Abstract: Under the Australian National Plan to Combat Pollution of the Sea by Oil and various State and regional supplements, an extensive framework for oil spill response has been established. The role of the Scientific Support Coordinator is identified as a major element of the overall response organization; the workshop sought to provide for the exchange of information. This report gives a summary of the proceedings of the workshop which also reviewed the current status of scientific preparation in the context of contingency plans. Major recommendations of the workshop included: information be prepared on oil and dispersant toxicity and guidelines developed for their use under a range of conditions; a need to clarify and evaluate the role of monitoring in spill response; coastal resources atlases are an important tool and could be improved by the transfer of information to field usable micro computer based systems.

Gorham, J. C., & Alevizon, W. S. (1989). Habitat complexity and the abundance of juvenile fishes residing on small scale artificial reefs. *In: Bulletin of Marine Science*, 44(2), 662-665.

Great Barrier Reef Marine Park Authority. (1989). Annual report 1988-1989. *In: Annu. Rep. Great Barrier Reef Mar. Park Auth*, 101.

Abstract: The report describes the activities of the Great Barrier Reef Marine Park Authority during the year 1988-89, and is presented under the following main section headings: Great Barrier Reef Marine Park Authority; Great Barrier Reef Ministerial Council; Great Barrier Reef Consultative Committee; Planning and management; Environmental impact management; Research and monitoring; Education and information; Aquarium; Administration; Canberra Office; and, Appendixes.

Hill, G., & Rosier, J. (1989). Wedgetailed shearwaters, white capped noddies and tourist development on Heron Island, Great Barrier Reef Marine Park. *In: Journal of Environmental Management*, 29(2), 107-114.

Abstract: A survey of the density and distribution of wedgetailed shearwater (*Puffinus pacificus*) and white capped noddy (*Anous minutus*) nesting populations, on Heron Island in the Great Barrier Reef Marine Park, has had interesting results. They indicate that, for both species, the developed and undeveloped halves of the island support similar numbers of nesting birds. These findings contradict some previous literature regarding the compatibility between development and seabird colonies on Heron Island and demonstrate that some seabirds are able to compensate for loss of space through more concentrated nesting activity. The work identifies key environmental elements associated with this adjustment in nesting behaviour of shearwaters and noddies and suggests ways in which management and planning may be directed to favour minimal loss of breeding potential. The problems involved in completing planning exercises based on inadequate scientific data are emphasised.

McClanahan, T. (1989). Kenyan coral reef-associated gastropod fauna: A comparison between protected and unprotected reefs. *In: Marine Ecology Progress Series*, 53(1), 11-20.
Notes: 36 ref.

Abstract: A comparative survey of prosobranch gastropods was undertaken within 3 marine parks and 3 unprotected reefs to compare faunal differences attributable to management and nonmanagement policies. The total gastropod fauna was typified by low densities and high diversity and variability in species composition. Protected reefs had a higher diversity for combined reef locations and higher species richness on reef edges and lagoons but not reef flats. Differences in reef edges are attributable to physical differences in reef aspect and wave energy but lagoon differences are attributable to human influences. Total gastropod densities were similar for comparisons between reef flat and edges but unprotected reef lagoons had higher densities than protected lagoons. Overall, most commercially collected species were not significantly denser in protected sites than unprotected sites. Some species such as *Lambis truncata* and *L. chiragra* were clearly more dense within protected sites.

Ramos-Espla, A., & Bayle Sempere, J. (1989). Management of living resources in the marine reserve of Tabarca Island (Alicante, Spain). *In: Bull. Soc. Zool. France*, 114(4), vp.

Abstract: The Marine Reserve of Tabarca is intended to be a protected zone of the environment and also an area which is subject to a rational management policy, permitting traditional fishing methods, such as selective artisanal techniques, in use around the island, depending on locality and season. Bearing this in mind, an extensive zone (1400 ha) has been divided into three areas, each subject to a different degree of management: an integral, protecting area, a damping area, and a transitional or peripheral area. Fishing activities (fixed inshore trap nets or morunas and trawl-lines or curricanes) are allowed in the second and third areas. In order to protect certain zones, some structures which prevent trawling (wooden hulls, cubic concrete blocks) were sunk. A pyramidal, alveolar reef was also exposed in order to observe fish behaviour.

Russ, G., & Alcala, A. C. (1989). Effects of intense fishing pressure on an assemblage of coral reef fishes. *In: Marine Ecology Progress Series*, 56(1-2), 13-27.

Notes: Bibliogr.: 58 ref.

Abstract: Fishing is the most important exploitative activity on coral reefs. This paper documents a natural experiment in the central Philippines: a dramatic increase in fishing pressure within a 750 m long marine reserve, previously protected from fishing for 10 yr (1974 to 1984). In 1983, the site had a significantly higher abundance of fishes, particularly those considered to be favoured targets of fishermen (e.g. serranids, lutjanids, lethrinids), than similar sites which were fished. Abundances were estimated by visual census within the reserve and at 3 control sites. In early 1984, protective management broke down and fishing by up to 100 municipal fisherman began, using traps, hand-lines, gill-nets, spears and occasionally more destructive, non-selective fishing methods, such as explosives and drive nets.

Schroeder, R. E. (1989). Enhancing fish recruitment through optimum reef design of artificial structures and marine reserves. *In: Trop. Coast. Area Manage.*, 4(3), 6-8.

Abstract: A discussion is presented on how to improve on the use of artificial reefs or the selection of marine sanctuary areas by elaborating the implications of the findings of the researches done on reef areas. (DBO).

Tisdell, C., & Broadus, J. M. (1989). Policy issues related to the establishment and management of marine reserves. *In: Coastal Management*, 17(1), 37-53.

Abstract: Several hundred marine reserves now exist and their number is growing. The demand for additional marine reserves can also be expected to grow. Basic socioeconomic reasons are given as to why governments should establish marine reserves. Management problems are illustrated by reference to the Great Barrier Reef Marine Park and to the National Oceanic and Atmospheric Administration's (NOAA) governing of Title III of the Marine Protection, Research and Sanctuaries Act. The nature, clarity, and precision of objectives as set out in legislation are discussed.

United Nations Environment Programme. (1989). Coastal and marine environmental problems of the United Republic of Tanzania. (p. 120). Nairobi (Kenya): United Nations Environment Programme.

Abstract: The Government of the United Republic of Tanzania approached UNEP in late 1987 with a request for assistance in assessing the coastal and marine environmental problems of the country and in drawing up a national action plan for the protection, management and development of its marine and coastal environment. The report consists of a summary describing specific coastal and marine environmental problems of the United Republic of Tanzania such as, coral reef destruction, mangrove cutting, fisheries over-exploitation and unnecessary intrusion in and disturbance of marine reserves. This summary is based on six sections on various regions of the United Republic of Tanzania, with their findings and recommendations; and of a proposed Action Plan for the protection, management and development of the marine and coastal environment of the United Republic of Tanzania.

White, A. (1989). Two community-based marine reserves: Lessons for coastal management. *In: T. E. Chua, & D. Pauly (eds), Coastal Area Management In Southeast Asia: Policies, Management Strategies And Case Studies*, Chap. 19, (pp. 85-96). [s. l.]: [s. n.].

Abstract: This paper contrasts the results of 2 community-based marine resource management projects in southern Philippines. The small island sites of Apo, Negros and Sumilon, Cebu, both have fringing coral reefs and support local fishermen. The sites benefitted from management efforts initiated by Silliman University in the mid-1970s (Sumilon) and early 1980s (Apo). The process of implementing marine reserves with sanctuary areas in each island is explained and

compared. Resource and economic benefits resulting from the management and accruing to local fishermen included: (1) increased fish yields from traditional fishing areas; (2) increased fish diversity and abundance within sanctuary areas; (3) slightly improved coral substrate cover resulting from the use of less-damaging fishing methods; and (4) increasing tourism.

Williams, G. C. (1989). A provisional annotated list of octocorallian coelenterates occurring on the sublittoral coral reefs at Sodwana Bay and Kosi Bay, northern Natal, with a key to the genera. *In: S. Afr. J. Sci.*, 85(3), 141-144.

Abstract: This article presents a preliminary key and faunal list of the octocorallian genera of the coral reefs and coral assemblages of Zululand. Although a detailed and illustrated field guide is currently in progress, it was thought that such a provisional list and key should be published as soon as possible, since so little information is presently available concerning the coral reef region of the St Lucia and Maputaland marine reserves, and because the larger work will not be available for some time.

Woodley, S. (1989). Management of water quality in the Great Barrier Reef Marine Park. *In: Water Science and Technology*, 21(2), 31-38.

Abstract: The Great Barrier Reef is the largest coral reef system in the world. It is recognised and appreciated worldwide as a unique environment and for this reason has been inscribed on the World Heritage List. The Reef is economically important to Queensland Australia, supporting substantial tourism and fishing industries. Management of the Great Barrier Reef to ensure conservation of its natural qualities in perpetuity is achieved through the establishment of the Great Barrier Reef Marine Park. The maintenance of water quality to protect the reef and the industries which depend on it is becoming an increasingly important management issue requiring better knowledge and possibly new standards of treatment and discharge.

Bohnsack, J. A. (1990). How marine fishery reserves can improve reef fisheries. Goodwin, M. H.; Waugh, G. T., and Butler, M. J., eds. Proceedings of the 43rd Gulf and Caribbean Fisheries Institute. Charleston, S. C. Gulf and Caribbean Fisheries Institute; pp. 217-241.

Causey, B. (1990). Biological assessments of damage to coral reefs following physical impacts resulting from various sources, including boat and ship groundings. Diving For Science 1990. Proceedings Of The American Academy Of Underwater Sciences Tenth Annual Scientific Diving Symposium, October 4 7, 1990, University Of South Florida, St. Petersburg, Florida St. Petersburg, Florida: University Of South Florida

Abstract: Physical damage to coral reefs from boat and ship groundings has been identified as a major impact to the coral reefs of the Key Largo and Looe Key National Marine Sanctuaries. Sanctuary regulations prohibit vessels from operating in such a manner as to strike or otherwise cause damage to the natural features of the sanctuary. Currently, the primary deterrent for this source of reef damage has been through civil procedures and penalties for vessel grounding cases. Litigation to recover damages to natural resources is also pursued in the case of large scale groundings. This legal process requires that the area impacted, or damaged, be accurately assessed for both biological damage and physical evidence to support the litigation. Methods for conducting such assessments are presented in this paper, along with recommendations on what observations are considered important. A review of assessment techniques and application of the information gathered during the assessment process are presented.

Claxon, P. G. (1990). Bibliography of scientific research for Gulf Islands National Seashore. (p. 182). [s. l.]: U.S. Natl. Park Surv.

Cole, R. G., Ayling, A., & Creese, R. G. (1990). Effects of marine reserve protection at Goat

Island, northern New Zealand. *In: New Zealand Journal of Marine and Freshwater Research*, 24(2), 197-210.

Abstract: The possible effects that marine reserve protection has had on densities of some reef fish and large invertebrates were investigated near Leigh (north-eastern New Zealand) by a series of sampling programmes between 1976 and 1988. Fish counts at intervals during the 6 years after the initial establishment of the Cape Rodney to Okakari Point Marine Reserve in 1975 suggested that red moki (*Cheilodactylus spectabilis*) had increased in abundance whereas five others had remained at approximately constant densities. A comparison of data between 1978 and 1988 also revealed few consistent differences in fish abundances. A detailed survey in 1988 between sites inside and outside the marine reserve showed no clear patterns for sea urchins (*Evechinus chloroticus*) and several fish; trends for increased abundances in the marine reserve of fish such as snapper *Pagrus* (= *Chrysophrys*) *auratus*, blue cod (*Parapercis colias*), and red moki; a very striking increase in number of rock lobsters (*Jasus edwardsii*) within the marine reserve; and an obvious trend for increased size of snapper in the marine reserve.

Dight, I. J., Bode, L., & James, M. K. (1990). Modelling the larval dispersal of *Acanthaster planci*. 1. Large scale hydrodynamics, Cairns Section, Great Barrier Reef Marine Park. *In: Coral Reefs*, 9(3), 115-123.

Abstract: The desire to understand the observed patterns of *Acanthaster* population spread throughout the Great Barrier Reef (GBR) has necessitated the development of numerical models which are capable of stimulating the hydrodynamics associated with large assemblages of reefs over the time scale of larval dispersal. Models are presented which provide an overview of the physical processes controlling the advection of larvae within the Cairns Section of the GBR Marine Park, on the scale of tens to hundreds of kilometers. The relevant scales and relative importance of the distinct processes are discussed. The models are based on a previously tested numerical hydrodynamic model and are validated by comparison with observations documented in the physical oceanographic literature.

Dight, I. J., James, M. K., & Bode, L. (1990). Modelling the larval dispersal of *Acanthaster planci*. 2. Patterns of reef connectivity. *In: Coral Reefs*, 9(3), 125-134.

Abstract: Numerical models capable of simulating the hydrodynamics associated with large assemblages of reefs are applied to the larval dispersal of *Acanthaster planci*. Larval distributions, which result from passive transportation, have been simulated and the resulting patterns of dispersal are compared with the distribution of adults and the observed pattern of *Acanthaster* population spread. Three forms of asymmetry in reef connectivity are identified within the southern portion of the Cairns Section of the Great Barrier Reef Marine Park. They confirm that larval dispersal within the region cannot be considered as an isotropic random process and the recruitment of reefs is not from a homogeneous larval pool. The three forms of asymmetry in the transport of larvae, together with the longshore currents within the main lagoon, provide a mechanism which results in the passive concentration of larvae adjacent to reefs that border the main lagoon.

Gittings, S. R., Bright, T. J., & Holland, B. S. (1990). Five years of coral recovery following a freighter grounding in the Florida Keys. *Diving For Science 1990. Proceedings Of The American Academy Of Underwater Sciences Tenth Annual Scientific Diving Symposium, October 4 7, 1990, University Of South Florida, St. Petersburg, Florida* St. Petersburg, Florida: University Of South Florida

Abstract: Coral community recovery has been followed for five years since the destruction of a portion of Molasses Reef, Key Largo National Marine Sanctuary, by a 122 meter freighter, which ran aground in August 1984. Underwater repetitive and random photographic methods, visual counts, and artificial substrates were used between 1984 and 1989 to assess coral

populations, cover, recruitment, and the fate of coral colonies damaged by the grounding. We report here on data and results from random photographic methods and underwater visual censuses.

Gombert, B. (1990). Algae Growth Threatens Reefs. *In: Underwater*, 7(7), 21.

Abstract: Along the coast of Florida from West Palm Beach south to the Keys, masses of thick, green algae cover reefs and are growing at an alarming rate. The algae has been a concern since it was first noticed in August 1989. The algae are killing sea fans and corals among the sanctuary boundaries. Algae are continuing to overgrow soft corals on the same reef as last year. Several suggestions have been made to slow the algal growth, such as an algacide like that used in freshwater pools, or the "vacuuming" process which has been used some what successfully against black band disease. Both these options have been ruled out because the algae are so widespread. Reefs like those in Key Largo Marine Sanctuary are affected by the algae but it is the areas from West Palm Beach to Boca Raton and from Key West to the Marquesas that are experiencing the greatest concentration of algae and the worst damage to the delicate reef system. It is of great concern because many of the reefs only see a centimeter or two of growth per year. Algae occur naturally in a symbiotic relationship with other organisms on and around the reef, but the recent growth is anything but symbiotic, with algae growing in an abundance never before seen. Some researchers claim that this is a Caribbean - wide problem, because it is similar to the problem of algae in reefs in Jamaica, while some have taken the position that this is a natural phenomenon. Another theory is that the proliferation of algae is due to trapping the fish that keep the algal levels down and to dumping untreated or partially treated sewage into the near - shorewaters - that is a direct effect of what some call population pressure. Population pressure in the form of 30,000 septic tanks and 5,000 cess pits which leach high levels of nutrients into the groundwater and flow unrestrained through the porous ground of South Florida into the nearshore waters. Unfortunately, one of the natural enemies of algal growth, cool temperatures, may alleviate, but will not solve this problem. In reality, it is during the winter months that the problem is actually compounded. Eighty percent of the area's rainfall occurs between June and October, with winter months staying very dry. In the winter, when South Florida's population doubles, septic tanks and cess pits are filled, but groundwater movement is limited. Polluted ground water is stationary until June when the tremendous amount of rain pushes it quickly through the porous substrate to the local near shorewaters. This dumps a high concentration of nutrients, which is unable to be absorbed, starting another deadly cycle of algae. Long-term solution is not possible without more information. One researcher suggests that the information necessary to solving the problem would be available through tests which measure nutrient and chlorophyll levels (rough indicators of phytoplankton) and also the amount of algae on the reef and the sea grass. Within 1yr., tests may yield enough compelling information to convince the state of a system-wide water quality problem

Gombert, B. (1990). Algae Problem Continues. *In: Underwater USA*, 7(6), 19a.

Abstract: Hair like algae still cover a section of elongated reef near the inshore boundary of the Key Largo National Marine Sanctuary, threatening an entire reef-dependent marine life community. The algae do not appear to be spreading to other reefs and may even be decreasing in quantity. Biologists believe that the cause of the algae bloom is a higher than normal level of nutrients in the water, a result of pollution such as sewage runoff and septic tanks. The algae was first observed in August 1989 as it attached to soft coral, sea fans, and gorgonians and blocked these organisms from the light they require. Algae thrive on high nutrient levels, but the reefs are adapted to low nutrient conditions. If left unchecked, the algae will eventually kill the entire reef. Researchers have begun investigating the algae problem to determine if nutrient levels are unusually high. Rather than testing the water itself, which can change rapidly, they

are testing plants which pick up nutrients in proportion to the nutrient concentration in the water. If the high nutrient theory is correct, these plants should have higher than normal levels of nitrogen. Other tests should determine the source of the excess nutrients. An expensive measuring device owned by the University of Virginia has the capability of detecting a "signature" possessed by nitrogen from sewage but not by marine nitrogen.

Great Barrier Reef Marine Park Authority. (1990). Annual report 1989-1990. *In: Annu. Rep. Great Barrier Reef Mar. Park Auth*, 106.

Abstract: The 14th annual report of the Great Barrier Reef Marine Park Authority for the year ended 30 Jun 1990 is presented as follows: Great Barrier Reef Marine Park Authority; Great Barrier Reef Ministerial Council; Great Barrier Reef Consultative Committee; Planning and management; Environmental impact management; Research and monitoring; Education and information; Aquarium; Administration; Canberra Office; and Appendixes - Authority functions, Consultative Committee functions, Authority senior officers, publications, staff papers published presented in 1989-90, members of Advisory Committees, financial statements, Auditor-General's report, abbreviations; and, Offshore developments map.

Jordan, D. E. (1990). Corales escleractinoes y gorgonaceos del ambiente arrecifal coralino de Sian Ka'an. *In: L. D. Navarro, & J. Robinson Diversidad Biologica En La Reserva De La Biosfera De Sian Ka' An, Quintana Roo, Mexico* (pp. 127-130). [s. l.]: [s. n.].

Abstract: A total of 17 coral families comprising 82 species were found in the Sian Ka'an reef. A list of all the found Scleractinia and Gorgonacea species is presented. A brief discussion on the environmental conditions supporting this reef is included.

Lipsky, L. (1990). Problems Persist Among the Reefs of the Florida Keys. *In: Underwater USA*, 7(7), 22-23.

Abstract: North America's only living coral reef in the Florida Keys is being threatened to the point where its future existence may be in doubt. Several factors are contributing to the reef's demise: boat groundings, anchor damage, spear-fishing, over-collecting, deteriorating water quality, pollution. Researchers have found that the ocean is being saturated with excessive amounts of nutrients from septic tank excrements, fertilizers from the agricultural industry, and the disposal of human waste offshore. These nutrients disrupt the natural balance of the coral's symbiotic relationship with the algae, causing algae overgrowth. This in turn has caused black band disease and coral suffocation. Excessive nutrients resulting from man's influence is also responsible for the deteriorating water visibility and the pea-green cast becoming more common on some of the reefs. Algae, suspended within the water along with a higher chlorophyll content, are partially to blame due to increasingly high amounts of nutrients entering the water. Silt from dredging and land-based construction in the Keys has clouded the water and in some areas smothered the corals. With an increasing amount of silt and other particulate matter in these waters, the coral and other marine life obtain less light which is essential for continued growth. Mooring buoys at most of the more popular dive sites has helped eliminate most of the anchor damage at reefs with buoys in place. But boat groundings, mostly within the shallow-water reef areas of Key Largo National Marine Sanctuary, have become a considerable threat, where 1990's total may easily double the 36 recorded incidents of only a couple of years ago. When a boat runs aground and the offender is caught, heavy fines are usually levied against the vessel's owner. Recently changed policy makes fines collected available to help benefit and repair damaged reef areas. All efforts to save the reefs themselves from pollution, anchor damage, and boat groundings are of little consequence if spearfishing, tropical fish collecting, and other destructive activities continue to deplete the underwater resources. Other dive destinations around the world protect their reefs by restricting spear fishing and other means of collecting. Discussions and studies are underway to extend the

boundaries of Key Largo National Marine Sanctuary further south towards Islamorada. The ideal solution would be some type of state or federal legislation that would designate the entire Keys as a marine sanctuary. This would provide a significant and positive impact on the reefs with numerous benefits.

McClanahan, T., & Shafir, S. H. (1990). Causes and consequences of sea urchin abundance and diversity in Kenyan coral reef lagoons. *In: Oecologia*, (83), 362-370.

Abstract: North America's only living coral reef in the Florida Keys is being threatened to the point where its future existence may be in doubt. Several factors are contributing to the reef's demise: boat groundings, anchor damage, spear-fishing, over-collecting, deteriorating water quality, pollution. Researchers have found that the ocean is being saturated with excessive amounts of nutrients from septic tank excrements, fertilizers from the agricultural industry, and the disposal of human waste offshore. These nutrients disrupt the natural balance of the coral's symbiotic relationship with the algae, causing algae overgrowth. This in turn has caused black band disease and coral suffocation. Excessive nutrients resulting from man's influence is also responsible for the deteriorating water visibility and the pea-green cast becoming more common on some of the reefs. Algae, suspended within the water along with a higher chlorophyll content, are partially to blame due to increasingly high amounts of nutrients entering the water. Silt from dredging and land-based construction in the Keys has clouded the water and in some areas smothered the corals. With an increasing amount of silt and other particulate matter in these waters, the coral and other marine life obtain less light which is essential for continued growth. Mooring buoys at most of the more popular dive sites has helped eliminate most of the anchor damage at reefs with buoys in place. But boat groundings, mostly within the shallow-water reef areas of Key Largo National Marine Sanctuary, have become a considerable threat, where 1990's total may easily double the 36 recorded incidents of only a couple of years ago. When a boat runs aground and the offender is caught, heavy fines are usually levied against the vessel's owner. Recently changed policy makes fines collected available to help benefit and repair damaged reef areas. All efforts to save the reefs themselves from pollution, anchor damage, and boat groundings are of little consequence if spearfishing, tropical fish collecting, and other destructive activities continue to deplete the underwater resources. Other dive destinations around the world protect their reefs by restricting spear fishing and other means of collecting. Discussions and world protect their reefs by restricting spear fishing and other means of collecting. Discussions and studies are underway to extend the boundaries of Key Largo National Marine Sanctuary further south towards Islamorada. The ideal solution would be some type of state or federal legislation that would designate the entire Keys as a marine sanctuary. This would provide a significant and positive impact on the reefs with numerous benefits.

Murdoch, L. (1990). Bali's first marine park: Pulau Menjangan. *In: Reflections*, (25), 12-13.

Abstract: The article briefly describes various aspects of Bali's national park. The wildlife reserve consists of coral reef, marine waters and forest, thus activities such as fishing and reef mining have made their impact on the local economy and way of life. A brief overview is given of management guidelines and methods of monitoring tourist arrivals.

Nielsen, A. (1990). Coupon Bight Aquatic Preserve management plan. Vol. 188). Tallahassee (USA): Florida Dep. of Natural Resources, Bur. of Submerged Lands and Preserves.

Abstract: Coupon Bight Aquatic Preserve, located off Big Pine Key in Monroe County, covers approximately 9,000 acres of an outstanding Florida Keys marine habitat. The preserve consists of a shallow water bay covered with dense seagrass beds and other associated marine communities, and it includes a portion of near-shore Atlantic waters containing a large assemblage of marine corals. Coupon Bight Aquatic Preserve is one of two aquatic preserves

located in the Florida Keys. It is unique as the only preserve in the state containing significant living coral communities. The resources of the preserve are being adversely impacted from increased development of adjoining uplands and from boating impacts on seagrasses. In particular, damages to the coral formations from boat anchorages is an immediate concern. Various resource restoration studies have been conducted in the preserve. (Contract NA89AA-D-CZ-228. Sponsored by National Oceanic and Atmospheric Administration, Washington, DC. Office of Ocean and Coastal Resource Management, and Florida State Dept. of Environmental Regulation, Tallahassee.)

Plan Development Team. (1990). The potential of marine fishery reserves for reef fish management in the U.S. Southern Atlantic. Chap. NMF-SEFC261,). [s. l.]: National Marine Fisheries Service//Southeast Fisheries Science Center.

Abstract: Marine fishery reserves (MFRs), areas with no consumptive usage, are recommended as a viable option for management of reef fisheries in the U.S. southern Atlantic region. MFRs are designed to protect reef fish stocks and habitat from all consumptive exploitation within the specified geographical areas for the primary purpose of ensuring the persistence of reef fish stocks and fisheries. This technical document reviews the life histories of reef fishes, patterns of exploitation, and the advantages and disadvantages of reserves compared to traditional fisheries management techniques.

Polunin, N. (1990). Marine regulated areas: an expanded approach for the tropics. *In: Resource Management and Optimization*, (7), 28-299.

Abstract: Protected areas such as national parks and nature reserves combat environmental problems only in so far as they preserve designated sites from further damage. They scarcely solve such underlying problems as mangrove destruction, the dynamiting of coral reef or over-fishing. In a broader view regulations related to areas should nevertheless be a major mode of conservation. Various types of regulation other than strict protection may in any case be more appropriate to the coastal zones of many tropical countries. A realistically designed regulated area should be planned with particular objectives in mind, and deal most of all with problems such as those of over-fishing, population replenishment, and conflicts between fisheries and various users of single ecosystems. However, there exist limitations to implementing this approach. Poor knowledge of larval recruitment patterns as yet precludes satisfactory design of replenishment areas. The multi species complexity of tropical fisheries makes simple management measures inadequate in many ways. There is limited knowledge of how certain beneficial ecosystem functions are maintained naturally. Such knowledge gaps will not be filled quickly, however, interim measures may nevertheless be feasible. Existing regulated areas may offer a focus for exploring the design of potential replenishment zones. There is little evidence yet that traditional marine reserves can contribute to modern management to any great extent.

Sweeney, L. (1990). Reports Being Prepared On Florida Groundings. *In: Underwater USA*, 6(10), 6.

Abstract: Damages to Florida's coral reef following three groundings within 17 d are being assessed. Key Largo Marine Sanctuary officials have studied the damage and are in the process of preparing reports for lawyers about the two groundings that happened within the sanctuary, the Alec Owen Maitland, a 163-ft, freighter which damaged 1,610 sq m of a no-name reef just south of Carysfort Reef October 25, 1989, and the Elpis, a 470-ft. Greek freighter which damaged about 3,000 sq m at the end of Elbow Reef November 11, 1989. Another grounding took place 5 d after the first one at Dry Tortugas, near Fort Jefferson National Monument. The Mavro Vetrican, a 475-ft. Yugoslavian freighter, destroyed almost three acres of some of the most beautiful coral in the world. At the site of the Maitland grounding, colonies of elkhorn coral, and some small and one larger brain coral were destroyed. Smooth starlet coral, quite a

few sea fans and gorgonians were affected, and the reef bottom was damaged. The Elpis got up to the beginning of one of the most popular reefs, Elbow Reef. Dry Tortugas, tiny isles 68 mi. west of Key West popular for skin and scuba diving, suffered damage over about 10, 000 sq. m of coral. It is an area of predominantly soft coral and some small coral heads. The state and federal government have filed claims against the freighter. The coral is expected to grow back, but it will take hundreds of years. Florida's reef system is the only living reef within the continental U.S., and it is important to tourism and to the commercial and sport fishing industries. Reefs also bear the brunt of storms, shielding the mainland.

Tongilava, S. (1990). The role of protected areas in sustaining island societies. *In: Parks*, 1(1), 18-20.

Abstract: Tonga declared five national marine parks and reserves in 1978. Their primary purpose is to protect reef organisms and to ensure that they can live and breed undisturbed, so no fishing or collecting is allowed. The reserves have been successful and their diverse and abundant life is a valuable economic resource. The reserves are also valuable for education. One of these, Pangaimotu Reef, was selected as the site of the country's first Coral Reef Trail, which opened on World Environment Day 1989. This paper describes how the trail was set up and what still needs to be done to realize its full educational potential.

Ward, F. (1990). Florida's Coral Reefs Are Imperiled. *In: National Geographic*, 178(1), 114-132.

Abstract: John Pennekamp Coral Reef State Park was established off Key Largo in 1960 with the idea that it would preserve the beautiful reefs for the enjoyment of future generations. Unfortunately, less than a generation later, the reefs in the park as well as throughout the Keys are dying. Although there is some debate over the causes of reef death, the human influence has certainly been a factor. Corals are living organisms which despite their sturdy appearance are actually quite fragile. They live within a narrow range of warm water temperatures and low nutrient and toxin concentrations. The increasing popularity of scuba-diving and snorkelling in the Florida Keys as well as the rapid development of Key Largo have placed a great deal of pressure on the coral reefs. Swimmers and boaters damage the coral both by direct contact and by the litter and pollutants they leave in the water. Over harvesting of fish and lobster have also contributed to destruction of the coral reef habitat. In addition to the direct effects of humans, effluents from the development of the Florida Keys, including sewage, runoff, and pesticides, always find their way into the waters surrounding the coral reefs. Nutrient and toxin overloading are pushing Florida reefs beyond their ability to survive. Besides the local pollutants, biologists studying the coral reefs say they normally detect pollutants from agricultural runoff and even pollutants from the Midwest which find their way to the Gulf Stream via the Mississippi River. Death of Florida's coral reefs may or may not be inevitable, but immediate action is necessary to manage water quality, fishing, boating and tourism. Installation of sewage systems on all the Florida Keys would be a major step in the right direction. Some experts advocate making all the reefs from Biscayne National Park to Dry Tortugas a part of the Florida Keys National Marine Sanctuary which is operated by the U.S. Department of Commerce. Banning fishing and lobstering has also been proposed.

Warwick, R. M., Clarke, K. R., & Suharsono. (1990). A statistical analysis of coral community responses to the 1982-83 El Nino in the Thousand Islands, Indonesia. *In: Coral Reefs*, (8), 171-179.

Abou Seida, M. M., & Al Sarawi, M. A. (1991). Utilization and Management of Coastal Areas in Kuwait. *In: Coastal Management*, 18(4), 385-401, 9 fig., 18 ref.

Abstract: Kuwait's coastal area is considered to have special importance because most urban,

industrial, commercial and recreational activities are concentrated in this zone. It also represents the main source of freshwater and electricity in the country. Besides, the coastal zone has a unique ecosystem and is a significant nursing ground for fish and shrimp. Coastal characteristics include variations of tides, currents, and waves acting on: a soft, muddy, intertidal flat; a sandy-rocky tidal flat; artificial, man-made sandy beaches; sandy beaches found in the open coastline; oolitic limestone beaches; and coral reefs. Utilization of the Kuwait coastal zone includes: power desalination plants and industrial discharges; harbors and marinas; and recreational and other coastal activities. Plans touse the coastal area initially included proposals for the recreational development of the coastline, a major onshore coastal motorway, recommended growth of urban areas and establishment of several marine park areas. Government authority in Kuwait is structured on national and local authorities. The agencies that have a particular impact on the coast are in the areas of planning, water and power, city physical planning, human health, transport and trade. Management problems associated with planning may be divided into two distinct categories: technical (conflict between coastal zone users; environmental pollution; destruction of coastal habitats by dredging and filling; and residential and industrial demands) and organizational (poor coordination among coastal users and management agencies; lack of information; absence of a planning, coordinating, regulatory body; and lack of public awareness). The essential elements for managing the Kuwait coast are: clearly articulated policies; designation of a leading agency; ensuring the availability of baseline data, analysis, and trained manpower; and power to achieve coordination and follow-up.(Fish-PTT)

Arthur, W. (1991). Sustainable development possibilities and limitations to indigenous economic development in the Torres Strait. Sustainable Development For Traditional Inhabitants Of The Torres Strait Region. Torres Strait Baseline Study Conference, Cairns, Qld. (Australia), 19 Nov 1990 Townsville, Qld (Australia): Great Barrier Reef Marine Park Authority *Workshop Ser. Great Barrier Reef Mar. Park Auth.:*

Notes: map, 4 tables, 22 ref.

Abstract: The social and economic characteristics of the Torres Strait region are briefly described, with emphasis on the possibility of increased islander participation in the non welfare economy, and some of the apparent constraints on such a development. Fishing is the Strait's major productive export industry. The majority of islanders involved in the industry are part time fishers who receive other income in the nature of unemployment benefits and other welfare payments. The structure of the welfare system does not give incentive to reduce dependence upon it. It may, however, be contributing to the fishing industry by in effect limiting the need for increased fishing pressure on limited stocks. There is evidence, moreover, that the attractiveness of the islands as a lifetime home for their indigenes is increasing. Sustainable development may thus depend on broadening the economic base by diversifying, rather than simply intensifying the existing fishing effort to what may be unsustainable levels. Further research is needed into the level of population that the region can economically sustain, rather than simply into the level of fish stocks

Asigau, W. (1991). The Maza Wildlife Management Area, Western Province, Papua New Guinea the resources and its management. Sustainable Development For Traditional Inhabitants Of The Torres Strait Region. Torres Strait Baseline Study Conference, Cairns, Qld. (Australia), 19 Nov 1990 Townsville, Qld (Australia): Great Barrier Reef Marine Park Authority *Workshop Ser. Great Barrier Reef Mar. Park Auth.:*

Notes: attachments

Abstract: The Maza Wildlife Management Area is one of the few marine conservation areas in Papua New Guinea. The area was declared under the Fauna (Protection and Control) Act, for conservation especially of dugongs and turtles. The intended management policies and

difficulties in operating and enforcing them are briefly reviewed

Baker, E. K. (1991). Copper and zinc distribution in the sediments of the Fly Delta and Torres Strait. Sustainable Development For Traditional Inhabitants Of The Torres Strait Region. Torres Strait Baseline Study Conference, Cairns, Qld. (Australia), 19 Nov 1990 [s. 1.]: Great Barrier Reef Marine Park Authority *Workshop Ser. Great Barrier Reef Mar. Park Auth.*: Notes: maps, graphs, 12 ref.

Abstract: The Fly Delta extends for about 30 k offshore from the southern coast of Papua New Guinea. The area is dominated by fine grained terrestrially derived muds. To the south the region of Torres Strait is represented by predominantly carbonate sediments. High levels of zinc and copper were found to be associated with the terrigenous sediments. The concentrations are comparable to those reported for industrialised areas elsewhere. Possible sources of the metals include erosion and drainage of the highly mineralised rocks found in the catchment area and the input of contaminated mine waste into the system. A linear correlation was found between the copper and zinc concentrations and the distance of sample sites from the estuary. A correlation was also found between the percentage of fine grained particles and copper concentrations. This study indicates that future work should investigate historical changes in copper and zinc concentrations in the sediments and the ultimate fate of metals associated with the particulate matter in the Fly River

Beckett, J. (1991). The Eastern Islands of Torres Strait. Sustainable Development For Traditional Inhabitants Of The Torres Strait Region. Torres Strait Baseline Study Conference, Cairns, Qld. (Australia), 19 Nov 1990 Townsville, Qld Australia: Great Barrier Reef Marine Park Authority *Workshop Ser. Great Barrier Reef Mar. Park Auth.*: Notes: 5 ref.

Abstract: The Eastern Islands of the Torres Strait region are of recent volcanic origin, set within coral reefs and surrounded by beaches from which they rise sharply. They lie within sight of one another, and therefore constitute a distinct anthropological unit. The culture of the peoples of the Eastern Islands is described, the circumstances and effects of contact and colonization, wholesale migration to Queensland in the post war period, and more recent population stabilisation. A deterioration in the supply of marine foods such as might follow from pollution of the sea, would impoverish the Islanders' diet as well as placing further strain on their meagre cash income. It would also terminate activities which people value as part of their cultural heritage.

Bright, T. J., Gittings, S. R., & Zingula, R. (1991). Occurrence of Atlantic reef corals on offshore platforms in the northwestern Gulf of Mexico. *In: Northeast Gulf. Sci.*, 12(1), 55-60.

Abstract: The occurrence of Atlantic reef corals on artificial structures on the outer continental shelf in the northwestern Gulf of Mexico, and their general absence from such structures inshore, is of considerable interest in terms of the dynamics of reef coral populations in the region. Comparative study of the coral species inhabiting oil and gas platforms and natural hard bottoms in the northwestern Gulf can provide insight into questions concerning distribution of adult populations, environmental controls, reproductive strategies and timing, larval sources, transport, dispersal and recruitment.

Cancelmo, J. (1991). Flower Gardens Near Sanctuary Status. *In: Underwater*, 8(8), 14.

Abstract: The East and West Flower Garden reefs, located off the Texas/Louisiana border, will be approved as the nation's 10th National Marine Sanctuary. These thriving coral reefs are the northern most in the continental U.S. The unique features of these ecosystems are of interest to marine scientists, and they are visited by more than 1,500 sport divers each year. Mobil Oil, Texas A&M, local dive clubs and dive charters, and the Gulf Reef Environmental Action

Team, have lobbied more than a decade for sanctuary designation. Two controversial issues have surfaced on the eve of sanctuary approval. One involves the issuing of permits to oil exploration companies by the Materials Management Services (MMS). Such permits allowed seismic surveys in areas that partially included the Flower Gardens. The surveys posed a possible threat to marine life and a disruption to divers. It appears that until the Flower Garden reefs are approved as a National Marine Sanctuary, the Materials Management Services will continue to approve survey permits in these sensitive environments. Once the sanctuary is finalized, NOAA (National Oceanic and Atmospheric Administration) will have a voice in such matters, but not necessarily the authority to prevent seismic survey work near the reefs. The second controversy involves a permit application of a different sort. The MMS National Director in Washington has recently rejected Texaco Pipeline's application to lay a 35-mi.-long pipeline between the two Flower Garden reefs. The permit rejection means that the pipeline will not be allowed to cross the 4-mi. shunt zones that surround each bank and overlap between them. It is expected that Texaco will proceed with a new pipeline route that will go far enough away from the reefs to be of no concern.

Ch'ng, K. L., & Thomas, C. (1991). Artificial reef program in Malaysia. Towards An Integrated Management Of Tropical Coastal Resources. Proceedings Of The Asean Us Technical Workshop On Integrated Tropical Coastal Zone Management, 28 31 October 1988. Temasek Hall, National University Of Singapore, Singapore Manila Philippines: International Cent. for Living Aquatic Resources Management

Abstract: Rapid development and lack of understanding about the cause and effect relationships between development and adverse ecological impact on the coastal zone have resulted in the degradation of coral reef ecosystems in Peninsular Malaysia, specifically on the west coast. Malaysia has, however, responded in two ways (1) it has declared the islands and the surrounding waters with intact coral reef ecosystems as protected areas as of 1984, with a view to creating marine parks; and (2) the country has embarked on an intensive artificial reef program. The artificial reefs are made of tires and concrete and/or confiscated boats. Preliminary research indicates that there is an increase in catch directly over the artificial reefs. However, this raises the question of whether this is an indication of actual increase in fish stock in the coastal areas or aggregation of the dwindling fish stock in the artificial reefs. If the increase in catch is a sign of the latter, the establishment of artificial reefs to enhance fishing would lead to the rapid depletion of the fish stock in the inshore zone. On the other hand, if the increase in catch is a sign of the former, the establishment of artificial reefs for conservation and habitat enhancement could reinforce and improve a dwindling fish stock.

Craik, W. (1991). Planning and management of the Great Barrier Reef Marine Park. Sustainable Development For Traditional Inhabitants Of The Torres Strait Region. Torres Strait Baseline Study Conference, Cairns, Qld. (Australia), 19 Nov 1990 Great Barrier Reef Marine Park Authority *Workshop Ser. Great Barrier Reef Mar. Park Auth.:*

Abstract: The Great Barrier Reef is the largest system of coral reefs and associated life forms in the world, covering some 350,000 square kilometers. The Great Barrier Reef Marine Park is a multiple use protected area, not a National Park in the normal definition. A brief overview is provided of the management of the Park, with emphasis on the role of the Great Barrier Reef Marine Park Authority, in conjunction with Queensland agencies, such as the National Parks and Wildlife Service in Queensland. Management has focussed very heavily on user involvement, cooperation between all agencies and organisations representing user interests, the importance of education and information, and the need for reasonable flexibility and compromise.

Eagle, A. M., & Higgins, R. J. (1991). Environmental investigations of the effects of the Ok

Tedi copper mine in the Fly River system. Sustainable Development For Traditional Inhabitants Of The Torres Strait Region. Torres Strait Baseline Study Conference, Cairns, Qld. (Australia), 19 Nov 1990 Great Barrier Reef Marine Park Authority *Workshop Ser. Great Barrier Reef Mar. Park Auth.:*

Notes: maps, 8 tables, 13 ref.

Abstract: Environmental investigations have been undertaken by Ok Tedi Mining Limited (OTML) since 1981. An environmental monitoring and management programme was implemented in 1983. The programmes included water quality monitoring, river flow and sediment monitoring, surveillance of aquatic biological communities and a health and nutrition study of the local people. These original programmes have continued, and additional programmes of work have been developed and revised to reflect changing operations and the need to focus investigations on specific areas and issues of concern. In April 1990, following the establishment by the Government of Papua New Guinea of environmental management criteria for the Fly River system, compliance monitoring programmes were introduced. Details of the programmes undertaken are presented.

Eid, E.-M. E., & Fawzi, M. A. (1991). Egyptian approach towards appropriate use of coastal zones on the Red Sea. *In:* T. Goda, & al. (eds), Int. Conf. on the Environmental Management of Enclosed Coastal Seas '90: EMECS '90, Kobe, Hyogo Prefect. (Japan), 3-6 Aug 1990 Vol. 23 (pp. 331-337). [s. l.]: [s. n.].

Abstract: Environmental management and appropriate use of coastal zones in Egypt is one of the major challenges facing Egypt. This is a natural outcome of its strategic geographical location straddling both the Mediterranean and the Red Sea which constitute two of the major enclosed coastal seas in the world. Therefore, the problem of the protection of the marine environment in the Egyptian coastal zones has received an early and serious concern by the Egyptian authorities. Due to the repeated and lasting occurrence of oil pollution on the shoreline of the gulf which endanger both the high coral diversity and mangroves which are equally valuable and in need of protection, oil pollution combating arrangements are being established at the entrance to the Gulf of Aqaba. This paper aims to illustrate the Egyptian approach in the coastal zone management, with special emphasis on the coastal zones of South Sinai adjacent to the Gulf of Aqaba.

Elmer, M., & Coles, R. (1991). Torres Strait fisheries management. Sustainable Development For Traditional Inhabitants Of The Torres Strait Region. Torres Strait Baseline Study Conference, Cairns, Qld. (Australia), 19 Nov 1990 Townsville, Qld Australia: Great Barrier Reef Marine Park Authority *Workshop Ser. Great Barrier Reef Mar. Park Auth.:*

Notes: map, 3 tables

Abstract: The management arrangements for fisheries resources in Torres Strait, and the way in which they aim to facilitate the sustainable development of the resources, are outlined. The arrangements are governed by the provisions of a treaty between Australia and Papua New Guinea signed in 1985. The treaty, inter alia, defines an area called the Torres Strait Protected Zone, to be managed separately by a Protected Zone Joint Authority, which provides an example of the kinds of consultative arrangements between Australia, Queensland and Papua New Guinea that are necessary for managing the entire fishery.

Fitzpatrick, J. (1991). Maza: A legend about culture and the sea. Sustainable Development For Traditional Inhabitants Of The Torres Strait Region. Torres Strait Baseline Study Conference, Cairns, Qld. (Australia), 19 Nov 1990 Townsville, Qld Australia: Great Barrier Reef Marine Park Authority *Workshop Ser. Great Barrier Reef Mar. Park Auth.:*

Notes: 2 maps, 17 ref.

Abstract: A Western Torres Strait myth is used to illustrate the connection between sea

territories and culture; the social links among people; and the value of the seascape. It is a story about Aukum, a legendary woman who symbolises the fertility of the reef. Her abundant, daily fish catch is shared with relatives and while she traverses the numerous marine zones deep water passages, platform reefs and the fringing home island reefs she stocks many reefs of Western Torres Strait with fish. This paper documents how peoples' lives are dependent on the vitality of the local seascape, and in particular the reef, Maza. It is argued that cultural identity is based on historical, symbolic and social associations with the sea and interminable use of the marine environment by Western Torres Strait Islanders

Furnas, M. J. (1991). Biological oceanographic measurements in the Torres Strait and far northern Great Barrier Reef. Sustainable Development For Traditional Inhabitants Of The Torres Strait Region. Torres Strait Baseline Study Conference, Cairns, Qld. (Australia), 19 Nov 1990 Townsville, Qld Australia: Great Barrier Reef Marine Park Authority *Workshop Ser. Great Barrier Reef Mar. Park Auth.:*

Abstract: Three chemical biological surveys have been conducted within the eastern Torres Strait and bordering zones of the far northern Great Barrier Reef and Gulf of Papua. Waters of the eastern Torres Strait and far northern GBR are characterised by moderately low dissolved and particulate nutrient concentrations. Elevated concentrations of silicate and nitrate are associated with extensions of low salinity waters of the Fly River plume into the northeastern Torres Strait region. Extensive mixing caused by tidal currents through the reef matrix results in a well mixed water column for most biological and chemical parameters. Because of their clarity and general shallowness, a significant proportion of light reaches the bottom, regardless of depth on the shelf. On a volume basis, shelf waters of the far northern GBR are highly productive, but production per unit area is low because of the shallowness of the water column.

Great Barrier Reef Marine Park Authority. (1991). Annual report 1990-1991. *In: Annu. Rep. Great Barrier Reef Mar. Park Auth*, 114.

Abstract: The report describes the activities of the Great Barrier Reef Marine Park Authority during the year 1991. It is presented under the following main headings: GBR Ministerial Council; GBR Consultative Committee; Planning and management; Environmental impact management; Research and monitoring; Education and information; Aquarium; Administration; Canberra Office; and External advisory services.

Guzman, H. M., Ross-Robertson, D., & Diaz, M. L. (1991). Distribucion y abundancia de corales en el arrecife del Refugio de Isla Iguana, Pacifico de Panama. *In: Revista De Biologia Tropical*, 39(2), 225-231.

Abstract: Data on the age, abundance and distribution of reef corals at the Wildlife Refuge of Iguana Island, Panama are presented. A total living coral cover of 30.6% was found comprising 11 species. Pocilloporidae were the main reef-building corals, representing 95% of the live coral coverage. A brief discussion on the effects of the lack of protection and bad management of this zone is included. Emphasis is made on the large reef areas that have been destroyed at a faster rate during the last three years due to human activities.

Harris, P. (1991). Sedimentation at the junction of the Fly River and the northern Great Barrier Reef. Sustainable Development For Traditional Inhabitants Of The Torres Strait Region. Torres Strait Baseline Study Conference, Cairns, Qld. (Australia), 19 Nov 1990 Great Barrier Reef Marine Park Authority *Workshop Ser. Great Barrier Reef Mar. Park Auth.:*

Notes: maps, diagrams, 47 ref.

Abstract: It has been speculated that freshwater and sediment discharge from the river in the Gulf of Papua New Guinea provide an explanation of the sudden cessation of the Great Barrier Reef at about 9 degrees South. Tidal currents dominate in the transport of sandy sediments

throughout the Fly Estuary. On the delta front, however, surface waves rework the muds and sands, and fluvial discharge events deposit a mud layer, resulting in seasonal sand mud interbeds. Pro delta deposits occur in 17 to 45 metres water depth and contain massively bedded muds deposited in low tidal and wave energy settings at up to 6 cm per year. In the Torres Strait and barrier reef lagoon environments, tidal currents rework seabed deposits, dispersing any Fly River sediments over a wide area. A preliminary sediment budget demonstrates that half of the Fly River sediment is deposited in the Fly Delta. A large proportion is probably deposited in the Gulf of Papua. Less than 2 percent of the annual discharge of the Fly River seems to enter the Torres Strait region. Other effects must explain the termination of the Great Barrier Reef.

Hixon, M. A. (1991). Predation as a process structuring total reef fish communities. The ecology of fishes on coral reef San Diego, CA: Academic Press

Johannes, R. E., & MacFarlane, W. (1991). Torres Strait traditional fisheries studies some implications for sustainable development. Sustainable Development For Traditional Inhabitants Of The Torres Strait Region. Torres Strait Baseline Study Conference, Cairns, Qld. (Australia), 19 Nov 1990 Townsville, Qld Australia: Great Barrier Reef Marine Park Authority *Workshop Ser. Great Barrier Reef Mar. Park Auth.:*

Notes: table, 47 ref.

Abstract : Results of CSIRO studies on the traditional fisheries of Torres Strait Islanders between 1983 and 1987 have important implications for sustainable development of marine resources in the area. Average rates of consumption of seafood in the Islands are among the highest recorded in the world. Green turtles, rather than finfish, are the most important seafood, and there is no evidence of overfishing of finfish. Torres Strait could support at least an order of magnitude more seafood than it does today. A major impediment to the exploitation of this opportunity is that education has not prepared islanders for commercial development. However, there is also little evidence of a cultural awareness of a limit to the resources of the sea, and this too should be part of the educational experience.

Kelleher, G. (1991). Sustainable development for traditional inhabitants of the Torres Strait Region. Sustainable Development For Traditional Inhabitants Of The Torres Strait Region. Torres Strait Baseline Study Conference, Cairns, Qld. (Australia), 19 Nov 1990 Great Barrier Reef Marine Park Authority *Workshop Ser. Great Barrier Reef Mar. Park Auth.:*

Notes: 11 ref.

Abstract: The geography of the Torres Strait region is briefly outlined, and the various social groups that depend upon the resources of the region are described. It is emphasised that despite the critical need for development of the region, such development must be sustainable ecologically, socially and economically. The importance of the Baseline study is assessed.

Kenchington, R. A. (1991). Tourism development in the Great Barrier Reef Marine Park. *In: Ocean and Shoreline Management*, 15(1), 57-78 .

Abstract: The paper provides a management case study of tourism as a reasonable use of the Great Barrier Reef Marine Park. It summarises the multiple-use management concept applied in the Marine Park, and discusses the Great Barrier Reef as a tourist attraction. It describes the general provisions of zoning and management that affect tourism, and the specific approach of the permit system which provides for case-by-case management and control of tourist programs and developments. It outlines the interaction of Great Barrier Reef Marine Park controls with other Commonwealth and Queensland environmental legislation, and describes the development of site management and strategic plans to provide guidance to permit applicants and delegates regarding possible developments and activities within the Great Barrier Reef Marine Park.

Kinsey, D. W., & Hopley, D. (1991). The significance of coral reefs as global carbon sinks--response to greenhouse. *In: Global Planet. Change*, 3(4), 363-377.

Abstract: Coral reefs are net sinks for C, principally as CaCO₃ accretion. It is possible to predict quite accurately the rate of production, given adequate information about any particular reef environment. The best data set for an extensive region is that for the Great Barrier Reef (GBR). Careful analysis of this region and the incorporation of previously documented present day system calcification rates suggest net production (G) varying from G = 1 (kg CaCO₃ m⁻² yr⁻¹) for fringing reefs, to G = 1.9 for planar (infilled platform) reefs, to G = 3 for ribbon reefs and lagoonal reefs. The 20,055 km² of reefs in the GBR are thus estimated to average G = 2.4, resulting in a total production of similar to 50 million tonnes yr⁻¹. In a 50-100 year Greenhouse scenario of rising sealevel, we predict that recolonisation of present day reef flats will be extensive and prolific. Production will increase substantially, and this could be by as much as similar to 40% (ranging from 0% for deep shoals to 180% for fringing reefs) to give similar to 70 million tonnes yr⁻¹ if the rate of sealevel rise reaches or exceeds 6-8 mm yr⁻¹. We estimate 115,000 km² of oceanic atolls worldwide. Drawing on points of equivalence from the detailed analysis of the GBR, we estimate the atolls presently produce 160 million tonnes yr⁻¹. We predict that a similar similar to 40% increase could be possible in the next 100 years or so resulting in a production of 220 million tonnes. Accepting an existing estimate of 617,000 km² for reefs worldwide, drawing from our projections from the GBR and the atolls, and making some assumptions about the remaining reef types (we suggest fringing reefs to dominate) we estimate global reef production at the present time to be similar to 900 million tonnes yr⁻¹. Within the next 100 years or so, we suggest this rate could almost double to similar to 1800 million tonnes. In the long terms (several centuries) we predict that the continuing trend of recolonisation, particularly of fringing and planar reefs could result in the production of > 3000 million tonnes yr⁻¹ if rates of sealevel rise approaching or exceeding 6-8 mm yr⁻¹ are achieved. Eventually (> 500 yr), reefs could actually "drown" due to inability to match the rate of sealevel increase it that rate significantly exceeds 6-8 mm yr⁻¹. Thus, coral reefs at present act as a sink for 111 million tonnes C yr⁻¹, the equivalent of 2% of present output of anthropogenic CO₂. In the short term Greenhouse scenario (100 yr) we predict this could increase to the equivalent of similar to 4% of the present CO₂ output. In the much longer term (several centuries), if all trends continue, this could increase to the equivalent of as much as similar to 9% of the present CO₂ output. Unfortunately, we also predict that this considerable sink for C will be most likely of negative value in alleviating Greenhouse because the immediate effect of CaCO₃ precipitation is to raise the P_{sub}(CO₂) of the surface oceans - ie, to encourage CO₂ efflux to the atmosphere. We do not attempt to quantify this effect. Other Greenhouse changes such as seawater temperature increase, changes in cloud cover, increased rainfall and runoff, increased storm activity, and changes in dissolved CO₂ concentration and surface ocean circulation may complicate the reef response. However, we suggest that sealevel rise will be the dominant influence, at least during the next 100 years or so (DBO).

Kwan, D. (1991). The artisanal sea turtle fishery in Daru, Papua New Guinea. Sustainable Development For Traditional Inhabitants Of The Torres Strait Region. Torres Strait Baseline Study Conference, Cairns, Qld. (Australia), 19 Nov 1990 Townsville, Qld Australia: Great Barrier Reef Marine Park Authority *Workshop Ser. Great Barrier Reef Mar. Park Auth.:* Notes: Summary only

Abstract: Turtles were traditionally hunted for subsistence and cultural purposes. Today, fisheries operating off Port Moresby and Daru are an important source of income for many local people. Turtles harvested at Daru are believed to be taken from at least three groups: one that is resident in Torres Strait, one that migrates to the area to breed and a third that migrates

through the area to various rookeries in the Great Barrier Reef. Green turtles are dominant in the catch, and most are breeding females; each of these trends is probably due to a combination of local availability and the preference of fishers and the market. Much of the catch is being taken from the eastern Australian breeding assemblage, and it may constitute a significant removal from that assemblage. The turtle stock being harvested at Daru is also extensively hunted in foraging areas in Indonesia. Current knowledge is not sufficient to recommend restrictive measures, but continued monitoring is strongly recommended.

Lawrence, D. (1991). The subsistence economy of the Kiwai speaking people of the southwest coast of Papua New Guinea. Sustainable Development For Traditional Inhabitants Of The Torres Strait Region. Torres Strait Baseline Study Conference, Cairns, Qld. (Australia), 19 Nov 1990 Townsville, Qld Australia: Great Barrier Reef Marine Park Authority *Workshop Ser. Great Barrier Reef Mar. Park Auth.:*

Notes: maps, 11 ref.

Abstract: The coastal Kiwai speaking people of the southwest coast of Papua New Guinea live on a narrow strip of sandy foreshore between the sea and the coastal swamps and savannah lands of the coastal plain. They have limited access to good gardening lands, but have unrestricted access to the waters of Torres Strait. For this reason they have remained predominantly subsistence fishermen. This makes them economically and culturally vulnerable to any adverse changes to the marine environment. With limited access to government support, and living in one of the least developed parts of Papua New Guinea, their future depends on maintenance of the quality of the fish they catch and the reefs on which they fish.

Lawrence, D. (1991). Sustainable development for traditional inhabitants of the Torres Strait region [a review]. Sustainable Development For Traditional Inhabitants Of The Torres Strait Region. Torres Strait Baseline Study Conference, Cairns, Qld. (Australia), 19 Nov 1990 Townsville, Qld Australia: Great Barrier Reef Marine Park Authority *Workshop Ser. Great Barrier Reef Mar. Park Auth.:*

Abstract: An introduction is given to the background, administration and progress of the Torres Strait Baseline Study, currently being undertaken by the Great Barrier Reef Marine Park Authority on behalf of the Australian Department of Arts, Sport, the Environment, Tourism and Territories. The objectives of the study are: (a) to establish existing levels of trace metals within the sediments and biota; (b) to identify the important transport, geochemical and trophic pathways of trace metals in the marine environment; (c) to determine the potential effects of trace metal concentrations on selected marine organisms; (d) to assess the potential effects of present and future mining operations in the Fly River area of Papua New Guinea on sediment loads and trace metal concentrations

Lawrence, D., & Cansfield Smith, T. (1991). Sustainable Development For Traditional Inhabitants Of The Torres Strait Region. Torres Strait Baseline Study Conference, Cairns, Qld. (Australia), 19 Nov 1990. (p. 535). Great Barrier Reef Mar. Park Auth.: *Workshop Ser. Great Barrier Reef Mar. Park Auth.:*

Abstract: The Torres Strait Baseline Study was instigated in response to concerns expressed by Torres Strait islanders, commercial fishermen and scientists, about possible effects on the marine environment in the area arising from mining operations in the Fly River catchment area of Papua New Guinea. The study began with the holding of a conference on the physical, biological and human environments of the region

Marsh, H., & Saalfield, K. (1991). The status of the dugong in Torres Strait. Sustainable Development For Traditional Inhabitants Of The Torres Strait Region. Torres Strait Baseline Study Conference, Cairns, Qld. (Australia), 19 Nov 1990 Townsville, Qld Australia: Great

Barrier Reef Marine Park Authority *Workshop Ser. Great Barrier Reef Mar. Park Auth.:*
Notes: map, 2 tables, 10 ref.

Abstract: An aerial survey of dugong populations in the Torres Strait region was conducted in November 1987, and partly repeated in March 1988. The minimum population estimate in November 1987 was about 12,000 dugongs at an overall density of about 0.4 per square km. The repeat survey revealed no significant differences, but relatively more sightings were made near the western islands. If the dugong population were increasing maximally, a total man induced mortality of 700 per year might be supportable; on a more realistic estimate of increase, the figure is closer to 300; and if females are being caught selectively, even less. In the absence of detailed catch statistics and adequate knowledge of the life cycle, it is impossible to confirm that the population is stable at present. Environmental education programmes should assume that no increase in catch is supportable. Proposals are made for extension of the current dugong sanctuary area.

Meganck, R. A. (1991). Coastal parks as development catalysts: A Caribbean example. *In: Ocean and Shoreline Management*, 15(1), 25-36 .

Abstract: The site of the proposed Pitons National Park comprises an area of 1600 acres of terrestrial and marine habitat that extends southward from the town of Soufriere on the west coast of St Lucia in the eastern, Caribbean. The park has great potential as a focal point for the economic revitalization of this depressed region, particularly considering the diversity of natural and cultural attractions in its immediate environs. Establishment of the park will create 400 permanent jobs and help to stabilize the local economy, including the long-term viability of the local fishing industry through sustained management of the reef systems. Without the establishment of the park, however, the economic future of Soufriere remains clouded. However positive this proposal sounds, the Government is also currently considering an alternative proposal to construct a large hotel-casino complex on the site of the proposed park.

Miller, J., & Limpus, C. J. (1991). Torres Strait marine turtle resources. Sustainable Development For Traditional Inhabitants Of The Torres Strait Region. Torres Strait Baseline Study Conference, Cairns, Qld. (Australia), 19 Nov 1990 Townsville, Qld Australia: Great Barrier Reef Marine Park Authority *Workshop Ser. Great Barrier Reef Mar. Park Auth.:*
Notes: map, graphs, 4 tables, 31 ref.

Abstract: Three of the six species of marine turtles that occur in the Torres Strait are represented by both nesting and foraging groups. Genetic uniqueness has been demonstrated for the regional green turtle nesting group but not for any of the other species. The number of nesting green turtles is correlated with an index on the Southern Oscillation. Pesticides and heavy metals do accumulate in the bones, soft tissues and eggs of marine turtles but the impact cannot be evaluated. International cooperation will be necessary for a regional conservation effort to be successful.

Mitchell, B., & Barborak, J. R. (1991). Developing coastal park systems in the tropics: Planning in the Turks and Caicos Islands. *In: Coastal Management*, 19(1), 113-134.

Abstract: A new national park system is being developed in the Turks and Caicos Islands, a sparsely populated archipelago at the southern extreme of the Bahamian platform. The small area supports pristine reef complexes, large tidal flats, nesting seabird colonies, and endangered species such as the green turtle (*Chelonia mydas*), humpback whale (*Megaptera novaengliae*), and Kirtland's warbler (*Dendroica kirtlandii*). The habitats are threatened by a recent boom in tourism and land development. In 1987, the Turks and Caicos government identified 32 marine and terrestrial sites for future designation as national parks, nature reserves, sanctuaries, and historical sites. A strategy for long-term financial support and training for development of a park system is discussed, including local management and enforcement capabilities

Nen, T. (1991). The need for an information database of resource development activities in the Torres Strait region. Sustainable Development For Traditional Inhabitants Of The Torres Strait Region. Torres Strait Baseline Study Conference, Cairns, Qld. (Australia), 19 Nov 1990 Townsville, Qld Australia: Great Barrier Reef Marine Park Authority *Workshop Ser. Great Barrier Reef Mar. Park Auth.* 11 ref.

Abstract: The reasons that Australia and Papua New Guinea need to create an information database of resource development activities in the Torres Strait region are presented. The strategies of government departments in Papua New Guinea involved in the renewable resources sector are briefly outlined. The primary objective of the Department of Environment and Conservation in its rationalisation of the development and exploitation of Papua New Guinea's natural resources is explained. The categories of specific information that are needed by such people as planners, policy makers and the people of the region are pointed out.

Pitcher, R. (1991). Research for sustainable development of the tropical rock lobster fishery in Torres Strait. Sustainable Development For Traditional Inhabitants Of The Torres Strait Region. Torres Strait Baseline Study Conference, Cairns, Qld. (Australia), 19 Nov 1990 Townsville, Qld Australia: Great Barrier Reef Marine Park Authority *Workshop Ser. Great Barrier Reef Mar. Park Auth.:*

Notes: 16 ref.

Abstract: The commercial fishery for the tropical rock lobster is a major source of income for Torres Strait Islanders. Research results on the life history, mortality, sources of recruitment, abundance, and catch characteristics of the lobster and the fishery are briefly outlined. Research will continue to be synthesized into models that provide the basis for enlightened management

Roberts, C., & Polunin, N. (1991). Are marine reserves effective in management of reef fisheries? *In: Reviews In Fish Biology And Fisheries*, 1(1), 65-91.

Abstract: Reefs protected from fish within reserves change from the state prevailing in fished areas. It has now been well established that the abundances and average sizes of many larger carnivorous fishes increase within protected areas. Smaller fishes and species from different trophic levels show similar patterns where they are targeted by fishermen. However, several key questions about the function of reserves in fishery management remain. The role of reserves in supplying recruits to fished areas has not yet been evaluated. Information on relative rates of production inside and outside reserves, and patterns of larval transport and mortality, are necessary to determine whether they may play a role in enhancing or sustaining catches in fishes areas. It should prove relatively easy to estimate egg production in reserve and non-reserve areas from knowledge of population structures and behaviour of the species concerned.

Ross, C. W. (1991). Staged development and environmental management of the Porgera Gold Mine, Papua New Guinea. Sustainable Development For Traditional Inhabitants Of The Torres Strait Region. Torres Strait Baseline Study Conference, Cairns, Qld. (Australia), 19 Nov 1990 Townsville, Qld Australia: Great Barrier Reef Marine Park Authority *Workshop Ser. Great Barrier Reef Mar. Park Auth.:* Notes: maps, diagrams, 10 ref.

Abstract: The Porgera Gold Mine is presently being constructed in the Central Highlands of Papua New Guinea. The mine is located within the catchment of the Porgera River which drains into the Lagaip, Strickland and Fly River system. Stage 1 of the mine and ore processing plant commenced production in September 1990. The staged development of the mine and ore processing plant are described. Information is given on management of mine wastes, with particular reference to chemical treatment of mine tailings. The predicted environmental effects resulting from riverine disposal of tailings are discussed.

Rowchai, S. (1991). Assessment and management of marine resources in Tarutao National

Park, Thailand. Towards An Integrated Management Of Tropical Coastal Resources, Proceedings Of The Asean Us Technical Workshop On Integrated Tropical Coastal Zone Management, 28 31 October 1988. Temasek Hall, National University Of Singapore, Singapore

Manila Philippines: International Cent. for Living Aquatic Resources Management
Abstract: The condition of marine resources in Tarutao National Park in Thailand was investigated and their major management problems were identified under the Office of the National Environment Board University of Rhode Island United States Agency for International Development Coastal Resources Management Project. In general, marine resources and habitats in the park have been degraded due to various improper uses. Several coral reefs have been destroyed or seriously harmed by blasting, anchor damage, tourism, storm damage and crown of thorns infestations. Coastal waters adjacent to areas of intensive use have become polluted due to the release of untreated waste effluents. Stock depletion of marine species has resulted from overharvesting and illegal trawling. Because of these, management programs, which emphasize park and public cooperation in the protection of marine resources, are recommended.

Santiapillai, C., MacKinnon, K., & Ramono, W. S. (1991). The story behind the emblem (Great Barrier Reef Marine Park Authority). *In: Parks*, 2(1), 25-27.

Abstract: The Great Barrier Reef Marine Park Authority was formed by the Australian Government in 1975. The emblem represents the beauty and grandeur of the Great Barrier Reef, which lies off the coast of Queensland. It is one of the world's greatest natural assets and, with an area of 343,800 km², it is the world's largest marine park. The area was inscribed on the World Heritage List in 1981. While the Authority recognises that any use of the reef or associated areas should not threaten the essential ecological characteristics or processes of the Great Barrier Reef, it is committed to minimising regulation of and interference in human activities.

Sullivan, K. M. (1991). The impacts of projected climate change on coastal land use in Papua New Guinea. Sustainable Development For Traditional Inhabitants Of The Torres Strait Region. Torres Strait Baseline Study Conference, Cairns, Qld. (Australia), 19 Nov 1990 Great Barrier Reef Marine Park Authority *Workshop Ser. Great Barrier Reef Mar. Park Auth.:* Notes: maps, table, 2 graphs, 45 ref.

Abstract: Approximately half of the population of Papua New Guinea live along the coastline. Subsistence and commercial agriculture are the main land uses, and the inhabitants also rely heavily on marine resources. The major likely direct impact of global warming and sea level rise are: increased humidity and decreased human comfort; coastal inundation; coastal flooding by storm surges; salt water intrusion of groundwaters; water table elevation; and changes to coastal landforms, especially if coral growth cannot maintain protection from wave action. Socio economic consequences would include: decreased agricultural productivity due to flooding and groundwater quality decline; salt contamination of drinking water; economic costs of maintaining and repairing buildings and infrastructure such as roads; out migration from islands and other areas that become uninhabitable

Swafford, D. (1991). Rx For a Sick Reef. *In: Sea Frontiers*, 37(6), 38-43, 62.

Abstract: The coral reefs of the Florida Keys have suffered from pollution, overfishing, shipping accidents, and all the resulting problems from an abundance of tourism. In an attempt to save the major living reef off the continental U.S., the Federal government has designated the water surrounding the Keys archipelago (group of islands) a national marine sanctuary. The establishment of the sanctuary, which includes 3,500 sq. statute mi. from just south of Miami to the Dry Tortugas almost 100 mi. past Key West, goes much further than local laws did to preserve the ecologically fragile coral reefs. The National Oceanic and Atmospheric

Administration(NOAA) is in charge of developing a management plan and locating alternative sources for funding, a factor that has many local business people worried. Dive and snorkel operators, charter fishermen, and tropical fish collectors believe that fees and taxes imposed on them would put them out of business. They claim that the reasons for the reef's decline had little to do with local business practices and more to do with pollution from southern Florida, agricultural run off from central Florida, and shipping accidents which could occur regardless of regulations. Most environmentalists believe, however, that the establishment of the Florida Keys National Marine Sanctuary is the most important step in preserving the area, although many suggest that more must be done to address the problem of pollution drifting from other areas down to the Keys. Over development in the Keys is also considered problematic for the reef, so another law, the Coastal Barrier Improvement Act, adds 67,000 acres of undeveloped land to the Coastal Barrier Resources System, making that land ineligible for federal development assistance and therefore severely limiting the possibility of its development

Turnbull, C. (1991). A review of QDPI research on commercial prawn species in Torres Strait. Sustainable Development For Traditional Inhabitants Of The Torres Strait Region. Torres Strait Baseline Study Conference, Cairns, Qld. (Australia), 19 Nov 1990 Townsville, Qld Australia: Great Barrier Reef Marine Park Authority *Workshop Ser. Great Barrier Reef Mar. Park Auth.:* Notes: Summary only

Abstract: Queensland set up a Torres Strait Project in July 1985 to investigate the movement and distribution of the commercial prawn species in the region and to assess seasonal and area closures to ensure that they are being applied in the most effective way. Data from trawl samples and tagging studies are being used to investigate the life cycles of *Penaeus esculentus*, the brown tiger prawn, *Metapenaeus endeavouri*, the endeavour prawn, and *P. longistylus*, the red spot king prawn. An unusual feature of the Torres Strait prawn fishery is that the juvenile seagrass nurseries are located on coral reef platforms rather than estuarine mudflats. Migration and spawning patterns are briefly described. There are indications that areas with high densities of undersized prawns are restricted to the wester side of the fishery, so that extended area closures may be more effective than total area seasonal closures. Future research will concentrate on spawning and recruitment patterns, and on simulation modelling for assessment of management options.

Waite, T. D., & Szymczak, R. (1991). Processes influencing the fate of trace metals in Torres Strait: A review of current data and concepts. Sustainable Development For Traditional Inhabitants Of The Torres Strait Region. Torres Strait Baseline Study Conference, Cairns, Qld. (Australia), 19 Nov 1990 Townsville: Great Barrier Reef Marine Park Authority *Workshop Ser. Great Barrier Reef Mar. Park Auth.:*

Abstract: The existing data on trace metals concentrations in Torres Strait waters and sediments is compiled, methods reviewed and the data briefly discussed. Physico chemical processes likely to be important in the supply to and mobilisation within Torres Strait are then considered, and on the basis of existing data attempts are made to refine the range of possibilities for sources, transformation processes and fate of heavy metals in the system. A brief compilation of additional data to assist in predictive modelling is also provided.

White, A. (1991). Coral reef management in the ASEAN/US Coastal Resources Management Project. Towards An Integrated Management Of Tropical Coastal Resources. Proceedings Of The Asean US Technical Workshop On Integrated Tropical Coastal Zone Management, 28 31 October 1988. Temasek Hall, National University Of Singapore, Singapore Manila Philippines: International Cent. for Living Aquatic Resources Management

Abstract: This paper discusses and summarizes the various approaches to coral reef management being attempted in the project sites of the ASEANUS Coastal Resources

Management Project (CRMP). Except in Indonesia, the coastal pilot sites of the other five ASEAN member countries include coral reef areas and resources. The specific sites of interest are Pelong Rocks and several patch reef areas in Brunei Darussalam; Pulau Rawa Archipelago and Pulau Sibul Archipelago Marine Parks, Johore, Malaysia; Santiago Island and several adjacent islands, Bolinao, Philippines; several offshore islands of Singapore; and Mu Ko Ang Thong and Ko Phi Phi National Marine Parks, Ko Samui and Ko Phangan, Upper South, Thailand. Since the various well known destructive impacts of coastal populations on adjacent coral reef areas are continually increasing at these sites, there is an urgency to complete a management program for implementation. Each proposed management regime, although not large in scale, is practical and has a good chance of success if given the necessary support.

White, A., & Palaganas, V. P. (1991). Philippine Tubbataha Reef National Marine Park: Status, Management issues, and proposed plan. *In: Environmental Conservation*, 18(2), 148-157.

Abstract: This assessment reviews the previous and current literature and documentation on Tubbataha Reefs, showing their dramatic change in environmental quality over a mere half-decade. It also discusses a management plan for the site.

Williams, G. C., & Staples, D. J. (1991). Australia's fisheries research in the Torres Strait protected zone. Sustainable Development For Traditional Inhabitants Of The Torres Strait Region. Torres Strait Baseline Study Conference, Cairns, Qld. (Australia), 19 Nov 1990 Townsville, Qld Australia: Great Barrier Reef Marine Park Authority *GBRMPA Workshop Series*:

Notes: 2 graphs, 8 ref.

Abstract: The Torres Strait Fishery Scientific Advisory Committee provides scientific advice to the Protected Zone Joint Authority through the Torres Strait Fisheries Management Committee. It is responsible for a large research effort including biological research into lobsters, prawns, effects of fishing, seagrass ecology, dugongs, and monitoring of traditional fishing. The National Residue Survey is investigating heavy metal contamination of prawn stocks. In general, these projects tend to be strategic research aimed at the longer term sustainability of the fishery resources.

Woesik, R., Ayling, A., & Mapstone, B. (1991). Impact of tropical cyclone "Ivor" on the Great Barrier Reef, Australia. *In: Journal of Coastal Research*, 7(2), 551-558.

Abstract: In late 1989, the Great Barrier Reef Marine Park Authority, the Crown-of-Thorns Starfish Review Committee, and the Australian Research Council funded a multi-disciplinary survey of 24 reefs between Cairns and Lizard Island. Most reefs were surveyed prior to cyclone "Ivor." Three of the more northern reefs were surveyed both immediately before and immediately after "Ivor" crossed the continental shelf. The effects of wave action on the structure and biota of Carter, Eyrie and Lizard Island Reefs were examined

Wolanski, E. (1991). A review of the physical oceanography of Torres Strait. Sustainable Development For Traditional Inhabitants Of The Torres Strait Region. Torres Strait Baseline Study Conference, Cairns, Qld. (Australia), 19 Nov 1990 Townsville, Qld Australia: Great Barrier Reef Marine Park Authority *Workshop Ser. Great Barrier Reef Mar. Park Auth.:*

Notes: map, 30 ref.

Abstract: The last ten years has seen a rapid increase in the understanding of the water circulation in the Torres Strait. The area is topographically extremely complex and forced nearly independently by the Arafura Sea and the Coral Sea through the continental shelf of the Great Barrier Reef. Additional local forcings are river runoff and local wind effects. A clear picture is rapidly emerging and some confidence can now be given to modelling the water

circulation in Torres Strait as the open boundary forcings are better understood.

Alder, J. (1992). Have six years of marine public education changed community attitudes and awareness ? Proceedings of the 7th International Coral Reef Symposium [s. l.]: [s. n.]

Abstract: The day to day management of the Cairns Section of the Great Barrier Reef Marine Park commenced in May of 1985. A survey to determine community attitudes towards and awareness of the marine park was conducted in August of that year. Over the next six years various public and user education programs were implemented. To gauge the effectiveness of these programs, the marine parks awareness survey was repeated in October of 1991. Preliminary results indicate changes in community awareness and attitudes

[**Anon.**]. (1992). Users could pay in Great Barrier Reef Marine Park. *In: Aust. Fish.*, 51(7), 19-21.

Abstract: In this excerpt from ABARE's report to the Great Barrier Reef Marine Park Authority, Gerry Green and Padma Lal focus on the development of a "user pays" charging system to help fund the conservation and management of the resources of the marine park

Ayling, A., Ayling, A., & Mapstone, B. D. (1992). Possible effects of protection from fishing pressure on recruitment rates of the coral trout (*Plectropomus leopardus*: Serranidae).

Australian Society For Fish Biology Workshop. Recruitment Processes. Hobart, 21 August 1991 Canberra, N.S.W. Australia : Australian Government Publishing Service

Abstract: An examination is made of data obtained during surveys conducted in the Capricorn Bunker Group of reefs in 1986 and in the Cairns Section of the Great Barrier Reef Marine Park in 1991 regarding the distribution patterns of the coral trout (*Plectropomus leopardus*). Findings suggest a relationship between fishing protection and recruitment for this species. In the Capricorn Bunker Group there were almost twice as many coral trout over 35 cm TL on protected reefs as on reefs open to fishing, whereas for those smaller than 35 cm TL there were more than twice as many on fished reefs as on protected reefs. In the Cairns Section more fish were found on the front of protected reefs than on the back, whereas more fish were found on the back rather than the front of the fished reefs

Baddiley, P. (1992). Fitzroy River Basin rainfalls and the 1991 flood event. Workshop on the Impacts of Flooding, Rockhampton, Qld (Australia), 27 Sep 1991 Townsville, Qld (Australia): Great Barrier Reef Marine Park Auth. **Notes:** tables, graphs

Abstract: The arrival of Cyclone Joy during late December 1990 heralded the commencement of a period of severe flooding along Queensland's central and north coast. One of the worst affected areas was around Rockhampton; flood levels in the Fitzroy River were the third highest since records begin in 1860. Rains associated with the cyclone fell from about 23 December 1990 to 7 January 1991. The highest totals of between 1000 and 2000 mm fell in the Connors River headwaters, a northern tributary of the Fitzroy River. The distribution and intensity of rainfall in the Fitzroy River watershed is discussed with comment on the predominant weather patterns active during the period. Some comparison are made with earlier flood events, in 1918 and 1954. The flood warning system for the Fitzroy River is briefly described

Berrow, S. D., Kelly, T. C., & Myers, A. (1992). The mussel caching behaviour of hooded crows *Corvus corone cornix*. *In: Bird Study*, 39(2), 115-119.

Bojos, R. M. Jr. (1992). Territorial use rights in fisheries: Policies and strategies for coastal area management. Policies and issues on Philippine fisheries and aquatic resources Proceedings of the Roundtable Discussion of Philippine Fisheries Policies, 12-13 December 1989,

Department of Science and Technology, Bicutan, Taguig, Metro Manila and the Workshop on Territorial Use Rights in Fisheries, 26 November 1991, Bureau of Soils and Water Resources Management, Diliman, Quezon City, Metro Manila Los Banos, Laguna Philippines: PCAMRD
Notes: Workshop on Territorial Use Rights in Fisheries, Diliman, Quezon City, Metro Manila, Philippines, 26 November 1991. Received 1996.

Abstract: The Central Visayas Regional Project (CVRP I) addresses the problems of declining productivity and rural poverty caused by continuing degradation of the region's natural resources. The project is designed to stabilize and improve the resource base through community based resource management thereby developing local capabilities to manage area development. This begins at the 'barangay' (village) level to generate employment opportunities in the rural areas. CVRP I recognizes the fishermen as the real day to day managers of the coastal resources. An analysis of the fishermen's present situation reveals that fish stocks especially those near the shore are heavily exploited, resulting in declining harvest and profitability. Strategies were developed to make coastal fishing opportunities more profitable. The strategies were: (1) restoration and management of the highly productive nearshore fish producing habitats such as coral reefs, mangroves and sea grass beds by the fishing community; (2) development of low overhead fishing and sea ranching opportunities allowing more fishermen to earn more profits from limited marine stocks; and (3) utilization of community based mechanisms through regulation of different fishing gears. Implementation of these strategies began in July 1984 at the four Central Visayas sites. Fishermen were assisted in implementing a series of resource management activities which provided the basis for the development of village, municipal and provincial level coastal resource management programs. Activities implemented by fishermen are: (1) family managed artificial reef clusters; (2) protection and management of coral reefs by coastal communities including the establishment of municipal marine sanctuaries; (3) mariculture on protected and managed reefs; and (4) local control of illegal and destructive fishing methods. The protection and management of coral reefs by coastal communities were creating many new opportunities for the ranching and farming of a wide variety of native marine life. There is however, a pressing need for government to provide the promised regulatory framework to allow community based resource management to prosper. Such framework needs to be flexible and allows the coastal communities to adopt basic strategies suitable to local conditions. Key among these are regulations to: (1) allow municipal licensing of family managed artificial reef clusters; (2) provide for the creation and management of municipal marine sanctuaries; and (3) provide for regional level approval of municipal fishing ordinances. All of these were promised by the government in the 1983 Memorandum of Agreement between CVRP I and the then Ministry of Agriculture (now Department of Agriculture)

Brodie, J., & Mitchell, A. (1992). Nutrient composition of the January 1991 Fitzroy River plume. Workshop on the Impacts of Flooding, Rockhampton, Qld (Australia), 27 Sep 1991
 Townsville, Qld (Australia): Great Barrier Reef Marine Park Auth.

Notes: 4 tables, 7 fig., 26 ref.

Abstract: During January 1991, the plume of the flooded Fitzroy River was studied at sampling stations on six transects from near the river mouth to north of the Keppel Islands. Water samples were analysed for salinity, ammonia, total nitrogen, nitrite, nitrate, organic and particulate nitrogen, phosphorus in a similar range of forms, silicate, chlorophyll, phaeophyton and suspended solids. Much of the phosphorus in the plume was present as dissolved inorganic P near the river mouth; but an increasing proportion of particulate P was found away from the mouth, suggesting some readsorption onto particles and uptake by phytoplankton. Nitrogen levels in the plume were very high, especially the dissolved inorganic forms. Chlorophyll levels were very high, comparable in fact to algal bloom conditions. The results are contributions to the current debate about the effects of riverine inputs on the ecology of the Great Barrier Reef.

Buxton, C. D. (1992). The application of yield-per-recruit models to two South African sparid reef species, with special consideration to sex change. *In: Fisheries Research*, (15), 146.

Abstract: Yield-per-recruit models were applied to *Chiysoblephus laticeps* and *C. cristiceps* both of which are important to the line-fishery industry in South Africa. Sex change and slow growth were investigated, particularly with respect to the ratio of males to the total number of mature fish in the population. Predictions based on the yield-per-recruit and spawner-biomass-per-recruit models were viewed with caution owing to the rapid decline in the number of survivors past the age of recruitment, and their failure to take into account the effects of sex change on the reproductive potential of the population. Model predictions correlated well with observations that indicated a relationship between population structure and the level of exploitation. Considering the options for the management of these and similar reef fishes, the tactic of protection through marine reserves is supported.

Byron, G. T. (1992). Fisheries and floods [in Keppel Bay, Queensland]. Workshop on the Impacts of Flooding, Rockhampton, Qld (Australia), 27 Sep 1991 Townsville, Qld (Australia): Great Barrier Reef Marine Park Auth.

Abstract: Recorded and anecdotal evidence regarding the effects of river plume from floods in the Fitzroy River on the fisheries of Keppel Bay, Queensland, is briefly reported. In general, finfish fisheries appear to suffer a decline of perhaps 30 percent for about 3 months. The reactions of crustacean and mollusc fisheries are quite varied and apparently unpredictable.

Byron, G. T. (1992). Workshop on the Impacts of Flooding, Rockhampton, Qld (Australia), 27 Sep 1991. (p. 155). Townsville, Qld (Australia): Great Barrier Reef Marine Park Auth., *Workshop Ser. Great Barrier Reef Mar. Park Auth.*

Abstract: In January of 1991 Severe Tropical Cyclone Joy crossed the eastern Australian coast near Ayr, North Queensland. Subsequently the cyclone turned into a rain depression, causing widespread flooding throughout various sections of the Fitzroy River catchment. More than 18.5 million megalitres of runoff escaped down the Fitzroy River and into Keppel Bay. The Queensland National Parks and Wildlife Service undertook a monitoring programme to evaluate the effects on the marine environment. In the course of the programme, a number of organizations and individuals with similar interests were encountered, and a workshop was convened to exchange and consolidate conclusions reached on the impacts of the floods on social, economic, physical and biological parameters.

Byron, G. T., & O'Neill, J. P. (1992). Flood induced coral mortality on fringing reefs in Keppel Bay. Workshop on the Impacts of Flooding, Rockhampton, Qld (Australia), 27 Sep 1991 Townsville, Qld (Australia): Great Barrier Reef Marine Park Auth. Notes: maps, 20 ref.

Abstract: Rainfall consequent on the arrival of Cyclone Joy in late 1990 caused extensive flooding in the Fitzroy River region of central Queensland. River discharge from the floods caused great damage to the shallow fringing reefs of the major islands of Keppel Bay, with mortalities of 90 percent of corals being common. Analysis of the mortalities showed that taxonomic and bathymetric differences created disparate patterns of overall effect. Ecological consequences are considered, and the contribution of man-induced factors discussed.

Cancelmo, J. (1992). Mass Spawning of Coral and More Seen on Reefs. *In: Underwater*, 9(8), 30.

Abstract: What amounted to a marine-like orgy occurred as predicted on the 20th of August, on the eighth night after the August full moon, on two reefs in the Flower Garden Marine Sanctuary, 100 mi. off the coast of Texas. The main participants were multiple colonies of common brain and star corals, but cowfish, wrasses, brittle stars, and even tube worms were video-taped in a display of undersea procreation. No one knows what triggers the multiple

spawning, nor why some species participate while others do not, nor why the timing coincides with the lunar cycle. This year, mass coral spawning was also reported in the Florida Keys: a Key Largo Sanctuary biologist observed small star corals erupt just before midnight, and a professor of zoology at the University of Georgia saw large male and female star corals become active a few minutes before sunset. Yet, for reasons unknown, vigilant divers at Florida's Cary start Reef observed no activity. A number of experiments are being considered for next year. Diving activities will be spread out to see if more species spawn than are currently known, fertilization rates of the released eggs by sperm will be studied, and experiments on the effects of oil and dispersants to reproduction viability are scheduled. One problem with next year's experiments is that there will be two full moons in August 1993 - one on the second and another on the thirty-first. Texas A&M researchers note that the potential for repopulation of the Flower Garden corals is of particular concern because of their relative isolation - they are more than 400 mi. from other Gulf reef systems, and may depend mostly on self-seeding for survival. The Flower Gardens are near the northern limit for coral reef development, yet scientists say the reefs are healthy, with an exceptional degree of coral cover

Clayton, D. (1992). Spotcheck: Updates on protected area issues (Solitary Islands Marine Reserve). *In: Parks*, 3(1), 40-41.

Abstract: Solitary Islands Marine Reserve off Coffs Harbour, is situated 600 km north of Sydney, New South Wales (NSW), Australia. It covers some 100,000 ha of rich marine and estuarine habitats and is the first marine protected area in the country to cover a complete succession of the coastal aquatic environments surrounding islands and headlands and including beaches, off-shore rocky and coral reefs, and estuaries. A significant biological diversity is attributed to a bio-geographic overlap of aquatic communities. A warm current from tropical waters mixes with a cooler southern current resulting in a fascinating mix of corals and fish from the Great Barrier Reef living with species from as far south as Tasmania. Indeed many species occurring in the Reserve are situated at their geographical extreme; the red mangrove *Rhizophora stylosa* occurs here at its southernmost location in the world.

Coates, M. (1992). Effects of the January 1991 Fitzroy flood on intertidal invertebrate communities of Keppel Bay. Workshop on the Impacts of Flooding, Rockhampton, Qld (Australia), 27 Sep 1991 Townsville, Qld (Australia): Great Barrier Reef Marine Park Auth.

Notes: Summary only

Abstract: Very heavy flooding of the Fitzroy River during January 1991 reduced salinities in the surface waters of Keppel Bay, Queensland, from a normal level of about 35 ppk to between 5 and 14 ppk for 13 days. The dilution caused heavy mortality of barnacles, oysters and gastropods along the Capricorn Coast. Mortalities on offshore islands of Keppel Bay seemed less severe, but baseline data here are not good. Long-term ecological studies are under way to study the recovery of these areas.

Craik, W. (1992). The Great Barrier Reef Marine Park: Its establishment, development and current status. *In: Marine Pollution Bulletin*, 25(5-8), 122-123.

Abstract: The paper reviews the development of and current status of management within the Great Barrier Reef Marine Park and the major issues facing the Marine Park: tourism, fishing, water quality, oil pollution, and the crown-of-thorns starfish. The current status of these issues and proposed strategies for addressing them are outlined.

Cribb, A. (1992). Fishing in God's own country. *In: West. Fish.*, 20-26.

Abstract: Ningaloo Reef, Western Australia, has a special place in the memory of anyone who's been lucky enough to spend some time there, either fishing or just looking. The reef has been protected in a marine park for over five years now, and increasing numbers of tourists are

making the long trek north in winter to while away their holidays in the balmy air of the coral coast. This year anglers arriving in Exmouth will find a seemingly complex set of new fishing rules for the marine park, including possession limits, bag limits, sanctuary zones and protected species. Fishing is still a big part of Ningaloo, but the key word is conservation.

Fairbairn, T. I. J., & Tisdell, C. (1992). Marine property rights in relation to giant clam mariculture in the Kingdom of Tonga. Giant clams in the sustainable development of the South Pacific: socioeconomic issues in mariculture and conservation (pp. 119-133, 6 ref., 2 maps). [s. l.]: ACIAR.

Abstract: Marine property rights in the coastal waters of the Kingdom of Tonga are fairly uncomplicated. Ownership of Tonga's reefs and lagoons, as well as its territorial waters as a whole, is vested in the Crown and has been so since the late 19th century. While such an arrangement effectively took away the traditional and customary rights of local groups over these waters, it allows open access to all Tongans for purposes of fishing, both subsistence and commercial. The main exceptions are certain restricted areas set aside as marine parks. Leases over reef sites for giant clam and other forms of mariculture can be negotiated with the government. The Fisheries Act of 1987 and the Fisheries Regulations of 1989 provide the basic legislative framework for such leases. Specific terms and conditions relating to leases are negotiated under the auspices of the Ministry of Agriculture, Forestry and Fisheries. Under existing legislation, the Minister of Agriculture, Forestry and Fisheries has fairly wide regulatory powers to ensure, among other things, that mariculture, and fisheries in general, proceed along sound lines. Tonga appears to possess many favourable features for giant clam mariculture. The country's many constituent and widely scattered islands support extensive reef and lagoon areas; the necessary legislative and tenurial framework is in place; while public awareness on the potential of clams as a major industry seems to be growing (Tonga's 'giant clam circle' project has contributed in this respect). The Ha'apai Group, with its large reef areas and generally favourable social environment, appears to be particularly well-placed to support a major clam project. For purposes of establishing a commercial clam project, including one with foreign participation, the collaboration of local groups seems to be a vital prerequisite. The involvement of local villagers can be particularly valuable for the policing of project sites to prevent poaching. Collaboration with other local groups also seems necessary, for example, the Fishermen's Association and local government officials.

Glazebrook, J. S., & Van-Woesik, R. (1992). Effects of low salinity on the tissues of hard corals *Acropora* spp. *Pocillopora* spp. and *Seriatothoa* sp from the Great Keppel region. Workshop on the Impacts of Flooding, Rockhampton, Qld (Australia), 27 Sep 1991 Townsville, Qld (Australia): Great Barrier Reef Marine Park Auth. Notes: Summary only

Abstract: The shallow coral reefs on the leeward edge of the Keppel Islands were substantially damaged by the effects of discharges from the flooded Fitzroy River, Central Queensland, in early 1991. Approximately 85 percent of the coral was dead and overgrown by turf algae two weeks after the flood event. Reefs to windward have only narrow reef flats and were only marginally affected. Mortality was most extensive to acroporids and pocilliporids. The species most vulnerable to low salinities (*Acropora*) dominate the reef assemblages. Ten coral fragments were collected from sites considered to be marginally affected. The microscopic appearance of the soft tissues examined suggested an acute toxic syndrome. Histopathological changes included hypertrophy, hyperplasia and lysis of the epidermis as well as degenerative changes in the gastrodermis which sometimes extended to necrosis. Bacterial emboli were present in the sub-epidermis.

Glynn, R. W., & Colgan, M. W. (1992). Sporadic disturbances in fluctuating coral reef environments: El Nino and coral reef development in the Eastern Pacific. *In: American*

Zoologist, (32), 707-718.

Great Barrier Reef Marine Park Authority. (1992). Annual report 1991-1992. *In: Annu. Rep. Great Barrier Reef Mar. Park Auth*, 146.

Abstract: The 16th Annual Report of the Great Barrier Reef Marine Park Authority for the year ended 30 June 1992 is presented under the following main headings: Great Barrier Reef Marine Park Authority; Great Barrier Reef Ministerial Council; Great Barrier Reef Consultative Committee; Twenty-five year strategic plan; Planning and management; Research and monitoring; Education and information; Aquarium; Administration; Canberra Office; and, External services.

Keane, M. (1992). Assessment of the 1991 Fitzroy River flood. How much water? Workshop on the Impacts of Flooding, Rockhampton, Qld (Australia), 27 Sep 1991 Townsville, Qld (Australia): Great Barrier Reef Marine Park Auth. Notes: map, 14 graphs

Abstract: Records of flow volumes recorded at selected stations along the Fitzroy River during the floods of January 1991 are summarised and discussed, and some comparisons made with earlier floods in the region. The use of such records in water resources management is summarised.

Kelleher, G., & Kenchington, R. A. (1992). Guidelines for establishing marine protected areas. (pp. vii, 79 ; 30 cm., Includes bibliographical references (77-78)). Gland, Switzerland: IUCN; Great Barrier Reef Marine Park Authority.

Kelly, G. C. (1992). Public participation and perceived relevance as critical factors in marine park management. Proceedings of the 7th International Coral Reef Symposium

Abstract: The success of management for the conservation of marine resources in a democratic country is directly related to public understanding, sympathy and support. Support for attempted management may derive from a perception of its' relevance to supporting individuals and organizations. The perceived relevance of management arrangements to certain users of marine reserves in five countries was examined. Public communication programs conducted to encourage public support were examined, and common successful components identified. Compliance with regulations as an indicator of public support for management constraints, was compared. Cultural differences in acceptance of the need for a particular style of management should be incorporated into public communication programs

McGinnity, P. (1992). Zoning: the Great Barrier Reef Marine Park. *In: Reeflections*, 27, 5-13.

Abstract: The Great Barrier Reef Marine Park, covering an area of 344 000 km², is the world's largest marine park and second largest protected area. It was inscribed on the World Heritage List in 1981 and declared a Particularly Sensitive Area in 1990. Impacts on and use of the region have changed in recent years. With greatly increased activity along the coastline, both terrestrial and marine, significant increases in commercial and recreational fishing and a current boom in tourism, it is important to ensure that impacts are not excessive or irrevocably damaging to the area's massive expanse of coral reefs, and unique and, in some cases, endangered, wildlife. To this end, a system of zoning has been introduced whereby the marine park is divided up into sections according to the levels of use that are allowed. In this way a balance can be achieved between conservation and human exploitation, and cultural and heritage values can be maintained.

Mcmanus, J. et al. (1992). Resource ecology of the Bolinao coral reef system. (p. 117). Manila, [Philippines]: International Cent. for Living Aquatic Resources Management.

O'-Neill, J. P., Byron, G. T., & Wright, S. C. (1992). Some physical characteristics and movement of the 1991 Fitzroy River flood plume. Workshop on the Impacts of Flooding, Rockhampton, Qld (Australia), 27 Sep 1991 Townsville, Qld (Australia): Great Barrier Reef Marine Park Auth.

Notes : illus., maps, graphs, 6 ref.

Abstract: During January 1991, the Keppel Bay area of central Queensland was inundated with fresh water from the third largest Fitzroy River flood ever recorded. Cyclone Joy had dropped prodigious amounts of fresh water in the Fitzroy River catchment and some 18.5 million megalitres of runoff emptied into Keppel Bay over about 25 days. The subsequent path of travel of the fresh water plume was plotted, and the predominant winds and tidal conditions at the time were found to strongly influence its shape and direction of movement. Salinity levels were found to drop below 10 ppt near the water surface over a wide area of the Bay; however most of the area of the plume retained a salt water lens beneath. The Keppel Islands were subjected to these low salinity conditions for about 15 days, and evidence suggests that such influxes of fresh water occur on a semi-regular basis linked to the periodicity of cyclone events.

Preker, M. (1992). The effects of the 1991 Central Queensland floodwaters around Heron Island, Great Barrier Reef. Workshop on the Impacts of Flooding, Rockhampton, Qld (Australia), 27 Sep 1991 Townsville, Qld (Australia): Great Barrier Reef Marine Park Auth.

Notes: Summary only

Abstract: Twelve oceanographic stations around four reefs of the Capricornia Group, Great Barrier Reef, were sampled in late January 1991 to monitor the effects of the Central Queensland floodwater discharge. Salinity, and levels of inorganic forms of nitrogen and phosphorus, and silicon, were measured. Compared to long-term data, salinities remained significantly low until mid-February. Two stations affected by low salinities were surveyed for signs of biota stress.

Roberts, C., & Polunin, N. (1992). Effects of marine reserve protection on northern Red Sea fish populations. Proceedings of the 7th International Coral Reef Symposium

Abstract: This study investigated the effects of establishment of the Ras Mohammed Marine Park on fish population structure. The park has been protected from most forms of fishing for 15 years. Cessation of fishing is expected to result in increases in abundance and average size of target species and may also lead to shifts in species composition. To determine if such effects were evident, populations of nine commercially fished families and pelagic piscivores were censused using point counts at 15 m depth. Effects of protection were determined by comparison of similar sites from three fishing levels: 1) none (Ras Mohammed), 2) little-fished, and 3) fished. Abundance of ~ of 45 species differed significantly among fishing levels. At the family level, surgeonfishes were more common on fished reef. Seven species increased in size with decreasing fishing intensity. Biomass of 32 14 species differed significantly among fishing levels, with higher biomass at protected sites for five species. At the family level, there were significant differences for parrotfishes and surgeonfishes, with the former greatest on little-fished reef and the latter on fished. Total biomass of all species combined did not differ significantly among fishing levels, although mean biomass was 1.2 times greater on protected reefs. These results provide some support for the view that marine reserve establishment has been effective in protecting stocks. However, fishing levels in the northern Red Sea are low and use of marine reserves to manage fisheries may prove most effective in regions where fishing intensities are high or use of damaging fishing methods widespread.

Robertson, J., & Mapstone, B. (1992). Research into the effects of fishing in the GBR [Great Barrier Reef] region. *In: Newsl. Aust. Soc. Fish Biol.*, 22(2), 50-51. Notes: Summary only.

Abstract: A formal program of research designed to address concerns by user groups,

managers and scientists over the effects of fishing on the Great Barrier Reef is being coordinated by the Great Barrier Reef Marine Park Authority. The general objectives of the programme are to evaluate the direct and indirect effects on reef and associated benthic communities of recreational and commercial line fishing, commercial prawn trawling in inter-reef areas and in the GBR lagoon inshore of the mid shelf reef complex, and the interaction between the two fisheries. The "Effects of Fishing" programme research commenced in the 1991/92 financial year with two main components: A joint research project by CSIRO and QDPI to assess the environmental effects of prawn trawling in the Far Northern Section of the Great Barrier Reef Marine Park; and a large scale experimental design developed to assess the effects of line and inter-reef trawling on reef and inter-reef communities within special 'Fisheries Experimental Areas' incorporated into the rezoning of the Cairns and Central sections of the marine park. The research is expected to run for 5 to 10 years.

Russ, G., Alcala, A. C., & Cabanban, A. S. (1992). Marine reserves and fisheries management on coral reefs with preliminary modeling of the effects on yield per recruit. Proceedings of the 7th International Coral Reef Symposium (pp. 978-985).

Abstract: The potential advantages and disadvantages of the use of long-term spatial closures to fishing in the management of coral reef fisheries are reviewed briefly. The effects of marine reserves on fisheries yield will depend upon the nature and extent of interchange of fish between fished and protected areas. Preliminary modeling of the effects of fluxes of post-settlement fishes across the boundaries of a reserve at Sumilon Island, central Philippines, on yield per recruit of the caesonid *Pterocaesio pisang* suggests that reserves may enhance yield per recruit by this mechanism only at high levels of fishing mortality. Under high fishing mortality reserves act as growth refuges. Detailed research on patterns of reef fish growth, mortality, and adult movement will have to be carried out before any marine reserve can be designed which will allow an explicit prediction of its effect on local reef fishery yield. The more substantial and longer term benefits of marine reserves are likely to be their potential for maintenance or enhancement of fisheries yield to broad regional areas by larval dispersal. Given the critical levels of over exploitation of many coral reefs, marine reserves may be the only viable option available to maintain levels of spawning stock biomass necessary to sustain reef fisheries.

Sweeney, L. (1992). Central America Nations Guard Biodiversity. *In: Underwater*, 8(10), 23.

Abstract: Endangered green sea turtles and other Caribbean wildlife will be better protected, since an important conservation decree was signed in Central America in the fall of 1991, defining Nicaragua's Miskito Cays Marine Reserve. Another important decree, to expand Costa Rica's Tortuguero National Park, is expected to be signed in early 1992. The Miskito reserve will encompass over 5,000 sq. mi. of reefs, sea grass beds, and coral islands in an area off the northeast coast of Nicaragua. The area is home to endangered sea turtles, manatees, and other rare species, along with productive shrimp and lobster fisheries. A multiagency commission will oversee an emergency plan to curb resource piracy by foreign fishing fleets, and provide a permanent resource conservation plan for the area. Representatives of the Miskito communities, which depend on the natural resources for their livelihoods, are included in the commission. The fisheries will be managed in order to support the native Miskito lifestyle, but the area will still be preserved in its natural state. While the grassbeds and reefs of the Miskito Cays are one of the world's most important foraging grounds for endangered green sea turtles (*Chelonia mydas*), many of these same turtles migrate 300 mi. south to a single nesting beach along the northeast coast of Costa Rica. Tortuguero National Park shelters one of the most significant green turtle nesting beaches in the world. Expansion of the park, which is in a region that is increasingly affected by tourism and deforestation, is being supported by the non-profit Caribbean Conservation Corporation with funding from the U. S. Agency for International

Development. When legal technicalities are completed, the first phase of the expansion will be to double the size of the park to nearly 40,000 hectares, encompassing a 9,000 hectare corridor connecting it with the Barra del Colorado National Wildlife Refuge to the north. The remainder of the sea turtle nesting beach, Tortuguero Mountain, and a strip of land along the San Juan River on the border of Nicaragua will be included. The second phase will include additional land bordering the park, and eventually a buffer zone will also be added to protect the park. The resulting preserve will shelter 80,000 hectares of intact lowland rain forests, mountains, estuaries, and beaches from timbering and development

Alder, J. (1993). Permits, an evolving tool for the day-to-day management of the Cairns Section of the Great Barrier Reef Marine Park. *In: Coastal Management*, 21(1), 25-36.

Abstract: The coastal zone is a dynamic system in which the nature of activities, levels of use, and spatial distribution of activities are in a constant state of flux. Managers are able to confront this dynamism by continually developing new roles for permits. In the Cairns Section of the Great Barrier Reef Marine Park, staff responsible for the assessment and issuance of permits have gradually developed a permit system that meets the particular needs of this park. Initially used to meet legislative responsibilities and control use, permits now play a critical role in day-to-day resource management, policy and management plan implementation, data collection, and public liaison. Managers have recognized the value of the permit system as its role changed with changing uses, and levels of use in the marine park. Users of the park have also come to realize that permits are to their benefit by: protecting their resources, providing a venue to discuss problems regarding their operations or other users, and resolving conflict

Ayukai, T. (1993). Resource availability to the larvae of the crown of thorns starfish in Great Barrier Reef waters - an overview. Workshop on the Possible Causes and Consequences of Outbreaks of the Crown of Thorns Starfish, Townsville, Qld. (Australia), 10 Jun 1992 Townsville, Qld. (Australia): Great Barrier Reef Marine Park Authority. Notes: 4 tables, 59 ref.

Abstract: Whether or not resource limitation is important in crown-of-thorns starfish (COTS), *Acanthaster planci*, larvae has been controversial. It has been suggested that the concentration of phytoplankton in Great Barrier Reef (GBR) waters is usually too low for COTS larvae to achieve normal growth and development. However, in situ rearing has shown no evidence of starvation in common GBR conditions. The key to reconciling these results would be the determination of the extent to which COTS larvae derive nutrition from other sources, such as dissolved organic matter or microbial biomass. The present study indicates that free-living bacteria are too small to be utilised. COTS larvae were however able to take up dissolved free amino acids. A carbon budget model suggests that even taking into account the contribution of amino acids, COTS larvae would often starve in GBR waters

Babcock, R. C., & Mundy, C. N. (1993). Seasonal changes in fertility and fecundity in *Acanthaster planci*. Workshop on the Possible Causes and Consequences of Outbreaks of the Crown of Thorns Starfish, Townsville, Qld. (Australia), 10 Jun 1992 Townsville, Qld. (Australia): Great Barrier Reef Marine Park Authority. Notes: 3 graphs, 12 ref.

Abstract: Changes in fecundity, measured as gonad index, and fertility, measured as fertilisation rate, were monitored over the recorded spawning season of *Acanthaster planci* at Davies Reef on the central Great Barrier Reef (GBR) from 1990 to 1992. This starfish has been observed spawning on the field from December to January in the GBR, most observations being in January. In contrast both gonad index and fertility peak early in the season, declining to low levels by late January. These observations indicate that the majority of successful reproductive events will take place early in the spawning season, before the end of the monsoonal wet season. The time of spawning may need to be considered in evaluating the importance of terrestrial runoff as a possible causal factor in outbreaks on the GBR

Barker, B. (1993). Early human exploitation of island environments within the Great Barrier Reef Marine Park. *In: Reef Research*, 3(3), 13-14.

Abstract: A brief discussion is presented on archaeological evidence of early human exploitation of coastal and island environments within the Great Barrier Reef Marine Park, considering in particular findings from the Whitsunday Islands. The relatively small population meant that resource levels were maintained and detrimental impacts to the environment were kept to a minimum. There is no evidence of overexploitation of resources which would have resulted in a change in size of shellfish, crustacean or fish biota through time

Barley, G. (1993). Integrated coastal management. The Florida Keys example from an activist citizen's point of view. *In: Oceanus*, 36(3), 15-18.

Abstract: The Florida Keys, a series of islands connected to each other and the mainland by bridges and a freshwater line, were developed haphazardly. For example, 30,000 septic tanks and cesspits, along with uncontrolled, untreated storm-water runoff, constitute an unmonitored, potentially serious inshore pollution problem. On the Atlantic side, a magnificent coral reef system exhibits serious symptoms of stress, while on the Gulf of Mexico side the Florida Bay ecosystem is in collapse. The multitude of authorities with jurisdiction in the keys include two federal fishery management councils, National Marine Sanctuary and Monroe County officials, several state agencies, and federal fish and wildlife and state undersea park management agencies. Fishery pressure from large recreational and commercial groups is increasing. Jet skiers, divers, fishermen, ocean freighter operators, treasure salvors, and boaters all exert pressure on Florida Keys marine resources. Following Congress's 1990 designation of the Florida Keys National Marine Sanctuary, the National Oceanic and Atmospheric Administration (NOAA) brought representatives of user groups and the public together with federal and state agency officials to assemble an integrated coastal management plan. How has it worked, and what has been learned from the process?

Black, K., Moran, P., & Burrage, D. (1993). Are the hydrodynamics guilty of causing or stimulating outbreaks of crown-of-thorns starfish on the Great Barrier Reef? Workshop on the Possible Causes and Consequences of Outbreaks of the Crown of Thorns Starfish, Townsville, Qld. (Australia), 10 Jun 1992 Townsville, Qld. (Australia): Great Barrier Reef Marine Park Authority. Notes: 31 ref.

Abstract: Evidence suggests that hydrodynamics are certainly implicated and may play a significant role in determining the evolution of outbreaks of *Acanthaster planci* (COTS) in the Great Barrier Reef (GBR). The pattern seems to be an initial outbreak seeding nearby reefs that give rise to subsequent outbreaks two to four years later. The excursion of the dispersing larvae is determined by (a) the current strength during the pelagic phase, (b) the interaction of the continental shelf coastal currents with the reef-scale circulation, and (c) the location along and across the shelf of the source of larvae. A 25-year time series of predicted currents in the central GBR confirms that the observed distribution and migration of COTS outbreaks may be simply a response to inter-reef larval exchange, carried by a reversing low frequency current from a reef saturated with spawning adults. There may yet prove to be correlations with larger ocean-scale cycles, even El Niño events.

Bombace, G., Fabi, G., & Fiorentini, L. (1993). Aspects théoriques et résultats concernant les récifs artificiels réalisés en Adriatique. *In: Boll. Oceanol. Teor. Appl.*, 11(3/4), 145-154.

Abstract: Artificial reefs are able to produce bio-ecological mechanisms for increasing fishery production. It is known that mortality reduction during the pre-recruitment phase, greater food availability and protection of adults favor the restocking processes and the increase of fishery and mobile biomass. The ecological mechanism of the artificial structures mainly consists of an increase of biological diversity through the development of spatial heterogeneity (gradient of

height, different structure orientation, diversified hole shape). In eutrophic areas the colonization of new artificial surfaces by larval biomass of sessile organisms especially bivalves also allows the recycling of coastal biochemical energy producing chemical effects, fishery increase and economic effects. The shelter effect for species which require protection has to be considered. All these aspects concern complex artificial reefs that may be called as 'intensive-multipurpose' reefs. 'Extensive' artificial reefs also exist; they are made of simple obstacles deployed on the sea bottom for preventing illegal trawling inside coastal areas forbidden to trawlers. In this case too, the protection effect produces an increase of demersal biomass, where the marine protected area is very large. Finally a combination of intensive and extensive artificial reefs may exist. Five multipurpose artificial reefs of identical design, but of different size, were constructed along the Italian Adriatic coast between 1987 and 1988, at depths ranging from 10 to 14 meters. Four reefs (Porto Garibaldi, Rimini, Cattolica, Senigallia) were deployed on sandy-muddy bottom far from natural hard substrates, while the fifth was placed in a bay surrounded by rocky shores (Portonovo). The reefs were formed of cubic concrete blocks (2 x 2 x 2 m) arranged in pyramids. Concrete cages (4 x 6 x 5 m) for shellfish culture were placed among the pyramids. Underwater observations and samplings showed rapid colonization of the concrete substrates at all locations. The sessile community was dominated by filter-feeders, mainly represented by mussels (*Mytilus galloprovincialis*) and oysters (*Ostrea edulis* and *Crassostrea sagas*). At all sites, fishing surveys with a standard trammel net were started one year before reef deployment and continued to be conducted for a few years after. The aim was to compare the effectiveness of the reefs in the different areas in terms of fishing yield and their impact on the fish assemblage of the original habitat. The fishing data obtained from one of these artificial reefs (Senigallia) were also compared with those reported from an unprotected control site. The scientific results obtained from the overall research can be summarized as follows: 1) The effects of artificial reefs are more evident at sites far from natural hard substrates; 2) Species richness, species diversity as well as fish abundance increase after reef deployment; 3) Higher catch rates are reported from the artificial reefs in comparison with unprotected areas (Senigallia zone); 4) The fish assemblage at the artificial reefs is affected by seasonal fluctuations as well as in the all coastal area; 5) Eventual collapses of reef-dwelling species stocks seem to be mitigated inside the artificial reefs in comparison with unprotected areas; 6) In eutrophic waters the new biomass of bivalve molluscs (e. g. mussels and oysters) settled on the artificial structures finds suitable conditions for developing and creates mariculture opportunities.

Bone, D., Losada, F., & Weil, E. (1993). Origen y efectos de la sedimentación sobre las comunidades coralinas del Parque Nacional Morrocoy, Venezuela. *In: Ectopicos*, 6(1), 10-21. **Abstract:** Before 1974, the coral communities of the National Park of Morrocoy, NW of Venezuela, were subjected to several man-made disturbances brought about by an uncontrolled increase in tourism and related activities. In May, 1974, the area was decreed National Park by the government. Despite all the protective measures, the damage suffered by some reefs has increased since then. To quantify this situation several structural parameters of four reefs with healthy and damaged communities were compared. A damage index was calculated, which measured the proportion of coral mortality in all reefs. From all parameters, the damage index was the most sensitive to the deterioration of the reefs. Sedimentological and mineralogical parameters from sediments samples of different reefs together with the analysis of Landsat satellite images, suggested that the extent and degree of the present damage in the northern reefs were mainly due to high sedimentation inputs resulting from erosion of land outside the boundaries of the Park (DBO).

Bull, D., & Bull, A. S. (1993). Salt Dome Sanctuary. *In: Sea Frontiers*, 39(2), 62-69. **Abstract:** Nearly 180 million years ago, the Gulf of Mexico was part of an inland, salty sea.

The shallow sea evaporated over time, leaving salt that was buried under sediment draining off North America as the Rocky Mountains grew. From beneath that load, the salt flowed up ward, becoming isolated salt domes called diapirs; eventually the underwater dome tops became capped with limestone. Throughout the centuries, tropical reef-building creatures carried northward by currents settled atop two domes and produced highly developed communities. The builders of the northern most coral reefs on the North American continental shelf exist in a delicate balance of hydrological conditions including salinity, temperature, and clarity. In January 1992, these coral reefs became the Flower Garden Banks National Marine Sanctuary. The area of both the East Bank and the West Bank that lies at a depth less than 118 ft. is named the Diploria-Montastrea-Porites zone. Eighteen species of reef-building corals flourish in this shallow area, and living corals occupy nearly 50% of the hard bottom. Commercial and sport fishes found in the zone include barracuda, crevalle jack, amberjack, dolphin, and groupers. Manta rays range over shallow areas of the Flower Garden Banks year-round. Winter migrants to the area include schools of adult hammerhead, tiger, blacktip, and other pelagic sharks. Many sharks species migrate in large schools during their search for food, and they may use large geographic formations such as the Flower Garden Banks as landmarks during migration. Yellow pencil corals almost entirely dominate the Madracis zone, which lies at depths ranging between 90 and 150 ft. In the deeper Stephanocoenia-Millepora zone (132 to 170 ft.), 12 known hermatypic coral species form heads and crusts. Between depths of about 150-280 ft., crustose coralline algae and encrusting sponges dominate reef-building and form large areas of rhodoliths (algal nodules), reef patches, and crust pavements. Below 300 ft. insufficient light prevents reef-building. Brineseeps have recently been discovered at the Flower Garden Banks. Organisms living within the brine complex represent a shallow-water version of deep-sea vent communities. These organisms use sulfide or methane as an energy source without need for oxygen. Numerous worms feed on these organisms; further down, benthic crustaceans and similar organisms, which are less tolerant of sulfide but capable of using the bacteria as food, gradually replace the worm community. The biologically productive reef communities that cap the Flower Garden Banks offer an esthetic appeal and recreational and research opportunities that few other oceanic areas can match. Now, national sanctuary offers the protection the communities need against activities that might otherwise threaten their existence

Buxton, C. D. (1993). The distribution and abundance of the littoral ichthyofauna in the Tsitsikamma National Park. Fish, Fishers And Fisheries. Proceedings Of The Second South African Marine Linefish Symposium Held In Durban 23-24 October 1992 (p. 45-51). Durban South Africa: Oceanographic Research Institute

Abstract: In this paper I will summarise the ichthyological component of an ongoing macrobenthic survey of the reef biota of the Tsitsikamma National Park (34 degree S, 24 degree E) and adjacent areas. This sort of study is fundamental to the fabric of the reserve because it forms both an inventory of the species occurring in the area and the basis on which conservation decisions can be made. The work is of interest to the linefish community because it impinges on the understanding of how a marine reserve functions in the protection of linefish species. In this respect we have been slow to follow the terrestrial example, where species conservation has been replaced by ecosystem conservation.

Buxton, C. D. (1993). Life-history changes in exploited reef fishes on the east coast of South Africa. *In: Environmental Biology of Fishes*, 36(1), 47-63.

Abstract: The impact of exploitation on various life-history characteristics of 2 sex changing, reef-dwelling sparid species was examined by comparing populations protected in a large marine reserve with those adjacent to the reserve. Like other sparids, *Chrysoblephus laticeps* and *C. cristiceps* grow slowly and are long lived, reaching ages of 17 and 21 years, respectively. No significant differences in the growth rate of *C. laticeps* were measured, but

growth in *C. cristiceps* was significantly slower in the exploited population. Observed data showed that sex ratios outside the marine reserve were skewed towards the females, a result of size selective exploitation. Size at sex change was also significantly smaller for *C. cristiceps* in the exploited area, but not so for *C. laticeps*. This difference between the species was explained as a function of the size at recruitment into the fishery and the degree of protection afforded both large females and male fish. Considering the possibility that reproduction could be impaired as a result of changes in population structure, the tactic of protection through marine reserves is supported as a hedge against recruitment failure

Buxton, C. D. (1993). Marine reserves the way ahead. Fish, Fishers And Fisheries. Proceedings Of The Second South African Marine Linefish Symposium Held In Durban 23-24 October 1992 (p. 2). Durban South Africa: Oceanographic Research Institute

Abstract: The establishment of marine reserves has been advocated as a viable alternative to the classical fisheries management techniques, or at least as an important addition tool in the management of reef fishes. Reasons for this include (a) protection of the spawner stock, (b) providing a recruitment source for surrounding areas, (c) restocking of adjacent areas through adult emigration, (d) maintenance of natural population age structure, (e) conservation of biodiversity, undisturbed habitat and natural life support processes, (f) insurance against failure of other management techniques and (g) simplified enforcement, amongst other incidental advantages. Such perceived benefits have been the explicit, but more often implicit motivation behind the establishment of many marine reserves throughout the world. Yet, despite the explosion of these areas we have been slow to quantify their benefits. When compared to terrestrial equivalents two important differences emerge. Firstly, offspring in terrestrial environments are held in the natal area whereas in the marine environment populations are open and pelagic dispersal phases may carry eggs and larvae far from their parents. Secondly, areas adjacent to marine reserves should benefit from the emigration of adults from the reserve. Until very recently predictions about both dispersal and emigration benefits remained untested. In South Africa considerable research has been aimed at assessing the benefits of the marine reserve option for the management of reef fish species. I will attempt to summarise this research and highlight areas of potential research.

Calumpong, H. P., & Solis Duran, E. (1993). Constraints in restocking Philippine reefs with giant clams. Biology And Mariculture Of Giant Clams (pp. 94-98). Canberra, A.C.T. (Australia): Australian Centre For International Agricultural Research.

Caribbean Fisheries Management Council. (1993). Amendment 2 to the fishery management plan for the shallow-water reef fish fishery of Puerto Rico and the US. Virgin Islands. Washington, D.C.: U.S. Department of Commerce.

Abstract: Amendment 2 would 1) expand the management unit to incorporate the most important species of the deepwater reef fish fishery and fin fish species taken in the marine aquarium trade; 2) add measures to reverse the decline of certain reef fish species; 3) restrict harvest and gear for various species in need of protection; 4) close spawning aggregation areas to conserve red hind and mutton snapper.

Carr, M. H., & Reed, D. (1993). Conceptual issues relevant to marine harvest refuges: examples from temperate reef fishes. *In: Canadian Journal of Fisheries and Aquatic Sciences*, (50), 2019-2028.

Cava, F. M., Robinson, J., & Earle, S. A. (1993). Should the Arabian (Persian) Gulf become a marine sanctuary? *In: Oceanus*, 36(3), 53-62.

Abstract: Against the background of a growing awareness of the relationships among human

health, a sound economy, and a healthy environment, attention worldwide has been drawn to the devastating assault on the Arabian (Persian) Gulf regional environment-its air, land, water, and biota-by the war waged against Kuwait by Iraq in 1990 and 1991. Among the horrors of the war was the injury caused to the region's natural resources from the torching of Kuwait's oil fields, the fallout of thousands of tons of oil and soot, and the deliberate dumping of an estimated 11 to 12 million barrels of oil into the Gulf from several tankers and loading facilities off the coast of Kuwait. These massive oil spills destroyed whole ecosystems that had developed and prospered over many millennia along the Saudi Arabian coast. In recent decades, other actions adverse to the environment have taken their toll. Overfishing is thought to have reduced localized populations of shrimp and many commercial fish species. Wetlands have been destroyed by coastal development, and siltation from seafloor disturbances has smothered important coral-reef and seagrass communities.

Chater, S. A. et al. (1993). Fishes from offshore reefs in the St. Lucia and Maputaland Marine Reserves, South Africa. *In: Lammergeyer*, 42, 1-17.

Abstract: Information obtained during research cruises carried out in St. Lucia and Maputaland Marine Reserves in South Africa during the period August 1987 - October 1990 concerning the diversity of the fish in offshore reefs is presented. Diving and angling activities recorded a total of 25 elasmobranch and 374 teleost species. The family Labridae was the most species-rich group with 45 species recorded during the study period.

Colwell, R. R. (1993). Biodegradation of oil in the open ocean. Workshop on the Use of Bioremediation for Oil Spill Response in the Great Barrier Reef Region, Townsville, Qld (Australia), 25 Feb 1991 Townsville, Qld (Australia): Great Barrier Reef Marine Park Auth.

Abstract: The American Society for Microbiology convened a panel of experts to respond to a request from the Environment Protection Authority for advice on the current state of the science of biodegradation of oil in the open ocean. Some of the major points in the response were as follows. Microbial degradation of petroleum is a natural process that can be enhanced. Addition of microorganisms to the open ocean should not cause significant adverse environmental effects. Bacterial emulsification of oil does not have the disadvantage of toxicity that attends the use of chemical dispersants. However, methods for the effective application of materials of any kind in the open ocean, given the often turbulent conditions, are not often tested, and there is little direct evidence for the effectiveness of bioremediation under such conditions. Even in the most favourable situations, enhanced biodegradation of complex hydrocarbons takes weeks to months. Hence the potential for bioremediation at sea is virtually unknown, is probably limited, and at best will be a long-term expedient.

Craik, W. (1993). Bioremediation in the Great Barrier Reef Marine Park. Workshop on the Use of Bioremediation for Oil Spill Response in the Great Barrier Reef Region, Townsville, Qld (Australia), 25 Feb 1991 Townsville, Qld (Australia): Great Barrier Reef Marine Park Auth. *Workshop Series Great Barrier Reef Marine Park Authority:*

Abstract: Some 2000 vessels travel through the Great Barrier Reef region each year, of which 200 are tankers. Since 1970 there have been about 175 recorded 'incidents' including collisions and groundings amongst others. The Great Barrier Reef Marine Park Authority has had a policy plan since the early 1980s to provide guidance for pollution responses and for intergovernmental cooperation in the response. The major difficulties in coping with a serious pollution incident include the distance of reefs and islands from the shore, the inhospitable weather for much of the year, and the remoteness from population centres of most of the Park. Bioremediation involves the application of bacteria and fertilisers to stimulate bacterial production. Apart from questions of its effectiveness in tropical waters, there are others about the need to introduce new organisms to the biota, and to add nutrients when there is already

concern about potential eutrophication.

Debernardi, E., & Allemand, D. (1993). Zones protegees sur le littoral de la Principaute de Monaco. *In: Boll. Oceanol. Teor. Appl.*, 11(3/4), 173-182.

Abstract: After a short geographic and juridical presentation of the 2 underwater reserves along the coast of the Principality of Monaco, this paper reviews their development as well as the results obtained. It describes the different types of artificial reefs immersed and their effect on the fauna. Particular attention is given to artificial reefs specially designed for rearing and breeding the Mediterranean red coral.

DeMartini, E. (1993). Modeling the potential of fishery reserves for managing Pacific coral reef fishes. *In: Fishery Bulletin*, (91), 414-427.

Abstract: The potential use of marine fishery reserves (MFRs) for managing fisheries on tropical Pacific coral reefs was assessed using the Beverton-Holt model. The effects of year-round fishery closures on harvests in adjacent 1.14 exploited areas were evaluated. Potential changes in spawning stock biomass per recruit (SSB/R) and yield per recruit \sim /R) were estimated from published data, approximated natural and fishery mortality rates, size- and maturity-at-age distributions, and transfer (emigration and immigration) rates. For select cases, fundamental transfer rates were adjusted for possible density dependent emigration from closed areas as relative densities decreased in surrounding nonclosed areas because of continued fishing. Three hypothetical "fish types" were constructed, bracketing the likely extremes in fundamental transfer rates - and related life-history parameters of Pacific coral reef fishes: a small-bodied, fast-growing and short-lived, strongly philopatric species of damselfish was contrasted with a large-bodied, relatively slow-growing, long-lived, vagile species of jack. A "surgeonfish" type was used to represent intermediate parameter values. Simulations corroborate previous observations that MFRs contribute little, if anything, towards increasing Y/R. Results for highly vagile jack confirm that rapid transfer rates will negate potential gains in SSB/R resulting from closures. At the opposite extreme, small reef philopatriots like damselfishes would almost never be harvested, because of negligible transfer rates, unless the MFR was periodically opened to fishing. The simulations suggest that the SSB/R of surgeonfish type is the most likely to benefit from MFRs, because moderate vagility allows biomass to accumulate within the closure despite harvesting in the nonclosed area. Results further suggest that growth rate, fishing effort in the nonclosed (open) area, natural mortality, maturity, and harvesting schedules influence the potential of MFRs to augment SSB when transfer rates are low to moderate.

Dixon, J. A. (1993). Economic benefits of marine protected areas. *In: Oceanus*, 36(3), 35-40.

Abstract: Marine protected areas contain valuable economic resources important to local and national economies. Careful management can allow both protection of biodiversity and economic development. Indeed, it is obvious that, rather than selecting the extremes of strict preservation or unmanaged development, balanced use of these resources for both economic and ecological functions is central to their sustainable management. Economic benefits of marine protected areas (MPAs) include job creation through harvest of renewable and nonrenewable resources such as fish and shells, and through use of MPAs for nonconsumptive activities such as tourism and recreation. Some MPA benefits are difficult to express in monetary terms; examples include the economic value of biological resources and "environmental services" such as wavebuffering by healthy reefs. Other benefits are easier to calculate in dollar terms: a prime example is the direct financial benefit to local economies from recreational and other activities centered on MPAs.

Dugan, J. E., & Davis, G. E. (1993). Applications of marine refugia to coastal fisheries

management. In: Canadian Journal of Fisheries and Aquatic Sciences, 50(9), 2029-2042.

Abstract: Marine fisheries refugia, unaltered areas that serve as sources of replenishment, can potentially compensate for recruitment and ecosystem overfishing and enhance fishery yields for some coastal stocks. The efficacy of refugia in fisheries management is virtually untested, despite the existence of many marine parks and reserves. Evidence from existing marine reserves indicates that increased abundance, individual size, reproductive output, and species diversity occurred in a variety of marine species in refuges of various sizes, shapes, and histories in communities ranging from coral reefs to temperate kelp forests. Fishery yield enhancement in areas surrounding refuges occurred in the few studies where yields were examined. Fishery refugia design should consider species life histories, oceanographic regimes, habitat quality, and socioeconomic factors

Dugan, J. E., & Davis, G. E. (1993). Introduction to the International Symposium on Marine Harvest Refugia. International Symposium On Marine Harvest Refugia, San Antonio, TX (USA), 12 Sep 1991

Abstract: On September 12, 1991, at the 121st annual meeting of the American Fisheries Society, more than 150 fisheries scientists, ecologists, and resource managers shared experiences and forged a link between fishery management and marine protected areas. Thirteen formal presentations on marine reserves and fishery refugia catalyzed a lengthy and far ranging discussion of the potential of refugia as fishery management tools, the strengths and limitations of refugia based management, existing evidence of refugia efficacy, the need for further testing, and design considerations for fishery refugia. The presentations represented a wide variety of ecological and socioeconomic systems, ranging from tropical coral reef in Western Australia, Florida, Bermuda, and the Cayman Islands, through temperate reef systems in California, New Zealand, and South Australia, to arctic systems in the Bering Sea; crustacean and molluscan fisheries were examined as well as those for temperate and tropical reef finfishes.

Edgehill, R. (1993). Bioremediation - the biological, physical and chemical bases. Workshop on the Use of Bioremediation for Oil Spill Response in the Great Barrier Reef Region, Townsville, Qld (Australia), 25 Feb 1991 Townsville, Qld (Australia): Great Barrier Reef Marine Park Auth.

Abstract: Bioremediation is the addition of microorganisms, or the stimulation of indigenous organisms, to a polluted system with the aim of breaking down the pollutant to relatively acceptable substances. For this to be as effective as possible, what is needed is an effective organism in close contact with a susceptible pollutant, in the presence of sufficient oxygen and nutrient, at a suitable temperature. Other factors may be a tendency of the pollutant to bind to particulate matter, and the presence of predators and parasites of the effective organism.

Gladstone, W. (1993). The history of crown-of-thorns starfish controls on the Great Barrier Reef and an assessment of future needs for controls. Workshop on the Possible Causes and Consequences of Outbreaks of the Crown of Thorns Starfish, Townsville, Qld. (Australia), 10 Jun 1992 Townsville, Qld. (Australia): Great Barrier Reef Marine Park Authority
Notes: 20 ref.

Abstract: The Great Barrier Reef Marine Park Authority is planning for the next series of outbreaks of crown-of-thorns starfish (*Acanthaster planci*) by developing a contingency plan. Part of the plan is devoted to the feasibility and desirability of primary controls aimed at preventing the southwards spread of outbreaks. The history of the Authority's policy on controls, the results of past and present controls and reasons for their success or failure are reviewed. The arguments likely to be raised for widespread controls in the event of another outbreak are discussed. The feasibility of such controls is examined in terms of costs, possible

effectiveness, side effects and alternatives

Great Barrier Reef Marine Park Authority. (1993). 1992/93 Annual report. Townsville, Qld. (Australia): Great Barrier Reef Marine Park Authority.

Abstract: The report covers activities conducted by the Great Barrier Reef Marine Park Authority during the year ending 30 June 1993. It is presented under the following main section headings: Great Barrier Reef Marine Park Authority; Great Barrier Reef Consultative Committee; Great Barrier Reef Ministerial Council; 25-year strategic plan; Corporate planning; Planning and management; Environmental impact management; Research and monitoring; Education and information; Aquarium; Administration; Caberra Office; External services; Corporate and strategic projects; and Appendixes.

Greene, L. E., & Shenker, J. M. (1993). The effects of human activity on the temporal variability of coral reef fish assemblages in the Key Largo National Marine Sanctuary. *In: Aquatic Conservation: Marine and Freshwater Ecosystems*, 3(3), 189-205.

Abstract: A visual assessment method, called Discrete Group Censusing, was used to assess and monitor five coral reef fish assemblages in the Key Largo National Marine Sanctuary, Florida, USA. Samples were obtained quarterly from Winter 1988 to Autumn 1990 to investigate a possible relation between the variability of reef fish assemblages and human disturbance. Two types of disturbance were studied: a ship grounding that occurred 4 years previous to the study, and intensive, recreational snorkel and SCUBA diving. These disturbances appeared to have no short-term effect on the temporal variability of the reef fish assemblages during the study period. Furthermore, the assemblages at all five study sites appeared to be extremely stable over the 2 year period of the study. These results support the theory that coral reef fish assemblages are highly ordered and stable over relatively large spatial scales. The Discrete Group Censusing visual assessment method was found to be a valuable and easily applied tool for the nondestructive in situ monitoring of reef fish assemblages on coral reefs.

Grip, K. (1993). Corales del Rosario National Park Colombia. Updating and revision of the existing master plan. Report to Inderena, Colombia. *In: Fish. Dev. Ser.*, (81), 30.

Abstract: The findings are presented of a consultancy conducted to review, revise and provide recommendations for the improvement of the existing Master plan of the National Marine Park "Corales del Rosario" in Colombia. Following a description of management issues covering topics related to park visits, island inhabitants, aquarium, long-term impacts of polluted coastal waters, park management, education and information, an examination is made of proposed measures concerning environmental policy and marine protected areas, institutional aspects and legal control measures, economic instruments, constructions and settlements, park supervision, research and monitoring, zoning, information and education.

Gutierrez-Carbonell, D., & Bezaury, C. J. E. (1993). Manejo del sistema arrecifal de Sian ka'an. *In: S. I. Salazar-Vallejo, & N. E. Gonzalez. Coastal And Marine Biodiversity Of Mexico. #Biodiversidad Marina Y Costera De Mexico* (pp. 772-786). [s. l.]: [s. n.].

Abstract: The limits of the marine portion in the Sian Ka'an Biosphere Reserve were reviewed. Marine boundaries excluded some coral formations, and marine core zones do not include the most important portions of the reef. We propose changes in boundaries and zoning for the marine portions of the Reserve. The proposed boundaries are modified to include all the reef system and to simplify navigation. Cayo Culebras should be eliminated as a marine core zone, since actual use makes it inoperative; some nesting sites in the core zone should be considered as a "special interest area" (frigate bird colony and Cays). Three marine core zones are suggested to protect 12.3% of the marine environment instead of the current 2.5%. Buffer zones

are subzoned into a zone for "integrated management of marine resources" and another for "integrated management of tourism" to accommodate present and foreseen uses. Finally, management guidelines for each zone are presented.

Hart, T. (1993). Long-term response of herbivorous fish to crown-of-thorns starfish outbreaks. Workshop on the Possible Causes and Consequences of Outbreaks of the Crown of Thorns Starfish, Townsville, Qld. (Australia), 10 Jun 1992 Townsville, Qld. (Australia): Great Barrier Reef Marine Park Authority. Notes: Summary only

Abstract: A comparative study is reported of three reefs in the Townsville section of the Great Barrier Reef affected by *Acanthaster planci* (COTS) predation, and three reefs not so affected. Although significant differences were found for both live coral cover and mean turf algal cover, there were no significant differences in densities, biomass, feeding rates or body condition of the fish species studied, *Scarus frenatus* and *Acanthurus nigrofuscus*. This is largely due to very distinct patterns of between-reef and cross-reef variation that is confounding the base comparison. It is concluded that the variates measured of the herbivores are not of great value when assessing the effects of COTS perturbations to the reef substrate. Others will be investigated.

Hixon, M. A., & Beets, J. (1993). Predation, prey refuges, and the structure of coral reef fish assemblages. *In: Ecological Monographs*, (63), 77-101.

Hoegh-Guldberg, O. (1993). Is *Acanthaster planci* able to utilise dissolved organic matter (DOM) to satisfy the energetic requirements of larval development? Workshop on the Possible Causes and Consequences of Outbreaks of the Crown of Thorns Starfish, Townsville, Qld. (Australia), 10 Jun 1992 Townsville, Qld. (Australia): Great Barrier Reef Marine Park Authority. Notes: 3 tables, 9 graphs, 25 ref.

Abstract: The role of two important forms of dissolved organic matter, alanine and glucose in the larval energy requirements of *Acanthaster planci*, the crown-of-thorns starfish (COTS), was examined. When compared to metabolic requirements, according to indirect calorimetry, transported glucose seems to be relatively unimportant. Data for alanine show that maximal transport rates in COTS larval bipinnaria were about 5 times greater than those for bipinnaria of similar mass cultured from related temperate starfish. The difference is far too great to be accounted for by temperature effects, and suggests that larval COTS have 3 times the number of transport sites for alanine than do its temperate relatives. Implications are discussed in relation to the nutritional biology of COTS and to preliminary data on the concentration of amino acids in the water column and boundary layers of the Great Barrier Reef.

Hoff, R. (1993). Bioremediation for oil spills -- an update. Workshop on the Use of Bioremediation for Oil Spill Response in the Great Barrier Reef Region, Townsville, Qld (Australia), 25 Feb 1991 Townsville, Qld (Australia): Great Barrier Reef Marine Park Auth.. Notes: 20 ref.

Abstract: Three main types of bioremediation technologies are currently being developed or applied in oil-spill cleanup: addition of fertiliser to oiled shorelines, addition of microbial products to oiled shorelines, and open water application of either fertiliser or microorganisms to open-water oil slicks. In each case, the effectiveness of the treatment depends on complex interactions between organisms, nutrients, and environmental factors such as temperature, salinity and oxygen supply. Decisions will continue to be made necessarily on a case-to-case basis. Open-water treatment in particular is at best an experimental technique, and cannot be recommended in practice for the moment.

Holland, K. N. et al. (1993). Movements, distribution and growth rates of the white goatfish

Mulloidides flavolineatus in a fisheries conservation zone. *In: Bulletin of Marine Science*, 52(3), 982-992.

Abstract: The movements, growth rates and distribution of a population of white goatfish *Mulloidides flavolineatus* were investigated in Kaneohe Bay, Oahu, Hawaii, using a combination of tag-and-release and sonic tracking techniques. The study site was a 137 km super(2) patch reef which has been a no-fishing conservation zone for over 30 years. The population showed high site fidelity; 93% of recaptures occurred at the release site, with times at liberty of up to 531 days. Tracking revealed crepuscular movements away from daytime schooling sites to consistent nighttime foraging groups up to 600 m away. The route taken between daytime and nighttime habitats was the same each night. Surround-net quadrats were used to measure goatfish densities on the nighttime feeding grounds. The high site fidelity and limited range of diel movements of these fish indicate that quite small harvest refugia can serve to effectively protect populations of mature adults, and that for most of the year, emigration of adults into adjacent fisheries was minimal.

Johnson, C., & Preece, A. (1993). Consequences of outbreaks -- relationships between spatial scales of outbreaks and temporal scales of recovery. Workshop on the Possible Causes and Consequences of Outbreaks of the Crown of Thorns Starfish, Townsville, Qld. (Australia), 10 Jun 1992 Townsville, Qld. (Australia): Great Barrier Reef Marine Park Authority. Notes: Summary only

Abstract: Spatial models indicate that recovery of coral cover after damage events, such as an outbreak of *Acanthaster planci*, depends on large-scale system level properties as well as biological ones. Monte Carlo studies showed that the relationship between recovery rate and the spatial extent of damage depends on the effective connectivity of the system, which affects availability of larvae for recruitment, and relative magnitudes of larval retention, coral longevity and survivorship of recent pre-damage recruits. Recovery rates may be highly dependent or largely independent of the spatial scale of damage, depending on the values of these parameters; and may vary with the intensity of damage per reef. At high reef densities coral recovery rates are sensitive to survival of recent pre-damage recruits if coral longevity is short, but the degree of self-seeding is relatively unimportant. In contrast, if the density of reefs is low, and there is no self-seeding, coral does not recover at all but either stabilises at reduced coral cover or declines, depending on its average longevity. If reef density is low and there is some larval retention, then recovery depends largely on survival of pre-damage recruits and coral longevity is less important.

Kelleher, G. (1993). A management approach to the COTS question. Workshop on the Possible Causes and Consequences of Outbreaks of the Crown of Thorns Starfish, Townsville, Qld. (Australia), 10 Jun 1992 Townsville, Qld. (Australia): Great Barrier Reef Marine Park Authority. Notes: 2 ref.

Abstract: Scientists and managers often view issues from different perspectives. Scientists as a group are traditionally curiosity-driven. Managers are usually required to focus on those aspects of matters that are vital to the solution of practical problems. From the manager's perspective, the fundamental question to be asked about the COTS (crown-of-thorns starfish, *Acanthaster planci*) phenomenon is whether or not it has been grossly affected by human activity. On the basis of the answer to that question, the manager will determine his response, particularly whether or not to interfere in the 'natural' system. The logic of this position is discussed.

Kelley, B. C., & Rhodes, S. H. (1993). Bioremediation of industrial wastes. Workshop on the Use of Bioremediation for Oil Spill Response in the Great Barrier Reef Region, Townsville, Qld (Australia), 25 Feb 1991 Townsville, Qld (Australia): Great Barrier Reef Marine Park Auth. Notes: 2 tables, 2 graphs

Abstract: Bioremediation has yet to be applied to marine oil spills in Australia, but the essential technology is being applied to a range of contaminated industrial sites. Case studies are presented covering situations from gasworks through pesticide plants to terrestrial spills of diesel fuel and lubricating oil additives. The case studies illustrate the development of the technology from the laboratory to commercial-scale operations. Its application in terrestrial situations will provide knowledge and experience as background to marine applications, and furthermore assist in gaining public assent, which will be necessary if it is ever needed in a sensitive area such as the Great Barrier Reef.

Larsen, R. M. (1993). Research into bioremediation of oil and related compounds in Australia. Workshop on the Use of Bioremediation for Oil Spill Response in the Great Barrier Reef Region, Townsville, Qld (Australia), 25 Feb 1991 Townsville, Qld (Australia): Great Barrier Reef Marine Park Auth. **Notes:** 13 ref.

Abstract: A summary is presented of the state of research into bioremediation of oil and related compounds in Australia, with a number of detailed descriptions of particular programmes and their institutional environments. Most of the research concerns biodegradation of collected or waste substances using bioreactors or digesters. Only one project is directly concerned with oil spills in a marine environment, partly because of the scepticism of responsible authorities towards newly introduced technologies in environmentally sensitive situations.

Lash, J., & Raaymakers, S. (1993). Workshop on the Use of Bioremediation for Oil Spill Response in the Great Barrier Reef Region, Townsville, Qld (Australia), 25 Feb 1991. (p. 64). Townsville, Qld (Australia): Great Barrier Reef Marine Park Auth. *Workshop Ser. Great Barrier Reef Mar. Park Auth.* **Notes:** includes bibliographical references

Abstract: Responding to an oil spill of any significant size in the Great Barrier Reef region presents a formidable task, and all options need to be considered. Bioremediation may offer a useful addition to the range of options available, but there are conflicting reports of its effectiveness and little is known about its use in tropical marine environments. There is a need to develop a policy statement to guide the Great Barrier Reef Marine Park Authority in the case of an emergency. This workshop was held with the aim of identifying GBRMPA's research needs, and of establishing links with government, industry and research communities to facilitate its establishment, and to work towards a GBRMPA policy statement.

Lassig, B. (1993). The need for a crown-of-thorns starfish contingency plan. Workshop on the Possible Causes and Consequences of Outbreaks of the Crown of Thorns Starfish, Townsville, Qld. (Australia), 10 Jun 1992 Townsville, Qld. (Australia): Great Barrier Reef Marine Park Authority

Abstract: Delays in the provision of funding for research and the initiation of research during both crown-of-thorns starfish (*Acanthaster planci*) outbreak episodes on the Great Barrier Reef resulted in lost opportunities to study primary outbreaks, truncated research programme duration, and minimal opportunities for cost-effective research. If control of the outbreaks had been considered a desirable option, the delays would have meant that such action would have been too late to have any chance of successfully preventing the southward progression of outbreaks. A contingency plan to secure funds and outline appropriate action in the event of another outbreak would facilitate a timely and effective response.

Mann, B., & Buxton, C. D. (1993). The biology and management of blacktail (*Diplodus sargus capensis*) and zebra (*D. cervinus hottentotus*) off the south eastern Cape coast. Fish, Fishers And Fisheries. Proceedings Of The Second South African Marine Linefish Symposium Held In Durban 23-24 October 1992 Durban South Africa: Oceanographic Research Institute

Abstract: The blacktail and zebra are two sparid fishes endemic to the coast of southern Africa.

Both species are important components of the recreational shore fishery. In order to provide a basis for the rational management of these fish, aspects of their biology were investigated in the Tsitsikamma National Park (TNP), a large marine reserve situated on the south east coast of southern Africa. A total of 382 blacktail and 304 zebra were collected for biological sampling by line and spearfishing both in the TNP and in areas adjacent to the Park. Juveniles were collected from intertidal rockpools and subtidal gullies using the ichthyocide rotenone. Distribution and abundance of both species were investigated using underwater line transects. Transecting was carried out at different depths on a variety of reef types to determine the depth and habitat preferences of the two species. A comparison was made between the abundance of both species in the marine reserve and in an exploited area adjacent to the TNP.

McCallum, H. (1993). Are crown-of-thorns starfish populations chaotic? Workshop on the Possible Causes and Consequences of Outbreaks of the Crown of Thorns Starfish, Townsville, Qld. (Australia), 10 Jun 1992 Townsville, Qld. (Australia): Great Barrier Reef Marine Park Authority. Notes: 6 graphs, 16 ref.

Abstract: A model of the interaction between coral and starfish is presented. The model is based on time-delayed differential equations, and addresses the question of whether *Acanthaster planci* (COTS) populations display chaotic dynamics. The preliminary conclusion is that they do not appear to do so - for most reasonable parameter combinations the model approaches a stable equilibrium, and even sustained cycles occur only for a narrow range of parameter values. It therefore appears that the apparent unpredictability in COTS population dynamics is generated mostly by stochastic variation. This conclusion must be qualified until further work is completed.

Musso, B. (1993). Effects of *Acanthaster* predation on bioerosion -- design and preliminary results. Workshop on the Possible Causes and Consequences of Outbreaks of the Crown of Thorns Starfish, Townsville, Qld. (Australia), 10 Jun 1992 Townsville, Qld. (Australia): Great Barrier Reef Marine Park Authority. Notes: 4 graphs, table, 29 ref.

Abstract: The downstream effects of *Acanthaster planci* (crown-of-thorns starfish, COTS) outbreaks on non-coral organisms have rarely been investigated. On reefs that have experienced severe outbreaks, the overall reworking of calcium carbonate by biological agents is expected to be greater than on reefs with high live coral cover. To establish whether the rates of bioerosion per unit area of substrate are enhanced on a reef following an outbreak, and what are the causes and effects of degradation of the standing coral skeletons left behind by COTS predation, two research programmes have been undertaken. One consists of simulating COTS damage in situ in restricted areas of the reef crest. The second consists of sampling dead substrates occurring on large bommies on both COTS-affected and unaffected reefs.

Pollard, D. (1993). Maximising the potential for both sustainable fisheries and alternative uses of fish habitat through marine harvest refugia. Proceedings. Sustainable Fisheries Through Sustaining Fish Habitat. Australian Society For Fish Biology Workshop. Victor Harbour, Sa, 12-13 August 1992 Canberra Australia : Australian Government Publishing Service

Abstract: A discussion is presented on various alternative non consumptive uses of marine/estuarine ecosystems, which may be broadly grouped into recreational, educational, scientific and aesthetic purposes. An examination is also made of an appropriate management regime to address the inevitable ecological pressures and use conflicts which will arise. It is believed that the maintenance of ecosystem biodiversity, in terms of both the sustainability of the fish and the preservation of their habitats should be the most critical and primary management objective. Reference is made to the great barrier Reef Marine Park which provides a model which demonstrates that a multiple use management approach based on the general principles of ecological sustainability and user equity can successfully operate within a suitable

framework of Commonwealth/State cooperation.

Polunin, N., & Roberts, C. (1993). Greater biomass and value of target coral-reef fishes in two small Caribbean marine reserves. *In: Marine Ecology Progress Series*, 100(1-2), 167-476.

Abstract: This article discusses a study of coral-reef fish communities of Saba Marine Park (Netherlands Antilles) and Hol Chan Marine Reserve (Ambergris Cay, Belize) in the Caribbean to assess differences between them and adjacent ecologically similar sites after four years of protection from fishing. Forty-five percent of target species commonly recorded in visual censuses in Belize (23% of all recorded target species), and 59 percent at Saba (22%), showed greater abundance, size, or biomass in shallow protected sites. These differences are considered primarily to reflect increased survivorship with the cessation of fishing mortality. The greatest estimated biomass were observed in locally protected snapper (Lutjanidae) in Belize and Saba. In both protected areas the local stock of visible demersal target fishes was 1.9 to 2.0 times greater in biomass and 2.2 to 3.5 times greater in commercial value than fished sites. Larger local stock of many target species is likely to support higher egg output from the protected areas, while larger predators biomass will mean more intense predation at the protected sites.

Roberts, C., & Polunin, N. (1993). Hol Chan: demonstrating that marine reserves can be remarkably effective. *In: Coral Reefs*, (13), 90.

Abstract: The Hol Chan Marine Reserve lies off Ambergris Cay 1 Belize. Covering 2.6 square km, the reserve has been protected from all forms of fishing since 1987. Although small, Hol Chan contains a higher biomass of fishes per unit area of reef than we have seen anywhere else in the world. Enormous schools of grunts and snappers, so dense they almost obscure the reef, mingle with huge roving black groupers and gray snappers. The standing stock of commercially important species reaches 340 grams per square meter in the center of the reserve, while at the periphery it averages 77 grams per square meter, about double that in adjacent fished areas. The reserve also contains seven more species of commercial fishes than areas subject to fishing. The presence of large fishes in the reserve is particularly important to replenishment because of their disproportionately large reproductive output, the reserve may also play an important role in protection of species which are vulnerable to fishing.

Roberts, C., & Polunin, N. (1993). Marine reserves: Simple solutions to managing complex fisheries? *In: Ambio*, 22(6), 363-368.

Abstract: Fisheries on coral reefs are highly complex, can be very productive, but typically have little or no management. Widespread overfishing and declining yields reveal an acute need for proper management. However, conventional management methods are inappropriate for two main reasons: they require much information on the biology of stocks and are expensive and difficult to enforce. Use of marine reserves has been suggested as an alternative. Protective management potentially has several important benefits including protection of spawning stocks; provision of recruits to replenish fishing grounds; enhancement of catches in adjacent unprotected areas through emigration; minimal requirement for information on biology of stocks; and ease of enforcement. However, the effectiveness of the reserve approach has not been properly tested. We evaluate the evidence available to test whether reserves function as predicted on theoretical grounds. In general, field studies from widespread sites around the globe support predictions of increases in abundance and average size of fishes in protected areas. However, evidence for enhanced catches in adjacent areas is more limited, and evidence to show that reserves can restock fishing grounds is lacking. Nevertheless, protective management appears to hold much promise for low-cost management of reef fisheries. Research programs in several areas of the Caribbean and Indo-Pacific have now been launched to refine the approach.

Salazar-Vallejo, S. I. et al. (1993). Areas costeras protegidas de Quintana Roo. *In: S. I. Salazar-Vallejo, & N. E. Gonzalez* Coastal And Marine Biodiversity Of Mexico (pp. 687-708). **Abstract:** Quintana Roo is the only Mexican state in the Caribbean Sea; it has 12 areas legally protected and 9 include or were established because of its coastal attractions. Most coastal areas are in northern Quintana Roo; they have been affected by tourism, organic pollution, deforestation and landfilling of wetlands, physical stress by divers and boats and were impacted by hurricane Gilbert in 1988. We suggest modifications in the limits of Punta Cancun, P. izuc, in the marine reserve of Cozumel island mainly to cover coral reefs, and buffer zones between urban areas and natural sites in Cozumel island. Tulum National Park has serious troubles on limits and land property. Several well-preserved sites deserve protection such as northern wetlands or Yalahau Lagoon, border zone of Chetumal Bay and some of its adjacent lagoons, and Chinchorro Bank. There are federal and state laws related to conservation but specific actions are still few or absent; Mexico signed the Kingston protocol on specially protected areas and wildlife. A state (or international) coastal management plan must be made soon.

Santaella, E., & Revenga, S. (1993). Artificial reefs and marine reserves. Implementation of the objectives from multi-annual guidance programmes 1987-1991 and 1992-1996. *In: Boll. Oceanol. Teor. Appl.*, 11(3/4), 165-172.

Abstract: Artificial reefs in Spain were included for the first time as a tool for fishing stocks enhancement in the Multi-Annual Guidance Programme 1987-1991, followed by the 1992-1996 one. As they are showing good results, Spanish administrations are planning to continue with them, adding other measures dealing with certain restrictions to fishing as intended wrecks of wood fishing vessels and marine reserves.

Scandol, J. P. (1993). CotSim -- scientific visualisation and gaming-simulation for the Acanthaster phenomenon. Workshop on the Possible Causes and Consequences of Outbreaks of the Crown of Thorns Starfish, Townsville, Qld. (Australia), 10 Jun 1992 Townsville, Qld. (Australia): Great Barrier Reef Marine Park Authority. Notes: 2 append., 27 ref.

Abstract: CotSim is a new type of population model for Acanthaster planci (crown-of-thorns starfish, COTS) on the Great Barrier Reef (GBR). This multi-reef model simulates the population dynamics of COTS on 270 reefs in the central GBR and integrates recent oceanographic modelling studies of the area. It has been designed to facilitate experimentation by non-modellers. Users can change initial conditions or any of the parameters for the underlying model, as well as editing starfish populations while the model is running. COTS dynamics are represented by a density-dependent size structured matrix model. Coral dynamics are represented by logistic equations. Spawning and fertilisation are stochastic processes quantified by user-defined parameters. The spatial structure of larval dispersal is determined by extensive oceanographic studies of the GBR. The motivation for this research was to experiment with new methods of presenting models to the scientific community; surveys have been designed and distributed in an attempt to gather responses.

Sheehy, A. J. (1993). Bioremediation of oil spills. Workshop on the Use of Bioremediation for Oil Spill Response in the Great Barrier Reef Region, Townsville, Qld (Australia), 25 Feb 1991 Townsville, Qld (Australia)Townsville, Qld (Australia): Great Barrier Reef Marine Park Auth.

Abstract: Bioremediation is the human augmentation of biodegradation, the manipulation of microbial activity so that the ecological balance is restored in favour of the microorganisms and the contaminant destroyed. It has been used, for instance in sewage treatment, for many years. Its first systematic application to a marine oil spill, in Prince William Sound, Alaska, in 1989, though greeted with scepticism by officials and environmentalists, proved a success. Its application to the Great Barrier Reef would require an understanding of the diverse composition of petroleum, the physical and chemical status of the area, and the sequence of

events after oil is spilled into the marine environment. At first sight, it would seem unlikely that new microorganisms would need to be introduced, and the level of nutrient addition that would be required would not be harmful to the natural biota. Only rapid physical removal is a preferable treatment for contaminated beaches, contained water bodies, and as a disposal method for physically collected oil.

Stump, R. (1993). Life history characteristics of *Acanthaster planci* (L.) populations, potential clues to causes of outbreaks. Workshop on the Possible Causes and Consequences of Outbreaks of the Crown of Thorns Starfish, Townsville, Qld. (Australia), 10 Jun 1992 Townsville, Qld. (Australia): Great Barrier Reef Marine Park Authority. Notes: 33 ref.

Abstract: A novel method of age determination using pigment band counts in aboral spines has offered potential insights into *Acanthaster planci* population biology. In *A. planci* growth, longevity and reproductive effort appear to be determined by the interaction between available coral resources and population density. Maximum determined ages ranged up to 12+ years, indicating that longevity is considerably greater than estimated from outbreak population studies. A qualitative model of population dynamics is presented to explain how a primary outbreak may be initiated. In particular hydrodynamic conditions, low density populations may seed intermediate populations with consistent age structure, through successive small-scale recruitment over several years. Further successful recruitment increases population density to a point where the switch between low density and outbreak phenotypic states is triggered in the developing recruits. Phenotypic expression of life history characteristics that promote reproductive success in high density populations suggests that outbreaks have occurred in the past over a long time-scale. It is still possible that increased recent activity is related to environmental stress on the reefs

Sweatman, H., & Butler, I. R. (1993). An experimental investigation of the ability of adult crown-of-thorns starfish to survive physical damage. Workshop on the Possible Causes and Consequences of Outbreaks of the Crown of Thorns Starfish, Townsville, Qld. (Australia), 10 Jun 1992 Townsville, Qld. (Australia): Great Barrier Reef Marine Park Authority

Abstract: On three occasions, adult crown-of-thorns starfish (COTS, *Acanthaster planci*) were collected from a high density population and subjected to various levels of physical damage, including bisection and trisection. They were then held in cages for about 15 days to monitor survival. Results were variable. In one instance, even bisection did not affect survival during the experimental period. On other occasions, damaged individuals showed poorer survival. Starving the animals for six weeks prior to the experiment did not reduce survival compared to that of newly collected individuals. Varying the density of animals in cages found lower survival at lower densities, implying that disease transmission was not artificially high in cages. These studies confirm others, in that predation on COTS is only conclusively effective if the whole animal is removed.

Vacchi, M., & Tunesi, L. (1993). Stationary visual census: A technique for the assessment of fish assemblages in Mediterranean protected coastal areas. *In: Boll. Oceanol. Teor. Appl.*, 11(3/4), 225-229.

Abstract: Fish assemblages of the Portofino Headland, a marine coastal area proposed to be protected by Italian National Law, were studied by the stationary visual census (SVC) technique, originally conceived for coral reef areas. Experience indicates that the SVC technique is also useful to study fish assemblages in coastal Mediterranean areas characterized by heterogeneous grounds. Preliminary data collected on fish assemblages in the Portofino area showed a high species diversity. Moreover the high percentage of small individuals of commercial species recorded suggests an excessive fishing pressure on local fish assemblages.

van-der-Knaap, M. (1993). Physical damage to corals caused by trap-fishing on reefs of Bonaire, Netherlands Antilles. *In: Environmental Conservation*, 20(3), 265-267.

Abstract: One of the objectives of the trap-fishery research project which was carried out in the Bonaire Marine Park in 1982 was to investigate ways in which optimal fish-yields might be obtained. These included determination of the minimum mesh-size, optimal "soaking time" of the trap and the most productive areas within the reef system. The other objective was to study the impact of trap-fishing on the reef, and the physical damage that it might cause to corals and other invertebrate organisms. Furthermore, it was hoped that a compromise between optimal catch and the lowest impact on the reef community could be found. This short communication deals with the impact of the traps on certain coral species and other sessile invertebrates.

Vargas-Hernandez, J. M., Hernandez-Gutierrez, A., & Carrera-Parra, L. F. (1993). The reef system of Veracruz, Mexico. *In: S. I. Salazar-Vallejo, & N. E. Gonzalez. Coastal And Marine Biodiversity Of Mexico.#Biodiversidad Marina Y Costera De Mexico* (pp. 559-575). [s. l.]: [s. n.].

Abstract: Since colonial times the coral reefs off Veracruz have been exposed to human impacts mainly coral extraction for building pollution, overfishing, souvenirs, and aquarists. To protect the reefs, a marine national park was decreed in August 1992. In this paper biotic and abiotic characteristics of the main reefs are described, the anthropogenic impact is analyzed and some suggestion are made for an adequate management plan.

Wall, L. (1993). The Exxon-Valdez oil spill - Woodward-Clyde Consultants' contributions to bioremediation . Workshop on the Use of Bioremediation for Oil Spill Response in the Great Barrier Reef Region, Townsville, Qld (Australia), 25 Feb 1991 Townsville: Great Barrier Reef Marine Park Auth.

Abstract: About eleven million gallons of crude oil were spilled into Prince William Sound, Alaska, when the Exxon Valdez supertanker ran aground in 1989. Physical methods of removal were not very effective and damaged the local environment. Microbial activity on the polluted beaches was found to be inhibited by lack of nitrogen and phosphorus. A proposed treatment advocates the use of an emulsifier, a soil activator, and slow-release nutrients applied sequentially by helicopter.

Wolanski, E. (1993). Facts and numerical artefacts in modelling the dispersal of crown-of-thorns starfish larvae in the Great Barrier Reef. *In: Australian Journal of Marine and Freshwater Research*, 44(3), 427-436.

Abstract: Existing models of the dispersal of crown-of-thorns starfish larvae in the Great Barrier Reef suffer from problems with numerical algorithms, unrealistic assumptions about open-boundary forcings, and unrealistic parameterization of dispersion processes in the presence of salient topography. These problems probably invalidate some of the published model results, and these models should probably not be used for management of the Great Barrier Reef Marine Park.

Zann, L. (1993). Some perspectives on the Acanthaster phenomenon. Workshop on the Possible Causes and Consequences of Outbreaks of the Crown of Thorns Starfish, Townsville, Qld. (Australia), 10 Jun 1992 Townsville, Qld. (Australia): Great Barrier Reef Marine Park Authority. Notes: Summary only.

Abstract: Although outbreaks of Acanthaster planci, the crown-of-thorns starfish (COTS) have occurred in many widely separated coral reefs of the Indo-Pacific over the past 30 years, research on the phenomenon and its causes has almost exclusively centred on the Great Barrier Reef. This study takes a wider view, examining the recent history of COTS in other parts of the Indo-Pacific, especially the geographically isolated groups in the South Pacific. Outbreak

histories were reconstructed from oral histories, published and unpublished reports, and dedicated studies. The outbreak histories in the main study groups and subgroups were related to their geographical and geomorphological characteristics, and the extent of anthropogenic impact

Barnabe, G., Chauvet, C., & Boisson, M. (1994). Evaluation of fish fauna of Monaco's submarine nature reserve. *In: Bulletin of Marine Science*, 55(2-3), 1326-1327. Notes: Summary only.

Abstract: The aim of this study was to evaluate the fish populations inhabiting various biotopes of the Monaco submarine nature reserve. These biotopes, ranging in depth from 0 to 40 m and including several artificial reefs, were evaluated visually by SCUBA diving. This method is of proven reliability. Three fixed stations (on the reefs) and three transects (pier, sea wall and Posidonia bed) were analyzed each season. The fixed stations corresponded to 80 m super(2) circles. The transects corresponded to "tunnels" of 10 m width and 5 m height. A 50 m transect corresponds to about three 900 m super(3) of water. The results have permitted the calculation of the species diversity, fish densities and biomass, as well as a distribution index for each sampling zone. Down to a depth of 20 m, the marine reserve has a high density of fish but a low species diversity (the most abundant species are *Chromis chromis* and *Spicara maena*). The Posidonia beds contain low numbers of fish (0.1-2.1 fish m super(2)), biomass = 2-25 gm super(2)) and a low species diversity (6). The total fish density on the rocks of the piers was 6.34 m super(2) equal to 107.6 fish linear m of pier (39.7 fish m if *Chromis* is excluded, and a total biomass of 2,138 g linear m or 126 gm super(2)). *Diplodus sargus* was the most abundant of the 29 species of fish encountered in this biotope. All of the size classes of this fish were present. The reefs, composed of stone blocks (100 m super(2) and 100 m super(3)) and situated at 20-30 m depth, showed the highest biomass of fish (90-212 gm super(2)), whilst built reefs (<5 m super(3)) are home to few fish (<6 species, biomass <10 gm super(2)). Fish abundance varied seasonally, with a minimum in summer. Species diversity showed only limited seasonal variations. The role of the most structurally heterogeneous (rough) zones and the role of nursery played by shallow water areas of the marine reserve are discussed as is the efficiency and tigmotrophism of the reefs.

Brookhouse, P. (1994). Management of wildlife operations. Workshop on Oiled Seabird Cleaning and Rehabilitation, Townsville, Qld (Australia), 26 Feb 1991 Townsville, Qld (Australia): Great Barrier Reef Marine Park Auth. Notes: 3 diagrams, 4 ref.

Abstract: The management of wildlife rescue operations is in principle no different to the management of any other kind of pollution event. Of the four processes of management, planning, organising, leading and controlling, the first two are discussed in relation to pollution events. Contingency planning consists of identifying the risks, identifying the authorities to be involved in management, developing cooperation between them, and developing in-house procedures for each. Organisation consists of allocating the overall management, the operations management, collection and dissemination of information, and the provision of support services. A command structure for wildlife operations is illustrated.

Carter, J. et al. (1994). Creation of the Hol Chan Marine Reserve in Belize: A grass-roots approach to barrier reef conservation. *In: Environmental Professional*, 16(3), 220-231.

Abstract: The mesoamerican nation of Belize is endowed with a true global treasure-its magnificent barrier reef ecosystem. However, in recent years rapid economic growth in tourism and fishing and increasing human population have placed unprecedented demands on these once pristine coastal and marine ecosystems. The degradation of marine habitats and subsequent loss of biodiversity threatens the long-term biological integrity of the barrier reef ecosystem and the livelihood of Belizean people who depend upon it. A common worldwide

approach to the conservation and protection of shallow-water tropical marine ecosystems has been through the establishment of protected areas. In 1987, the government of Belize established the Hol Chan Marine Reserve in an effort to conserve a small but complete portion of the Belize marine ecosystem, including coral reef, lagoon, and mangrove habitats. The Hol Chan Marine Reserve has achieved a modicum of success and serves as a catalyst for the creation of other parks in the region. This paper provides information on the development and implementation of the Hol Chan Marine Reserve and discusses implications for its value as a model for other such areas proposed for the Belize Barrier Reef.

Cattaneo Vietti, R., & Bavestrello, G. (1994). Four years rearing experiments on the Mediterranean red coral. *In: Biologia Marina Mediterranea*, 1(1), 413-417.

Abstract: Details are given of observations made during the 4 year period following the transplantation of some 100 colonies of red coral (*Corallium rubrum*) in artificial concrete caves immersed in January 1989 in the Marine Reserve of Monaco. In January 1993, roughly 50% of the transplanted colonies are alive and appear generally healthy and active.

Chin, G. D., & Simmons, R. (1994). Evaluating artificial reefs at Porteau Cove Provincial Park. Fifth International Conference On Aquatic Habitat Enhancement, Long Beach, CA (USA), 3-7 Nov 1991. Notes: Summary only.

Abstract: The development and monitoring of artificial reefs established for recreational use in British Columbia, Canada is described. Established over a 10 year period since 1981, the reefs are situated on a sandy substrate type of an estuarine system, semi protected but subject to seasonal high energy waves and currents. A variety of materials have been used including tires, concrete, steel and wooden derelict vessels. By monitoring marine life colonization through underwater surveys and video record, it was determined that concrete and steel were the most successful materials to enhance species diversity and abundance.

Christie, P., White, A., & Buhat, D. (1994). Community-based coral reef management on San Salvador Island, the Philippines. *In: Society and Natural Resources*, 7(2), 103-117.

Abstract: The Marine Conservation Project for San Salvador Island, Zambales (MCPSS) was initiated in 1988. The primary goal was to organize a community-based marine resource management scheme for the island community. This paper provides an overview of the MCPSS, a profile of the site, the means of implementation, and results from the first 2 years of work with lessons for similar programs. The MCPSS has succeeded in establishing a municipal marine park with a 125-ha nonfishing sanctuary and a traditional fishing reserve surrounding the island. These zones have been established through a process of community education, organization, and participatory decision making which resulted in a municipal ordinance and community support. The MCPSS, although encountering various obstacles of local island politics, technical deficiencies, and limited funding, has shown that it is possible to engage island communities of fisherfolk in coral reef protection and management that may be sustainable.

Clements, E. (1994). Marine survey and the safe carriage of hazardous substances. Hulls, Hazards And Hard Questions Shipping In The Great Barrier Reef. Meeting of Experts. Shipping in the Great Barrier Reef - Reducing the Risk of Spilling Oil and Other Hazardous Substances, Canberra, A.C.T. (Australia) (pp. 125-129). Great Barrier Reef Marine Park Authority

Abstract: The surveys carried out by or on behalf of the Australian Maritime Safety Authority of the hull, machinery, safety and pollution prevention equipment carried on Australian cargo ships engaged in overseas or interstate voyages are described. AMSA's actions to safeguard ships from cargo hazards are summarised. The importance of safe manning and crew

competence are highlighted.

Craik, W. (1994). Seabird cleaning and rehabilitation in the Great Barrier Reef Marine Park. Workshop on Oiled Seabird Cleaning and Rehabilitation, Townsville, Qld (Australia), 26 Feb 1991 Townsville, Qld (Australia): Great Barrier Reef Marine Park Auth. Notes: map, diagrams
Abstract: The Great Barrier Reef region has not yet been subject to a large oil-spill. However, there are a number of hazards to shipping, including 2900 reefs, 300 coral cays, and 600 high islands, strong trade winds and local currents, and occasional cyclones. About 2000 vessels pass through each year, of which about 200 are tankers. There are some 242 species of birds in the region, of which about 40 are seabirds. The Great Barrier Reef Marine Park Authority has responsibility under a joint State and Federal Committee on oil spills to give scientific support and media liaison services in the event of a spill in the region. Clearly, the cleaning and rehabilitation of affected seabirds will be an important component of each of these duties if a major oil spill does occur.

Dann, P., & Jessop, R. (1994). The effect of oil on birds -- an evaluation of the birds at risk along the Great Barrier Reef and a brief general review of the effects of oil on individuals and populations. Workshop on Oiled Seabird Cleaning and Rehabilitation, Townsville, Qld (Australia), 26 Feb 1991 Townsville, Qld (Australia): Great Barrier Reef Marine Park Auth. Notes: illus., 2 graphs, 2 tables, 17 ref.

Abstract: All seabirds are not equally at risk from oil pollution. Using a classification of foraging methods, those most at risk are pursuit divers such as cormorants, plungers such as boobies and sometimes shearwaters, surface seizers such as gulls and pelicans, and when the oil is blown onshore, intertidal foragers such as waders. Lethal effects on individual birds include asphyxiation, immobilisation, poisoning and hypothermia. Mortality can also result from shock and microbial infections as secondary effects. Effects on populations obviously depend on the severity of the oil spill, and recorded examples are presented and discussed.

Davidson, R. J., & Chadderton, W. L. (1994). Marine reserve site selection along the Abel Tasman National Park coast, New Zealand: Consideration of subtidal rocky communities. *In: Aquatic Conservation: Marine and Freshwater Ecosystems*, 4(2), 153-167.

Abstract: At present, marine reserves do not represent the full range of community types throughout New Zealand. To assist with the placement of a marine reserve along the Abel Tasman National Park coast (northern South Island), dominant subtidal laminarian and furoid algae, echinoids and herbivorous molluscs were quantitatively investigated. Results from 100 quadrats collected from 19 random transects at six selected sites showed that algae and grazer assemblages varied between granite and limestone substrata. Granite had a high percentage cover of crustose coralline algae (mean 82%-90%), a sublittoral fringe of brown macroalgae and no *Ecklonia radiata* or red foliose algae. Limestone sites were distinguished by a relatively low percentage cover of coralline algae (mean 13%) and high cover of foliose red algae and *E. radiata* (2%-36% cover and 0.2-13.9 stipes m super(-2), respectively). On limestone, molluscs *Turbo smaragdus* and *Cookia sulcata*, and the echinoid *Evechinus chloroticus* were larger than those on granite. On limestone sites with little macroalgae, herbivore size was intermediate. Grazers were more abundant on granite than limestone (mean 34.6 m super(-2), and 10.8 m super(-2) respectively). Differences in herbivore composition were recorded between granite substrata, while both algal and herbivore composition varied between limestone sites. We suggest that a variety of environmental factors including substratum influence algal and herbivore assemblages along the Abel Tasman coast. It is recommended that selection of a marine reserve site or sites along the coast of Abel Tasman National Park recognizes differences in community structure both between and within limestone and granite substrata.

Driml, S. (1994). Protection for Profit : Economic and Financial Values of the Great Barrier Reef World Heritage Area and Other Protected Areas : A Report to the Great Barrier Reef Marine Park Authority. Townsville, Queensland: Great Barrier Reef Marine Park Authority.

Dwyer, K. (1994). The jurisdiction and operation of tourist and fishing vessels in the Great Barrier Reef. Hulls, Hazards And Hard Questions Shipping In The Great Barrier Reef. Meeting of Experts. Shipping in the Great Barrier Reef - Reducing the Risk of Spilling Oil and Other Hazardous Substances, Canberra, A.C.T. (Australia) (pp. 44-50). Great Barrier Reef Marine Park Authority

Abstract: An overview is presented of tourism and the marine industry in Queensland with particular reference to the Great Barrier Reef region. Recreational boating and supporting facilities are described, and the organization and extent of the commercial fishing industry, including licensing arrangements. The present administration of marine safety in Queensland, and proposals for a new maritime legislative regime in the State, are explained, including new marine pollution provisions. Duty of care principles and the responsibilities of vessel operators are discussed, with emphasis on a holistic approach to vessel safety.

Eldridge, M. (1994). The last wild place: Marine reserves and reef fish. (p. 19). Washington, D.C: Center for Marine Conservation.

Abstract: This summary article presents information on the status of fishery resources and the importance of marine fishery reserves in protecting the long- term viability of commercial species in the Florida Keys. The article provides an overview of the decline in many commercial stocks, such as grouper, and the possible benefits to areas in the Florida Keys closed to fishing.

Filor, K. (1994). Marine accidents - present trends and a perspective of the human element. Hulls, Hazards And Hard Questions Shipping In The Great Barrier Reef. Meeting of Experts. Shipping in the Great Barrier Reef - Reducing the Risk of Spilling Oil and Other Hazardous Substances, Canberra, A.C.T. (Australia) (pp. 159-166). Great Barrier Reef Marine Park Authority

Notes: graph, 2 tables

Abstract: Shipping casualty trends in the world trading fleet are briefly analysed, with emphasis on tanker casualties generally, and on accidents in the Great Barrier Reef region. A view is presented of the human element in industrial accidents that is gaining currency in high hazard, low risk industries such as aviation and the nuclear power industry.

Forestell, P. H., & Kaufman, G. D. (1994). Resource managers and field researchers - allies or adversaries? Townsville, Qld Australia: Great Barrier Reef Marine Park Authority

Notes: 16 ref.

Abstract: As the public demand for access to marine creatures in their natural habitat increases, so will the challenge for resource managers to balance public appetite on the thin edge of ecosystem integrity. In co-ordinating frequently mis-matched agenda of the public, commercial interests, conservationists, endangered species and threatened habitats, resource managers need input from many sources. Ways in which marine mammal field researchers can facilitate the task of resource managers in permitting public participation while limiting the degree of negative impact are discussed.

French, G. (1994). Protecting the marine environment of the Great Barrier Reef - what is the role of international law? Hulls, Hazards And Hard Questions Shipping In The Great Barrier Reef. Meeting of Experts. Shipping in the Great Barrier Reef - Reducing the Risk of Spilling Oil and Other Hazardous Substances, Canberra, A.C.T. (Australia) (pp. 132-157). Great Barrier

Reef Marine Park Authority

Abstract: International legal mechanisms for protection and preservation of the marine environment are outlined, particularly as they relate to areas of great environmental significance such as the Great Barrier Reef. Proceeding from the 1982 United Nations Convention of the Law of the Sea, relevant global and regional conventions are examined. The interface between domestic and international law is explored. Particular emphasis is given to the role of the International Maritime Organisation in introducing protective measures that go beyond those normally applied to coastal zones. The recently emerged concept of particularly sensitive areas represents an important aspect of this role. Options for increasing current levels of protection are examined.

Gehling, R. (1994). Latest developments in the subdivision and construction standards of vessels with special regard to the prevention of pollution after damage. Hulls, Hazards And Hard Questions Shipping In The Great Barrier Reef. Meeting of Experts. Shipping in the Great Barrier Reef - Reducing the Risk of Spilling Oil and Other Hazardous Substances, Canberra, A.C.T. (Australia) (pp. 114-123). Great Barrier Reef Marine Park Authority. Notes: illus.

Abstract: The structural integrity and subdivision of ships, particularly oil tankers, are major factors in the prevention of pollution. Improvements made to international requirements in this area over recent years are described and placed in context with other areas of the maritime industry. On the structural side, existing standards are adequate as long as they are properly enforced. As to subdivision, requirements are being substantially upgraded in a series of amendments to MARPOL, to the stage where new tankers are truly environmentally friendly.

Gittings, S. R. et al. (1994). Coral mass spawning on the Flower Garden Banks, NW Gulf of Mexico. *In: Bulletin of Marine Science*, 54(3), 1076.

Abstract: Between 1990 and 1992, several coral species on the reefs in the Flower Garden Banks National Marine Sanctuary (FGBNMS) were observed to participate in annual mass spawning (massive, synchronous gamete release by multiple species). In 1992, reports from Looe Key (lower Florida Keys) indicated substantial activity by two of the four species seen spawning at the Flower Gardens. Observers reported no activity on Carysfort Reef (upper Keys). During each year, colonies in the FGBNMS released enormous amounts of eggs, sperm, or egg/sperm bundles after dark, eight evenings after the August full moon. Mass spawning of four species (*Diploria strigosa*, *Montastrea annularis*, *M. cavernosa*, and *Stephanocoenia michelini*) has been documented. Peak activity occurred after 2100 hours, but gamete release was seen between 1830 and 0030 hours. Minor spawning activity has occurred on the evening prior to the major event, prior to sunset on the most active dates, and on the evening following mass spawning, as well as seven days following the July full moon in 1991. Future research in the FGBNMS, as well as the Florida Keys and other western Atlantic reefs should include evaluations of the extent to which various coral species spawn, the timing of gamete release by various corals, the reproductive behaviors of different species, the dispersal patterns and fate of output, and fertilization success. It is important that researchers and resource managers evaluate and consider the implications of coral reproductive viability on reef ecosystem condition and health.

Grajios, R. (1994). Tanker owner's and operator's perspective. Hulls, Hazards And Hard Questions Shipping In The Great Barrier Reef. Meeting of Experts. Shipping in the Great Barrier Reef - Reducing the Risk of Spilling Oil and Other Hazardous Substances, Canberra, A.C.T. (Australia) (pp. 110-112). Great Barrier Reef Marine Park Authority

Abstract: The commercial shipping industry in Australia gives a high priority to pollution prevention. Measures being taken or considered are described under the following headings: (a) safety and environment protection management, including moves to adopt an International

Safety Management Code; (b) the recent adoption of a charter of practice for Australian shipping; (c) controls on drug and alcohol use aboard ships; (d) on-board contingency plans for action following an oil spill, no matter how small; (e) the National Plan to Combat Oil Pollution.

Grigg, R. W. (1994). Effects of sewage discharge, fishing pressure and habitat complexity on coral ecosystems and reef fishes in Hawaii. *In: Marine Ecology Progress Series*, (103), 25-34.
Abstract: The major factor controlling the abundance of reef fishes in Hawaii appears to be habitat complexity. Fishes aggregate in areas of high habitat complexity at biomass levels which, in areas protected from fishing, may significantly exceed levels supported by primary production within the ecosystem. High relief natural areas act like artificial reefs in terms of aggregating fishes. Reef fish abundance is also affected by fishing pressure in the main Hawaiian Islands. Areas protected from fishing support standing crops of reef fishes that average about 43 grams per square meter higher than areas open to fishing. In areas unprotected from fishing, reef fish abundance has significantly declined in recent years. Conservation and management of reef fishes would be improved if more high relief areas were protected from fishing. Thus far, 11 no-fishing zones have ~ established in such areas as Hawaii. The discharge of primary or secondary sewage effluent into the ocean in Hawaii through deep ocean outfalls causes no apparent negative environmental impact to coral reef ecosystems. Increases in abundance around the outfalls appears to result from increased habitat complexity brought about by the construction of the pipelines and surrounding caprock and concrete. A small amount of the variability in reef fish abundance around the outfalls may also be due to food subsidies. No species of fish, coral, invertebrate, or algae at the outfalls exhibited any pathological symptoms. Hence, statewide declines in reef fish abundance in areas unprotected from fishing are not related to the discharge of sewage effluent via deep ocean outfalls. Rather, these declines appear to have been caused by over-fishing

Hockey, P. A. R., & Branch, G. M. (1994). Conserving marine biodiversity on the African coast: Implications of a terrestrial perspective. *In: Aquatic Conservation: Marine and Freshwater Ecosystems*, 4(4), 345-362.

Abstract: Conservation principles developed for terrestrial habitats are frequently inapplicable in marine situations. This dichotomy arises because of different characteristics of the substratum and the existence of water as a ubiquitous marine dispersal medium. Physical differences are manifest in biological differences including reproductive mode, range requirements and levels of endemism. Marine systems differ further from terrestrial ones in that they have been subject to a very limited anthropogenic fragmentation, in contrast to land where many habitats have become highly fragmented. Estuaries and coral reefs, however, are naturally fragmented and particularly vulnerable because their substrata are strongly influenced by biological processes which are easily disrupted. One of the greatest threats to life in the sea is resource exploitation by man. In Africa, marine conservation is secondary to terrestrial conservation—only four countries in sub-Saharan Africa have marine reserves. Marine reserves are effective in increasing population sizes of exploited stocks and supplementing stocks in adjacent areas through emigration. They also have the potential to provide recruits to exploited areas. Biogeographic patterns can be used to site marine reserves. We propose a middleedge arrangement of 'biodiversity reserves', linked to biogeographical regions. Such reserves would achieve conservation of both representativeness (middle) and high diversity areas (edge). As a necessary corollary, we also suggest a second tier of reserves which has the specific purpose of improving local yields of exploited species. The sizes of biodiversity reserves should be determined by local habitat heterogeneity. Second-tier reserves should be designed to maximize their benefit to adjacent areas while minimizing their size.

Hutchings, P., Payri, C., & Gabrie, C. (1994). The current status of coral reef management in French Polynesia. *In: Marine Pollution Bulletin*, 29(1-3), 26-33.

Abstract: The current status of French Polynesian coral reefs is reviewed with respect to the resources, both renewable and non-renewable, which are extracted from the reef areas. The various factors impacting on the reefs such as sewage, land run-off, overfishing, industrial and agricultural effluent, and tourism are discussed together with any legislation controlling these activities. The three marine reserves and the protected species legislation are reviewed together with comments on the latest planning initiative which potentially will allow an integrated approach to coastal zone management to occur. Finally, the problems of the lack of enforcement of existing legislation are discussed and the real need for a more effective integrated management of the reefs. Currently much of the economy of French Polynesia is largely dependent upon reef resources, such as tourism, fisheries and pearl culture and, therefore, the maintenance of "healthy reefs" is vital, and yet little enforcement of even existing legislation appears to be occurring; this is despite the reefs of French Polynesia being better known than many other reefs in the South Pacific.

Jennings, S., Brierley, A. S., & Walker, J. W. (1994). The inshore fish assemblages of the Galapagos Archipelago. *In: Biological Conservation*, 70(1), 49-57.

Abstract: Following the creation of a Marine Resources Reserve around the Galapagos archipelago, it is a priority to implement a zoning plan for the management of the reserve. Ideally, this should guarantee protection for a proportion of the fauna within each biologically distinct region of the archipelago. In the present study, the estimated abundance and species composition of non-cryptic, diurnally active fish communities associated with inshore rock or reef habitats was determined at ten reserve sites using a visual census technique. Sites were grouped according to the similarity of their fish assemblages, and the geographical positions of sites within each group were shown to correspond closely with regions throughout which there was minimal spatial variation in surface water temperature. This finding is discussed with reference to previous studies and a proposed zoning plan. It is concluded that clearly identifiable and biologically disparate regions do exist within the Marine Resources Reserve and that the proposed zoning plan should ensure protection for a variety of significantly different fish communities.

Jordan Dahlgren, E. et al. (1994). The Sian Ka'an Biosphere Reserve coral reef system, Yucatan Peninsula, Mexico. *In: Atoll Research Bulletin*.

Abstract: The coastal shelf of the Sian Ka'an Biosphere Reserve was surveyed in order to determine the distribution and composition of coral reefs, and to assess the nature and relative cover of coralline biota along the Reserve shelf, both in reef and non-reef habitats. A census of 11 living morphological attributes (including stony corals, sponges, algae and gorgonians), and 3 non-living ones, was quantitatively estimated by means of line-transects at 30 sampling stations. Well developed coral reef structures, are mostly restricted to shallow *Acropora palmata* reefs, forming a fringing-barrier reef bordering the shoreline. A relatively high proportion of dead *A. palmata* was found in these reefs, both in the crest and in the shallow fore reef zone. The cause of *A. palmata* mortality is unknown. In deeper waters, isolated raised karstic features are colonized by a rich and diverse coral community. However, the majority of the bottom of the shallow shelf consists of hardgrounds with sparse coral cover. Coral community composition and relative degree of development seems to be influenced principally by the magnitude of the submarine topographical relief and depth.

Julian, M. (1994). Review of oil spill contingency planning in Australia and overseas. Hulls, Hazards And Hard Questions Shipping In The Great Barrier Reef. Meeting of Experts. Shipping in the Great Barrier Reef - Reducing the Risk of Spilling Oil and Other Hazardous

Substances, Canberra, A.C.T. (Australia) (pp. 52-62). Great Barrier Reef Marine Park Authority

Abstract: Planning and legislation relating to the control of oil spills varies between countries. The USA system makes the shipowner responsible for oil spill response activity through a commercial cleanup contractor; this approach is also being taken in Canada. However, in Australia and New Zealand, it is unlikely that the available work would support such a contractor. The system in the United Kingdom, funded by the taxpayer and structured as a one-tier system encompassing all facets of marine pollution management, is not suited to Australia's federal system of government. The Australian approach, therefore, is to put joint responsibility on the State and Federal Governments. Government policy is to put the burden of cost, wherever possible, on the section of industry responsible for a particular polluting incident.

Kleypas, J. A., & Burrage, D. (1994). Satellite observations of circulation in the southern Great Barrier Reef, Australia. *In: International Journal of Remote Sensing*, 15(10), 2051-2063.

Abstract: Twenty-one NOAA-9 AVHRR satellite images of the southern Great Barrier Reef, spanning the period from June 1986 to September 1988, were examined for sea surface temperature patterns in order to trace circulation within this bathymetrically complex area. Our findings are in general agreement with the few field studies of this region. The East Australian Current tended to flow outside the reefs along the shelf break until it entered the Capricorn Channel, where it either meandered westward along the narrowing shelf, adhering closely to the slope contours, or flowed directly southward. It then impinged upon the shelf break, near Fraser Island, where it bifurcated to produce a southward continuation of the current, and a cyclonic eddy within the Capricorn Channel. Cool water, which commonly occurred over the shelf between Fraser Island and Cape Clinton, has probable significance for biological production within the adjacent Capricorn Bunker Reefs of the Great Barrier Reef Marine Park. Interpreted as a response to upwelling, this cool water may be the result of: 1. the combined effect of tidal pumping and coastal trapped waves; 2. effects of the longshore wind component; or 3. topographically-induced upwelling of slope waters due to flow of the East Australian Current along the continental shelf break. The evidence for each of these possible factors is discussed.

Langford, D. (1994). Future marine navigation systems. Hulls, Hazards And Hard Questions Shipping In The Great Barrier Reef. Meeting of Experts. Shipping in the Great Barrier Reef - Reducing the Risk of Spilling Oil and Other Hazardous Substances, Canberra, A.C.T. (Australia) (pp. 99-107). Great Barrier Reef Marine Park Authority. Notes: illus.

Abstract: The Australian Maritime Safety Authority currently provides an extensive network of visual aids in the Great Barrier Reef (GBR) and Torres Strait regions, supplemented by a few racons. No radio navigation systems have ever been provided for the Great Barrier Reef region. The Global Positioning System (GPS) operated by the US Department of Defence will provide a horizontal fixing accuracy of 100 metres. This will probably be the major worldwide radio navigation system for many years. However, for such demanding environments as the GBR, 100 metres is not accurate enough. A Differential GPS (DFGPS) would improve it to better than 10 metres. The main features of a DGPS system and the implications for users are described. Indicative details for a possible DGPS network for the GBR, Torres Strait and Great North East Channel are outlined.

Larkum, A. W. D., & Steven, A. (1994). ENCORE: The effect of nutrient enrichment on coral reefs. 1. Experimental design and research programme. *In: Marine Pollution Bulletin*, 29(1-3), 112-120.

Abstract: An in situ reef fertilization experiment is being undertaken on the Australian Great Barrier Reef, to investigate the response of coral reefs to nutrient enrichment. This experiment, known as ENCORE, is designed to quantify the fate of nitrogen and phosphorus within a coral

reef, and compare their impact on a variety of coral reef organisms. Co-ordinated by the Great Barrier Reef Marine Park Authority (GBRMPA), 30 scientists from eight Australian and three overseas organizations are undertaking research encompassing cellular through to community level responses. This research will provide a scientific basis for developing appropriate water quality management strategies in coral reef environments, and may identify a number of sub-lethal indicators of nutrient stress.

Lash, J., & Raaymakers, S. (1994). Workshop on Oiled Seabird Cleaning and Rehabilitation, Townsville, Qld (Australia), 26 Feb 1991. (p. 66). Townsville, Qld (Australia): Great Barrier Reef Marine Park Auth., *Workshop Ser. Great Barrier Reef Mar. Park Auth.*

Notes: includes bibliographical references

Abstract: In the event of an oil spill in the Great Barrier Reef region it is most likely that seabird populations would be subject to significant impact. Rescue, cleaning and rehabilitation of oiled birds would form a major, high-profile part of the response effort and would provide a useful activity for the concerned volunteers that would respond to the news of a crisis. There is a pressing need to develop a plan for coordinating the activity. Research is also needed into effective methods of cleaning and rehabilitation. The workshop was held as a contribution to the development of the plan, and as a stimulus to complementary research.

Lassig, B., & Woodley, S. (1994). Systems for selection and management of marine protected areas. *In:* J. L. Munro, & P. E. Munro. Workshop on the Management of Coral Reef Resource Systems, Townsville (Australia), 3-5 Mar 1992 (pp. 61-63). Manila-Philippines : ICLARM .

Abstract: This paper outlines some of the guidelines generally proven to be successful when applied to natural resource management and in particular marine protected areas (MPAs) like the Great Barrier Reef Marine Park.

Leech, J. W. (1994). Transport of oil and other hazardous substances in the Great Barrier Reef: Hydrographic aspects. Hulls, Hazards And Hard Questions Shipping In The Great Barrier Reef. Meeting of Experts. Shipping in the Great Barrier Reef - Reducing the Risk of Spilling Oil and Other Hazardous Substances, Canberra, A.C.T. (Australia) (pp. 81-97). Great Barrier Reef Marine Park Authority. Notes: maps, tables

Abstract: Shipwreck is one of the main causes of catastrophic marine pollution. One of the main instruments in avoiding shipwreck is the nautical chart, which describes and locates dangers to shipping. Thirty percent of the Australian continental shelf has been adequately surveyed by modern techniques and standards; a further 20 percent is regarded as temporarily adequate. Inevitably, many of the unsurveyed areas carry significant volumes of shipping; and this includes parts of the Inner Route of the Great Barrier Reef. Despite the introduction of compulsory pilotage on this route, human error continues to be a frequent cause of groundings. The continuation of the hydrographic survey of the continental shelf at a reasonable rate of effort must remain high on national priority ratings, both in itself and as a basis for the introduction of electronic charting systems such as ECDIS.

Maragos, J. E. (1994). Description of reefs and corals for the 1988 protected area survey of the northern Marshall Islands. *In:* Atoll Research Bulletin.

Abstract: The Republic of the Marshall Islands requested a natural and cultural biodiversity survey of 6 northern atolls (Bok-ak, Pikaar, Toke, Wotto, Rondik, Adkup) and one reef (Jemo) which was accomplished over 17 days in September 1988. This report examines the results of the survey of the reefs and corals during the expedition. Ninety-five marine sites were snorkeled and the shorelines of all island were surveyed during the expedition. A total of 168 species and 55 genera and subgenera of stony corals were reported including several new species and one new genus recorded (Polyphyllia) for the Marshalls.

McClanahan, T. (1994). Kenyan coral reef lagoon fish: Effects of fishing, substrate complexity, and sea urchins. *In: Coral Reefs*, 13(4), 231-241.

Abstract: Population density, number of species, diversity, and species-area relationships of fish species in eight common coral reef-associated families were studied in three marine parks receiving total protection from fishing, four sites with unregulated fishing, and one reef which recently received protection from fishing (referred to as a transition reef). Data on coral cover, reef topographic complexity, and sea urchin abundance were collected and correlated with fish abundance and species richness. The most striking result of this survey is a consistent and large reduction in the population density and species richness of 5 families (surgeonfish, triggerfish, butterflyfish, angelfish, and parrotfish). Poor recovery of parrotfish in the transition reef, relative to other fish families, is interpreted as evidence for competitive exclusion of parrotfish by sea urchins. Reef substrate complexity is significantly associated with fish abundance and diversity, but data suggest different responses for protected versus fished reefs, protected reefs having higher species richness and numbers of individuals than unprotected reefs for the same reef complexity. Sea urchin abundance is negatively associated with numbers of fish and fish species but the interrelationship between sea urchins, substrate complexity, coral cover, and management make it difficult to attribute a set percent of variance to each factor - although fishing versus no fishing appears to be the strongest variable in predicting numbers of individuals and species of fish, and their community similarity. Localized species extirpation is evident for many species on fished reefs (for the sampled area of 1.0 ha). Fifty-two of 110 species found on protected reefs were not found on unprotected reefs.

Mcmanus, J. (1994). The Spratly Islands: A marine park? *In: Ambio*, 23(3), 181-186 .

Abstract: The Spratly Islands encompass a dense system of several hundred coral reefs in the most biodiverse of the world's seas. They serve as breeding grounds for a wide variety of organisms including sea turtles, birds, marine mammals, and tuna. A study of pelagic larval survival times and current patterns indicates that they may supply recruiting organisms for maine ecosystems throughout the South China Sea. They may be of growing importance in replenishing over-harvested stocks which provide food and livelihood to coastal villagers in the Philippines, Taiwan, mainland China, Vietnam, and Malaysia. Strategic concerns and vague possibilities of hydrocarbon deposits have led each of these countries to station troops in the area, resulting in violent confrontations and environmental stress. Future oil drilling could have widespread impacts. A more sustainable-use strategy would be to freeze current claims on the islands and establish an international marine park. Such a park would rival the Great Barrier Marine Park in size, number of reefs and biodiversity, and could generate on the order of USD 1 billion annually from tourism. Carefully managed, the park would safeguard substantially-sized populations of tens of thousands of species, and help to ensure a steady supply of recruits to regional fisheries.

Morton, B. (1994). Hong Kong's coral communities: Status, threats and management plans. *In : Marine Pollution Bulletin*, 29(1-3), 74-83.

Abstract: This paper reviews the sparse literature on Hong Kong's scleractinian coral communities and explains, in terms of a locally complex climate and hydrography, the broad aspects of their distribution. Corals are restricted to the less polluted, oceanic, eastern waters of Hong Kong and are most diverse in the middle reaches of protected bays from CD to similar to -10 m CD. Historical evidence suggests that local corals were once more widely distributed but that the settlement of Hong Kong, particularly since its colonization in 1841, has progressively restricted them. Coral collection for lime burning was common until World War II, but has since stopped. Local coral communities, therefore, started anew some 50 yr ago. In recent years, the economic development of Hong Kong has, through uncontrolled pollution, destroyed many coral areas, notably in Tolo Harbour. Today, construction of the new Chek Lap Kok

airport and associated infrastructure, requires the dredging of >500 million m³ of marine sands. Dredging operations in eastern waters have destroyed coral communities, through silt suffocation. Other reclamations and borrow areas have also adversely affected corals. Legislation is being drafted and plans are being developed to create marine parks and reserves in Hong Kong. The proposed marine park at Hoi Ha Wan is to try and protect a local coral community. The proposed marine reserve at Cape d'Aguilar is also a coral area within the framework of a more wave-dynamic habitat. Existing legislation has not hitherto protected Hong Kong's corals. The proposed legislation may help, but the reality is that only remnants of what once must have been a spectacular coral community may survive in the territory's remotest bays

Ottesen, P. (1994). Hulls, Hazards and Hard Questions Shipping in the Great Barrier Reef Reducing the Risk of Spilling Oil and Other Hazardous Substances Proceedings of a Meeting of Experts. Meeting of Experts. Shipping in the Great Barrier Reef Reducing the Risk of Spilling Oil and Other Hazardous Substances, Canberra, A.C.T. (Australia), 14 Apr 1993 Townsville (Australia): Great Barrier Reef Mar. Park Auth. *Workshop series. Great Barrier Reef Marine Park Authority:*

Abstract: An undercurrent of public concern about the possibility of an oil spill in the Great Barrier Reef (GBR) Marine Park surfaces whenever there is a large shipping accident or spill elsewhere. Well publicised incidents over the past four years have raised concern to such a level that the Marine Park Authority decided to focus even more on prevention, recognising that the effectiveness of action after the fact is very limited. The Australian Maritime Safety Authority agreed to organise jointly with the Marine Park Authority a meeting of experts in ship design, construction and operation and maritime law, as well as those involved with the GBR. This report comprises three sections: records of the papers presented, outputs of the five workshops that were held, and the appendices, reporting on the programme, the participants, the media release, and publications of the Marine Park Authority on oil related matters.

Parker, R. O. Jr., Chester, A. J., & Nelson, R. S. (1994). A video transect method for estimating reef fish abundance, composition, and habitat utilization at Gray's Reef National Marine Sanctuary, Georgia. *In: Fishery Bulletin*, 92(4), 787-799.

Abstract: Reef fish communities at Gray's Reef National Marine Sanctuary, Georgia, differed over five different habitat types. Numbers of species and overall densities were highest on ledge habitat, intermediate on live-bottom (three categories of low relief [<15 cm] rock outcroppings covered by algae and macrofauna), and lowest over sand. On average, abundance over ledges exceeded that over sand bottoms by a factor of 50. Generally, community composition at sites over ledges and dense live-bottom areas was similar and distinct from sites found over sparse live-bottom and sand. Many species were found in more than one habitat and few individual species could be considered indicators of a single habitat type. A nondestructive, repeatable procedure of randomly dispersed video transects was devised for assessing diurnally active fishes.

Post, J., Munasinghe, M., & McNeely, J. (1994). The economic feasibility and ecological sustainability of the Bonaire Marine Park, Dutch Antilles. Protected area economics and policy: linking conservation and sustainable development (pp. 333-338, 3 ref.). [s. 1.]: [s. n.].

Abstract: This case study describes an example of a protected area that in its capacity as a tourist centre for scuba diving has become ecologically sustainable and economically feasible for the community and for the individual, the Bonaire Marine Park in the Dutch Antilles. It determines whether the objectives of the park are successful, asks who benefits from the park, who pays, and whether exploitation of the park is sustainable. Two major kinds of benefits have been distinguished: financial (private) and economic (public). These benefits can occur through

the collection of various taxes, through the creation of employment, and through foreign exchange. An assessment of the ecological sustainability of the park is done through an investigation of the perceived carrying capacity of the resource and through a photo-analysis of coral cover in areas of high diving pressure. It concludes that the Bonaire Marine Park provides a good example of an area where biodiversity conservation and economic development have been mutually reinforcing. Close monitoring of the health of the reefs as a function of the number of divers is necessary to set eventual limits, whereas strict pollution control is essential.

Postle, D., & Simmons, M. (1994). Encounters with Whales '93: A Conference to Further Explore the Management Issues Relating to Human Whale Interactions. Conference. Encounters With Whales '93, Lady Elliot Island, Qld (Australia), 6 Sep 1993 Townsville (Australia): Great Barrier Reef Mar. Park Auth. *Workshop series. Great Barrier Reef Marine Park Authority:*

Abstract: It has become possible in recent times for large numbers of tourists to be transported daily in some areas to view whales in their congregation areas, close up and in the wild. Within the Great Barrier Reef there has been a rapid increase in the number of tourist operators applying for permits to run such functions on a commercial basis. Increasing opportunities to view whales bring with them the potential for harassment, particularly in the critical offshore breeding and nursery areas. The Great Barrier Reef Marine Park Authority is aware of the need to discuss with other management authorities the requirement for guidelines for whale watching and associated management issues. The conference reported here is one result.

Puotinen, M. L. (1994). Designing effective baseline monitoring programs for the Great Barrier Reef Marine Park, Queensland, Australia. *In: Coastal Management*, 22(4), 391-398.

Abstract: Rising pressure for both the protection and expanded use of coastal and marine resources underscores the need for effective management of these dynamic and often poorly understood environments. Yet the long-term data required to make ecologically sound decisions is often lacking, highlighting the importance of effective baseline monitoring programs. This is particularly evident for the Great Barrier Reef Marine Park, the largest marine protected area of its type in the world. This paper briefly describes the marine park and how it is managed, discusses the components of an effective baseline monitoring program, explores the worth of various monitoring program designs, and introduces the Reef Research Allocation Model (RRAM), a GIS-based spatial decision support tool under development for use in selecting monitoring sites.

Quirk, P. (1994). Developments in ship safety standards: Implications for protection of the Great Barrier Reef. Hulls, Hazards And Hard Questions Shipping In The Great Barrier Reef. Meeting of Experts. Shipping in the Great Barrier Reef - Reducing the Risk of Spilling Oil and Other Hazardous Substances, Canberra, A.C.T. (Australia) (pp. 25-41). Great Barrier Reef Marine Park Authority. **Notes:** 8 tables, 3 maps

Abstract: The Australian Maritime Safety Authority (AMSA), inter alia, is responsible for ensuring that national and international ships working within Australian waters are seaworthy and operated safely. The general nature of navigational safety hazards faced by shipping transiting the Great Barrier Reef at present is described, along with the characteristics of the shipping including the numbers and types of vessels and their flags. Some details of cargoes and trade statistics are also provided. The core issues related to safety of shipping are then addressed, including the problem of lack of observance of safety standards by some states and ship owners, and what AMSA and the international maritime community are doing to redress these issues.

Raaymakers, S. (1994). Ship sources oil pollution in the Great Barrier Reef: Causes,

frequency, response and prevention. Hulls, Hazards And Hard Questions Shipping In The Great Barrier Reef. Meeting of Experts. Shipping in the Great Barrier Reef - Reducing the Risk of Spilling Oil and Other Hazardous Substances, Canberra, A.C.T. (Australia) (pp. 11-22). Great Barrier Reef Marine Park Authority. Notes: 2 tables, 11 ref.

Abstract: Ship sources oil spills are discussed in the context of the Great Barrier Reef, including Torres Strait, which falls within the REEFPLAN area. About 2000 ships pass through the area each year, about 100 of which are tankers. There have been no significant spills in the area since 1970; however, there have been 19 collisions and 24 groundings of large ships since 1979, and operational discharges from large ships are commonly reported. The impacts of oil on the tropical marine ecosystems found in the area are discussed. The nature and extent of impacts from major spills can not be predicted with any accuracy, and actual examples have tended to be more detrimental than expected from experimental results. Arrangements for the prevention of spills in the area are described, and opportunities for improvement identified.

Roberts, C. (1994). Marine reserves: A brief guide for decision makers and users. Coastal and Ocean Resource Management

Notes: NGO Islands Forum, UN Global Conference on the Sustainable Development of Small Island Developing States

Abstract: Marine reserves are becoming widely used in efforts to protect and manage coastal resources. In recent years they have attracted much interest for their possible role in sustaining reef fisheries. Protection of fish stocks within marine replenishment reserves should lead to increased abundance and size of target species, thereby translating into increased egg production, which should benefit fisheries by planktonic dispersal and subsequent recruitment to fishing grounds. Ongoing studies of fish stocks around the island of Saba, Netherlands Antilles, where a section of the marine park has been closed to fishing since 1987, have shown a rapid response to protection. There is now a significantly higher standing stock of commercially important species in the protected area compared to the fished area. Moreover, between 1991 and 1993 there has been a rapid increase in standing stock of fish within the reserve, with some families tripling over a two-year period, and an overall increase of 63 percent. These findings show that even very small reserves can protect significant fishery stocks. Benefits from protected stocks are likely to be felt locally through emigration of fishery species to fishing grounds, and by export of planktonic larvae. Although some of these larvae may drift away from the place where the reserve is located, recent studies of current patterns around small islands suggest that a substantial proportion of larvae will be retained, thus benefiting the host nation. Marine reserves also seem to be a promising means of protecting and enhancing biodiversity, and in doing so may yield further economic benefits. In Belize for example, the large and abundant fishes within the Hol Chan Marine Reserve provides a powerful attraction to tourists and so comprises a key to economic development of Ambergris Cay.

Shinn, E. A., Lidz, B. H., & Harris, M. W. (1994). Factors controlling distribution of Florida Keys reefs. *In: Bulletin of Marine Science*, 54(3), 1084.

Abstract: Regional and area-specific high-resolution seismic profiling, combined with core drilling and analysis of aerial photography, indicates that the distribution of Florida's reefs is regulated by two factors. The primary control is Pleistocene topography, created before Holocene sea-level rise (conversion of landscape to seascape). The secondary influence is water quality, which has progressively changed with rising sea level and changing seascape. A regional sequence of flooding, patterns resulting from sea-level rise, is shown by converting contoured structural maps of the under-lying Pleistocene limestone into pale shoreline maps. The maps show that (1) the area of the reef tract off the Lower Florida Keys flooded sooner than that off the Upper Keys, suggesting that Holocene reef growth began first off the Lower

Keys; (2) the major offshore reefs formed around offshore islands, probably as fringing reefs, and became bank reefs as sea level arose; and (3) rising sea level created wide passes through the Lower and Middle Keys, allowing influx of inimical Florida Bay and Gulf of Mexico waters onto the reef tract 3 to 4 ka and causing senility in major Holocene reefs opposite the passes. Detailed seismic mapping of the reef tract in a portion of the Key Largo National Marine Sanctuary off north Key Largo shows that about 6 to 7 ka a linear chain of barrier islands (Pleistocene outlier reefs) extended along the edge of the platform margin from The Elbow to French Reef. Rising sea level caused flooding of the platform through prominent bedrock depressions south of The Elbow and between French and Molasses Reefs, creating a linear, protected embayment. Corals recruited to a bedrock terrace within the embayment and flourished, forming 14-m-thick linear Holocene reefs, such as Grecian Rocks and Key Largo Dry Rocks. With further rise in sea level, coral patches became established at Mosquito Bank in a bedrock depression within Hawk Channel. At about the same time, marine sediments began to fill a 600-m-diameter sinkhole near Key Largo Dry Rocks. Surprisingly, coral growth along the outlier-reef islands did not lead to major Holocene accumulations at the edge of the platform margin, and reefs such as The Elbow, French, and Molasses are thin (similar to 1 m thick) and are considered geologically senile. These observations are consistent with new data from the Great Barrier Reef of Australia, which also show that older and thicker reef accumulations occur on lagoonal topographic highs rather than on the offshore barrier

Sluka, R., Chiappone, M., & Sullivan, K. M. (1994). Comparison of juvenile grouper populations in southern Florida and the central Bahamas. *In: Bulletin of Marine Science*, 54(3), 871-880.

Abstract: Visual surveys conducted in shallow-water (< 10 m) reef habitats were used to compare grouper abundance, size distribution, and species richness in the central Bahamas and northern Florida Keys. The mean density of groupers was three times greater in a marine park in the central Bahamas closed to fishing. Although a higher percentage of larger groupers were observed in the Bahamas, differences in the size distribution between the two areas were not significant. Species composition differed between the two areas and were attributable to different habitat requirements. For example, graysby, red grouper, red hind, and black grouper dominated the species assemblage in the Florida Keys, while Nassau grouper and coney constituted the majority of individuals in the central Bahamas.

Small, P. (1994). The Great Barrier Reef environment: A pilot's function. Hulls, Hazards And Hard Questions Shipping In The Great Barrier Reef. Meeting of Experts. Shipping in the Great Barrier Reef - Reducing the Risk of Spilling Oil and Other Hazardous Substances, Canberra, A.C.T. (Australia) (pp. 64-80). Great Barrier Reef Marine Park Authority. Notes: maps, diagrams

Abstract: A vessel proceeding from Asia to Australia or New Zealand has a choice of two basic routes: Torres Strait and across the Coral Sea; or the Inner Route of the Great Barrier Reef. Of the latter course, the section from Torres Strait to Cairns is the main compulsory pilotage area. Pilotage must be considered as a preventive safety operation. The emphasis over the past 15 years has almost entirely shifted from the welfare and quick passage of the vessel itself to the protection of the environment. Methods of operation and the main problems encountered are described.

Stevens, T. F., & Page, A. J. (1994). Towards a conservation plan for cetaceans in Queensland. Encounters With Whales '93: A Conference To Further Explore The Management Issues Relating To Human Whale Interactions. Lady Elliot Island, Qld (Australia), 6 Sep 1993 (pp. 27-44). Townsville: Qld Australia Great Barrier Reef Marine Park Authority. Notes: 18 ref.

Abstract: The background to the introduction of specialist legislation for the protection and management of cetaceans in Queensland waters is discussed. The process for formulation of a conservation plan is explained. In considering the biology, population dynamics and conservation issues relating to cetaceans, a division into large and small species is utilised. This will probably be reflected in different management approaches to these two groups. A range of management options for improved protection of large whales in Queensland and adjacent Commonwealth waters is canvassed. A discussion of some issues affecting the conservation of cetaceans is included.

VenTresca, D. A. et al. (1994). Artificial fish habitats as a tool for assessing settlement success of rockfishes. Fifth International Conference On Aquatic Habitat Enhancement, Long Beach, CA (USA), 3-7 Nov 1991 [s. 1.]: [s. n.]. Notes: Abstract only.

Abstract: The waters off California are inhabited by more than 60 species of rockfish (*Sebastes* spp.), many of which constitute a significant component of sport and commercial fisheries. Due to the importance of this complex, and the decline of many stocks, the California Department of Fish and Game has initiated studies to evaluate harvest refuges as a management strategy for this group. These refuges will provide protection for populations of sexually mature fishes whose larvae may be transported by currents to other areas. We are studying the interannual variability of time of settlement, distribution, abundance, and growth of young of the year (YOY) rockfishes to determine if larvae from adult rockfishes within a refuge will contribute to fish populations in other areas. Most benthic rockfishes are territorial and cryptic and often take refuge in holes or crevices. Young of the year rockfishes have strong micro habitat preferences and some species readily occupy artificial habitats (CONDOS) which resemble their preferred natural micro refuges. We deployed CONDOS on nearshore reefs in 10 to 20 m along the central California coast from Santa Cruz to Port San Luis. We are using the number of fish per CONDO to assess temporal and spatial variability of settlement of several species of YOY rockfish.

Walker, T. (1994). Seabird distribution on the Great Barrier Reef. Workshop on Oiled Seabird Cleaning and Rehabilitation, Townsville, Qld (Australia), 26 Feb 1991 Townsville: Great Barrier Reef Marine Park Auth.

Abstract: Characteristics of each of the 23 species of seabirds known to breed on Great Barrier Reef islands are summarised. Tables provide details of the cross-shelf distribution of each species, approximate seasons and localities where each species is most concentrated in number, and characteristics of species likely to reduce their susceptibility to oil-spill effects. Finally, a list is provided of breeding islands and the numbers of species known to nest there, in approximate order of decreasing biomass of birds supported.

Walraven, E., & Vogelnest, L. (1994). Emergency care for birds at Lake Liddell oil spill. Workshop on Oiled Seabird Cleaning and Rehabilitation, Townsville, Qld (Australia), 26 Feb 1991 Townsville, Qld (Australia): Great Barrier Reef Marine Park Auth. Notes: 3 ref.

Abstract: In September 1990 at least 10,000 litres of diesel spilled into a cooling lake at Bayswater Power Station in New South Wales. Taronga Zoo staff were requested to attend the emergency treatment of birds on site. The treatment given is outlined and recommendations provided for possible future spills. Of about 140 birds of 10 species treated, only black swans survived to be released after rehabilitation.

Watson, M., & Ormond, R. (1994). Effect of an artisanal fishery on the fish and urchin populations of a Kenyan coral reef. *In: Marine Ecology Progress Series*, 109(2-3), 115-129, Bibliogr.: 51 ref.

Abstract: An investigation of the effects of artisanal fishing on coral reef fish assemblage

structure was undertaken through a comparison of fish stocks on 2 apparently identical sets of reefs, one (within the Kisite Marine National Park) on which all fishing is prohibited, and one (within the Mpunguti Marine National Reserve) on which artisanal fishing only is allowed. Replicate visual censuses of fish along 250 x 10 m band transects at 6 intensive study sites demonstrated that there were large differences in population density and biomass of the principal families of commercial reef fish (Lethrinidae, Lutjanidae and Serranidae) between the unfished marine park area and the adjacent intensively fished marine reserve area, with abundances of commercial species within the park (unfished) being up to 10 or more times those in the reserve (fished). In addition, 6 species of butterflyfish (Chaetodontidae) and 2 species of triggerfish (Balistidae) were significantly more abundant on shallow and/or deep transects within the park. For most species of commercial fish, larger individuals were observed in the park than in the reserve, an effect expected from greater fishing pressure within the reserve. In contrast, smaller *Cephalopholis* spp. (Serranidae), 1 species of butterflyfish, and sea urchins (mostly *Echinometra mathaei*) were significantly more abundant on transects in the reserve. It is suggested that these increased abundances may be second order effects (mediated by reduced competition or predation) of increased fishing pressure. In particular, opposing differences in abundance of predatory triggerfishes (Balistidae) and emperors (Lethrinidae) and of sea urchins are compatible with the view that higher populations of sea urchins may sometimes occur where the densities of their predators are reduced. Overall results allow an assessment of the effect of the artisanal fishery on the fish stocks, and provide a measure of the effectiveness of protection afforded by the marine park.

Weru, S. (1994). Optimum coral reef resource use: Case study of a marine protected area. Nairobi Univ., Kenya.

Abstract: A protected area, Mombasa Marine Park and Reserve, Kenya was established in 1986, in an area that was previously fished. Exclusion of fishermen was however not fully achieved until 1990. This study was conducted between 1992 and 1993 in an attempt to determine the conservation area design and management guidelines, which maximize resource protection and optimize economic return without adverse effects to the coral reef ecosystem. The study considered tourism, space needs for various fish guilds and fisheries yield. Tourism in Mombasa Marine Park earned 36% of all revenue accruing from Marine Parks and Reserves in Kenya. Tourist activities in the sea were concentrated in area estimated at 5 km². From the questionnaire survey, over 72% of the tourists indicated this area to be in either satisfactory or excellent condition. There was no statistically significant difference between the park and the reserve in terms of predation (percentage of tethered sea urchin eaten). The difference in terms of predation between the coral and seagrass zones was significant in the reserve. In the park, one site (across the channel) shows significant difference but the other (wreck) shows no difference. In terms of herbivory (percentage of sea grass blade eaten), both the park and the reserve show no significant difference in general. Similarly, the reserve does not show any difference in herbivory levels between the coral and sea grass zone, whereas the park shows a significant difference. Marine Parks enjoy total protection from any consumptive utilization whereas marine reserves allow artisanal fisheries using traditional gear. To determine changes in community structure in space and time, species turnover for damselfish and wrasse were assessed using underwater visual census techniques. For both the marine park and reserve, species turnover is achieved after 400 m² in the park at 200 m² in the reserve. The species-area relationship becomes asymptotic at 600 m² for 14 species of damselfish and at 800 m² for 17 species of wrasses. For the families sampled, the park shows a higher species density than the reserve. However, in terms of diversity, the two areas show a significant difference only for damselfish but not for wrasses. The similarity indices between the park and reserve are 80.7% and 88.24% for wrasses and damselfish respectively. Artisanal fishermen have centralized landing points where fisheries scout is

deployed to collect catch data. From a sample of 25 fishing boats spread over a period of three months, it was noted that 21.3% of the total weight of fish landed at the Jomo Kenyatta Public Beach landing point was not recorded/declared to the fish scout. An analysis of effort and yield data suggests that for optimum gain, the number of fishermen per fishing boat working for six hours should be 2, that is 12 man-hours. To increase protection of species diversity, revenue from tourism and support from fishermen, The size of the current park should be reduced by 3 km super(2) and a smaller fully protected area of 1 km super(2) established at Ras Iwatine/Nyali coral gardens. This is also expected to increase fishing yield.

Yates, B. F. (1994). Implementing coastal zone management policy: Kepulauan Seribu Marine Park, Indonesia. *In: Coastal Management*, 22(3), 235-249.

Abstract: Since the early 1980s, the Indonesian Government has attempted to protect a coral archipelago known as Kepulauan Seribu from overexploitation by creating a national marine park. The government agency charged with managing the park was unable to implement this policy decision effectively owing to a number of variables, including institutional arrangements within the implementing agency, jurisdictional conflicts with other levels of government, and the diversity of stresses impacting the park. This study uses a widely accepted model for policy analysis to describe the past failings of Kepulauan Seribu National Park and suggests lessons that may be learned for future coastal zone management efforts in Indonesia.

Agardy, T. (1995). Marine eco-tourism: Fundamental characteristics and links to conservation. Sustainable Financing Mechanisms For Coral Reef Conservation: Proceedings of a Workshop Washington, DC (USA): World Bank

Abstract: Nature-based tourism that occurs in coastal areas, commonly called marine eco-tourism, can provide economic and social incentives for promoting coral reef conservation. However, development of tourism in coastal areas of developing countries can be fraught with risk, and those looking to eco-tourism as a way of supporting and financing conservation must evaluate local conditions and constraints carefully. Planners, prospective participants, and financiers of eco-tourism development must consider the social and cultural dimensions, the ecological and environmental dimensions, and the long term economic feasibility before reaching conclusions about the suitability of eco-tourism development in an area.

Andersson, J. (1995). Marine resource use in the proposed Mafia Island Marine Park. (p. 34). [s. l.]: Unit for Environmental Economics, Department of Economics, Gothenburg University.

Abstract: The marine resource users in the proposed Mafia Island Marine Park include the local men, women, and children and an increasing number of outsiders, mainly from Dar es Salaam, Mtwara, Lindi, and Zanzibar. Finfish were the main marine resource, but the individual income earnings were larger for the collection of corals. Octopus fishing was the activity that involved the largest number of people; this is mainly because it can be performed by women and children. Octopus is the product that had the largest difference in buying price on Mafia and selling price in Dar es Salaam. Other identified marine resource activities of significance to the locals were shell and sea cucumber collection. These had very small or no relevance for local consumption and were sold to external markets. Identified environmentally harmful activities were coral collection, dynamite fishing, the use of destructive fishing gears, and the illegal cutting of coastal and mangrove forests. The economic incentives to burn corals for the production of lime were large. Dynamite fishing was generally considered as 'bad', but there was a discrepancy in the perception of the activity between the smaller islands included in the proposed park area. The perception among the locals towards the implementation of the park was very positive. The largest expectations among the local resource users were for the park to secure and eventually improve the productivity of their fishing grounds

Belhadjali, K. (1995). Tuvalu country statement. South Pacific Commission And Forum Fisheries Agency Workshop On The Management Of South Pacific Inshore Fisheries, Noumea (New Caledonia), 26 Jun - 7 Jul 1995 (pp. 55-65). Noumea (New Caledonia): SPC *Technical document*: Vol. 11 .

Abstract: Tuvalu is an island nation consisting of 9 atolls and coral islands, namely, Funafuti (the capital), Nukufetau, Nui, Niutao, Nanumea, Vaitupu, Nukulaelae, Niulakita, and Nanumaga. Each island is governed by a local council, except for Niulakita, which is governed by the Niutao Island Council. There are two separate bodies that have authority over fisheries legislation in Tuvalu. The Government of Tuvalu under the Fisheries Act has power to protect, promote, regulate and control fish and the fisheries industries. The Minister of Natural Resources exercises a number of these powers. Under the Local Government Act, each island council is given power to regulate the fisheries in their island. At the present time there are few fisheries regulations in effect. However, with the development of fisheries from subsistence level to artisanal level, the problem of overpopulation on Funafuti, and the possible development of a commercial scale deep-water snapper fishery, the need for management measures and legislation is becoming more apparent. The Fisheries Department is currently in the process of drafting several management proposals: 1) A fisheries management plan for the sustainable exploitation and management of the deep-sea snapper resources; 2) A ban on the use of diving equipment for the harvest of benthic organisms; 3) The establishment of a fish inspection unit that would certify the quality of all seafood exports out of the country, with particular emphasis on high value species such as deep-sea snappers; 4) A minimum mesh size of 3 inches for gillnets. In addition, because of the high population density in Funafuti and the resultant pressure on the resources, the Funafuti Town Council is considering imposing several management measures such as the establishment of a marine park and sanctuary in the Funafuti lagoon, and licensing of all commercial fishermen in Funafuti.

Bleakley, C. (1995). A cooperative program to implement the marine protected areas report. Sustainable-financing-mechanisms-for-coral-reef-conservation:-proceedings-of-a-workshop Washington-Dc-Usa: World-Bank

Abstract: The foundation for the report, A Global Representative System of Marine Protected Areas, is a marine management network through CNPPA-a regional network of working groups comprised of managers and scientists, representatives of government and nongovernment communities. We believe this composition makes the network ideally suited for developing biodiversity conservation through international waters project proposals, and in implementing the recommendations in the report. An important linkage has been established with the ICRI's Framework for Action. Some initial support is available to IUCN through the U.S. government to use the marine management network in contributing to the ICRI process, and participate in the ICRI regional workshops. The aim of this network and partnering is to facilitate on-the-ground action. We hope to emerge from this process with country-driven proposals for the GEF and other donors that implement recommendations of the report and priorities identified for ICRI.

Bohnsack, J. A., Harper, D. E., & McClellan, D. B. (1995). Fisheries trends from Monroe County, Florida. *In: Bulletin of Marine Science*, 54(3), 982-1018.

Abstract: Fishing is an important activity in the Florida Keys National Marine Sanctuary (FKNMS). Concern exists that excessive fishing could be deleterious to individual species, disrupt marine ecosystems, and damage the overall economy of the Florida Keys. We examined data from commercial, recreational, and marine life fisheries in Monroe County, Florida. Invertebrates comprised the majority of commercial landings. In 1992, the total reported commercial landings were composed of 52% invertebrates (4.09×10^6 kg), 28% reef fishes (2.19×10^6 kg), and 21% non reef fishes (1.62×10^6 kg). In the

recreational headboat fishery, reef fishes accounted for 92% of 0.107 x 10 super(6) kg average total annual landings from the Dry Tortugas and 86% of 0.201 x 10 super(6) kg landed from the Florida Keys since 1981. Average annual landings for other recreational fisheries were estimated at 1.79 x 10 super(6) kg for reef fishes (45%) and 2.17 x 10 super(6) kg for non reef fishes (55%) from 1980 through 1992. Finer resolution of catch and effort data are needed, especially for recreational fisheries. Landings for some species varied greatly over time. The most conspicuous declines were for pink shrimp, combined grouper, and king mackerel while the most conspicuous increases were for amberjack, stone crab, blue crab, and yellowtail snapper. Landings of spiny lobster have generally remained constant. Fisheries closed to harvest included queen conch, Nassau grouper, jewfish, and stony corals. Effective fishing effort has increased over time with more participants and more effective fishing technology. Since 1965, the number of registered private recreational vessels has increased over six times, while the number of commercial and headboat vessels has remained stable. The number of management actions have continually increased and become more restrictive with increased fishing effort. The new FKNMS provides a unique opportunity to shift management emphasis from a species approach to an ecosystem and habitat based approach.

Brodie, J., & McPhail, I. (1995). Science and management: The Great Barrier Reef Marine Park Authority experience. Proceedings of the Second International Symposium and Workshop on Marine and Coastal Areas: Integrating Science and Management . Washington, DC. Office of Ocean and Coastal Resource Management, NOAA, and the U.S. Man and the Biosphere Reserve Program.

Burnett, W. J. (1995). Techniques for allozyme electrophoretic analysis of zoanthid samples. *In: Aust. Inst. Mar. Sci.*, 20, 30.

Abstract: The Zoanthidae (zoanthids) form an order of the Anthozoa (Cnidaria) in the subclass Hexacorallia, which also includes the Actiniaria (sea anemones), Antipatharia (black corals), Ceriantharia (tube anemones), Corallimorpharia and Scleractinia (stony corals). Like most of these groups, the zoanthids have historically proven taxonomically difficult. Zoanthid samples were collected inter-tidally, using SCUBA or snorkel, from a large number of localities in the Great Barrier Reef Marine Park and the Torres Strait (Australia). Allozyme electrophoresis was used to identify species boundaries in zoanthids and to allow a rigorous revision of the order. Exact details of experimental protocols, of great value to future workers, are provided, with particular emphasis on the initial surveys of enzyme activity, determination of optimum running conditions and the correct interpretation of allozyme banding patterns, all of which represent a major investment of time and effort.

Causey, B. (1995). A coordinated research program for the Florida Keys National Marine Sanctuary. *In: Bulletin of Marine Science*, 54(3), 1073. Notes: Abstract only.

Abstract: The passage of the Florida Keys National Marine Sanctuary and Protection Act has made it possible to consider the development of management strategies that are ecosystem wide in scope. The 2800 square nautical mile Sanctuary encompasses the entire marine environment of the Florida Keys. It includes all of the major communities that help to comprise and support the diverse coral reef ecosystem that Congress has declared significant. Equally diverse are the various uses of the marine resources of the Keys that experience enormous levels of direct and indirect human impact. Comprehensive, holistic management is a relatively new concept in the management of marine protected areas in the United States. The success of this innovative, ecosystem approach to marine management is largely dependent upon the degree of coordination and cooperation that is established between Sanctuary management and the scientific community. At the October 1991 Research Planning Workshop, which was jointly sponsored by NOAA and RSMAS, there was a strong consensus that managers and researchers

must drive each other's agenda in the Florida Keys National Marine Sanctuary (FKNMS). It was suggested that management decisions should be based on a scientific understanding of the functioning of the ecosystem, as determined through existing and planned research. An objective of this paper is to review the policy recommendations that were generated at the 1991 Workshop and to suggest a protocol for establishing a working partnership between Sanctuary management and the scientific community. The merits of a scientific advisory board and Memoranda of Agreements between various agencies will be discussed. Other mechanisms for establishing a solid partnership between Sanctuary management and the scientific community, including various government agencies, academia, non governmental organizations, and the private sector will be explored. Hopefully, this paper will serve to rally scientific interest toward ecosystem based research. Such an approach will require that researchers coordinate with one another at unprecedented levels. Some dogmatic approaches to research problems may have to be stripped away to allow for increased coordination and cooperation within the scientific community. The various federal, state, and local agencies affected by the development of the management plan for the FKNMS have shown an enormous amount of interagency cooperation and coordination during the planning process. These efforts should serve to exemplify for the scientific community, the significance of the task at hand in South Florida.

Causey, B. (1995). An ecosystem approach to managing marine protected areas for sustainable use. Sustainable Financing Mechanisms For Coral Reef Conservation: Proceedings Of A Workshop, Washington, DC (USA), 23 Jun 1995 Washington, Dc Usa : World Bank
Abstract: The Florida Keys extend approximately 220 miles southwest from the southern tip of the Florida peninsula in the United States. Located adjacent to the Keys' land mass are spectacular, unique, and nationally significant marine environments, including seagrass meadows, mangrove islands, and extensive living coral reefs. These communities are the marine equivalent of tropical rain forests in that they support high levels of biological diversity, are fragile and easily susceptible to damage from human activities. Warning signs that the Keys' environment and natural resources were fragile, and not infinite, came early. In 1957, a group of conservationists and scientists held a conference at the Everglades National Park and discussed the demise of the coral reef resources in the Keys at the hands of those who were attracted there because of their beauty and uniqueness. The conference resulted in action that created the world's first underwater park, the John Pennekamp Coral Reef State Park, in 1960. Other management efforts were undertaken to protect the coral reefs of the Florida Keys. The Key Largo National Marine Sanctuary was established in 1975 to protect 103 square nautical miles of coral reef habitat stretching along the reef tract from just north of Carysfort Lighthouse to south of Molasses Reef, offshore of the Upper Keys. In 1981, the 5.32 square nautical mile Looe Key National Marine Sanctuary was established to protect the popular Looe Key Reef, located off Big Pine Key in the Lower Keys.

Chater, S. A. et al. (1995). Underwater visual census of fishes in the St. Lucia Marine Reserve, South Africa. *In: Lammergeyer*, 43, 15-23.
Abstract: The first quantitative estimates of fish abundance on the high latitude (27 degree S) coral reefs in the St Lucia Marine Reserve on the South African coast are presented. Selected species were monitored annually by underwater visual census at fixed transect sites at Two Mile Reef and Leadsman Shoal during the period 1987-1992. The wrasse *Thalassoma hebraicum* was the only monitored species to be recorded on all 22 transects and had a mean abundance of 24,2 per 1000 m super(2) at Two Mile Reef and 40,1 per 1000 m super(2) at Leadsman Shoal. Other species which had high frequencies of occurrence were *Acanthurus leucosternon*, *Chaetodon madagaskariensis*, *C. unimaculatus*, *Forcipiger flavissimus*, *Lutjanus kasmira*, *L. russelli*, *L. bohar*, *Bodianus diana*, *B. bilunulatus* and *Amphiprion allardi*.

Chesher, R. H. (1995). Giant clam sanctuaries in the Kingdom of Tonga. *In: Tech. Rep. Mar. Stud.*, (2), 87. Notes: Incl. bibliogr.: 84 refs.

Abstract: The report provides an account of activities conducted during a public environment improvement project conducted in Tonga during the period June 1987 - October 1990 in order to enhance the stocks of giant clam (*Tridacnidae*). It is presented in 3 parts. The first part details public involvement in the establishment and maintenance of community giant clam sanctuaries and the second deals with how it can be scientifically proven that the giant clam sanctuary actually improved wild stocks of wild giant clam on nearby reefs. The biology of the giant clams of Vava'u are examined in the third part, covering *Tridacna derasa*, *T. squamosa* and *T. maxima*.

Cheung, C. (1995). Status of marine conservation in Vietnam. *In: Coast. Manage. Trop. Asia*, (4), 21-23.

Abstract: A brief account is given of the activities and findings of phase I of the Vietnam Marine Conservation Project, which commenced in July 1992. Its major objectives were to identify sites of high conservation priorities by means of surveys, to initiate priority projects/actions based on survey findings and also to pinpoint problems and issues related to marine conservation on a broad scale. Surveys on the biodiversity, resource utilization and threats from human activities were completed for 7 coral reef sites from north to south of Vietnam. National and local action include: 1) Establishment of the National Council for Marine Conservation; 2) Marine protected area system (MPAS); and, 3) Recommendations on development of management plans for the MPAS.

Christie, P., & White, A. (1995). Reef fish yield and reef condition for San Salvador Island, Luzon, Philippines. *In: Asian Fisheries Science*, 7(2-3), 135-148.

Abstract: The annual reef fish yield has been estimated for San Salvador Island, Philippines, for 2 consecutive years. From April 1988 to March 1989, reef fish yields were approximately 7.0 t km super(-2) times year. Reef fish yield increased 100.0% to 14.0 t km super(-2) year for the following year, primarily as a result of increased catches of juvenile fusiliers (*Caesionidae*). Catch per unit effort, however, did not significantly increase over the period of the study and has been estimated at 3.148 kgwork hour for the 2 years. This information forms a baseline for the future from which to analyze the impact of the establishment of a marine sanctuary and traditional fishing reserve on San Salvador Island. In order to assess the relative condition of San Salvador's fishery, these findings are compared to other coral reefs in the Philippines. San Salvador's reef has a low percent coral cover and low richness and density of fish, possibly as a result of the historic use of destructive fishing methods. However, findings indicate that a community-based resource management plan may have the potential to positively affect the island's fishery.

Davies, C. R. (1995). Movement of a small serranid, *Serranus cabrilla* within the Loano artificial reef in the Ligurian Sea, Italy. *In: Biologia Marina Mediterranea*, 2(1), 91-94 .

Abstract: The importance of movement in the population dynamics of exploited species of demersal reef fish has received little attention. This is despite its potential importance in relation to the effectiveness of fisheries management measures such as artificial reefs and marine reserves. This presentation describes the design and methods of a study of the movement of a small serranid, *Serranus cabrilla*, within an artificial reef at Loano (Italy) in the Ligurian Sea, (NW Mediterranean). The techniques and approach used in this study may be applied equally to other species and other habitats, such as natural temperate and tropical reef systems.

Dight, I. J. (1995). Understanding larval dispersal and habitat connectivity in tropical marine

systems. A tool for management. *In*: T. Agardy (eds.), The science of conservation in the coastal zone. New insights on how to design, implement and monitor marine protected areas (pp. 41-46). Gland, (Switzerland): IUCN .

Abstract: Computer models have been developed which are able to reproduce large scale patterns of water motion around Australia's Great Barrier Reef and the movement of larvae between reefs. These models, based on well understood physical principles, determine the probability that larvae from any given source reef will be carried to a sink reef where they will develop into adults. Efforts are aimed at such modelling of 46 important reefs of the Great Barrier Reef Marine Park. With increasing human pressures upon reefs in this park, stress on reef communities can be minimised through zoning schemes that incorporate information about source-sink relationships. In many marine systems this is especially important since the ability of a system to recover from stress will depend largely on the availability of juveniles to the population.

Doherty, P. J., Planes, S., & Mather, P. (1995). Gene flow and larval dotation in seven species of fish from the Grcat Barrier Reef. *In*: Ecology, (76), 2373-2391.

Done, T., Ogden, J., & Wiebe, W. (1995). Coral reefs. *In*: United Nations Environment Programme (ed), Global biodiversity assessment (pp. 381-387). Cambridge, UK: Cambridge University Press.

Dufour, V., Jouvenel, J. Y., & Galzin, R. (1995). Study of a Mediterranean reef fish assemblage. Comparisons of population distributions between depths in protected and unprotected areas over one decade. *In*: Aquatic Living Resources, 8(1), 17-25.

Abstract: Differences in Mediterranean fish communities of two rocky coastal areas, one inside an integral marine reserve and the second outside the reserve, near Banyuls-sur-Mer were compared using underwater visual census after a 12-year interval. Water depth affected the relative abundance of fish communities and the number of species was roughly maintained in both sites. The abundance of species has decreased in the integral reserve whereas it has been maintained outside the reserve; Nine species are more abundant in the integral reserve and nine others are more abundant outside the reserve. Among the species vulnerable to fishing, such as *Labrus merula*, *Symphodus tinca*, *Mullus surmuletus*, *Diplodus sargus*, *Diplodus vulgaris*, *Scorpaena porcus*, *Oblada melanura*, 6 of the them are more abundant outside the integral reserve and 4 others are more abundant outside. These results stress the need for a more regular and more extensive survey of the fish assemblage in and around the marine reserve of Cerbere-Banyuls.

Fishelson, L. (1995). Elat (Gulf of Aqaba) littoral: Life on the red line of biodegradation. *In*: Isr. J. Zool., 41(1), 43-55.

Abstract: During the last three decades, intensive industrialization along the head of the Gulf of Aqaba has adversely affected the shallow water community, including the fringing coral reef. The main factors in this biodegradation and species extinction appear to be domestic and industrial effluents, dust from fertilizers from the harbor-loading station, and oil spills. In the last decade, tourism became a major negative factor, especially at the Elat Coral Reserve. The most prominent results of this deterioration is the depletion of the soft-bottom communities, with a serious decline in macro-infauna, such as echinoderms and some gastropod molluscs, and the dominance of nematodes and polychaetes on the polluted sites. The decline is also documented in the intertidal *Tetraclita-Cellana* community, which disappeared along with accompanying species. This has also been observed in the Coral Reserve. A similar decline is also seen in tidal fish populations of blennies, gobies, and singnathids. Pollution in the Coral Reserve has also adversely affected the dominant branching coral species, destroying most of

these, thus causing the almost complete disappearance of symbiotic fish species, such as *Dascyllus aruanus*, *Gobiodon* spp., *Paragobiodon* spp., and *Pseudochromis olivaceus*, that formerly sheltered in these corals. Data are provided on the endangered species of the Elat littoral, including the Coral Reserve. It is suggested that only direct and immediate prevention of land-borne pollutants can halt the collapse of the littoral coral communities and, thus, enable their regeneration.

Geoghegan, T. (1995). Revenue generation to sustain coral reef conservation. Sustainable Financing Mechanisms For Coral Reef Conservation: Proceedings Of A Workshop Washington,-Dc-Usa: World Bank

Abstract: With well-managed and fully self-financing marine protected areas in three territories of the region (Saba Marine Park, Bonaire Marine Park, and the marine protected areas of the British Virgin Islands), the Caribbean may be leading the way in local financing of coral reef conservation. In all of these territories, the revenue generation strategies employed are based on user fees levied on scuba divers and, in the case of the British Virgin Islands, yacht charters as well. The success of these strategies has been largely dependent on a high level of collaboration between the protected area managers and the commercial users of the marine protected areas; that is, the dive operators and charter boat companies. In every case, the fees are actually collected by the commercial users, who also share other tasks related to administering the systems.

Glynn, P. W., Rumbold, D. G., & Snedaker, S. C. (1995). Organochlorine Pesticide Residues in Marine Sediment and Biota from the Northern Florida Reef Tract. *In: Marine Pollution Bulletin*, 30(6), 397-402.

Abstract: As part of a two-phased study, sediment and biota were collected from Pennekamp Coral Reef State Park and Key Largo National Marine Sanctuary and analysed for organochlorine pesticide residues. Phase 1 consisted of an inter-laboratory comparison using replicates of unspiked field samples. The five participating contract-laboratories differed in methodology, detection limits and their ability to detect pesticides. The highest concentration of pesticide reported in Phase 1 samples was 4.4 ng g⁻¹ wet wt aldrin, found in a fillet of *Haemulon plumieri*. Based on the inter-laboratory comparison, one laboratory was selected to analyse additional samples collected in Phase 2. Pesticides were detected in 43 of the 52 Phase 2 samples. The highest concentration reported in Phase 2 samples was 2.3 ng g⁻¹ [alpha]-BHC in *Panulirus argus* tail muscle. These results suggest that while most samples contained one or more residues, pesticide concentrations were low and trends in residue profiles were minor.

Gwynne, H. L. (1995). Impact of tourist pontoons on fish assemblages on the Great Barrier Reef. The Best Available Information - Its Implications For recreational Fisheries Management. Workshop At Second National fisheries Managers Conference Held At Bribie Island, Queensland, 18 October 1994. (pp. - Pp. 80-84). [s. l.]: [s. n.].

Hammond, J. (1995). Underwater features of South Australia. *In: South. Fish.*, 3(1), 14-16. Notes: illus.

Abstract: The CSIRO Division of Fisheries is engaged in a major project to document all of Australia's coastal underwater features, with emphasis on reefs and seagrass meadows - valuable nursery and feeding areas for fish, crustaceans and other marine animals. Maps will be produced that will be essential in the designation of marine parks and reserves, pinpointing vulnerable areas that need protection from pollution, and invaluable in the event of an oil spill or similar disaster.

Haskell, B. D., Lindelof, E., & Causey, B. (1995). Monitoring the health of the Florida Keys

National Marine Sanctuary: Research needs. *In: Bulletin of Marine Science*, 54(3), 1078.

Abstract: The Florida Keys National Marine Sanctuary is the first sanctuary in the Nation to encompass an entire ecosystem. It is composed of several productive and biologically diverse communities such as the coral reefs, seagrasses, and mangroves, some of which are showing signs of severe stress. Recognizing the threats to these unique resources, the President signed the Florida Keys National Marine Sanctuary and Protection Act (Keys Act) on November 16, 1990. The Keys Act calls for the protection of resources and requires NOAA to develop a comprehensive management plan. The sanctuary will be managed to allow continued, compatible multiple uses while achieving the resource protection goals of the Keys Act. This will be accomplished through coordinated interagency resource protection efforts, education which promotes wise use of resources, zoning to minimize conflicts and protect biodiversity, and research designed to better understand the ecosystem. In addition to identifying research needs, the Keys Act requires that NOAA establish a long term ecological monitoring program. To successfully protect this ecosystem, NOAA must understand and monitor its health. This will require considerable input from researchers. This paper will review research needs and will propose a framework for a long term monitoring program for the sanctuary

Horrill, C. (1995). Formulating a practical management strategy for biodiversity conservation of Mafia Island's coral reefs. *In: L. A. Bennun, R. A. Aman, & S. A. Crafter (ed), Conservation of biodiversity in Africa: Local initiatives and institutional roles, Nairobi (Kenya), 30 Aug - 3 Sep 1992* (pp. 309-320). Nairobi Kenya : Centre for Biodiversity, National Museums of Kenya.

Abstract: The marine ecosystems of the waters around Mafia Island are amongst the most pristine on the East African coast, supporting a high level of biodiversity. In contrast, the status of many other examples of Tanzania's coral reef ecosystems has declined markedly over the last 25 years, despite the creation of several solely protective marine reserves in 1975. Failure of these reserves, coupled with unsustainable resource utilization and the extended nature of marine ecosystems, has highlighted the need for a new approach to management. The management strategy formulated for Mafia Island provides for an integrated approach to these problems and the conservation and biodiversity within marine ecosystems. Management of activities in the area will utilize a collaborative approach between the Mafia Island Marine Park authorities and the local communities. Involvement of the indigenous population is regarded as a crucial factor in the success of this type of management.

Jennings, S., Grandcourt, E. M., & Polunin, N. (1995). The effects of fishing on the diversity, biomass, and trophic structure of Seychelles' reef fish communities. *In: Coral Reefs*, (14), 225-235.

Abstract: A fishery independent underwater visual census technique was used to assess the effects of fishing on the diversity, biomass, and trophic structure of the diurnally active non-cryptic reef-associated fish communities of the Seychelles. One-hundred and thirty-four species associated with three significantly different types of reef habitat were censused at one protected ground and in six fishing grounds subject to different fishing intensities. There was an inverse relationship between fishing intensity and the biomass of several species targeted by the fishery. The diversity of families containing target species (Lutjanidae, Lethrinidae) was significantly higher at protected and lightly fished sites as was the total biomass of the fish community and the biomass of piscivorous, piscivorous/invertebrate feeding, and herbivorous trophic groups. However, there was no indication that the biomass of non-target species increased in response to the removal of their predators by fishing. The findings of this study are significant for fishery managers because they suggest that intensive differential cropping of top predators will not necessarily lead to increases in the biomass and productivity of prey

Johnson, D. (1995). Managing marine protected areas in the UK: Lessons from conserving reef systems. *In: D. Whitmarsh, & J. Northern* Management Techniques In The Coastal Zone (pp. 215-222). [s. l.]: Portsmouth Univ.

Abstract: Coral represents a special, delicate marine ecosystem, which is particularly susceptible to physical damage and environmental stress. Whilst coral has been destroyed in many areas, reef systems have also inspired extremely successful attempts to protect and manage marine habitats. This paper briefly examines the management of the world's two most extensive reef systems. Australia's Great Barrier Reef is protected by a well-established, comprehensive, statutory zoning system which has recently undergone its first five yearly review. In contrast, the Coral Cay Conservation Project, winner of the 1994 British Airways Golden Globe Award for the finest example of environmental tourism, is helping to initiate coastal zone management which aims to secure a future for the reef system of Belize.

Kelleher, G. (1995). History of the marine protected areas report. Sustainable Financing Mechanisms For Coral Reef Conservation: Proceedings Of A Workshop (pp. 10-12). Washington, Dc Usa : World Bank

Abstract: A Global Representative System of Marine Protected Areas (MPAs). What does the term mean? It means a representative of every kind of marine ecosystem that exists in the sea. These four volumes represent a combination of nine years work by three institutions-the World Conservation Union (IUCN), the Great Barrier Reef Marine Park Authority (GBRMPA) and The World Bank. The program started in 1975 when IUCN recognized the problem of potential threat to the integrity of much of the world's marine resources. In 1979 the GBRMPA realized it as well. In the First General Assembly of IUCN, a resolution was adopted to work toward creation of a global representative system of MPAs. In that same year a resolution was passed by the World Wilderness Congress in Colorado

Kelleher, G., Bleakley, C., & Wells, S. (1995). A global representative system of marine protected areas. Volume IV. South Pacific, Northeast Pacific, Northwest Pacific, Southeast Pacific and Australia/New Zealand. *In: G. Kelleher, C. Bleakley, & S. Wells* (eds). Washington, USA: Great Barrier Reef Marine Park Authority, the World Bank and the World Conservation Union (IUCN).

Kerr, R. (1995). Community groups and the protected areas resource conservation project. Sustainable Financing Mechanisms For Coral Reef Conservation: Proceedings Of A Workshop Washington, Dc Usa : World Bank

Abstract: Started in 1989, the Protected Areas Resource Conservation (PARC) Project is a joint initiative between the Government of Jamaica, the U.S. Agency for International Development (USAID) and The Nature Conservancy. PARC's principal objective is the establishment of a system of protected areas in Jamaica. This system was pioneered by two pilot parks: the Blue and John Crow Mountains National Park and the Montego Bay Marine Park. Both parks have been officially opened for the past two and three years, respectively. The success of establishing protected areas in Jamaica has foundations in two areas: Sound appreciation of the diversity of stakeholders involved in natural resources management (largely locals, who are the de facto managers) and their critical role in the successful financing and management of both marine and terrestrial protected areas. Development of strategy, methods and organizational form to create partnerships which convert resource-use conflicts into motive forces for conservation and sustainable development initiatives. For both pilot parks in Jamaica, the conservation values (biodiversity and developmental) provided platforms for building and expanding partnerships with long term commitments to conservation.

Kimani, E. N. (1995). Coral reef resources of east Africa: Kenya, Tanzania and the Seychelles.

In: Naga, 18(4), 4-7.

Abstract: Coral reefs are widespread along the east African coast and Seychelle islands. Their roles in island building and coastal protection are often underestimated, they are also important fishery habitats and major tourist attractions. The east African marine fishery production, estimated at 1.4-4.9 tonnes per km super(2), is principally a result of artisanal fishing. Siltation, trampling, and destructive fishing methods are the main cause of coral reef degradation along the east African coast and associated islands. Legislation has been implemented to protect coral reefs by establishing marine parks and reserves. However, poaching and anchor damage are widespread on these protected reefs. Legislative provision to increase the benefit to fishing communities may reduce poaching. The establishment of exclusive nature reserves may be one way to ensure preservation of some coral reefs in the region.

King, M., Faasili, U., & Ropeti, E. (1995). Management strategies for inshore fisheries in tropical Pacific Islands. South Pacific Commission And Forum Fisheries Agency Workshop On The Management Of South Pacific Inshore Fisheries (pp. 507-519).

Abstract: Reasons for declines in the stock sizes of some Pacific Island lagoon and reef species include overexploitation, the use of damaging and overly-efficient fishing practices and environmental deterioration. In many cases, these have been exacerbated or caused by inadequate knowledge and poor management practices. An examination is made of such concerns and constraints, offering also possible strategies to address them. The use of previously published data to suggest safe sustainable yields from different types of environments and relative catch rates are recommended to indicate the health of the fish stocks and the need to take appropriate action. An important strategy is to move the focus away from commercial fisheries, and concentrate on subsistence fisheries. The marine environment continues to suffer from the effects of sewage disposal, mangrove clearance, land reclamation and, particularly, siltation in lagoon systems. The use of co-management, between central governments, fisheries authorities, fishers and village communities is an important ingredient in strategies to conserve inshore fish stocks. Nationally imposed fisheries regulations are likely to be ineffective unless they have the support of the community. Innovative ways of ensuring the sustainability of fish stocks include the establishment of community-supported Marine Protected Areas within a village's usual or traditional fishing area.

Littler, M. M., & Littler, D. S. (1995). Impact of CLOD pathogen on Pacific coral reefs. *In: Science*, (267), 1356-1360.

Maida, M., Padovani Ferreira, B., & Bellini, C. (1995). Avaliação preliminar do Recife da Baía do Sueste, Fernando de Noronha, com ênfase nos corais escleractíneos. *In: Bol. Tec. Cient. CEPENE*, 3(1), 37-47.

Abstract: This paper presents a preliminary evaluation on the status of scleractinian corals in the Sueste Bay reef in the National Marine Park Fernando de Noronha. *Siderastrea stellata* was almost always observed on the reef top, of these 48% presented signs of partial necrosis possibly caused by uncontrolled tourism activities.

Man, A., Law, R., & Polunin, N. (1995). Role of marine reserves in recruitment to reef fisheries: a metapopulation model. *In: Biological Conservation*, 71(2), 197-204.

Abstract: While marine reserves can replenish local populations of reef fishes exploited by fishermen through enhanced survivorship of post-recruitment fishes, the manner in which reserves enhance larger-scale recruitment to fish stocks is poorly understood. We investigate a metapopulation model to see how marine reserves might help to conserve such populations and benefit fisheries. The model defines two kinds of patches: (i) those open to fishing and (ii) those maintained as reserves free from exploitation. Each patch may occur in one of two states

according to whether or not it contains fishes recruited to the fishery. It is shown that reserves become highly beneficial as the local extinction rate caused by fishing becomes large because they provide a source of recruitment into fished-out patches. In such circumstances, the introduction of reserves meets the needs both of conservation and of sustainable exploitation of the fishery. The abundance of the exploitable population is maximized when half of all patches (reserves + exploited patches) are occupied by the stock. The sustainable yield is also maximized when half of all patches are occupied, assuming that yield is proportional to the local extinction rate. This result could provide a rule of thumb for fishery managers addressing the specific question of enhancing recruitment in heavily depleted stocks of certain reef fisheries. However, like other metapopulation models, the one here makes some important simplifying assumptions which would need to be addressed in the application of these results to specific fisheries

Maragos, J. E., & Cook, C. W. Jr. (1995). The 1991-1992 rapid ecological assessment of Palau's coral reefs. *In: Coral Reefs*, 14(4), 237-252.

Notes: Special Issue: Science and Management.

Abstract: At the request of the Palau and US governments, a team of 30 scientists under the leadership of the Nature Conservancy completed a rapid ecological assessment (REA) of nearshore marine resources in Palau in 1992. The REA provided ecological input to Palau's ongoing master plan for economic development and identified 45 marine sites worthy of special protection. The REA relied on previous literature, 1992 aerial photography, interviews, and field observations. A combination of qualitative and quantitative techniques were used to assess stony corals, other reef invertebrates, reef and shore fishes, macroscopic algae, seagrasses, sea turtles and other marine organisms. The REA covered a variety of coral reef habitats including beaches, seagrass beds, fringing reefs, lagoons, passes, channels, reef holes, patch and pinnacle reefs, barrier reefs, atolls, submerged reefs, mangroves, and "rock" islands. Major stresses to Palau's coral reefs include sedimentation from soil erosion, overfishing, and damage from periodic storms and waves. Minor stresses include dredge-and fill activities, sewage pollution, anchor damage, tourism use, ship groundings, aquarium fish collecting, and minor crown-of-thorns (*Acanthaster*) infestations.

McCawley, R., & Teaff, J. D. (1995). Characteristics and environmental attitudes of coral reef divers in the Florida Keys. *In: General Technical Report Intermountain Research Station*. (Report No. INT-323.). [s. l.]: [s. n.].

Abstract: This 11-day study determines whether relationships exist among coral reef divers' demographic characteristics, diver specific characteristics, sports diving activity, sports diving trips, reasons for diving, knowledge of coral reef ecology, and attitudes toward the environment. The two study sites were in the Florida Keys National Marine Sanctuary, USA (Key Largo and Key West). The programme provides divers with an exciting non-routine diving experience, and allows them to enjoy the undersea environment while learning to identify fish species and coral. It is concluded that coral reef divers who desire to learn about and be a part of the coral reef environment tend to be concerned with the negative impacts persons are having on the natural environment and will, thus, be more supportive and understanding of rules and regulations.

McClanahan, T. (1995). Fish predators and scavengers of the sea urchin *Echinometra mathaei* in Kenyan coral-reef marine parks. *In: Environmental Biology of Fishes*, 43(3), 187-193.

Abstract: Predation on 120 adult sea urchins of the species *Echinometra mathaei* was observed during daylight in shallow-water coral reefs (0.5 to 3 m deep) in a variety of sites in 3 Kenyan marine parks. The predators were few (8 species) and dominated by the triggerfish *Balistapus undulatus* (65% of all observations) followed by terminal-male wrasses *Coris formosa*, *C.*

aygula and *Cheilinus trilobatus*, and lastly the scavenger *Lethrinus mahsena*. Those species that attempted, but failed, to prey on *E. mathaei* were slightly more numerous (11 species), while scavengers of opened carcasses were the most diverse (20 species). Based on these observations, it is suggested that *B. undulatus* is a 'keystone predator' and that fishery regulations that protect this species may be necessary in order to reduce the detrimental consequences of high sea urchin abundance -- such as high reef substrate erosion and competitive exclusion of fishes.

McClanahan, T., & Obura, D. (1995). Status of Kenyan coral reefs. *In: Coastal Management*, 23(1), 57-76.

Abstract: The existence of four marine parks and numerous reefs experiencing intense human resource use has provided the opportunity for a number of studies that have helped increase the understanding of human impacts on Kenyan reefs. Studies indicate that the removal of finfish is having the largest impact on unprotected reefs and has a number of secondary and tertiary effects on other faunal groups and ecological processes. A high abundance of sea urchins in unprotected reefs result from reductions in sea urchin predators - largely due to overfishing. High sea urchin populations are associated with reefs with lower coral cover, topographic complexity, and reduced calcium carbonate deposition rates. One reef was converted into a marine park during the study period (1987 to 1994) and showed rapid recovery in coral cover and fish abundance and diversity. Some species of gastropod appear to be affected by shell collecting, but the total fauna seems more affected by removal of their finfish predators. River sediment discharges and eutrophication are of secondary importance but are not severe as yet; they are difficult to distinguish from natural variations over geologic history. We briefly suggest alternative management and research actions for Kenyan reefs on the basis of their existing management

McManus, J. (1995). Future prospects for artificial reefs in the Philippines. *Artificial Reefs In The Philippines* (pp. 33-39). Manila, (Philippines): International Cent. for Living Aquatic Resources Management *ICLARM conference proceedings*: Vol. 49.

McManus, J. (1995). Large and small-scale marine protected areas: Planning, investment and intergenerational quality of life. *Sustainable Financing Mechanisms For Coral Reef Conservation: Proceedings Of A Workshop* Washington, Dc Usa : World Bank

Abstract: Two proposed marine protected areas in the South China Sea are contrasted in terms of planning and investment frameworks and their contributions to the intergenerational quality of life (IQL) of coastal villagers. The small (6 km super(2)) proposed marine reserve park system in Bolinao, northwestern Luzon, is designed for bottom-up implementation and management within a coastal area planning and community development program. The proposed Spratly Island Marine Park involves 200,000 to 300,000 km super(2) disputed by six claimant governments, and would require a top-down implementation and management by a professional organization. The two protected area systems are designed to provide sustainable harvests and other benefits to coastal villagers, in one case adjacent to the protected area, and in the other hundreds of miles away from it. The need is reiterated for setting aside 20 percent of all coral reef areas as small reserves and for a set of strategically placed larger reserves to ensure the maintenance of inter- and intra-specific biodiversity and IQL benefits to coastal dwellers.

Meier, O. W., & Porter, J. W. (1995). Long-term monitoring of Floridian coral reefs: Changes before and after Hurricane Andrew. *In: Bulletin of Marine Science*, 54(3), 1080-1081. Notes: Abstract only.

Abstract: Six coral reef locations in the Florida Keys were permanently marked and have been

photographed periodically between 1984 and 1992. Our photostations consist of two locations on Looe Reef in the Looe Key National Marine Sanctuary (monitored since 1984), two locations on Carysfort Reef in the Key Largo National Marine Sanctuary (monitored since 1984), and two locations in Biscayne National Park: Ball Buoy Reef and Triumph Reef (monitored since 1989). During each monitoring episode we determined species number, species diversity, and percent cover of living coral. Between the initial sampling year and 1991, all photostations lost between 13% and 29% of their initial species number, and five of the six photostations declined in percent cover of living coral. Losses ranged from 7.3% to 43.9% of initial projected surface area. Coral cover increased in only one photostation during this period, but that station was on one of the reefs hardest hit by Hurricane Andrew. It is remarkable, however, that the amount of damage to reefs in the path of this Class 4 hurricane was still less than the losses incurred by reefs elsewhere in the Florida Keys from other impacts. This presentation will focus on a comparison of pre hurricane and post hurricane patterns among corals in terms of sources of mortality, species specific patterns of coral loss, and geographic trends among reefs in mortality rates and patterns. For example, while Triumph and Ball Buoy Reefs were located approximately equidistant from the epicenter of the hurricane, the force released at Triumph Reef was greater than that released at Ball Buoy Reef. Hypotheses explaining the differences in damage will be presented.

Melendez, R. (1995). Conflict management and benefit sharing as a means toward conservation of marine biodiversity. Sustainable Financing Mechanisms For Coral Reef Conservation: Proceedings Of A Workshop Washington, Dc Usa : World Bank

Abstract: This paper summarizes a presentation of case studies related to the use of conflict management processes with the objective of attaining conservation of coastal and marine resources. Two cases are based on recent experiences fostered by Fundacion Futuro Latinoamericano (FFLA).

Mndeme, Y. E. S. (1995). Mafia marine resources in peril. *In: Naga*, 18(2), 12-13 .

Abstract: The rich marine resource of the Mafia District, Tanzania, especially its coral reefs and mangroves, are in danger of collapse. The proposed marine park faces chronic problems of dynamite fishing and coral mining. The Mafia fisheries resources and the importance of coral reefs are presented together with proposed measures to rescue the Mafia marine environment.

Munro, J. L. (1995). Alternative strategies for coastal fisheries rehabilitation. *In: J. L. Munro, & M. C. Balgos (eds.), Artificial Reefs In The Philippines* , Chap. 49, (pp. 42-51). Manila, (Philippines): ICLARM.

Abstract: Alternative uses are proposed for financial resources devoted to the construction and installation of coral reefs. These include environmental management and rehabilitation, the development of community-based resource management or co-management systems, the creation of marine protected areas, active management of fish stocks and fisheries enhancement for selected species. The benefits and constraints of these alternatives are evaluated and it is concluded that many of these options should be give priority over the installation of artificial reefs.

Mwanje, J. I. (1995). Coastal tourism in East Africa: Perspective, concepts, development and management. Proceedings Of The Workshop And Policy Conference On Integrated Coastal Zone Management In Eastern Africa Including The Island States. Report From The Swedish Agency For Research Cooperation With Developing Countries Marine Science Program Manila: Manila Coastal Management Center

Abstract: The East African coast is an area of great physical beauty encompassing a variety of coastal ecosystems which are of vital importance to tourism development. Sandy beaches, coral

reefs, marine parks, sport fishing and the nearby game reserves and national parks are increasingly attractive to tourists, particularly within the unique sociocultural setting of the region. The economic value of tourism is increasingly important to the region, particularly in terms of foreign exchange earnings. In 1993, Kenya and Tanzania were expected to receive 1,000,000 and 215,000 tourists, respectively. As tourism continues to expand, there are serious concerns about the effects of poor development practices on this sector, caused by coastal pollution, erosion and sedimentation, destruction of coastal habitats and urbanization. Tourism development itself can also have a number of direct negative impacts on the natural and sociocultural environments of coastal areas. Poorly planned tourism development may result in pollution and degradation of coastal habitats, overexploitation of natural resources, skyrocketing land costs and clashes with local attitudes and values. Most countries in the region have ministries and other relevant organizations charged with the development and management of tourism. There is, however, a need to better synchronize and integrate policies and legislation affecting tourism at both the national and regional levels, particularly within the broader context of coastal zone management.

Omar, R. M. N. R. et al. (1995). Design and construction of artificial reefs in Malaysia. *In: Bulletin of Marine Science*, 55(2-3), 1050-1061.

Abstract: Malaysia has embarked on the construction of an artificial reef complex using 10 cm PVC pipe. Beginning 3 March 1991 100 units of X-shaped modules (the primary design) were assembled in the Pulau Perhentian Marine Park waters in 18 m. Modules measuring 2 m highlands 2 m wide were arranged in an "E" shape (the secondary design) on a seabed of about 1.860 m super(2). This concept is different from other artificial reef designs such as pyramidal shapes discarded tires and cylindrical concrete culverts. These later reefs have been designed to recruit fish from natural sources whereas the PVC reefs used in this study were intended to retain fish fry released in the reef complex and to explore the possibility of rearing fish fry in the wild. When the fish reach marketable size the local fishermen will be allowed to fish using hooks and lines

Ossipov, D., & Noskov, A. (1995). The initiative of Russian-Finland island reservation organization in the Gulf of Finland eastern part. *In: R. S. Volskis (ed), Species And The Environment* (pp. 54-58). Venice Italy : Roste .

Abstract: At the end of the 1980s the Finland nature protecting organizations and State Committee of Nature Protection of the former USSR made an attempt to organize the reservation in the frontier neighbouring area. The international experience of protected areas formation demonstrates a favourable influence of frontier regime being one of the initial conditions of region recommendation for reservation status. In the result of the mutual vigorous efforts and planned measures realization, the reservation "Friendship-1" has been created near the frontier of Finland and Karelia. The conception of the organization of island cluster reservation, including the islands Seskar, Maly, Bolshloy and Maly Tuters, Gogland, Fiskar, Sommers, Virgin Islands, Nerva, Vigrund, Kurgal reef islands, etc, is based on the use of different protected area status. The introduction of the reservation regime on some islands would make it possible to preserve the biological diversity, including the rare and disappearing plant and animal species, more than 300 of which are among the specially protected objects of this region and Europe

Pearson, M. (1995). The role of marine parks and reserves as a mechanism for large scale management of coastal resources. IOC PERSGA ACOPS Workshop on Oceanographic Input to Integrated Coastal Zone Management in the Red Sea and Gulf of Aden. Jeddah, Saudi Arabia, 8 October 1995 Paris France : UNESCO

Abstract: Recognizing the close linkage between coral reefs, associated marine governments

and tourism development objectives in Southern Sinai, the Egyptian government, with assistance from the EU, developed the Ras Mohammed National Park at the southern extremity of the Sinai Peninsula. The National Park, now extended to cover 52% of the Egyptian Gulf of Aqaba littoral, has become the driving force behind a successful coastal zone management strategy that has achieved a balance between economic development activities and the conservation of critical marine resources.

Pendleton, L. H. (1995). Valuing coral reef protection. *In: Ocean & Coastal Management*, 26(2), 119-131.

Abstract: Past economic valuations of tropical marine parks inaccurately measure their economic benefits because they value the resource protected and not the protection provided. Instead, the economic benefit of a marine park should be measured as the savings from avoided losses in reef value that would result in the absence of park protection, net of any costs of protection. Proponents of marine parks posit that reef quality will decline in the absence of active park protection. The economic benefit of the marine park is the value of avoided reef degradation. An economic framework is developed to show how marine parks and protected areas ought to be valued. An example using data from the Bonaire Marine Park is given.

Porter, J. W., & Meier, O. W. (1995). Assessing change in Floridian coral reefs. *In: Bulletin of Marine Science*, 54(3), 1082. Notes: Abstract only.

Abstract: Our widely reported studies on coral loss in the Florida Keys demonstrate that (1) all six stations showed a reduction of biotic diversity, (2) five of six stations showed a loss of living coral cover, and (3) no station showed any recruitment of juvenile corals of any major reef building species during the seven years of the survey. These alarming results raise three questions: (1) Are these trends statistically significant? (2) Are the areas chosen representative of surrounding reef areas? and (3) Are the sample size sufficient to extrapolate to the entire Florida reef tract? In answer to these questions: (1) yes, (2) yes, and (3) no. To address the third question, we report on a whole reef survey initiated by the Great Barrier Reef Marine Park Authority. Their survey utilizes 216 video belt transects, each 50 m long and 2 m wide, arranged in the following manner: 6 bands perpendicular to the shore line (stretching out to the reef from Cairns to Heron Island); 3 reefsband (a near shore reef, a mid shelf reef, and an off shore reef); and 12 video transectspere reef (three "key reefs," photographed annually; plus 9 "cycle reefs," photographed once every three years). The video camera moves along permanent transects. Videos are analyzed either by fixed points on randomly grabbed frames or random points on regularly grabbed frames. Power analyses predict that this technique will detect 20% change among common biota. This system could be adapted for Florida Keys coral reefs.

Post, J., Hooten, A. J., & Hatzios, M. E. (1995). Sustainable financing mechanisms for coral reef conservation: Proceedings of a workshop. (p. 123). Washington, DC USA: World Bank.

Abstract: Shortly after the World Bank's Environment Department was established, biodiversity became an area of great interest. A symposium on the subject of biodiversity was organized; however, surprisingly little attention was initially given to the area of marine biodiversity. In the early stages, the Bank's role in biodiversity conservation was difficult to define. The challenge was to join finance with scientific rigor and action, with results realized in a reasonable timespan. In the late 1980s and early 1990s, a series of workshops was held and proposals solicited. The Bank decided to build on existing activity and adopt an ongoing IUCN program. Using 18 groups world-wide, IUCN was identifying priority areas for marine conservation. The effort has resulted in the production of the report we are launching today: A Global Representative System of Marine Protected Areas. How the report can contribute to future conservation efforts is discussed by the representatives on this panel.

Rajasuriya, A., & White, A. (1995). Coral reefs of Sri Lanka: Review of their extent, condition, and management status. *In: Coastal Management*, 23(1), 77-90.

Abstract: Sri Lanka, with 17 million people and a coastline of about 1,585 km, has nearshore coral reefs of varying quality along about 2% (up to 32 km) of the linear coast. Reefs are mostly of fringing type in nearshore waters or patch reefs on rocky substratum varying distances from the shore on the continental shelf. True coralline reefs are few, and most with their general locations known have been surveyed. The most extensive coral reefs occur off the northwest and east coast up to and around the Jaffna Peninsula. Offshore barrier reefs of good condition occur at two locations along the western coast, as well as on two submerged ridges off the southeast coast (Great and Little Bases). Sixty-five coral genera (171 species) and 35 species of butterflyfish are recorded from Sri Lankan reefs. Reef condition is generally poor and declining in nearshore waters. The only relatively pristine reefs are offshore patch or barrier type reefs located away from population centers in a few locations. Sedimentation and coral mining are damaging many nearshore reefs, while the use of explosives and bottom-set nets in fishing are damaging offshore reefs in specific sites. Although institutions and laws are sufficient in theory to manage and protect the reefs in Sri Lanka, authorities in the field have taken little effective action.

Riggio, S. (1995). Research on artificial reefs in Sicily. *In: Biologia Marina Mediterranea*, 2(1), 129-164.

Notes: ORIGINAL TITLE: Le barriere artificiali e l'uso conservativo della fascia costiera: risultati dei 'reefs' nella Sicilia n/o

Abstract: Man-made reefs are a multipurpose technique addressed either to the improvement and reclamation of endangered coastal ecosystems or the passive prevention of illegal trawling and curbing of overfishing. Their ability to enhance the stock replenishment of sand and muddy seagrounds is pointed out and substantiated by numerous experimental data collected in as long as 20 years of research on artificial substrata. Two outstanding case-histories examined in northern Sicily are extensively reported; some hypotheses about new food webs produced by the artificial reefs are examined.

Rinkevich, B. (1995). Restoration strategies for coral reefs damaged by recreational activities: the use of sexual and asexual recruits. *In: Restoration Ecology*, 3(4), 241-251, many ref.

Abstract: Increased leisure time and interest in diving, snorkelling, and other non-extractive forms of recreation have created severe pressure on coral reefs worldwide. Consequently, varying levels of degradation are recorded in all frequently visited reefs, which became more and more accessible to all kinds of recreational activities with the rapid development of offshore tourism. Consequently, the concerns of marine ecologists and decision-making authorities for the future of these coral reefs have led to the management strategy of proclaiming these areas as marine reserves and park system, yet this system has not been found to be a satisfactory conservation policy since such policies have dramatically increased the impact of tourism on reef habitats through activities such as SCUBA and skin diving, fishing, human trampling and sediment resuspension. An alternative strategy is outlined in this paper which proposed to rehabilitate such damaged habitats by the alternate strategy of gardening coral reefs with sexual and asexual recruits.

Roberts, C. (1995). Effects of fishing on the ecosystem structure of coral reefs. *In: Conservation Biology*, (9), 988-995.

Roberts, C. (1995). Rapid build-up of fish biomass in a Caribbean marine reserve. *In: Conservation Biology*, 9(4), 816-826.

Abstract: Marine reserves, where fishing is excluded, have been argued to be an effective

means of managing complex reef fisheries and of protecting populations of species vulnerable to overfishing. The argument rests on predictions of increases in abundance and size of fishes after the elimination of fishing mortality, which in turn leads to greater egg production per unit of reef and greater export via pelagic dispersal to fishing grounds. This study reports responses of fish populations to area closure in a small Caribbean marine reserve surrounding the island of Saba in the Netherlands Antilles. Part of the reserve has been closed to fishing since 1987, and the remainder is subject only to light fishing. Fish populations were visually censused and sizes of individuals present estimated from counts in fished and unfished areas of the marine park in 1991 and 1993. For four of five commercially fished families, biomass was greater in the unfished area than in the fished. Predictions of greater abundance and size in the unfished area were upheld for many of the species observed. Between 1991 and 1993 overall biomass of commercially important families increased 60%, based largely on increases in abundance between years. The predatory snappers (Lutjanidae) increased 220%. Fishing pressure in Saba was reduced between censuses due to changing employment opportunities. It was notable that populations increased in both fished and unfished areas of the park, and the latter is probably an effect of this reduced fishing intensity. Reserves have been suggested as refuges for species vulnerable to overexploitation, especially groupers. Despite protection from fishing, the Saba Marine Park has low population densities of such species, perhaps due to a lack of supply of larvae from unprotected source areas. My study shows that target fish populations may respond swiftly to reductions in fishing pressure and that reserves could play an important role in fisheries management. But protection of vulnerable species is only likely to be successful if networks of reserves are established throughout species ranges to link larval supply and settlement areas.

Rouphael, T., & Inglis, G. (1995). The effects of qualified recreational SCUBA divers on coral reefs. Tech Rep Crc Reef Res Cent Vol. 4 (p. 39). Townsville (Australia): Cooperative Research Cent. for the Ecologically Sustainable Development of the Great Barrier Reef .

Abstract: The primary objectives of this study were: to determine the type and amount of damage done to coral reef habitats by qualified SCUBA divers; to develop an effective technique for assessing diver damage for use in surveying dive sites and in categorizing them according to the degree of damage; to provide preliminary recommendations to the diving industry on how best to minimize diver related damage on coral reefs. The effects of SCUBA divers on corals were studied and coral reef dive sites were examined to see if the topography influenced the type and amount of damage caused by divers. At Agincourt Reef, in the Cairns section of the Great Barrier Reef Marine Park, Queensland (Australia), 214 qualified SCUBA divers were directly observed. No discernible damage to reef benthos was caused by 85% of divers and damage caused by the remaining divers normally consisted of the loss of one or two small fragments per coral colony. There was evidence to suggest that the amount of damage caused by divers is related to the amount of branching coral found at the site.

Sedberry, G. R., & McGovern, J. C. (1995). Reef fish monitoring and assessment at the Marine Resources Research Institute (MRRI). A Coral Reef Symposium On Practical, Reliable, Low Cost Monitoring methods For Assessing The Biota And Habitat Conditions Of Coralreefs .

Shea, K. et al. (1995). Structural restoration of two coral reefs in the Florida keysnational marine sanctuary. Coastal zone (pp. 19-20). New York: ASCE.

Sluka, R. (1995). Influence of habitat on density, species richness, and size distribution of groupers in the upper Florida Keys, USA and central Bahamas. University of Miami, Coral Gables, Florida.

Abstract: The influence of habitat on the density, species richness, and size distribution of groupers (Serranidae) was studied in the upper Florida Keys and central Bahamas from 1992-94. Four major reef types were selected for study: patch reefs, high -relief spur and groove, relict reef flat, and low-relief spur and groove. The size distribution of groupers differed among reef types; the majority of groupers in deeper, low profile habitats were less than 15 cm TL. Protection from fishing influenced the frequency and size distributions of species. A discussion of marine fisheries reserves as a potential management tool for conserving grouper assemblages is provided.

Smith, A. (1995). Community involvement in coral reef monitoring for management in the insular Caribbean. Collaborative And Community-Based Management Of Coral Reefs. Lessons From Experience (pp. 59-67). West Hartford CT (USA): Kumarian Press.

Spergel, B. (1995). Environmental trust funds. Sustainable Financing Mechanisms For Coral Reef Conservation: Proceedings Of A Workshop Washington, Dc Usa : World-Bank

Abstract: Environmental trust funds are an innovative financing mechanism being used by more than twenty countries to cover the recurrent costs of conservation activities, such as strengthening environmental institutions, conserving biological diversity, and promoting sustainable development in general. Environmental funds are established as independent legal entities outside of government, and are managed by a board of directors within the country concerned. An environmental fund acts as an in-country donor that awards grants to NGOs, government agencies and local community groups. For example, an environmental fund in Uganda allocates 60 percent of its grants for projects in local communities surrounding the national parks, 20 percent for park management, and 20 percent for research activities. Usually an environmental fund is set up with an endowment from international donors, and then invested to produce a steady stream of income for supporting conservation activities. These endowments vary in size from US\$1-100 million or more. Money for the endowment may come from grants by international aid donors, private sector sources, and often from debt-for-nature swaps or official debt forgiveness. Annual investment income from the endowment can be supplemented by revenues raised on an on-going basis from "conservation fees" or earmarked taxes collected from tourists and other natural resource "users."

Stanton, J., Robert J., & Flugel, E. (1995). An accretionary distally steepened ramp at an intrashelf basin margin: an alternative explanation for the Upper Triassic Steinplatte "reef" (Northern Calcareous Alps, Austria). *In: Sedimentary Geology*, 95(3-4), 269-286.

Abstract: The Upper Triassic massive limestone (the Oberrhatkalk) at the Steinplatte, Austria, formed along the edge of an intrashelf basin that was situated within a shallow-marine to supratidal shelf approximately 40 km wide. This transition from shelf to intrashelf basin is marked by a distinct slope break that has been widely cited as an example of a reef-rimmed shelf. It is, instead, a distally steepened ramp. The Oberrhatkalk consists of the ramp sediments lying between the Dachsteinkalk of the shelf and the Kossen Formation of the intrashelf basin. The ramp interpretation is based on the geometry and lateral facies progression in the profile from the shallow-marine to peritidal shelf, across the ramp, and into the basin, and on the absence of reef or grainstone deposits at the slope break typical of a rimmed shelf. The Oberrhatkalk at the Steinplatte is an important example of shelf-margin deposition because: (1) It formed in a protected and low-energy intrashelf basin setting, thus expanding the range of distally steepened ramps that have been used to develop a general model. (2) It differs from previously described examples of distally steepened ramps, largely from open-ocean shelf-margin settings, in that: (a) it evolved constructionally from a homoclinal ramp rather than forming at a drowned shelf edge or an antecedent tectonic structure; (b) the sediments of the distal slope are largely autochthonous; (c) slumping and breccia deposits on the distal slope are

of minor importance; turbidites on the basin floor are absent; and (d) skeletal packstone and grainstone characterize the outer ramp and slope rather than mudstone and wackestone.(3) It provides an alternative ramp model for other Upper Triassic shelf and platform margins in the Northern Calcareous Alps, which have commonly been interpreted as reef or sediment rimmed.

Trexler, J. (1995). Implications of population genetics and life history evolution for the management of Florida Keys fishes. *In: Bulletin of Marine Science*, 54(3), 1087. Notes: Abstract only.

Abstract: The management of fish populations in the Florida Keys should consider the consequences of man's activities for genetic variation of fish life histories. Population genetic structure yields information about the scale over which population processes are carried out, but spatial patterns of genetic variation assessed by molecular techniques may not correspond to spatial patterns of genetic variation for life history traits. The consequences of activities such as size selective fishing for fish stocks, therefore, cannot be predicted from population structure alone. Sailfin mollies from the Florida Keys, where these species are ubiquitous, illustrate this point. Life history patterns, physiological adaptations to salinity variation, and allozymes vary on different spatial scales in Keys populations. Should morphologically distinct local populations in the Florida Keys ever be extirpated, efforts to reestablish them should consider all types of genetic variation. The implications of these observation for reef fish management and the design of marine reserves will be discussed

Tunstall, B. R. (1995). Environmental impact assessment of the Cowley Beach Training Area. (p. 76). CSIRO, Division of Water Resources.

Abstract: This report considers the environmental impacts associated with military use of the Cowley Beach Training Area (CBTA) near Innisfail on the north Queensland coast. The land lies within the Wet Tropics of Queensland World Heritage Area, and the marine areas lie within the Great Barrier Reef Marine Park. The CBTA has therefore to be managed for conservation as well as military training. The prime objective of the report is to indicate how sustainable multiple land use can be achieved. Following an introduction, the report is divided into 7 main sections covering: physical environment, biological environment, land use, military infrastructure, environmental impacts, natural resource conservation, and the management plan. The introduction addresses the objectives and context of the report; it also considers the authorities having responsibilities for the area and the legislative constraints. The sections on the physical and biological environment summarise knowledge of these resources. The physical aspects include climate, geomorphology, and soils. The interaction between these elements is considered by way of a regional water balance. The biological aspects are addressed by way of vegetation, fauna, conservation status, and weeds and vermin. Regional land uses are summarised and the military training requirements given. Analyses are given of the capabilities and suitabilities of the land to sustain the land uses. The section on military infrastructure details the facilities, procedures, and practices used in military exercises. The interaction between these activities and natural resources is considered in the section on environmental impacts. Impacts from natural sources such as fire, and non-military sources such as feral animals, are considered along with the impacts associated with military activities. Procedures are given for ameliorating these impacts. The final section provides a tactical-level management plan. We suggested that, by implementing this plan, it is possible to coordinate range control and management activities so as to efficiently achieve sustainable land use.

Uy, W. H., Acuna, R. E., & Moleno, E. (1995). Survey of coral reefs in Initao Marine Park: Fish communities. Third National Symposium In Marine Science Of The Philippine Association Of Marine Science PAMS. Notes: Supplement.

Abstract: The fish communities in the coral reefs of the proposed marine park at Initao,

Misamis Oriental were assessed in November 1993 to January 1994. The daytime fish visual census was used in the conduct of the investigation at five established stations. Two 50 meter transects were laid at two depths, 3m and 10m in each station. Spot checking and collection of fish samples were also done to identify fish species in the area. A total of 53 species were identified belonging to 7 orders, 23 families and 38 genera. The pomacentrids dominate the upper reef slope accounting for 62.90% of the total population. Lutjanidae and Labridae follow next in rank accounting for 15.43% and 9.63% of the total population. For the lower reef slope, pomacentrids accounted for 84.74% followed by labrids and lutjanids with 6.18% and 6.09% respectively. The "indicator" species of the family chaetodonts recorded an average count of 4 and 7 ind/100m for the upper and lower reef slope, respectively. Economically important "target" species were found to be generally low in abundance and diversity.

Uy, W. H., & Openiano, P. L. Jr. (1995). Survey of coral reefs in the proposed Initao Marine Park: Coral communities. Third National Symposium In Marine Science Of The Philippine Association Of Marine Science PAMS. Notes: Supplement.

Abstract: Coral reefs of the proposed marine park in Initao, Misamis Oriental were surveyed last November 1993 to January 1994 to assess their ecological status. Rapid resource assessment was done using the manta tow reconnaissance technique. The coral benthos and associates were assessed using the lifeform line intercept technique in five sites. Five 20-meter transect tapes were laid in two depths at 3m and 10m in each site. A total of 68 species of hard corals were recorded. Results of the manta tow showed relatively healthy coral communities fronting the Initao forest park and along the northeastern portion. The southwestern portion fronting the different beach resorts showed relatively low coral cover. Results of the lifeform transect showed live coral cover, ranging from 11.37-49.77% in the upper reef slope and 13.42-50.49% in the lower reef slope. Dead coral cover gave an average of 26.96% and 12.06% for the upper and lower reef slope, respectively. Massive type *Porites* and *Euphyllia* dominated both the upper and lower reef slopes. Among the associates, soft corals recorded relatively high cover, ranging from 0.99-28.67%, with highest cover in the upper reef slope fronting the Initao forest park. Live coral cover in the proposed marine park is generally fair. Proper management measures are recommended to prevent further habitat degradation and to increase coral abundance in the area.

Waltemath, M., & Schirm, B. (1995). Effects and management of artificial reefs, including experiences outside the Philippines. Artificial Reefs In The Philippines., Iclarm, Manila(Philippines) Manila, (Philippines): International Cent. for Living Aquatic Resources Management *ICLARM conference proceedings*:

Wantiez, L., Thollot, P., & Kulbicki, M. (1995). Effects on coral reef fish communities from five islands of New Caledonia's southern lagoon marine reserve. *In: P. Dalzell, & T. J. H. Adams* South Pacific Commission And Forum Fisheries Agency Workshop On The Management Of South Pacific Inshore Fisheries, Chap. 12, (pp. 393-395). Noumea, [New Caledonia]: South Pacific Comm. Notes: Summaries only

Abstract: The effect of the marine reserve on coral reef fish communities was studied on 5 islands located in New Caledonia's Southern Lagoon. Sampling was undertaken before the fishing closure and after five years of protection. Reference stations located in unprotected sites were also sampled to assess natural variability on the same time scale. Species richness and density and fish biomass on the protected reefs increased respectively by 67%, 160% and 246%. This increase was far more substantial than the variations observed at the reference stations. An enhancement of the species richness and density and the biomass of the major commercial fish families was observed: Serranidae, Lutjanidae, Lethrinidae, Mullidae, Labridae, Scaridae, Signidae and Acanthuridae. Chaetodontidae, which are thought to be

indicators of reef health, had also developed. No significant increase in the mean size of fish was noted among the main species with the exception of the rabbitfish, *Siganus doliatus*. Size structure had, however, generally changed because of the presence of more small specimens after five years of protection. This change to fish community structure can first be attributed to the effects of the marine reserve, leading to an increase in the relative abundance of large edible species within the aggregations. Fish populations are also distributed according to an inshore-offshore gradient. This before-and-after study validates several marine reserve benefits: protection of spawning stock biomass, development of fish populations, and sustaining of population age structure. Marine reserves also indirectly protect fish populations by improving the habitat.

Wells, S. (1995). Marine protected areas in Belize. Sustainable Financing Mechanisms For Coral Reef Conservation: Proceedings Of A Workshop. Washington, DC (USA), 23 Jun 1995
Washington, Dc Usa : World Bank

Abstract: In some ways Belize is a special case, given the level of attention it has received. Coral reefs of Belize are the mainstay for the government, through tourism and fisheries. The first marine protected area (MPA) was Half Moon Caye, established in the late 1960s or early 1970s. However, there has been no active management of Half Moon Caye. Although it has been declared as a protected area, money is still not available to develop a management plan. Even in the face of donor activity in Belize, we are still relying upon voluntary support for developing management plans and other on-the-ground activities vital to management of the reef. In Belize a variety of legislation can be used to protect coral reefs. The Ministry of Natural Resources covers parks and protected areas, and fisheries legislation allows for the formation of marine reserves. Half Moon Caye was established under the Ministry of Natural Resources, and Hol Chan Marine Reserve was established under the Fisheries Department. These two government agencies have different approaches to protecting marine resources. The Ministry of Natural Resources identifies an area that is considered appropriate for conservation, and once boundaries have been established, it can be designated with little or no ground work. However, requirement for a management plan follows designation. As a result, there are a number of paper parks in Belize.

Weru, S. (1995). Marine conservation in Kenya. Status And Future Of Large Marine Ecosystems Of The Indian Ocean. A Report Of The International Symposium And Workshop
Gland Switzerland: IUCN

Abstract: The Kenyan coastline is protected from the open sea by a fringing reef that runs along the entire coastline except at the mouths of the Sabaki and Tana rivers. This reef has created highly productive reef lagoons, which are placed under three levels of management: protected, partially protected, and unprotected. Nine marine conservation areas covering a total of 760 km² have been created under the first two management levels. This has arisen out of the realization that a community's state of development is a significant variable affecting the coastal marine resources of Kenya. Research has shown that protected and partially protected areas have higher total finfish and coral abundances than unprotected areas. Finfish are also reported to be much smaller in size in unprotected areas. It has become necessary, now more than ever before, to address the optimal size of marine parks and reserves, referred to in this paper as the "single large or several small" (SLOSS) argument. Ecological and socioeconomic considerations are becoming increasingly important prerequisites in decision making.

Williams, D., & Russ, G. (1995). Reserves, resilience and recruitment. South Pacific Commission And Forum Fisheries Agency Workshop On The Management Of South Pacific Inshore Fisheries (pp. 673-676). Noumea (New Caledonia): South Pacific Comm. *Noumea New Caledonia Spc* : Vol. 12.

Abstract: An examination is made of the development of marine reserves as tools for management of fish stocks. Possible effects of reserves on the non-reserve area are likely to be either 1) the movement of fish that have recruited to the reserve and grown there, to adjacent non-reserve areas; or 2) providing sources of juvenile replenishment to non-reserve areas via larval dispersal from the protected spawning stock. Given the current critical levels of over-exploitation of many coral reefs and the general lack of effective fisheries management, networks of marine reserves may be the only viable option available to maintain the levels of spawning biomass.

Anderson, I. (1996). Return of the Coral Eaters. *In: New Scientist*, 149(2015), 7.

[Anon.]. (1996). ReefBase: a global database on coral reefs and their resources. Version 1.0. Manila-Philippines: ICLARM.

Abstract: ReefBase is a global database on coral reefs developed by International Center for Living Aquatic Resources Management (ICLARM) in response to the demand for summary information on the uses, ecological status and management of reefs worldwide. ReefBase 1.0 is a user-friendly database on CD-ROM intended for the use of scientists, academicians, students, resource managers in government and private institutions, divers and other coral reef enthusiasts. This version has information on over 6,300 coral reefs around the world. These include some 1,114 records on bottom cover measurements, detailed resource maps from the World Conservation Monitoring Centre (WCMC) of over 130 of the most important reef systems in the world, data over 400 marine protected areas, and at least 1,870 reported perturbations to coral reefs. It also contains human reef use indicators developed and integrated into the database by the Rapid Assessment of Management Parameters (RAMP) project in collaboration with the University of Rhode Island. It features the results of some of the field tests of RAMP indicators in Jamaica and Philippines. ReefBase also has summary tables and offers geographical approach to avail information, through WinMap. ReefBase 1.0 uses WinMap to generate maps on country reef distributions, coral reef ecology, uses and management, and natural and anthropogenic stresses. ECOPATH II, the ICLARM-developed aquatic ecosystems modeling software, has been attached to ReefBase 1.0 to allow ReefBase to model coral reef ecosystems, and describe average states and estimate rates of key reef processes based on available data in ReefBase

Bohnsack, J. A. (1996). The impacts of fishing on coral reefs. *In: Biological Conservation*, 76(2), 211.

Abstract: Fishing has significantly reduced populations of some reef species, particularly larger species which are often top predators. Reef organisms tend to be vulnerable to overfishing because of life history characteristics that are not adapted to high adult mortality associated with fishing. Reduced fish populations can indirectly impact coral reefs particularly by changing patterns of predation and herbivory which are important structuring forces in coral reef ecosystems. Marine fishery reserves offer opportunities to better understand the impacts of fishing on coral reef health and function

Brown, B. E. et al. (1996). Natural and anthropogenic disturbances of intertidal reefs of SE Phuket, Thailand 1979-1992. *In: Biological Conservation*, 76(2), 217.

Abstract: Human influences include discharge of tin-ore washing liquors onto the reef and the effects of dredging for a deep-water port facility. Natural factors include widespread coral bleaching (possibly as a result of increased seawater temperatures) and the effects of sub-aerial exposure and localised solar bleaching.

Chansang, H., & Phongsuwan, N. (1996). Health of fringing reefs of Asia through a decade

of change: a case history from Phuket Island, Thailand. *In: Biological Conservation*, 76(2), 217.

Abstract: Data from 1980-1992 show a decrease of live coral cover in five transects, whereas coral cover increased at one site and remained more or less the same at the other. Of the sites which showed a decline in coral cover, the causes of decline were natural causes (Acanthaster predation, storm damage, coral bleaching) and man-made effects, (boat anchoring, damage from tourists, coral collection, fishing in reef areas and possibly eutrophication).

Cook, C. B., Dodge, R. E., & Smith, S. (1996). Fifty years of impacts on coral reefs in Bermuda. *In: Biological Conservation*, 76(2), 214-215.

Abstract: The high latitude coral reefs of Bermuda have been impacted by two major kinds of events since the early 1940's. The first was the dredging operation in Castle Harbour, where sedimentation, turbidity and altered hydrology caused a mass mortality of corals, especially of the major reef-building genus *Diploria*. While there has been post dredging recruitment of corals, *D. strigosa*, a species sensitive to sedimentation, has been particularly slow to recover and is less prevalent at this site than elsewhere in Bermuda. Also, since 1940, 13 major ship groundings have occurred on the reefs which have destroyed an estimated 1% of the outer reefs. It is estimated that 100-150 yr would be required to restore coral coverage and species diversity, with species of *Diploria* being particularly slow to recover.

Cortes, J. (1996). A reef under siltation stress: a decade of degradation. *In: Biological Conservation*, 76(2), 215.

Abstract: The coral reef at Cahuita National Park, Caribbean coast of Costa Rica, has been stressed by sediments from watersheds of rivers that flow to the sea near the Park. High sediment loads in these rivers are due to deforestation on the highlands and to inappropriate agricultural practices on the coastal plains. During the last decade natural disturbances (coral bleaching in 1983, sea urchin *Diadema antillarum* die-off in 1983 and 1992, at 7.4 earthquake in 1991) and other anthropogenic stresses (pollution, tourism) have contributed to the degradation of the coral reef.

Cox, C. et al. (1996). Nocturnal foraging in the Caribbean spiny lobster, *Panulirus argus*. Twenty Fourth Annual Benthic Ecology Meeting, Held In Columbia, South Carolina, March 7-10, 1996 (p. 30).

Notes: Abstract only

Abstract: Spiny lobsters (*Panulirus argus*) were observed during the night by diving along randomly selected transects across sand, seagrass, and rubble zones within the reef flat in the Looe Key National Marine Sanctuary. Lobsters from dens on the fore reef were repeatedly observed foraging on the reef flat during the night. Preferred foraging areas were extensive rubble ridges surrounding the reef flat. Subsequent sampling of the rubble area revealed hundreds of species of potential prey items. Gut contents of 75 intermolt lobsters caught in Biscayne Bay and Dry Tortugas consisted of a myriad of prey items dominated by molluscs, especially gastropods (48%), chitons (14%) and bivalves (11%), and by crabs (11%). Abundance of *Cerithium litteratum*, a favored food item, was as high as 348 snailssq. m in the rubble zone at Looe Key. Prey items were relatively scarce in sand and seagrass.

Craik, W. (1996). The Great Barrier Reef Marine Park, Australia: A model for regional management. *In: Natural Areas Journal*, 16(4), 344-353.

Abstract: The Great Barrier Reef Marine Park, a multiple-use marine protected area covering some 344,000 km super(2), extends from low-water mark along much of the Queensland coast out to the Coral Sea. The area encompassed within the park's outer boundaries is managed as a single ecosystem through agreements between the Commonwealth and the Queensland Government relating to Marine Parks and Island National Parks. The advantages of the Great

Barrier Reef Marine Park model of large area management fall under the heading of ecosystem management: managing for ecologically sustainable use, including recognition and balancing of all interests and legitimate extractive activities, and providing for protection of significant areas where resource extraction is prohibited. The model includes legislative support of the complementary management arrangements of state and federal agencies (e.g., fisheries agencies). Disadvantages of the model include the geographical restriction of the Great Barrier Reef Marine Park to marine areas (major impacts undoubtedly arise on the mainland), the magnitude of resources required to manage such a large area adequately, the difficulties of having several agencies involved in management, and legislative requirements. On the balance, however, large area management is a more rational and forward-looking method of achieving ecologically sustainable use.

Darwall, W. R. T., & Dulvy, N. K. (1996). An evaluation of the suitability of non-specialist volunteer researchers for coral reef fish surveys. Mafia Island, Tanzania -- a case study. *In: Biological Conservation*, 78(3), 223-231.

Drake, S. F. (1996). The International Coral Reef Initiative: A strategy for the sustainable management of coral reefs and related ecosystems. *In: Coastal Management*, 24(4), 279-299.

Abstract: The International Coral Reef Initiative (ICRI) is a new and innovative strategy developed by countries and nongovernmental partners as a means to implement the recommendations on coral reefs and related ecosystems found in Agenda 21 and other international agreements. The ICRI uses a multilevel (international, national, regional, and local), participatory (both top-down and bottom-up) approach based on partnerships formed among many different sectors and stakeholders to promote capacity building, research and monitoring, and sustainable use and management of coral reefs and related ecosystems (mangroves and sea grass beds). The ICRI builds on the principles related to coastal zone management and sustainable development-partnership, integration, coordination, and participation. The ICRI has been effective in creating political will and momentum among many different sectors and facilitating the development of an international agenda with priorities for coral reefs. An analysis of ICRI's effectiveness to date is provided along with recommendations for its future success.

Gischler, E. (1996). Late Devonian-Early Carboniferous deep-water coral assemblages and sedimentation on a Devonian seamount: Iberg Reef, Harz Mts., Germany. *In: Palaeogeography, Palaeoclimatology, Palaeoecology*, 123(1-4), 297-322.

Gittings, S. R., Bright, T. J., & Hagman, D. K. (1996). The MV Wellwood and other large vessel groundings: coral reef damage and recovery. *In: Biological Conservation*, 76(2), 218.

Abstract: Coral community recovery was followed for five years on Molasses Reef (Key Largo National Marine Sanctuary) after the grounding of a 122 m freighter. Substantial population recovery occurred in the five years following the grounding, but colonies remained small. Hard coral recruitment was dominated by species that brood larvae. Though, in time, complete recovery would occur naturally, transplantation could be used to increase the relative abundance of species found only rarely as recruits. These include primarily the large massive corals conspicuous in mature reef communities. Most are broadcast spawners, and have long planktonic stages, low recruitment rates, and low relative abundances in mature communities. Following large vessel groundings that cause extensive flattening of portions of the reef surface, transplantation could also serve to restore lost habitat complexity, and enhance the rate of development of associated invertebrate and reef fish assemblages.

Gittings, S. R., Bright, T. J., & Hagman, D. K. (1996). Protection and monitoring of reefs on

the Flower Garden Banks, 1972-1992. *In: Biological Conservation*, 76(2), 215.

Abstract: Escalating oil and gas production on the outer continental shelf of the Gulf of Mexico in the 1970s stimulated monitoring programs to document any related long-term changes in coral populations and growth rates on the reefs of the Flower Garden Banks. Regulations prohibiting industrial development on the banks, and those requiring the shunting of discharges to deep water within four miles of the banks have been in place since 1974. No significant changes have been observed in coral cover, population levels, diversity, evenness, or accretionary and encrusting growth. However, demonstrable impacts have resulted from vessel anchoring and natural catastrophes such as the mass mortality of the sea urchin, *Diadema antillarum*.

Hartcher, M., & Shearin, J. (1996). Developing a corporate wide network for GIS. *In: Reef Research*, 6(2), 8-12.

Abstract: The use of Geographic Information Systems (GIS) at the Great Barrier Reef Marine Park Authority, Queensland (Australia) has been less than ideal, given that the Reef contains about 3,000 reefs and 1,000 islands, including vast lengths of coastline with critical habitats such as mangroves and seagrasses, sites for endangered species such as turtle and dugong and supporting a plethora of commercial activities including trawling, line fishing, tourism and recreational activities. A strong commitment by GIS users to develop coordination and standards has led to a dramatic increase in the use of information to guide decision making, accompanied by an increase in the level of conceptual understanding of GIS and spatial analysis to the level where users can develop methods to solve spatial problems. The future focus for GIS in the Great Barrier Reef Marine Park Authority should be on the coordination of data needs, modelling and reporting systems.

Hawkins, J. P., & Roberts, C. (1996). The growth of coastal tourism in the Red Sea: present and possible future effects on coral reefs. *In: Biological Conservation*, 76(2), 216.

Abstract: About 19% of Egypt's reefs are currently affected by tourism, but this is expected to rise > 26% by the year 2000. However, the intensity of effects on reefs is likely to increase much more during this period. Israel plans a further 50% increase in coastal tourism, Jordan 100% and Egypt a 13-fold expansion. Tourist development has already caused substantial damage to inshore reefs near Hurghada from infilling, sedimentation and over-fishing for marine curios. Elsewhere new constructions are also beginning to modify reef habitats. Until now damage to Sharm-el-Sheikh's reefs has been mainly caused by the direct effects of diving and snorkelling. Whilst current levels of recreational use appear to be sustainable, the massive expansion planned throughout the region will place the long-term future of reefs in doubt. The carrying capacity of coral reefs seems sure to be exceeded with widespread reef degradation the likely result.

Hill, G. et al. (1996). Nesting activity, breeding success and colony size for the wedge-tailed shearwater *Puffinus pacificus* on Heron Island. *In: Australian Journal of Ecology*, 21(3), 316-323.

Abstract: The Capricorn Group of islands in Australia's Great Barrier Reef Marine Park sustains one of the world's largest breeding populations of the Wedge-tailed Shearwater *Puffinus pacificus*. Heron Island, a 13.5 ha coral cay which supports tourist and research station leases as well as a national park, is the third largest nesting island in the group. Sample censuses of breeding burrows were conducted each year between 1985 and 1990 and a further survey was completed in 1993. These returned estimates of between 13 264 plus or minus 1387 and 16 337 plus or minus 1545 active burrows (Y plus or minus SE). Burrow densities within each of the habitats monitored showed no significant trends between years, although there were large differences in burrow density between habitats. There were roughly the same number of

burrows in the developed (west) and national park (east) halves of the cay. A miniature video camera system (burrowscope), which allowed nesting chambers at the ends of burrows to be inspected, was used in 1989, 1990 and 1993. This demonstrated that around half the burrows were occupied by incubating birds. Variations were found in the distribution of incubating birds between habitats, although this did not remain constant between the years. In the 1993 season, breeding activity was traced from the burrow establishment to fledging stage. Fifty-one per cent of burrows were used for breeding (eggs laid), 77% of eggs hatched and 80% of chicks produced a fledgling. Overall breeding success for the island was estimated at 61%. In 1993 the area designated as Buildings was found to have significantly lower hatching success compared with natural habitats. Most mortality occurred at the egg stage; however, in the Fringe habitat, mortality was highest at the chick stage. Previous surveys have estimated the breeding population from burrow counts. It now appears that only about 30% of such burrows produce fledglings.

Hodgson, G. (1996). Sedimentation damage to reef corals. *In: Biological Conservation*, 76(2), 217-218.

Abstract: At El Nido, Palauran, Philippines, logging significantly increased soil erosion and sediment transport of the bay: > 80% of surface erosion came from logging roads. Coral cover and number of species declined significantly during the study period. Tests of sedimentation tolerance among 50 species of coral revealed a tolerance hierarchy based on growth form, corallite diameter and polyp extensional ability. The abundance of corals highly susceptible to injury from sedimentation declined significantly over the 12-month period.

Holbrook, S. J., & Schmitt, R. J. (1996). On the structure and dynamics of temperate reef fish assemblages are resources tracked ? *In: M. L. Cody, & J. A. Smallwood (eds), Longterm studies of vertebrate communities* (pp. 19-48). San Diego;Californie, USA: Academic.

Holland, K. N., Lowe, C. G., & Wetherbee, B. M. (1996). Movements and dispersal patterns of blue trevally (*Caranx melampygus*) in a fisheries conservation zone. *In: Fisheries Research*, 25(3-4), 279-292.

Abstract: The short- and long-term movement patterns of blue trevally (*Caranx melampygus*) were monitored using a combination of sonic tracking and tag-and-release techniques. All fish were captured and released on the patch reef surrounding Coconut Island in Kaneohe Bay, Oahu, Hawaii, which has been a no-fishing conservation zone for over 30 years. Sonic tracking produced fine-scale movement data from five fish for periods spanning up to 18 days. All fish displayed diel movement patterns within consistent home ranges, which encompassed different parts of the reef during the night than during the day. Movements were predominantly along the walls of the patch reef, with occasional forays to nearby sections of adjacent reefs. Four hundred and ten fish were tagged and released on the Coconut Island reef, and the recapture sites of 85 recaptured fish indicated that most did not move far from their point of release; 75.5% were recaptured within 0.5 km of their release points. Time at liberty ranged from 4 to 454 days, and distance between release and recapture sites was not related to time at liberty. Some fish were observed many times in the same areas over periods of several months. Both the tracking and recapture data indicate strong site fidelity in this species and low occurrence of long distance emigration. These behavioral traits suggest that successful husbandry of this species may be accomplished through the use of management practices such as establishing no-fishing zones.

Kelleher, G. (1996). Can the Great Barrier Reef model of protected areas save reefs worldwide? *In: Biological Conservation*, 76(2), 218.

Abstract: The conservation of the world's coral reefs requires integrated planning and

management of coastal seas. Australia's Great Barrier Reef Marine Park, the world's largest marine protected area, provides a management model for such integration.

Kelleher, G. (1996). A global representative system of marine protected areas. *In: Ocean & Coastal Management*, 32(2), 123-126.

Abstract: The first major phase of the IUCN's program to establish a global representative of marine protected areas was completed with the publication by IUCN of Guidelines for Establishing Marine Protected Areas and, in association with the World bank and the Great Barrier Reef Marine Park Authority, of the four volume report A Global Representative System of Marine Protected Areas. This latter report lists existing marine protected areas (MPAs) in each of the major biogeographic regions into which the world's coastal seas have been divided and identifies priorities, on both regional and national bases, for establishing new MPAs or for improving management in those which exist but are poorly managed or not managed at all. In addition, general recommendations are made relating to the protection and sustainable use of marine biological diversity and productivity, with particular emphasis on the need for management regimes which provide for integrated management of ecosystems, either by incorporating complete ecosystems in MPAs or by using MPAs as a component of a wider integrated system of planning and management, such as integrated coastal management.

Kulbicki, M. et al. (1996). Les peuplements de poissons de la réserve marine du récif Abore (Nouvelle-Calédonie): composition scientifique, structures trophique et démographique avant l'ouverture à la pêche. *In: Doc. Sci. Tech. Cent. ORSTOM Noumea*, 1(1), 210.

Abstract: An inventory of the fish assemblages was undertaken in a marine reserve of New Caledonia. Part of this reserve will be soon open to fishing. This study has two parts, on one hand the study of the fish assemblages and on the other hand the study of commercially or recreationally important species. The reserve covers 80 km², with three major biotopes, the reef flat, the dropoff and a submerged reef of branching *Acropora*, called locally the "forest". A total of 32 stations were sampled by 32 transects for fish assemblages and 157 transects for commercial fish species. These stations are distributed equally among 6 zones, each zone being divided into the three biotopes (reef flat, dropoff, forest). A total of 340 species were observed, of which 147 were of commercial interest. The dropoff had the most species (254), the reef flat and the forest having a similar number of species (204 and 206). The average density was 3.6 fishm super(2) (*Clupeidae* excluded), the highest densities being on the dropoff (3.65 fishm super(2)) and the lowest in the forest (1.9 fishm super(2)). The density of commercial species (0.91 fishm super(2)) followed the same trends. The major families in density were the *Pomacentridae*, *Labridae*, *Scaridae*, *Acanthuridae*, *Mullidae* and *Chaetodontidae*. The species composition in density changed from one biotope to the next, the major families remaining the same. The most abundant commercial species were the *Scaridae* and *Acanthuridae*. The average biomass was 338 gm super(2), however if the very large and rare species (sharks and rays) were excluded, then the biomass was of 262 gm super(2). Nearly 70% of the biomass was made of commercial species. The dropoff had the highest biomass (326 gm super(2)) and the reef flat the lowest (195 gm super(2)). The benthic macrocarnivores had the most species (96), followed by the herbivores (62 species), the microcarnivores, zooplanktivores and piscivores having a similar number of species (from 38 to 43). There was no difference between biotopes in the trophic structure in species number. Zooplanktivores were the most abundant with the herbivores, these two categories totaling more than 70% of the total density. The variability between biotope of the abundance of the various trophic groups was small. Biomass was dominated by macrocarnivores and herbivores, whereas zooplanktivores represented only a low proportion of the biomass. There were more piscivores in the forest than in the other biotopes. The biomass of herbivores increased with the amount of hard substrate. The analysis of the size structure suggests migrations with age between biotopes and different growth rates depending

on the biotope for a large number of species. The distribution of the life history strategies suggested that the most stable assemblages were found in the least disturbed biotopes (forest and bays in the reef), and the least stable being found on the reef flat. Most of the stock was in the forest, this biotope having a large area. The families contributing the most to the commercial stock were the Scaridae and Acanthuridae, however, *Plectropomus leopardus* was the major commercial single species. The MSY was grossly estimated. The fishing effort needed to reach this MSY is well beyond the local fishing potential. However, the fishing effort should not be distributed evenly, the reef flat and the dropoff being much easier to fish, whereas these biotopes support only 20% of the commercial stock

Kuta, K. G., & Richardson, L. L. (1996). Abundance and distribution of black band disease on coral reefs in the northern Florida Keys. *In: Coral Reefs*, 15(4), 219-223.

Abstract: The abundance and distribution of black band disease on the reef building corals *Montastraea annularis*, *M. cavernosa*, *Colpophyllia natans*, *Diploria clivosa*, *D. labyrinthiformis* and *D. strigosa* were determined at Algae Reef, Grecian Rocks and Key Largo Dry Rocks in the Key Largo National Marine Sanctuary, Florida, USA. During July and November of 1992 and July 1993, surveys of permanently marked sites covering 9424 m² of reef tract showed that up to 0.72% of 1397 coral colonies of these species were infected with black band disease. The distribution of the disease among the thirty 20-meter diameter sites was clumped, suggesting that the disease is infectious. Year-round monitoring revealed that seasonal disease patterns varied between reefs. Three seasonal patterns were apparent: some coral colonies were infected year round; several colonies exhibited previously unreported reinfection on a seasonal basis; and some exhibited the widely reported pattern of infection limited to the warmer months of the year (sea water temperatures 25 °C or higher).

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Leao, Z. M. A. N. et al. (1996). Impact of tourism development on the coral reefs of the Abrolhos area, Brazil. *In: Biological Conservation*, 76(2), 215-216.

Abstract: The reefs of the Abrolhos area (the southernmost coral reefs in the Atlantic) have an undoubted importance for scientific studies, as they are ecologically unique and rich in endemic species. They are also economically valuable for fisheries. A five year survey on the effects of marine tourism in the offshore reefs of the Abrolhos Marine Park revealed that the regional tourism is the most active one, and although severely controlled, visitor activity has been hazardous to the reefs. In the nearshore zones, the reefs are not under any kind of environmental control. They have been impacted by high sedimentation influx, caused by deforestation of the Atlantic rainforest. This is now reinforced with the fast growth of urban

centers in the coastal zones.

Letourneur, Y. (1996). Réponses des peuplements et populations de poissons aux réserves marines: Le cas de l'île de Mayotte, Océan Indien occidental. *In: Ecoscience*, 3(4), 442-450.

Abstract: This study investigates the effects of establishment of a marine reserve on the coral reef fish communities at Mayotte Island, Western Indian Ocean, after three years of protection. Both total species richness and global abundance did not differ significantly between protected and non-protected areas. There were significant differences for numerous families and species. Most of the high carnivorous fishes were more diverse and more abundant in the marine reserve. Other fishes, presented the opposite pattern. The mean biomass of commercial fish species was significantly higher in the reserve than in non-protected areas. This pattern was also evident for carnivorous fishes, and semi-pelagic fishes. In contrast, other commercial species had higher biomass in non-protected areas. Despite this apparent contradiction, results seem to be linked with the marine reserve protection. Cessation of fishing activities in the reserve may have caused increases in diversity, abundance and biomass of large carnivores. The decrease in the number of these fishes in non-protected areas due to fishing may favour development of other populations, dominated by potential prey for carnivorous fishes.

Lohse, R. M., & Kildow, J. T. C. (1996). Impact of tourist pontoons on fish assemblages on the Great Barrier Reef. *Stellwagen Bank National Marine Sanctuary Monitoring Plan Vol. MIT-T-96-004* (p. 122). [s. l.]: MIT Sea Grant.

Lombardi, A. (1996). Venezuela: le parc national de Los Roques. *In: Courrier De La Nature*, (160), 18-23.

Abstract: The Los Roques archipelago in the Caribbean Sea, north of Caracas in Venezuela, is a vast natural area which is rich in coral reefs, bird and marine life. Intense fishing activity and scientific research have long been a feature of these islands. Since the 1980s, they have also been attracting a growing number of tourists which has had a negative effect on the natural environment. Some species of marine life have even been threatened with extinction. Concerned by this problem, the Venezuelan government has designated the area as a national park. The park has been divided into zones which afford differing levels of protection, some of which are totally out of bounds except to scientific research and others of which permit only certain activities. Public access has been limited to those zones which are outside the protected areas. A special unit of environmental wardens has been established to ensure that the park's rules are enforced.

Macintyre, I. G., Cortes, J., & Glynn, P. W. (1996). Anatomy of a dying coral reef: Punta Islotas Reef, Golfo Dulce, Costa Rica. *In: Biological Conservation*, 76(2), 215.

Abstract: A well-developed fringing coral reef off the Pacific coast of Costa Rica, is being smothered with fine sediment and has a present-day live coral cover of < 2%. The present-day final stage of degradation is related to heavy sedimentation associated with a recent increase in human activity along the adjacent shores.

Marshall, S. S., Jennings, S., & Polunin, N. (1996). Seychelles' marine protected areas: comparative structure and status of reef fish communities. *In: Biological Conservation*, 75(3), 201-209.

Abstract: Effective management of Seychelles' reef resources is essential because the conflicting demands of fishing, tourism and conservation must be reconciled if sustainable development and the protection of natural resources is to be assured. Marine protected areas play a key role in the existing management strategy and yet there is little quantitative understanding of the benefits they may provide. We compare the biomass and species richness

of fish assemblages on coral and granitic reef habitats in four areas which receive different levels of protection from fishing and other human activities. Species richness of the total fish community, biomass of the total fish community and species richness and biomass of many families were higher on both coralline and granitic reefs in two marine protected areas where protective regulations were effectively enforced. However, the biomass of the three principal families of fishes targeted by the fishery was significantly lower in one of these areas. This was attributed to illegal fishing and the fishing concessions offered to local people. We conclude that poaching and minor fishing concessions did not affect the aspects of the fish community which are important to most tourist visitors (biomass and overall species richness), but that they have a statistically significant effect on the structure of the fish community. Furthermore, whilst a small well-patrolled area will provide an effective refuge from fishing, it will often be stocked by larval fishes which are the progeny of adults living many kilometres away. As such, the protected area cannot operate in isolation to maintain biomass and diversity. A valid long-term aim of reserve management may be to assure the protection of a greater proportion of Seychelles' fishes throughout their life history. This may be achieved if current plans for the management of marine protected areas can be instituted.

Martinez-Osegueda, E., Munoz-Chagin, R., & De la Cruz-Aguero, G. (1996). Alacranes and Akumal coral reefs, Mexico. Their health, uses and concerns. *In: Biological Conservation*, 76(2), 215.

Abstract: Benthic coverage is dominated by algae. Among scleractinian corals, *Montastrea annularis* is dominant, with *M. cavernosa* and *Siderastrea radians* condominants in Alacranes. Alacranes supports important fisheries, while Akumal is subject to touristic-related activities. At present, Alacranes and Akumal are in good health. Alacranes is on the way to being the first Mexican marine biosphere reserve protected by Federal laws, while Akumal will be subjected to higher development pressure from huge touristic project and related human settlements along the Mexican Caribbean coast.

McClanahan, T. (1996). Restoration of coral reefs: possible and necessary. *In: Window Newsl.*, 7(2), 5-6.

Abstract: Experiments were conducted in Kenya to restore coral reef fishes and fisheries through the conservation of coral reefs which have become increasingly degraded by uncontrolled marine resource over-exploitation. The study compared the effect of reducing sea urchins in eight study plots, of which four plots were within a protected marine park and four were in a moderately to heavy fished reefs. Eight additional plots were left as unmanipulated controls. The study revealed that restoration of coral reefs is dependent on the management that precedes and follows the reduction of sea urchins. Specifically, if fishing is eliminated or reduced then sea urchin reduction can result in increased numbers and species of fish. In reefs that were heavily fished however, there were only small increases in the numbers of fish and living coral was reduced by as much as 30% in one year due to algae that grew over the coral and smothered it in absence of sufficient grazing. High sea urchins abundance slow the recovery of reef areas even when all fishing was excluded. All experiments suggest that recovery of coral reefs can be accelerated by intervening and reducing grazing urchins. If this management is not done, it could be a long time before fish recovered even in marine parks.

McClanahan, T., & Kaunda-Arara, B. (1996). Fishery recovery in a coral-reef marine park and its effect on the adjacent fishery. *In: Conservation Biology*, 10(4), 1187-1199.

Abstract: Numbers of fish and their wet weights were estimated in Kenyan coral-reef lagoons on seven reefs over 6 years. Two sites were protected from fishing for over 20 years, whereas the other five sites were heavily fished in recent years. A heavily fished site was converted into a marine park (Mombasa Marine National Park, approximately 10 km super(2), no fishing

allowed), and the number of fishers allowed was slowly decreased between August 1991 and August 1992. The area adjacent to the park was converted into a marine reserve (only fishing traps, lines, and gill nets allowed) that provided fishing grounds for fishers excluded from the park. Data from a fish-landing site adjacent to the newly created marine park were collected for 3 years and analyzed to determine the effect of the park's creation on fish catches. Results suggest that fishing in the reserve reduced fish wet weight by about a factor of 10 and reduced fish numbers and species richness by a factor of two. Both field studies and landing data suggest harvesting at a bionomic equilibrium. For example, approximately 65% of the landing site's fishing grounds were protected with the creation of the park, and 65% of the fishers quit the studied landing, leaving nearly the same density of fishers in the remaining area (similar to 12 fishers/km²). Further, fishers using pull seines were excluded from the reserve, and their numbers were replaced by fishers using other gear (mostly basket traps). Although the overall catch per unit effort increased by about 110% after the park's creation, the total fish landed decreased by 35% and the catch per unit effort decreased toward the end of the study period despite increasing fish abundance in the park. Although establishment of small parks elsewhere have increased the total catch, the large park we studied did not; one reason may have been the lower ratio of edge to park area of the large park. Alternatively, the park's edge may have provided a good fishing area, so fishing effort may have been highest along the park's edge. Consequently, a barrier may have been created that restricted fish dispersal to most of the reserve. Therefore, the area that had an increased catch was small (<1 to 2 km from the edge) and could not compensate for the lost fishing area. Most fish species within the park showed recovery after fisher exclusion. Total fish wet weights 3 years after the fishers' exclusion were 25% below the older marine parks. Poor recovery of the herbivorous parrot and surgeonfish can account for much of this shortfall. Competition for resources with sea urchins appear to be slowing recovery of these two groups. A study site 2.5 km from the park's southern boundary, in the reserve section of the protected area, showed no changes in fish abundance over the study period, despite changing gear regulations.

McClanahan, T., & Obura, D. (1996). Status of Kenyan coral reefs. *In: Biological Conservation*, 76(2), 217.

Abstract: Kenyan coral reefs have been relatively well-studied from the view of human impacts largely due to the existence of four marine parks and numerous reefs experiencing intense human resource use. Removal of finfish is having the largest impact on unprotected reefs and has a number of secondary and tertiary effects on other faunal groups and ecological processes. The high abundance of sea urchins in unprotected reefs may result from a reduction in their predators due to overfishing. Sea urchins are associated with reefs of lower coral cover, topographic complexity, and reduced calcium carbonate deposition rates. Some species of gastropod appear to be affected by shell collecting, but the total fauna seem more impacted by removal of their predators. River sediment discharges and eutrophication are of secondary importance.

McKain, D. W., & McKain, V. E. (1996). Unique reef replication. *In: Ocean News Technol.*, 2(3), 32.

Abstract: On 25 October 1989, the 47 meter oil supply vessel, M/V ALEC OWEN MAITLAND, ran aground in 2 to 3 meters of water. The site is about 1.5 nautical miles southwest of the Carysfort light. The area of total destruction measured 880.5 square meters. On 11 November 1989, less than a month later, the M/V ELPIS, a 143 meter motor freighter ran aground on a living coral reef in 8.5 - 10 meters of water. The site is located approximately .25 nautical miles northeast of the Elbow Reef light. Both locations are within the boundaries of the Key Largo Marine Sanctuary as well as the Florida Keys Marine Sanctuary. Under the National Marine Sanctuaries Act (NMSA), National Oceanic and

Atmospheric Administration (NOAA) is authorized to pursue civil action to recover response costs and damages from parties who destroy, cause the loss of, or injure sanctuary resources. In an unprecedented effort, a NOAA contractor, Team Marine Services, Inc., used a Link-Belt LS-218H crane to help replicate, restore and rehabilitate a severely damaged coral reef in the Florida Keys.

Newman, S. J., Williams, D., & Russ, G. (1996). Variability in the population structure of *Lutjanus adetii* (Castelnau, 1873) and *L. quinquelineatus* (Bloch, 1790) among reefs in the Central Great Barrier Reef, Australia. *In: Fishery Bulletin*, 94(2), 313-329.

Ngoile, M., & Kiwia, M. A. (1996). Community participation in the development of Mafia Island marine park. *In: O. Linden, & C. G. Lundin National Workshop on Integrated Coastal Zone Management in Tanzania, Zanzibar, (Tanzania), 8-12 May 1995* (pp. 124-132). Washington, -D.C.-USA : World Bank, Environmental Department, Land, Water and Natural Habitants Division.

Abstract: The southern part of Mafia Island hosts a great variety of natural resources and habitat types with considerable physical and biological diversity. Larvae produced within the reef system of southern Mafia is likely to contribute to the maintenance of reef related marine life, including commercial fish stocks in Tanzania and the northern Eastern Africa coastal waters. Thus southern Mafia may serve as a seed bank for an area much more extensive than Mafia itself. Threats undermining the sustainable resource use at Mafia include the recent rise in dynamite fishing, clear felling mangroves, use of illegal fishing gears, coral mining for building and lime production, anchorage damage, pollution from oil discharge and siltation and imbalances caused by changes in terrestrial run-off after deforestation in the Rufiji Delta. Marine turtles are threatened by encroachment at breeding sites and increasing numbers are caught in shark nets.

Ogden, J. C., & Ogden, N. B. (1996). The coral reefs of the San Blas Islands: revisited after 20 years. *In: Biological Conservation*, 76(2), 215.

Abstract: Coral reef sites studied and photographed in a Gulf of San Blas on the Caribbean coast of Panama in 1970-71 were revisited in 1991. There was a dramatic decline in the most common foliose and branching corals and an increase in algal cover. *Agaricia* spp. which formed most of the patch reefs and lines the slopes of channels and deep bays were mostly dead or being outcompeted by the brown alga *Lobophora*. Extensive, shallow *Porites porites* mounds had been harvested. Deeper mounds were overgrown 50-100% by algae. Only debris fields and scattered small colonies remained of once extensive thickets of *Acropora cervicornis* and, in higher wave energy areas, *A. palmata* was mostly dead. Massive corals appear generally healthy. These changes have taken place in a context of natural and human impact including the sea urchin *Diadema* mass mortality, coral bleaching and diseases, fishing, coral mining, deforestation, and increased nutrients.

Rajasuriya, A. (1996). Marine sanctuaries and conservation of fishery resources. Report And Proceedings Of The Sri Lanka Fao National Workshop On Development Of Community Based Fishery Management. Colombo, 3 5 October 1994. 1996:

Abstract: The dwindling of coastal resources is of great concern to many developing countries. Critical habitats such as coral reefs, mangroves and seagrass beds make up the coastal ecosystems. These ecosystems are important for the well being of people, coastal communities in particular. Coastal fisheries sustain many economies, coral reef associated fisheries supply 10 to 12% of the world's total fish landings. About 90% of fish landings in tropical developing countries comes from coastal waters and supplies 40% to 95% of animal protein consumption. Human activities have begun to degrade these ecosystems. Destructive fishing methods, over

harvesting, pollution and sedimentation due to unplanned land use practices are the major causes. Several countries have attempted to arrest this trend by introducing various regulations to manage resource exploitation and by declaring marine protected areas. However, measures taken to protect and manage the resources have not produced the desired results, mainly due to the lack of involvement of the communities concerned.

Rakitin, A., & Kramer, D. L. (1996). Effect of a marine reserve on the distribution of coral reef fishes in Barbados. *In: Marine Ecology Progress Series*, (131), 97413.

Abstract: High population densities of larger fishes within reserves could result in emigration of fish to surrounding non-reserve areas, producing a gradient of abundance and mean size across the reserve boundaries. The difference in fish abundance and size between reserves and non-reserves should be higher for sedentary than for mobile species and for highly catchable than for less catchable species. To test these hypotheses this study estimated the abundance and size of fishes by trapping and visual census on fringing reefs in Barbados: 5 reef within the 22 km of the Barbados Marine Reserve (BMR) and 8 reefs in the non-reserve (NR) area within 4 km of the reserve boundaries. The abundance of large, trap pable ~ fish of all species combined was higher in the BMR than NR. Trap catches decreased gradually with distance from the BMR center, but this gradient of abundance was less evident in visual census counts of trappable size fishes of all species combined, and not apparent in trap or visual census estimates of abundance for individual species. Mean size was larger in the BMR than NR for 18 out of 24 species. The relative difference in both abundance and size between BMR and NR did not differ between mobile and sedentary fishes. However, for sedentary taxa, the relative differences in abundance and size increased with trappability. These patterns suggest that the BMR does protect the fish community from fishing mortality and that emigration rates are generally low. Trappability and mobility depend on complex behavioral characteristics of fishes and are potentially important for the functioning of marine reserves.

Raymond, K. (1996). The long-term future of the great barrier reef. *In: Futures*, 28(10), 947-970.

Riegl, B., & Riegl, A. (1996). Studies on coral community structure and damage as a basis for zoning marine reserves. *In: Biological Conservation*, 77(2-3), 269-277.

Abstract: The analysis of coral community structure and diversity by means of line transects provides a powerful tool for reef management. In South Africa, this approach was used to develop a zoning scheme for the Maputaland and St Lucia Marine Reserves. Coral communities differed between reefs. Shallow reefs were dominated by Alcyonacea of the genera *Lobophytum* and *Sinularia*. Tissue regeneration experiments suggested that these corals were able to survive lesions, which can be inflicted, for example, by careless divers or by anchoring, so no special protection was considered necessary. Deep reefs were dominated by Scleractinia of the genus *Acropora*. Monitoring of breakage and fragment survival experiments indicated that the dominant species in this community were easily damaged and therefore special protection is needed. Sanctuary areas are proposed in diverse upstream reefs to serve as larval reservoirs in case degeneration occurs downstream.

Russ, G. (1996). Fisheries management: what chance on coral reefs? *In: Naga*, 19(3), 5-9.

Abstract: Failures of fishery management to control fishing effort globally and how this affects the coral reef fisheries are discussed. The use of marine reserves in coral reef fisheries management is also emphasized.

Russ, G., & Alcalá, A. C. (1996). Do marine reserves export adult fish biomass? Evidence from Apo Island, Central Philippines. *In: Marine Ecology Progress Series*, 132(1-3), 1-9.

Notes: Bibliogr.: 46 ref.

Abstract: A frequent expectation of the use of marine reserves in management of coral reef fisheries is maintenance or enhancement of yields to areas adjacent to reserves by adult (post-settlement) movements from reserve to fished areas (the so-called 'spillover effect'). Demonstration of this effect has been rare. This paper reports on some circumstantial evidence derived from underwater visual census monitoring of densities of large predatory coral reef fish [Serranidae (Epinephelinae), Lutjanidae, Lethrinidae and Carangidae as a group] inside and adjacent to a small marine reserve at Apo Island in the central Philippines over a 10 yr period (1983 to 1993). The marine reserve (sanctuary) at Apo Island was established in 1982 and was protected from fishing for the duration of the study. The non-reserve area was open to fishing by up to 200 municipal fishers using traditional fishing gear (bamboo traps, hooks and lines, gill nets and spears). Significant positive correlations of both mean density and species richness of large predatory fish with duration of reserve protection (from 1 to 11 yr) were observed in both the reserve and non-reserve areas surveyed. The minimum distance from the boundary of the reserve to the non-reserve area surveyed was 200 m. During the first 8 yr of reserve protection combined, the density of large predatory fish at distances 200 to 300, 300 to 400 and 400 to 500 m from the reserve boundary did not differ significantly from an even distribution (chi-squared test, $p > 0.05$). During the period of 9 to 11 yr of protection combined, there was a significantly higher density of these fish in the area closest to the reserve (i.e. in the 200 to 300 m area, chi-squared test, $p < 0.05$). This visual census data is consistent with a proposed model of adult fish export from the reserve to the non-reserve areas. Along with interview data collected in 1986 and 1992 that showed that fishers were unanimous that their yields had increased since the reserve was implemented, this study provides evidence for export of adult fish from reserve to fished areas.

Shinn, E. A. et al. (1996). A giant sediment trap in the Florida Keys. *In: Journal of Coastal Research*, 12(4), 953-959.

Abstract: Aerial photography, high-resolution seismic profiling, coring and jet probing have revealed a large sediment-filled sinkhole in the Key Largo National Marine Sanctuary off Key Largo, Florida. The 600-m-diameter feature straddles coral reef and carbonate-sand facies and contains >55 m of marine lime sand and aragonite mud. Bulk super(14)C age determinations of mud from a 30-m sediment core indicate infilling rates exceeding 20 m/ka between 3 and 5.6 ka. The total thickness and nature of the sediment near the base of the sinkhole are not known.

Sluka, R., Chiappone, M., & Sullivan, K. M. (1996). Habitat preferences of groupers in the Exuma Cays, Bahamas. *In: Bahamas Journal of Science*, (4), 844.

Abstract: Habitat has been shown to affect the abundance of groupers at many spatial scales. This study examined the potential relationship between quantified benthic features of coral reef and the abundance and biomass of groupers in the Exuma Cays, central Bahamas. Data were collected at 21 sites north of and 19 sites within the park during October to November 1995. Haphazard quadrats were used to quantify percent coverage of bottom types in three habitat types: channel reefs, fringing reefs, and windward hard-bottom. Vertical relief and depth were also measured. Data on the species composition, abundance, and size of groupers were collected using strip transects measuring 2 (~m x 5 -m. Results indicated no significant correlation between grouper size or biomass and benthic habitat features within the park. However, graysby (*Epinephelus cruentatus*) biomass and size outside of the park were correlated to coral cover, whereas coney (*E. fulvus*) biomass and size were negatively correlated with coral cover, but positively correlated with algal cover. In particular habitats, some species were prevalent. Rock hind (*F. adscensionis*) and tiger grouper (*Mytceroperca tigris*) were most abundant in fringing reef while graysby was most abundant in channel ~4s. Coney were most prevalent in windward hard -bottom habitats. Outside of the park, fishing

pressure was considered to be a more significant influence on abundance and distribution of targeted grouper species.

Sluka, R. et al. (1996). Habitat and Life in the Exuma Cays, Bahamas: Status of groupers and coral reefs in the northern cays. Vol. Supplemental Volume: Appendices). Coral Gables, Florida: The Nature Conservancy, Florida//Caribbean Marine Conservation Science Center.

Abstract: This supplemental volume to the document, Habitat and Life in the Exuma Cays, Bahamas: Status of groupers and coral reefs in the northern cays, presents site-specific data on groupers and benthic community structure. Field surveys of groupers and coral reef habitats were made during October and November of 1995 to evaluate the species composition, abundance, size, and biomass of commercially important groupers in relation to the Exuma Cays Land and Sea Park. Surveys were also made to quantify depth, vertical relief, and percent coverage of bottom types in quadrats. The supplemental volume includes figures illustrating the spatial extent of the study area and location of reef habitats surveyed over 90 km of the Exuma Cays archipelago. Figures are also included to illustrate the coverage distribution of algae, sponges, corals, and octocorals using visual estimates in quadrats. Tables provide species presence-absence and percent coverage data. Data on grouper density, size, and biomass are also included.

Sluka, R. et al. (1996). Habitat and Life in the Exuma Cays, the Bahamas: The status of groupers and coral reef in the northern cays. Nassau, Bahamas: Media Publishing.

Abstract: The role of the Exuma Cays Land and Sea Park, central Bahamas, in protecting groupers within the Exuma Cays was investigated from October-November 1995. Four hard-bottom habitats were surveyed for benthic community structure and grouper species composition, abundance, and size. Habitats included patch reefs, channel reef windward hard - bottom, and fringing reef. Surveys were conducted at 74 sites from Sail Rocks to Staniel Cay, a distance of roughly 90 km. In each site, 10 20m x 5m strip transects were surveyed for groupers, while 25 1-m x 1-m quadrats were used to visually estimate bottom coverage using cover classes as well as point-intercept measurements of coverage. Results indicated that the park is protecting the size, abundance, and reproductive output of the most targeted grouper species, Nassau grouper (*Epinephelus striatus*). However, the entire park is not effectively protected; the area of effective protection is limited to what the park ranger can patrol. There was evidence that groupers were moving across park boundaries to potentially become available to legal catch by the fishery. There were also second-order effects in which non-targeted species, such as graysby and coney, were more abundant outside the park.

Smith, S. (1996). Status and recent history of coral reefs at the CARICOMP network of Caribbean marine laboratories. In: *Biological Conservation*, 76(2), 215.

Abstract: Fourteen of 19 Caribbean marine laboratory members of the CARICOMP (Caribbean Coastal Marine Productivity) network responded to a questionnaire requesting qualitative information on the historical and present status of the coral reefs selected for long-term research in the program. Eight of the 14 sites indicated that coral cover had recently declined. While much of the loss was attributed to natural events, nutrient-loading, sedimentation, and over-fishing were also implicated. Six sites reported algal cover as medium to high (10- > 30%), the suspected result of reduced herbivory by over-fishing, *Diadema* antillarum mortality, and nutrient-loading. Nine of the sites reporting are located in marine parks, preserves, or areas of restricted access. Generally, coral cover has remained stable at these sites, except where threatened or damaged by direct tourist impact or distant forest clearing causing coastal sedimentation

Stump, R. (1996). An investigation to describe the population dynamics of *Acanthaster planci* (L.) around Lizard Island, Cairns section, Great Barrier Reef Marine Park. Tech Rep Crc Reef Res Cent Vol. 10 (p. 56). Townsville (Australia): Cooperative Research Cent. for the Ecologically Sustainable Development of the Great Barrier Reef .

Abstract: Renewed reports of *Acanthaster planci* (L.) in the northern Cairns section of the Great Barrier Reef Marine Park, Queensland (Australia) have prompted opinion that the third episode of large scale outbreaks since 1960 is developing in the region. A lack of data on population dynamics and inconsistent use of survey methods have failed to identify the early stages of outbreaks. This project aimed to investigate methods to describe *A. planci* population dynamics off Lizard Island through a series of three field exercises using mark, release, recapture (MRR) techniques and the application of a novel method of age determination, using counts of pigment bands on cleaned aboral spine ossicles. The potential significant contribution of MRR population dynamics studies in understanding *A. planci* outbreaks was demonstrated and a unique opportunity exists to describe patterns of temporal and latitudinal recruitment, population dynamics and growth, as well as gathering the complementary data required to assess variation in the life history characteristics of growth, mortality and reproduction

Sweatman, H. (1996). Impact of tourist pontoons on fish assemblages on the Great Barrier Reef. Tech Rep Crc Reef Res Cent Vol. 5 (p. 54). Townsville (Australia): Cooperative Research Cent. for the Ecologically Sustainable Development of the Great Barrier Reef .

Abstract: The most common way for tourists to experience the Great Barrier Reef (GBR), Queensland (Australia) is to make a day trip to one of the nine tourist pontoons along the Queensland coast. The Great Barrier Reef Marine Park Authority requires the operators of pontoons to support monitoring of various aspects of the local biota, particularly corals and fishes. Aggregations of fishes are frequently associated with these pontoons, which provide shade and concentrations of natural food as many operators actively feed the fishes. Concern has been expressed that the aggregations of carnivorous fishes may lead to increased predation pressure on prey organisms. While this study indicates that there is no evidence that the formation of aggregations at pontoons causes any measurable depletion from local populations, their formation is unarguably a human impact that would be very unlikely to occur otherwise. The apparent lack of predatory impact from aggregations and the suggestion that aggregations represent a relocation of a focus of natural aggregation behaviour within a reef area raises questions about the relevance and efficacy of components of current monitoring programs.

Tenshi-Ayukai, Miller, D., & Swann, L. (1996). Dissolved free amino acid conservation: implications for COTS larval nutrition. Tech Rep Crc Reef Res Cent Vol. 9 (p. 30). Townsville (Australia): Cooperative Research Cent. for the Ecologically Sustainable Development of the Great Barrier Reef .

Abstract: Understanding the cause of outbreaks of crown-of-thorns starfish (COTS) (*Acanthaster planci*) is critical to the effective management of the Great Barrier Reef Marine Park, Queensland (Australia). One of the two main theories to explain COTS outbreaks relates to the possible increase in food for larval starfish resulting from increases in nutrient levels due to freshwater runoff from adjacent land masses. The substantial quantities of nutrients contained in terrestrial runoff often lead to increases in phytoplankton, which is the primary food source of larval COTS, but they do have alternative sources of nutrition, particularly dissolved free amino acids (DFAA). Concentrations of amino acids in coral reef waters under normal conditions are too low to make a significant contribution to the larval diet, if DFAA is taken up for nutritional purposes. The results of this study indicate that DFAA concentrations were not affected by terrestrial runoff and throughout the COTS spawning season, amino acid concentrations remained at levels where this potential food source would not play a significant

role in larval nutrition.

Tilney, R. L. et al. (1996). Ichthyoplankton distribution and dispersal in the Tsitsikamma [Coastal] National Park marine reserve, South Africa. *In: South African Journal of Marine Science*, 17, 1-14.

Abstract: The nature of ichthyoplankton distribution within the Tsitsikamma National Park marine reserve was investigated in an attempt to evaluate the potential for export of larvae of commercially and recreationally important reef species to adjacent, exploited areas. Monthly, inshore ichthyoplankton samples were taken using Bongo nets over an 18-month period. Sampling sites were located over areas of high-profile reef and sand. Current-meter measurements of the area were used to determine current velocity, direction and reversal periodicity. Statistical analysis of the data was performed independently for larvae from four families: Blenniidae, Gobiesocidae, Sparidae and Engraulidae. Results suggested that blenniid and gobiesocid larvae practised active position retention throughout their pelagic phase, while this feature was less defined in sparid and engraulid larval distribution. Using larval distribution and current-meter information, projected dispersal distances for sparid larvae, the family containing the most target commercial and recreational angling species, were estimated. The results suggest that sparid larvae are exported from the reserve to adjacent, exploited areas.

Watson, M. et al. (1996). The effects of fishing on coral reef fish abundance and diversity. *In: J. Mar. Biol. Assoc. U.K.* 76(1), 229-233.

Abstract: The effect of artisanal fishing on the abundance and diversity of coral reef fish assemblages was investigated in the Kisite Marine National Park and Mpunguti Marine National Reserve at Shimoni, Kenya. Fishing is prohibited within the Park whereas in the Reserve artisanal fishing using traditional methods is practised. Visual censuses of six representative reef fish families (Chaetodontidae, Lethrinidae, Lutjanidae and Serranidae in 1992 and 1994, and Labridae and Pomacentridae in 1994 only) were undertaken along 250x10 m band transects on two similar pairs of reefs subject to differing fishing pressure. The abundance of commercial species (Lethrinidae, Lutjanidae and Serranidae) was depressed in the Reserve. The unfished butterflyfishes (Chaetodontidae) and damselfishes (Pomacentridae) also showed a greater abundance in the Park than in the Reserve. However, neither species number nor Shannon diversity (H') of any of these families was affected by fishing pressure. Possible reasons for these findings are discussed. The abundance of commercial species, though not of non-commercial unfished species, increased significantly in the Reserve between 1992 and 1994, suggesting that the unfished Park may be acting as a source of larvae or supply of emigrating adults for the depleted Reserve. The results are comparable with other recent studies describing the effects of fishing pressure and also with those studies detailing the effects of habitat refugia in coral reef areas.

Wilkinson, C. R. et al. (1996). Status of coral reefs in Southeast Asia: threats and responses. *In: Biological Conservation*, 76(2), 217.

Abstract: Coral reefs of SE Asia are both at the center of reef biodiversity, especially the archipelagos of Indonesia and the Philippines, and the focus of rapid economic and population growth. Major stresses are anthropogenic: organic and inorganic pollution, sedimentation and over-exploitation. Many countries have enacted strong legislation to protect coral reefs and gazetted some marine protected areas, but the resources are neither available nor of sufficient priority to ensure adequate protection of their coral reefs. Many reefs have already collapsed. Because human populations are expanding and economies are growing, it is predicted that most of the coral reefs in the region will be exterminated within the next 40 yrs. This situation will only be prevented if governments provide: resources for education for sustainable exploitation practices; management of large areas; and the authority at the local government level for the

protection and management of the coral reefs by the people who directly use them.

Yet, N. H. (1996). Some aspects about coral reef conservation in nearshore waters of Vietnam. Viet Nam National Wetland Conservation And Management Strategy: Status, Utilization, Conservation And Management. Workshop Proceedings. Ha Noi (Viet Nam), 7-8 Feb 1996
Hanoi: Viet Nam Assoc. Conservation of Nature and Environment

Abstract: According to the definition of the Ramsar Convention, coral reefs of the shallow zones are considered as wetlands. In the Vietnamese coastal zone, coral reefs cover around 40,000 ha and can be divided into three areas: west of Tonkin Gulf, central coast and west of Cochin Chine. A total of 350 species belonging to 76 general of scleractinians have been recorded. Coral reefs are among the most productive marine ecosystems. About 3,000 species of plants and animals have been found. They play a major role in providing protein, in the development of tourism activities and in protecting the shoreline from erosion by storms and wave action. Coral reefs of the Vietnamese coastal zone are being degraded seriously for many reasons: overexploitation, human activities, tropical storms and temperature changes. In order to protect the coastal coral reef ecosystems 16 marine protected areas are being proposed.

Andrews, G. (1997). Development of Mafia Island Marine Park. *In: O. Linden, & C. G. Lundin* The journey from Arusha to Seychelles: Successes and failures of integrated coastal zone management in Eastern Africa and Island States (pp. 241-254). Washington, DC USA : The World Bank, Environmental Department. **Notes:** Paper also presented at: Experts and Practitioners Workshop on Integrated Coastal Area Management for Eastern Africa and Island States, 12-16 Aug 1996. Also published in: *Sharing Coastal Management Experience in the Western Indian Ocean*. Edited by Humphrey, S. and J. Francis, 1997

Abstract: The Mafia Island region (Tanzania) contains estuarine, mangrove, coral reef and marine ecosystems. Habitats in the area of the Mafia Marine Park (MIMP, 400 km super(2)) include hard coral dominated reefs, soft coral and algal dominated reefs, sheltered back reef systems, intertidal flats with hard and soft substrate, mangrove and coastal forests, seagrass beds, algal, sponge and soft coral subtidal beds. The fisheries around Mafia provide much of the area's subsistence protein as well as a substantial income for the community. The productivity of Mafia's marine and coastal habitats are threatened by activities that include: destructive fishing techniques, particularly dynamite fishing; over-exploitation of fisheries resources and the access to that resource; excessive coral mining for aggregate and lime production; excessive harvesting of mangroves for building and fire wood; clearing of coastal forests for agriculture and unsustainable resource use; and unmanaged tourism development. Throughout Eastern Africa, integrated conservation management and policy development has generally concentrated on terrestrial ecosystem. However, the recognised economic and ecological importance of marine and coastal environments prompted the government of Tanzania to prepare a legislative base for marine protected area by passing the Marine Parks and Reserves Act in 1994. A management plan for the Mafia Island Marine Park (MIMP) was developed in 1993 and the park was officially gazetted in April 1995. The management systems and institutional capacity for Mafia Island Marine Park are addressed

[**Anon.**]. (1997). La protection de l'environnement équilibre le développement du tourisme: La zone de protection marine du Golfe d'Aqaba. *In: Bulletin EC Fisheries Cooperation*, 10(1), 9-12

Abstract: Faced with the rapid development of tourism in southern Sinai, the Egyptian Government established management and conservation measures. With European Union support there are now four protected areas in southern Sinai, together with monitoring and protection work to prevent damage to the coral reefs. The Egyptian Environmental Affairs Agency is considering introducing a fee for each tourist night to self finance the operation

[Anon.]. (1997). ReefBase: a global database on coral reefs and their resources. Version 3.0. Manila-Philippines: ICLARM.

Abstract: ReefBase 3.0 updates the two earlier versions. This relational database locates over 8,000 reefs, identifies related resources, describes marine protected areas and their features, and provides information on reef stresses, threats, management initiatives, reef-related socioeconomic variables and tourism. It also features several types of maps, photographs, satellite pictures, related databases, information on the Aquanaut monitoring method and a comprehensive query system. New features in ReefBase 3.0 include NASA satellite photos, the Reefs at Risk report - a joint publication by the World Resources Institute, ICLARM, the World Conservation Monitoring Centre (WCMC), and UNEP - a manuscript of Charles Darwins book on coral reefs, the ARMDES database of the Australian Institute of Marine Science, a wide range of summary graphs, and an improved query system. Also included is a substantial amount of data generated during the worldwide 1997 Reef Check Program based at the University of Science and Technology, Hongkong.

Attwood, C. G., Harris, J. M., & Williams, A. (1997). International experience of marine protected areas and their relevance to South Africa. *In: South African Journal of Marine Science*, 18, 311-332.

Abstract: Marine protected areas (MPAs) have become necessary to counter modern threats to marine biodiversity and the sustainability of fisheries. Sensitive habitats, including coral reefs, estuaries and mangroves, have been effectively protected in large MPAs, which control resource use. Protection from pollution and physical destruction by fishing gear are important functions of MPAs in tropical and temperate regions. MPAs have been used to protect endangered species and to allow population recoveries. The advantages for fishery management include maintenance of spawner biomass, improvement of yield, simplified enforcement, research opportunity, insurance against stock collapse and maintenance of intraspecific genetic diversity. MPAs can be small with narrow, focused objectives, or large with core areas, buffer zones and exploitable areas to provide an integrated management approach. A variety of design considerations, based on ecological, fishery and socio-economic conditions, is presented. Optimal size and spacing have not been extensively tested and only theoretical arguments guide the choice of how much to protect. The process of establishing an MPA can be initiated by local communities or by governmental authorities. The former has better public support, whereas the latter promises a well planned system of MPAs. Community and industry involvement in the establishment process is essential for the effective functioning of MPAs. Successful MPAs are administered by national programmes and managed according to management plans. Monitoring, communication and enforcement are integral components of MPA management. South Africa is party to a number of international conventions which promote the designation of MPAs. Better protection of the physical marine environment, incorporation of MPAs in fishery management procedures and the management of MPAs are the major areas where South Africa can improve its marine protection

Ault, J. S., Bohnsack, J. A., & Meester, G. A. (1997). Florida Keys National Marine Sanctuary: Retrospective (1979-1995) reef fish assessment and a case for protected marine areas. *In: D. A. Hancock, D. Smith, A. Grant, & J. P. Beumer. Developing and sustaining world fisheries resources. The state of science and management* (pp. 415-425). Collingwood-Australia : CSIRO.

Abstract: Designating certain marine areas as 'protected' -- usually by officially naming them 'sanctuaries' or 'reserves' -- is a revolutionary resource-management tool used in mitigating habitat degradation and overfishing. In reserves, critical habitats are protected in an effort to conserve biodiversity and environmental quality, and to sustain resource usage. Despite widespread interest in this new concept, few quantitative paradigms or management models are

available for implementing or developing strategic plans for reserves in terms of their overall design, number, total area, and proximity to physical features. The Florida Keys National Marine Sanctuary (FKNMS), USA, is a national treasure with rich subtropical multi-species reef fisheries, a multi-billion dollar tourist economy, and unique aesthetic qualities. The increase in the protection of this valuable habitat and its resources brought about by its status as a sanctuary underscores the need for an adaptive management strategy that defines the structure and function of reserves within the FKNMS. In support of reef fish management, preliminary assessments were conducted with a systems approach using a nexus of advanced visualization, data assimilation, and quantitative analysis techniques to develop; a spatially-explicit model that links relatively sparse survey estimates of reef fish densities and sizes to key physical factors; and a multi-species assessment index that uses the metabolic variable 'average size' as a biological indicator of stock status or health. These approaches can be very helpful in making fishery management decisions concerning the FKNMS resources, and can help to define the evolving role of marine protected areas in fishery management

Bavestrello, G. et al. (1997). Damage by fishing activities to the Gorgonian coral *Paramuricea clavata* in the Ligurian Sea. *In: Aquatic Conservation: Marine and Freshwater Ecosystems*, 7(3), 253-262.

Abstract: The analysis, by means of line transects, of a *Paramuricea clavata* (Anthozoa: Gorgonacea) population forming a facies of the Mediterranean coralligenous community along the Portofino Promontory (Ligurian Sea, Italy) evidenced a high per cent of lesions inflicted to the gorgonian coenenchyme by anchoring and fishing activities. This damage favours the development of aggregates of epibionts (mainly hydroids and bryozoans) which leads to greater mechanical stress through increased resistance of the colonies to water movement; where polychaetes and nematodes colonize the denuded skeleton, their burrowing activity weakens the colony. In situ tissue regeneration experiments suggested that aggregation of epibionts can develop only if the injuries result, from continuing abrasion. Injuries caused by anchoring and fishing can therefore be considered the major cause of mortality of *Paramuricea clavata* in the Portofino Promontory. *Paramuricea clavata* re-colonizes experimentally denuded areas slowly and colonies take many years to reach the size of existing individuals and can be damaged easily by fishing and anchoring. Special protection is needed for this key species of Mediterranean coral at Portofino Promontory, which is proposed as a Natural Marine Park.

Beets, J., & Creswell, R. L. (1997). Are Caribbean Fisheries Sustainable? Conservation and Exploitation Strategies Should be Compatible. (pp. 156-160). [s. l.]: [s. n.].

Abstract: Most fisheries in the Caribbean are in decline. Regional governments have implemented fisheries management strategies with varying degrees of success. Although there are few examples of sustained fisheries in the Caribbean, there is evidence that damaged fisheries can recover and that some fisheries are sustainable. Recent research has documented that reef fish abundance can increase in closed areas and marine reserves. Investigations in the Virgin Islands have documented that species composition may be maintained at relatively low fishing effort. Fisheries landings may be sustained at higher fishing effort, but the species composition may change with increased yields of fecund, fast-growing species (e.g., surgeonfishes and parrotfishes) and depressed yields of long-lived, slow growing species (e.g., groupers and snappers). Sound management strategies are dependent on reliable fisheries data collection and efficient assessment methods, however, many conventional approaches are not effective for most tropical reef fisheries and ignore changes in fish assemblage structure. Assessments which use information on species composition may prove beneficial for management in tropical reef fisheries. The greatest challenge will be to derive fisheries strategies which will sustain fisheries, with intact assemblage structure, over decades.

Boldo, L., & White, A. (1997). Reclaiming the island reefs. *In: People and the Planet*, 6(2), 22-23.

Abstract: The paper reports on the exploitation of coral reefs around the Philippines, and more recent efforts to protect these areas. The destruction of reef areas had left local coastal communities with very poor fish catches. The case of Apo Island is described, noting its community-based coastal management programme that has seen the establishment of marine reserves and sanctuaries, livelihood projects, environmental education activities, community development training, agroforestry and water development schemes. Such projects operated by local stakeholders has reversed the decline of the coral reef and the fish stocks, and also increased tourist revenue. The island is now seen as a model of successful community-based management.

Brownlow, R. (1997). Strict liability for damage to new marine sanctuary U.S.v.M/V Jacquelyn L., 100 F. 3d 1520 (11th Cir. 1996). *In: Water Log*, 17(1), 4-5.

Abstract: The 11th Circuit recently affirmed a district court decision which imposed strict liability on a ship that ran aground on Western Sambo Reef, an area in Florida waters protected by the Florida Keys National Marine Sanctuary Act. The owners of the vessel contended that Western Sambo Reef was not part of the sanctuary because Governor Martinez had at one point objected to Florida territory being included in the sanctuary. Both the federal district court and the 11th Circuit found that the Governor had not objected to the designation and that the state territory where the grounding occurred was part of the sanctuary.

Cesar, H. et al. (1997). Indonesian coral reef - An Economic analysis of a precious but threatened resource. *In: Ambio*, 26(6), 345-350 .

Abstract: Indonesia's coral reefs are currently undergoing rapid destruction from human activities including: poison fishing; blast fishing; coral mining; sedimentation; pollution and overfishing. In this paper, these destructive activities are described and the private gains from these activities accruing to individuals are compared with the associated costs to society. It is shown that the social costs by far outweigh the short-term private gains. Yet, powerful forces have a clear interest in maintaining the status quo of destruction. These forces vary from high risk, high payoff poison fishing to poverty-trap activities such as coral mining. The paper concludes with a discussion on designing appropriate policy responses such as: local threat-based approach; national threat-based approach; integrated coastal zone management; and the use of marine protected areas.

Corless, M. et al. (1997). Assessing the Potential for Fish Migration From Marine Reserves to Adjacent Fished Areas in the Soufriere Marine Management Area, St. Lucia. Vol. 49 (pp. 71-98). [s. l.]: [s. n.].

Abstract: The movement of reef fish was investigated by tagging and visual recapture methods in two protected areas and two adjacent fishing areas in the recently established Soufriere Marine Management Area, St. Lucia. A total of 2,301 fish from 10 families were tagged, and visual recaptures were conducted weekly by SCUBA surveys for nine weeks following tagging. The maximum visual recapture proportion was 44%, and decreased with time following tagging. The mean dispersal distance from the release point over the nine week survey period differed significantly between families, being highest for Carangids (similar to 260 m) and Labrids (similar to 110 m), and lowest for Holocentrids (similar to 15 m) and Serranids (similar to 10 m). For most families, mean dispersal distance was <50 m, and did not differ significantly with time following tagging or between study sites. There was no significant effect of protection from fishing (i.e., Marine Reserve) on the movement of fish. Moreover, most individuals in all families showed strong homing behavior and site attachment, quickly returning to their capture point when released some 100 m to 800 m away. These results

demonstrate that the potential export of fish biomass from protected areas to adjacent fishing areas through emigration of catchable fish is negligible under the conditions in the management area during the first year following zoning. Current theory predicts that the extent of movement and probability of fish re-locating their home sites will increase markedly at the higher fish densities that characterize mature protected areas. Under these conditions export of catchable fish to adjacent fished areas will increase. This remains to be demonstrated as the Soufriere Marine Management Area matures.

De-Silva, M. W. R. (1997). A new threat to the coral reefs of the Hikkaduwa Marine Sanctuary in Sri Lanka. *In: Tropical Coasts*, 4(1), 16-19 .

Abstract: The Hikkaduwa Marine Sanctuary, located south of Colombo, Sri Lanka, was created in May 1979 to sustainably manage the natural assets of golden sand beaches, high diversity coral reefs, clear waters and the shallow reef lagoon. A list is given of the main threats to the coral reefs of the Sanctuary, which include: 1) uncontrolled glass bottom and mechanized fishing boat activities; 2) sedimentation; 3) collection of corals and shells as souvenirs; 4) tourists visitors stepping and walking on live coral areas; 5) collection of ornamental fish lobsters organisms; 6) discharge of untreated semi-treated effluents sewage from hotels and restaurants; 7) polluted freshwater runoff from canals; 8) changes to current patterns due to illegal constructions on the beach; 9) discharge of wastes by visitors; and, 10) use of explosives to catch fish just outside the Sanctuary. A recent survey has brought to light a new threat posed by an overgrowth of the calcareous green alga *Halimeda*. In the shallow sublittoral areas of the reef lagoon, the alga had colonized many coral areas; most disturbing was *Halimeda* invasion of good live coral areas. Possible causes of *Halimeda* growth and various management options are discussed.

DeSilva, M. W. R. N. (1997). Trials and tribulations of Sri Lanka's first marine sanctuary The Hikkaduwa Marine Sanctuary. Regional Workshop on the Conservation and Sustainable Management of Coral Reefs, Chennai (India), 15 17 Dec 1997 Chennai India: M.S. Swaminathan Res. Found.

Abstract: Coral reefs are under tremendous pressure from over exploitation of resources, unplanned tourism development pollution and other direct or indirect human related activities. The major threats to the coral reefs of the Hikkaduwa Marine Sanctuary are given. Substantial efforts have been made to focus attention on the Hikkaduwa Marine Sanctuary and to stem the degradation of the coral reefs, but very little ground level action has been taken to resolve some of the conflicts. The major constraints to the conservation and sustainable management of coral reefs have been outlined.

Devaraj, M. (1997). A brief on the contribution of the Central Marine Fisheries Research Institute to research and knowledge of coral reefs of India. Regional Workshop on the Conservation and Sustainable Management of Coral Reefs, Chennai (India), 15 17 Dec 1997 Chennai India: M.S. Swaminathan Res. Found.

Abstract: The Central Marine Fisheries Research Institute (CMFRI), Kochi, India has conducted special indicative surveys in the coral reefs of India to assess their mariculture potential and to estimate the impact of fishing and other allied activities in the reefs on their biodiversity, habitat alterations, degradations etc. The survey findings have facilitated a better understanding of the natural and anthropogenic factors responsible for the regression of coral growth and the degradation of species diversity (i.e. the assessment of the environmental qualities and infrastructure facilities available and the formulation of appropriate strategies for the conservation and sustainable management of the reefs. All the research findings of the CMFRI stress the need for new research inputs, regular monitoring and specific guidelines for the effective management of the three National Marine Parks the Gulf of Kutch Marine Park,

the Wandoor National Marine Park and the Gulf of Mannar Marine Park.

Devi, K., & Rao, D. V. (1997). New records of reef fishes from Andaman waters. *In: J. Andaman Sci. Assoc.*, 13(1-2), 104-106.

Abstract: New records of four fishes belonging to the families Muraenidae, Scorpaenidae, Chaetodontidae and Monacanthidae are collected from the reef areas of Delgarno Island Sanctuary, North Andaman. The species recorded are *Gymnothorax javanicus*, *Pterois russelli*, *Forcipiger longirostris*, *Chaetodon longirostris*, *Balistis scopas* and *Annases scopas*. A systematic account of these species is presented in this paper.

Dorairaj, K. (1997). Status of coral reefs of Mahatma Gandhi Marine National Park, Wandoor, Andamans. Regional Workshop on the Conservation and Sustainable Management of Coral Reefs, Chennai (India), 15-17 Dec 1997 Chennai India: M.S. Swaminathan Res. Found.

Abstract: The Mahatma Gandhi Marine National Park, Wandoor, Andamans, was notified on 24th May 1983 for the protection of marine life including corals and nesting sea turtles. Out of the 15 islands and islets in the Park, Wandoor, five islands were selected for detailed survey of coral reefs. They are Jolly Boys, Red Skin, Tarmugli, Boat and Twins Islands. The coral reefs of the Park were mostly of fringing type. The live coral coverage on the reef and their composition and the list of coral species recorded in these five islands are given. Among the five islands, live coral coverage was highest (53%) in Twins Island. *Acropora*, *Porites* and *Millepora* were the dominant coral forms in the Park region. Soft corals were relatively more in number in Jolly Boys and Twins islands than in other islands and they were represented by four genera. Based on species diversity and substratum coverage with live corals, the status of coral reef of the park area may be broadly categorised as 'Fair' in Jolly Boys, Tarmugli and Boat islands and as 'Good' in Red Skin and Twins islands. The major groups of invertebrate fauna inhabiting the reef in the order of abundance were Gastropods, Bivalves and Echinoderms. Among the fishes, Pomacentrids represented by 5 species were the dominant group in all the islands. The algal coverage was poor and the sponge, *Phyllospongia* sp. was the only species recorded in all islands. Human interference and crown of thorns infestation have caused damages to corals and coral reefs in the Park.

Dorairaj, K., Soundararajan, R., & Jagadis, I. (1997). Studies on the marine fauna of the Mahatma Gandhi Marine National Park, Wandoor, South Andaman, Part 1: Corals. *In: J. Andaman Sci. Assoc.*, 13(1-2), 10-31.

Abstract: A comprehensive survey was carried out during October 1990 to April 1991 to document the marine flora and fauna, found in the Mahatma Gandhi Marine National Park, Wandoor, South Andaman. The present paper deals with coral species distribution, abundance and their present status in five islands of the park. The coral reefs were of fringing type. Nearly 4% of the reef area was covered with live and luxuriant corals of different species. Soft corals formed about 3% and dead corals 36% of the reef areas. Of the 31 corals recorded under 25 genera, *Acropora*, *Porites* and *Millepora* were the dominant forms. In a few stations, corals were partially damaged due to boat anchorage, human interference and crown of thorns starfish predation. Based on the species diversity and extent of live coverage, the status of coral reefs of the park is broadly classified as 'good' in Red Skin and Twin Islands and as 'fair' in Jolly Boys, Tarmugli and Boat Islands.

Duff, J. A., & Brownlow, R. (1997). National Marine Sanctuaries Act. *In: Water Log.*, 17(1), 7-9.

Abstract: Congress enacted Title III of the Marine Protection Research and Sanctuaries Act ("Sanctuaries Act") in 1972 to protect marine sanctuaries that, "possess conservation, recreational, ecological, historical, research, educational, or esthetic qualities which give them

special significance." National Marine Sanctuaries can be created in one of two ways. The Secretary of Commerce may designate sanctuaries pursuant to the Sanctuaries Act. Alternatively, Congress may directly designate a sanctuary. In January 1976, the Secretary of Commerce designated the Monitor National Marine Sanctuary to protect the historic Civil War ironclad USS Monitor. Since then sanctuaries have been designated in areas ranging from areas in the Gulf of Mexico to Hawaii to Washington State to New England. These sanctuaries primarily protect marine resources such as coral reefs and sea life

Edgar, G. J. et al. (1997). The conservation-related benefits of a systematic marine biological sampling programme: the Tasmanian reef bioregionalisation as a case study. *In: Biological Conservation*, 79(2-3), 227-240.

Goodridge, R. et al. (1997). Changes in the Shallow Reef Fishery Associated With Implementation of a System of Fishing Priority and Marine Reserve Areas in Soufriere, St. Lucia. Proceedings of the Gulf and Caribbean Fisheries Institute. Christ Church (Barbados), Nov 1996 Vol. 49, Chap. 316-353.). [s. 1.]: [s. n.].

Abstract: Conceptually, Marine Protected Areas (MPAs) are a good fishery management tool, since they are known to help protect reef habitat; allow for recovery of fish population abundance, increases in individual fish size and thus fecundity; and allow for restoration of a climax community structure, within the boundaries of the MPA. However, there are few documented cases, to date, where MPAs have been shown to actually benefit surrounding reef fisheries. The Soufriere Marine Management Area (SMMA), spanning an 11 km stretch of the central west coast of St. Lucia, opened on August 1, 1995, and comprises a series of zoned fishing priority and marine reserve areas. It is the first example in the Caribbean of a serious attempt at complex co-management of nearshore marine resources, striving to integrate management of these resources for the benefit of several (often conflicting) users. Monitoring the effects of the SMMA zoning not only on the resources themselves, but also on the resource users is therefore all the more important. This paper reports on the effects of the SMMA zoning on the shallow reef fishery in Soufriere by documenting changes in catch rates and in fisher behavior, including the areas fished, the types of fishing gears used, and the distribution of fishing effort, which have occurred with the implementation of the SMMA.

Grey, D. (1997). Marine parks in New South Wales: what are they all about? *In: Fish NSW*, 1(Summer), 3-7.

Abstract: In its 'Nature conservation strategy' and its 'Vision for the NSW coast', the New South Wales (Australia) Government gave a commitment to introduce legislation to establish a comprehensive system of marine parks based on the Great Barrier Reef Marine Park model and to establish the first of these at the Solitary Islands and Jervis Bay. As a management system which would cover all marine conservation activities was required, the government created a Marine Parks Authority and enacted the Marine Parks Act to bring these new arrangements into effect. The Act has the objectives of conserving marine biological diversity and marine habitats, maintaining ecological processes in marine parks, providing for ecologically sustainable use of fish and marine vegetation in marine parks and providing opportunities for public appreciation, understanding and enjoyment of marine parks.

Harriott, V. J., Davis, D., & Banks, S. (1997). Recreational diving and its impact in marine protected areas in eastern Australia. *In: Ambio*, 26(3), 173-179 .

Abstract: Recreational scuba diving has generally been perceived as an activity with low environmental impact. With the rapid growth in popularity of diving, concerns have arisen that some heavily-dived sites may have diver visitation rates approaching the limit of ecological sustainability. The potential impacts of divers were assessed in underwater surveys at four

major dive-sites in Eastern Australia. Recreational divers were followed for 30 minutes, and all contacts with and damage to the substratum or biota were recorded. Information on diver qualifications and experience was collected. The mean number of contacts with the substratum per 30 minute dive at each site ranged from 35 to 121, with a maximum of 304 in a single dive. The majority of contacts were made with fins. Breakage of coral ranged from an average of 0.6 per dive to 1.9 per dive. Most divers damaged no coral, but a small minority of divers broke between 10 and 15 corals each per 30 minute dive. The level of damage to the sites studied appeared to be sustainable at present levels of use by divers. However, at intensively dived, coral-dominated sites, the potential exists for considerable environmental impact as the number of recreational divers increases beyond present levels.

Haynes, D. (1997). Marine Debris on Continental Islands and Sand Cays in the Far Northern Section of the Great Barrier Reef Marine Park, Australia. *In: Marine Pollution Bulletin*, 34(4), 276-279.

Hinrichsen, D. (1997). Coral Reefs in Crisis. *In: BioScience*, 47(9), 554-558.

Hodgson, G. (1997). Resource use: Conflicts and management solutions. *In: C. Birkeland* (ed.), Life And Death Of Coral Reefs (pp. 386-410). [s. l.]: Chapman & Hall .

Abstract: Coral-reef management solutions require more than just a knowledge of coral-reef biology. The direct and indirect effects of human activities on coral reefs can also cause several types of socioeconomic conflicts that must be considered in the management strategy. We will take a detailed look at a case study from the Philippines that shows how the techniques of ecology and economics can be combined to provide answers to questions of resource use. Then we will examine the methods used for coastal zone and marine park planning and management, and discuss the potential for successful implementation in developed and developing nations.

Kumar, K. (1997). The coral reef ecosystem of the Andaman and Nicobar Islands: Problems and prospects and the World Wide Fund for Nature India initiatives for its conservation. Regional Workshop on the Conservation and Sustainable Management of Coral Reefs, Chennai (India), 15-17 Dec 1997 Chennai India: M.S. Swaminathan Res. Found.

Abstract: For the Andaman and Nicobar Islands (ANI), WWF's Biodiversity Hotspots Conservation Programme (BHCP) has chalked out priorities to address fragile ecosystem like coral reefs and to start with identified, development of an action plan for coral reef conservation and management. In a bid to continue the efforts to identify global representative system of Marine Protected Areas, WWF contributed substantially for the Central Indian Ocean Marine Region. The marine protected areas in Andaman and Nicobar Islands were assessed. Marine sites and coastal sites in this region were also identified. An account of the coral reefs distribution and species diversity is given. The following account gives an overall picture of the legal and policy framework for the conservation of coastal and marine resources and protected areas: (1) Constitution of India, (2) Wildlife Protection Act 1972, (3) Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), (4) Environment (Protection) Act, 1986, (a) the Coastal Regulation Zone Notification 1991 and (5) The Fisheries Act of A & N Islands.

Luttinger, N. (1997). Community-based coral reef conservation in the Bay Islands of Honduras. *In: Ocean & Coastal Management*, 36(1-3), 11-22.

Abstract: The evolution of a community-based marine conservation effort in the Bay Islands serves as a valuable example to all islands that face similarly conflicting economic and environmental pressures. Like many small developing tropical islands, the main island of Roatan is undergoing rapid development to accommodate a surge in nature tourism. As the

traditional fish and shrimping industries have dwindled, the island's economic base has become increasingly dependent on the growth of reef-based tourism. With pre-existing environmental policies that were insufficient in scope as well as in implementation, the coral reef ecosystem began to suffer severe impacts. Recognizing the critical importance of maintaining the health and quality of this system, yet with no support from the national or local governments, two communities organized among themselves to create and manage a marine protected area. While several recent developments threaten its continued success, this case study nevertheless provides valuable lessons concerning the early processes of building consensus and reserve organization, as well as future potential issues that may arise and threaten such efforts

MacDonald, L. H., Anderson, D., & Dietrich, W. E. (1997). Paradise threatened: Land use and erosion on St. John, US Virgin Islands. *In: Environmental Management*, 21(6), 851-863.
Abstract: Rapid development and the concomitant increases in erosion and sedimentation are believed to threaten the reefs and other marine resources that are a primary attraction of St. John and Virgin Islands National Park. Average annual sediment yields from undeveloped areas were estimated from a sediment pond and a mangrove swamp as less than 20 and less than 40 tkm super(2)yr, respectively. Geomorphic evidence indicates that plantation agriculture during the 18th and 19th centuries did not cause severe erosion. Since about 1950 there has been rapid growth in roads and development due to increasing tourism and second-home development. Our field investigations identified the approximately 50 km of unpaved roads as the primary source of anthropogenic sediment. Field measurements of the road network in two catchments led to the development of a vector-based GIS model to predict road surface erosion and sediment delivery. We estimate that road erosion has caused at least a fourfold increase in island-wide sediment yields and that current sedimentation rates are unprecedented. Paving the dirt roads and implementing standard sediment control practices can greatly reduce current sediment yields and possible adverse effects on the marine ecosystems surrounding St. John

Martens, E. E. (1997). KWS Coastal Wetlands Conservation Project. *In: J. Hoorweg (ed.), Environmental management, research and training in coast province, Kenya*, Chap. 1, (pp. 27-29). Nairobi Kenya : Acts Press.

Abstract: The three main coastal wetland biotopes constitute mangrove forests, intertidal seagrass beds and coral reefs. The coastal wetlands support abundant marine life, area refuge for rare or threatened species and are crucial resting and feeding grounds for resident and migratory birds. They have important interrelationships, which are the basis for biodiversity. In addition to being a centre for social, subsistence and recreational activity, wetlands also add to the economy through tourism, fisheries and fisheries products. Because of the inextricable linkage of wetlands to their surrounding systems, their conservation management must be pursued in the context of an integrated approach to environmental conservation and ecologically sustainable development. The main objective of the programme is to promote and facilitate conservation and integrated management of marine protected areas and coast wetlands to safeguard the biodiversity and integrity of ecosystems and their productivity. The overall objective follows the three main goals of KWS which are biodiversity conservation, partnership and nature tourism. The coastal wetland projects, which are funded by the Netherlands government supports conservation and management activities in the marine parks and reserves along the coast. The projects give special attention to endangered species such as turtles, dugongs and also mangroves within and outside protected areas. Other wetland conservation and training programmes funded by the Netherlands are the inland wetlands project based at KWS Nairobi headquarters and training project at Naivasha Training Institute

Martinez, J. E., Valdes-Pizzini, M., & Creswell, R. L. (1997). Culture, Rationality, and Development: Historical Constructions and Distortions of Conservation Efforts in the Fisheries

of Southwestern Puerto Rico. Vol. 49 (pp. 419-429). [s. l.]: [s. n.].

Abstract: A historical analysis of the fisheries in southwestern Puerto Rico suggests that government development efforts (both local and federal) have contributed to the depletion of marine resources, while advocating conservation practices. Local fishermen have also developed, through years of daily contact with resources, perceptions and cultural constructions about conservation and unsustainable practices. It is argued that productive and social processes in the fisheries are heavily influenced by market forces. Thus, the practice of small scale fishers, as well as their cultural perceptions on conservation issues, are oftentimes constructed by forces fitting into their logic of production and reproduction of daily life. It is this logic and cultural construction that tend to influence their decisions related to what technology to use and the fishing grounds to exploit. This paper explores the many instances in which the fishermen of La Parguera express through their discourses and practices about production and the importance of conservation practices. This paper also takes a critical look at the actual conservation practices and those circumstances that prevent full sustainability on their behalf. Perhaps, the most crucial event related to conservation is the action movement towards the development of a Marine Fishery Reserve (MFR). This can also be seen in the way they chose a reef to be designated a MFR. Because the chosen area was perceived by the fishermen of La Parguera as the least productive in terms of quantity of fish, it was seen as the "perfect" place for the establishment of the marine reserve so it can be "saved" for future use

McClanahan, T. et al. (1997). The effects of traditional fisheries management on fisheries yields and the coral-reef ecosystems of southern Kenya. *In: Environmental Conservation*, 24(2), 105-120.

Abstract: Many traditions of coastal peoples may be viewed as traditional forms of marine conservation because, like modern fisheries management, they restrict fishing gear, fishing times, and places, but their effects are little studied in practice. A study was undertaken of human culture and fisheries resources in an area of southern Kenya, designated as a national marine reserve, to determine the effect of the existing 'traditional management' on fisheries yields and on the ecological condition of the fished reefs. This area has one of the oldest and most elaborate cultural traditions concerning sacred sites and rituals of sacrifice along the Kenyan coast. The purpose of the customs is, however, to appease spirits rather than to regulate fish stocks which are traditionally seen to fluctuate independently of fishing effort. Many of these traditions have decayed in recent times as Islamization of the culture has occurred, and authority has shifted towards national organizations, weakening the effectiveness of the traditional leaders. Coincidentally, fishers have adopted new or foreign gear, colleagues, and traditions. Two adjacent landing sites (Mvuleni and Mwanyaza) have, however, successfully stopped pull seiners from landing their catch at their sites for over 20 years through passive means.

McClanahan, T., & Obura, D. (1997). Sedimentation effects on shallow coral communities in Kenya. *In: Journal of Experimental Marine Biology and Ecology*, 209(1-2), 103-122.

Mcmanus, J. et al. (1997). ReefBase aquanaut survey manual. (p. 61). Manila, [Philippines]: International Cent. for Living Aquatic Resources Management.

Mcmanus, J., & Menez, L. A. B. (1997). The proposed international Spratly Island Marine Park: ecological considerations. *Eighth International Coral Reef Symposium* Balboa, Panama: Smithsonian Tropical Research Institute

Medio, D., Ormond, R., & Pearson, M. (1997). Effect of briefings on rates of damage to corals by scuba divers. *In: Biological Conservation*, 79(1), 91-95.

Mollah, A. R. (1997). Status of coral and associated resources in Bangladesh. Regional Workshop on the Conservation and Sustainable Management of Coral Reefs Chennai India: M.S. Swaminathan Res. Found.

Abstract: While no formed coral reef exists, the subtidal zone of Narikel Jinjira island supports a total of 66 scleractinian coral species, belonging to 22 genera, a number of which represent reef building species. The coral beds in Narikel Jinjira extends from the seaward margin of the intertidal to about 200 600 m offshore. Corals are found around most of the island, but their abundance and cover is generally low. Coral covers various from 4 10% of the surface area. The density estimate of coral is 1.3 colonies/m². Porites spp. are the most abundant group of coral, followed by Favites spp., Goniopora, spp., Cyphastrea spp., and Goniastrea spp. The coral resources are heavily exploited in narikel Jinnira. It has been estimated that about 30,000 colonies are removed annually which is 24% of the existing coral population in the extractable areas. The coral community in Narikel Jinjira supports associated fish and invertebrate fauna characteristics of coral reef environment. There are at least 86 species of reef associated fish, 4 species of Zoanthids, 4 spp. of Echinoids, one species of Asteroids, one species of Holothuroid and 4 spp. of Crinoids have been identified from the coral beds of the island. Molluscs are the most abundant group of invertebrate found in the coral bed, 61 species of them have been identified. Siltation, fluctuations in salinity, cyclonic storms and tidal surges, over exploitation of resources have been identified as the potential threats to the resource degradation, Narikel Jinjira satisfies the requirements for category 11 (Marine Park) designation. A zoning plan has been proposed as a key tool for the management of Narikel Jinjira as a marine protected area. Local community based eco tourism has been strongly suggested. It is strongly recommended that new scientific studies are planned for the island, since the unique and dynamic nature of the intertidal and subtidal rocky habitats offer excellent research opportunities.

Moscardo, G., Woods, B., & Pearce, P. (1997). Evaluating the effectiveness of pictorial symbols in Reef visitor education. (p. 30). Townsville (Australia): Cooperative Research Cent. for the Ecologically Sustainable Development of the Great Barrier Reef.

Abstract: Eight cartoon style symbols were developed for the Great Barrier Reef Marine Park Authority for use in information sheets and signs. The behaviours depicted included not standing on or touching coral, placing litter in bins, not chasing fish and other marine life, not collecting coral or shells and not feeding fish. The effectiveness of these pictograms in informing a wide range of visitors about appropriate Great Barrier Reef (GBR) behaviours was evaluated. The main finding from questioning 727 visitors to the GBR was that there were generally high levels of knowledge about appropriate human behaviours in all groups of visitors before they saw the symbols. This suggests that management and industry should focus on reminding visitors about appropriate behaviours.

Munro, J. L. (1997). ICLARM's research on coral reef resource systems. In: C. Annala (eds.), Fisheries and aquaculture research planning needs for Africa and West Asia (pp. 13-14). Makati City, Philippines: ICLARM.

Abstract: ICLARM's current research programs on coral reef resource systems are focused on three main areas: 1) increasing sustainable yields and economic benefits from coral reef systems by the cultivation of desirable species or enhancing natural recruitment by the release of hatchery-reared juveniles; 2) improving ecosystem and resource management, through integrated coastal resources management, including the role of marine protected areas, the valuation of resource systems and alternative uses of resources (tourism and recreation), and the development of a global database on coral reef ecosystems; and 3) assessing and managing multispecies fishery resources. Proposed research activities of the Center are also presented in this paper.

Muthiga, N., & McClanahan, T. (1997). Coral Reef Conservation Project. *In: J. Hoorweg (ed.), Environmental management, research and training in coast province, Kenya*, Chap. 1, (pp. 61-63). Nairobi Kenya : Acts Press.

Abstract: Coral reefs are among the earth's most diverse ecological systems and may serve as important biological laboratories for determining impacts on the small scale of human resource use to larger scale environmental factors of global warming. The main aim of the Coral Reef Conservation Project (CRCP) is to study the impact of human activities on coral reefs in Kenya, and the East Africa region in general. CRCP is financially supported by the Wildlife Conservation Society, Food and Health Foundation, the Rockefeller Foundation and USAID. It is affiliated to KWS and KMFRI. Within the WIO region, the greatest concentration of research has been based on Kenya's fringing reef. Studies of impacts on corals include surveys on finfish, sea urchins, substrate cover, shell abundance and diversity, river discharge and eutrophication. The long term success of reef monitoring will depend on a regional association of nationally based marine scientists who can exchange ideas and learn and compare field methodologies. CRCP offers an internship programme in collaboration with MU; KMFRI, TAFIRI (Tanzania) and Department of Environment (Eritrea). The internships which are for 3 to 6 months, are open to nationals of African coastal countries. As Kenya marine parks continue to be haven for fish, corals, gastropods and many other unstudied organisms, it is imperative that these areas continue to receive protection.

Nickerson, D., Hiew, K., & Chong, G. (1997). Special area management for conservation and sustained production of marine biodiversity in Malaysia. *In: Tropical Coasts*, 4(1), 12-15 .

Abstract: Much effort and resources has been put in the establishment of marine parks in Malaysia by the Department of Fisheries since 1983. The idea of a Special Area Management Plan (SAMP) was new to Malaysia at the beginning of the project, but it made sense and is now a well-established management approach. The SAMP approach allows decision-makers to focus on the unique features of the area's ecosystem, and the people living in the area, who depend on the health of the ecosystem in one way or another. Although the project is still in the early stages, there have been some interesting applications of science to coastal resources management decision-making, which are improving the quality of and public confidence in the difficult choices made under the project. Fisheries status and trends, additional ecological indicators, and trends and probable effects of tourism are discussed. The goal of the SAMP for the Pulau Payar Marine Park and surrounding areas is to promote the conservation and sustained production and use of the area's reef fisheries resources and habitats. Science applied to the SAMP process is helping to create an understanding and acceptance among the key stakeholders of the need for and benefits of Integrated Coastal Zone Management and helping to obtain their collaboration as stewards of the local resources in pursuit of this goal.

Ogden, J. C. (1997). Marine managers look upstream for connections. *In: Science Washington*, 278(5342), 1414-1415.

Abstract: The Florida Keys are the focus of a major national effort to manage a large land-sea area. In response to drastic declines in coral reefs and fishes and to create a buffer zone from shipping, Congress in 1990 created the 9500-km super(2) Florida Keys National Marine Sanctuary. Although it is now exceeded in size by the Monterey Bay National Marine Sanctuary, its unique management plan includes virtually every conceivable human interaction with the marine environment. A state-federal partnership implementing this pioneering effort at coastal marine resources management was signed on 1 July.

Ohman, M. C., Rajasuriya, A., & Olafsson, E. (1997). Reef fish assemblages in north-western Sri Lanka: distribution patterns and influences of fishing practises. *In: Environmental Biology of Fishes*, 49(1), 45-61.

Abstract: The distribution and abundance of reef fishes in relation to habitat structure were studied within Bar Reef marine Sanctuary (BRMS) and on an adjacent reef, disturbed by destructive fishing techniques, in northwestern Sri Lanka, by visually censusing 135 species groups using fifty metre belt-transects. Two types of continental shelf patch-reefs are found in the study area: coral reefs and sandstone reefs, which are divided into distinct habitats, four for the coral reef (shallow reef flat, shallow patch reef, deep reef flat and Porites domes) and two for the sandstone reef (structured sandstone-reef and flat sandstone-reef). Fish assemblages varied in structure between reef types and among habitats within reef types. Functional aspects of habitat structure and composition, such as available food and shelter, seemed to be important factors influencing distribution patterns. The strongest separation in the organisation of fish assemblages in BRMS was between reef types: 19% of all species were confined to the coral-reef patches while 22% were restricted to the sand-stone reef patches and 59% were represented on both reef types. In terms of distribution among habitats, 21% of all species were restricted to one habitat while only 1.5% were present in all. The highest density of fish was in the coral reef habitats while highest species diversity was found in the most structurally complex habitat: the structured sandstone-reef. This habitat also had the highest proportion of species with restricted distribution. Planktivores were the most abundant trophic group in BRMS, and the species composition of the group varied among habitats. The comparison of the disturbed reef with BRMS suggested that habitat alteration caused by destructive fishing methods has strongly influenced the fish community. Within the fished area the structure of the fish assemblages was more heterogenous, fish abundance was lower by an order of magnitude and species numbers were lower than in BRMS.

Ong'-anda, H. O., & Mwandotto, B. A. J. (1997). Kenya Integrated Coastal Area Management (ICAM) pilot project: Bamburi-Nyali-Shanzu area, Mombasa. *In*: B. G. Rawlins, & T. M. Williams (edS), ODA/LOCS Workshop on Environmental Monitoring in the Coastal Zone, Mombasa (Kenya), 23-25 Apr 1997 (p. 1). Nottingham-UK : British-Geological-Survey. Notes: Summary only.

Abstract: The Kenyan Coast is endowed with a number of natural resources. There are coral reefs, mangrove forests, lowland and Kaya forests, and sandy beaches. These resources support a number of thriving industries ranging from the multi-million dollar tourism industry, reef fisheries and mangrove harvesting. The port town at Mombasa is also a centre of importexport and other commercial activities supporting a population close to 1.4 million people. The dynamics of the socio-economic, cultural and ecological situations has necessitated the need for sustainable exploitation of these coastal resources. This gave rise to the first pilot study of ICAM in Kenya. Seven (7) Kenyan Coastal institutions drawn from the governmental and non-governmental agencies constituted a working team led by Coast Development Authority for implementing the ICAM pilot study. The study site, an area approximately 100 km super(2) has an interesting profile consisting of hotels, mangroves, human settlements, roads, marine park and reserve, urban market, research centre, industry and it has a sea front. The process of fact finding included verbal interviews, personal observations and verification of archive data. The resulting profile was discussed and crystallized at local and national stakeholders workshops. Seven issues were finally identified namely: The need for improved land use management; Provisions for adequate infrastructure and public services; Fresh and coastal water quality degradation; Declines in the reef fishery and the viability of artisanal fishing as livelihood; Degradation of coastal and marine habitats-mangroves, coral reefs, beaches and seagrasses; Coastal erosion; and Increasing on-water and land use conflicts. For all these issues, short and long-term management strategies that are practical in addressing them using local resources were proposed. Some demonstration activities have been employed to amplify the benefits of ICAM to the local communities. Various stakeholders participate in the demonstration activities. To continue the evolution of ICAM process in Kenya to cover the whole of the

coastline, a coastal management steering committee has been put in place to oversee the many activities which have been planned in the strategy document that will be carried out by the respective technical (working) groups according to the issues. This study is part of the wider effort to develop ICAM for the whole of Western Indian Ocean Coastal countries including the Island states

Rinaldi, A. et al. (1997). Realization of 'Biological protected area' in the north Adriatic Sea. *In: Biologia Marina Mediterranea*, 4(1), 619-625 .

Notes: ORIGINAL TITLE: Realizzazione di una 'zona di tutela biologica' nell'Adriatico nord-occidentale

Abstract: A 'biological protected area' is situated offshore Ravenna, Italy, on a large dimension submerged platform. On this site an artificial reef has grown, which is very interesting scientifically. The oceanographic characteristics of this area are described, considering the physical-chemical, trophical and biological conditions, and the reasons for protecting this area, also accessing modalities for subaqueous activities related only to scientific research and to hobbies. The vicinity of the Po Delta causes constant levels of eutrophy and of salinity, transparency and dissolved oxygen variations. This area's high productivity causes phytoplankton growth and large settling of sessile and mobile organism populations. This has an important role for ichthyofauna protection and nursery grounds.

Roberts, C. (1997). Connectivity and management of Caribbean coral reefs. *In: Science*, (278), 1454-1457.

Abstract: Surface current patterns were used to map dispersal routes of pelagic larvae from 18 coral reef sites in the Caribbean. The sites varied, both as sources and recipients of larvae, by an order of magnitude. It is likely that sites supplied copiously from upstream reef areas will be more resilient to recruitment over-fishing, less susceptible to species loss, and less reliant on local management than places with little upstream reef. The mapping of connectivity patterns will enable the identification of beneficial management partnerships among nations and the design of networks of interdependent reserves.

Rooker, J. R. et al. (1997). Fish assemblages on artificial and natural reefs in the Flower Garden Banks National Marine Sanctuary, USA. *In: Coral Reefs*, 16(2), 83-92.

Abstract: Visual censusing was used to characterize fish assemblages on artificial and natural reefs located within the boundaries of the Flower Garden Banks National Marine Sanctuary (FGBNMS) in the northwestern Gulf of Mexico. Emphasis was placed on determining spatial and temporal patterns in habitat utilization by fishes on an offshore artificial reef (Mobil Platform HI-A389A). Overall, 43 species were observed during diurnal surveys in the upper 24 m of the artificial reef. Midwater pelagic fishes (i.e., carangids and scombrids) accounted for over 50% of all taxa enumerated on the artificial reef; however, these taxa were transient members of the assemblage and were observed infrequently. Labrids, pomacentrids, and serranids were the dominant reef-dependent taxa. Distinct trends in vertical, diel, and seasonal abundances were observed for juvenile and adult fishes. Of the three designated depth zones (upper 1.5-9.0, middle 9.0-16.5; lower 16.5-24.0 m), abundance and species diversity were lowest in the upper zone. Nocturnal counts were characterized by a marked reduction or complete absence of most species, due in part to twilight cover-seeking and movement activities. Seasonal variation in community composition and species abundance (May versus September) was primarily due to recruitment of juveniles (0-age fishes) to the artificial reef in late summer. Increases in total fish abundance (all taxa combined) coincided with both increasing habitat rugosity and degree of fouling. Species richness on natural coral reefs in the FGBNMS was higher than on the artificial reef. Unlike the artificial reef, fish assemblages on the natural reefs were dominated by a single family (Pomacentridae) which accounted for over

50% of all individuals observed.

Samoilys, M. A. (1997). Movement in a large predatory fish: Coral trout, *Plectropomus leopardus* (Pisces: Serranidae), on Heron Reef, Australia. *In: Coral Reefs*, 16(3), 151-158.

Abstract: Movement by the larger more mobile species of coral reef fish plays a significant role in determining patterns in abundance and population structure. Fish movement is also relevant to the use and effectiveness of marine reserves in managing fish populations. Coral trout are large piscivorous serranids supporting major fisheries on the Great Barrier Reef (GBR). This study reports on the within-reef movement of the common coral trout, *Plectropomus leopardus*, at Heron Reef, southern GBR, over a twelve month period, investigated by tagging and underwater tracking. Tracking of coral trout revealed no apparent relationship between the area moved and stage of tide or time of day. However, movement areas were affected by the size of fish: In spring a linear relationship between fish size and area of movement was measured, but in summer the largest (male) fish moved over significantly smaller areas than medium-sized fish. Movement of males may be related to cleaning behaviour and spawning. Fifty nine percent (n = 101) of the tagged fish were resighted over periods of 4-5 months, in "home sites" measuring similar to 2000 m super(2). Coral trout were not restricted to home sites, but moved on average 2 km along the reef slope; maximum distances of 7-7.5 km were measured. Coral trout appear to range as mobile, opportunistic predators, but also maintain home sites for access to shelter and cleaning stations.

Sara, G., & Mazzola, A. (1997). Effects of trophic and environmental conditions on the growth of *Crassostrea gigas* in culture. *In: Aquaculture*, 153(1-2), 81-91.

Abstract: In order to study the possibility of exploiting protected marine areas, comparative data on the cultivation of the oyster *Crassostrea gigas* in the South Tyrrhenian Sea are reported. The oysters were cultured at -7 and -13 m on long lines linked to artificial reefs. The observations, made during a 12-month period, were of the chemical-physical and trophic properties of the water column and growth rates of the oysters. Temperature ranged between 19.81 plus or minus 4.67 degree C at -7 m and 18.03 plus or minus 3.03 degree C at -13 m. Salinity showed typical Mediterranean values. The area presented oligotrophic features: the chlorophyll-a (CHLa) concentration ranged between 0.05 plus or minus 0.01 and 0.04 plus or minus 0.02 $\mu\text{g l}^{-1}$ at -7 and -13 m, respectively. The labile particulate organic matter (LPOM) ranged between 344 plus or minus 201 and 334 plus or minus 228 $\mu\text{g l}^{-1}$ at -7 and -13 m, respectively, and the CHLa carbon:POM carbon ratio (index of the autotrophic vs heterotrophic conditions) was never above 3%. POM concentration and POM gross energy content showed significant differences ($P < 0.05$) at the two depths, POM bulk being greater at -13 m. The oysters, sampled monthly, had an initial average size of 11.50 plus or minus 2.78 mm (0.0036 plus or minus 0.01 g dry weight) and had reached 47.50 plus or minus 12.30 mm (0.13 plus or minus 0.04 g dry weight) at -7 m and 41 plus or minus 11.43 mm (0.11 plus or minus 0.04 g dry weight) at -13 m, after 12 months. The length-weight relationship showed the best allometric coefficient for the oysters at -13 m, although the growth trends did not show significant differences. Although a correlation between food quantity and quality and somatic and valvar production in situ was not demonstrated, it is probable that the greater POM bulk at -13 m was the cause for the better growth trajectories of these specimens.

Schmidt, K. F. (1997). "No-take" zones spark fisheries debate. *In: Science Washington*, 27(5325), 489-491.

Abstract: An unusual experiment is getting underway this month on a 30-kilometer-square patch of coral reefs, sea grass meadows, and mangrove swamps off the Florida Keys. Federal officials are banning all fishing from this part of the Florida Keys National Marine Sanctuary--in order to help replenish fisheries elsewhere. The hope is that the Western Sambo's Ecological

Reserve, as it's called, will serve as a source of fish, larvae, and eggs that will spill over into surrounding waters to help restock populations suffering from overfishing, pollution, and heavy tourism. The reserve is the first no-fishing zone set up for this purpose in U.S. waters, but many ecologists and fisheries scientists hope it will fuel a trend. They argue that no-take reserves are crucial for preserving marine biodiversity and healthy ecosystems, and for restoring the ocean's dwindling fisheries. But although the Florida Keys reserve is finally a reality after six tumultuous years of back and forth between scientists, fishers, divers, aquarium fish collectors, local business leaders, and county, state, and federal officials, the idea that it and others like it will help enhance fish stocks is still very much a theory. Even those who support the strategy acknowledge that, in most instances, researchers don't know where many fish species spawn and how they disperse, making it difficult to pick out the best areas for protection.

Singh, B. (1997). Marine parks and protected areas. 1997 the Year of the Coral Reef Save Fiji's Coral Reefs Symposium on Sustainable Harvest of Fiji's Marine Resources, March 20th 1997.

Abstract: A brief discussion is presented on traditional measures used in Fiji to manage protected areas. Particular reference is made to a pilot programme of the National Trust regarding the setting up of the marine parks around Treasure Island, Beachcomber Island, Vomo and Vomo lailai islands.

Sladek Nowlis, J., & Roberts, M. (1997). You can have your fish and eat it, too: theoretical approaches to marine reserve design. Proceedings of the 8th International Coral Reef Symposium (pp. 1907-1910). Panama: Smithsonian Tropical Research Institute

Sluka, R. et al. (1997). The benefits of a marine fishery reserve for Nassau grouper *Epinephelus striatus* in the central Bahamas. Proceedings of the 8th International Coral Reef Symposium (pp. 1961-1964).

Abstract: Nassau grouper (*Epinephelus striatus*) are an important coral reef fish, both economically and ecologically. Intense fishing pressure has been shown to decrease the abundance and average size of this species. Marine reserves have been suggested as areas which can ameliorate the effects of intense fishing pressure while protecting the size, abundance, and reproductive output of targeted species. The benefits of marine fishery reserve in the central Bahamas, the Exuma Cays land and Sea Park, were evaluated with regard to these factors. Seventy-four sites among four coral reef and hard-bottom habitat types were sampled along 90 km of the Exuma Cays during the fall of 1995. Survey sites were selected north, inside, and south of the reserve. Underwater strip transects (20~ m x 5-m) were carried out to inventory grouper species, density, and size. The average biomass and size of Nassau grouper was statistically greater inside reserve. Size and biomass of Nassau grouper did not differ significantly among habitat types. Estimated reproductive output of adult, female Nassau grouper was over 6 times greater inside the reserve. It is concluded that: 1) the reserve is protecting Nassau grouper resources and 2) the reserve is likely exporting grouper biomass across park boundaries.

Suharsono, Lillie, A., & Andamari, R. (1997). Report of the Working Group on Coral Reefs and Ornamental Fish. Report on the Indonesia; FAO; DANIDA Workshop on the Assessment of the Potential of the Marine Fishery Resources of Indonesia held at Jakarta, Indonesia, 13 24 March 1995 Rome Italy: FAO

Abstract: A discussion is presented on the ornamental fish and coral industry in Indonesia. The condition and value of the coral reefs of Indonesia are examined, considering coral reef degradation and marine conservation areas. Four categories of protected areas exist in Indonesia: strict nature reserve; national park; wildlife reserve; and, national recreation parks.

Sweatman, H. (1997). Long-term monitoring of the Great Barrier Reef. *In: Aust Inst Mar Sci.*, 2, 161.

Abstract: In 1992, the Australian Institute of Marine Science initiated a Long-Term Monitoring Program for the Great Barrier Reef (GBR) (Australia) in conjunction with the Great Barrier Reef Marine Park Authority. In 1993, the program was included as a task of the newly formed Cooperative Research Centre for Ecologically Sustainable Development of the Great Barrier Reef. Results of the 1993-1994 and 1994-1995 broadscale and intensive surveys are presented. Broadscale surveys covering the length of the GBR in 11 latitudinal sectors have been carried out since 1985-1986. In 1993-1994, the lowest number of *Acanthaster planci* was recorded since the program began in 1992. Locations of highest and lowest live coral cover are recorded, with information as to whether any decline was related to crown-of-thorns starfish (*A. planci*) or not. Intensive surveys of fixed sites on northeast aspects of reefs in six of these sectors have been carried out annually since 1992-1993. In 1993-1994, 32 reefs were surveyed and in 1994-1995, 48 reefs were surveyed. Detailed changes in fish and benthic communities over all three years are presented for 14 of these reefs.

Tejam, C. S. (1997). Socioeconomic benefits of integrated coastal management and environmental management programs: The case of clean rivers, marine parks, and fisheries. *In: S. Ross, C. S. Tejam, & R. M. P. Rosales (eds), Sustainable Financing Mechanisms: Public Sector Private Sector Partnership*, Chap. 6, (p. 215). GEF; UNDP; IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas.

Abstract: This paper reviews the experiences of coastal and environmental management programs according to the three themes of clean rivers, marine parks, and fisheries development. It concentrates on the successful implementation of the Clean River Program of Singapore; the Coral Reef Protection and Marine Park Management Program in Phuket Island, Thailand; and the Coastal Resource Management Program of Brunei Darussalam, particularly on the concrete social and economic benefits that coastal and marine management programs have brought to the countries that invested in them.

Tilney, R. L. et al. (1997). Ichthyoplankton distribution and dispersal in the Tsitsikamma National Park Marine Reserve, South Africa. *Air & Waste Management Association 90. Annual Meeting, Toronto, Ontario (Canada), 8-13 Jun 1997* Vol. 17 (pp. 1-14).

Abstract: The nature of ichthyoplankton distribution within the Tsitsikamma National Park marine reserve was investigated in an attempt to evaluate the potential for export of larvae of commercially and recreationally important reef species to adjacent, exploited areas. Monthly, inshore ichthyoplankton samples were taken using Bongo nets over an 18-month period. Sampling sites were located over areas of high-profile reef and sand. Current-meter measurements of the area were used to determine current velocity, direction and reversal periodicity. Statistical analysis of the data was performed independently for larvae from four families: Blenniidae, Gobiesocidae, Sparidae and Engraulidae. Results suggested that blenniid and gobiesocid larvae practised active position retention throughout their pelagic phase, while this feature was less defined in sparid and engraulid larval distribution. Using larval distribution and current-meter information, projected dispersal distances for sparid larvae, the family containing the most target commercial and recreational angling species, were estimated. The results suggest that sparid larvae are exported from the reserve to adjacent, exploited areas.

Upreti, A., & Shanmugaraj, T. (1997). Gulf of Mannar Marine Biosphere Reserve. (p. 47). Tamil Nadu, India: Tamil Nadu Forest Dep.

Abstract: Biosphere reserves are protected areas of representative environment. The Gulf of Mannar is one of the marine biosphere reserves (GOMMBRE) situated along the coastline of east coast of India and Sri Lanka. It is covering an area of 10,500 sq. km. and included 21

islands. The Gulf of Mannar is one of the biologically richest and important habitat for sea algae, seagrass, coral reef pearl banks, sacred chank bed, fin and shell fish resources, mangrove endemic and endangered species. Nearly 3,600 species of flora and fauna are represented here. The 21 islands and Gulf of Mannar are declared as marine national park in 1986 for the purpose of protecting marine wild life and its environment by Government of India and state of Tamil Nadu. Objectives of GOMMBRE, bio-physical environmental features, important fauna and flora, management strategy and infrastructural facilities are discussed

Valentine, P., Newling, D., & Wachenfeld, D. (1997). The estimation of visitor use from GBRMPA data returns. Tech Rep Crc Reef Res Cent Vol. vol. 16 (p. 54). Townsville (Australia): Cooperative Research Cent. for the Ecologically Sustainable Development of the Great Barrier Reef .

Abstract: Due to the lack of a formal database, estimates of visitor use of the Great Barrier Reef Marine Park, Queensland (Australia) have been very difficult to compile. Partial estimates, which are probably quite accurate, have been compiled from assessments by Great Barrier Reef Marine Park Authority (GBRMPA) staff, based on knowledge of permits issued to commercial tourism operators. The introduction of the Environmental Management Change in the second half of 1993 and the associated logbook returns now provide an opportunity to monitor more closely the levels of use of specific reefs and sections of the Great Barrier Reef (GBR). A clear set of guidelines is provided for researchers wishing to use the data available from GBRMPA's different databases. The new Data Return Database provides an excellent tool for researchers to monitor and identify commercial tourism use at the widest possible range of scales for the GBR. Some critical issues which can assist database users to avoid producing erroneous data are identified.

Veron, J. (1997). Coral Species: The Search for Truth. *In: Ocean Realm*, Autumn, 82-92.

Wantiez, L., Thollot, P., & Kulbicki, M. (1997). Effects of marine reserves on coral reef fish communities from five islands in New Caledonia. *In: Coral-Reefs*, 16(4), 215-224.

Abstract: The effect of marine reserve protection on coral reef fish communities was studied on five islands located in the southwest lagoon of New Caledonia. Commercial fish communities and Chaetodontidae, sampled before fishing prohibition and after five years of protection, were compared. Reference stations were also sampled to assess variability in unprotected communities on the same time scale. The hypothesis that marine reserves protect and develop fish stocks was confirmed. Species richness, density and biomass of fish on the protected reefs increased respectively by 67%, 160% and 246%. This increase was statistically significant whereas the reference stations showed only a small increase in density. There were significant increases in the species richness, density and biomass of the major exploited fish families (Serranidae, Lutjanidae, Lethrinidae, Mullidae, Labridae, Scaridae, Siganidae and Acanthuridae) and also of the Chaetodontidae. No significant increase in the mean lengths of fishes was noted among the main species, with the exception of one species of Siganid. Size structure changed for most of the main species, as the proportion of small individuals increased after five years of protection. Detrended correspondance analysis indicated that marine reserve protection was the most important determinant of the fish community structure. The second determinant was the position along an inshore-offshore gradient. Marine reserve protection resulted in an increase in the relative abundance and species richness of large edible species within the assemblages.

White, A. (1997). Collaborative and community-based management of coral reef resources: Lessons from Sri Lanka and the Philippines. Workshop on Integrated Reef Resources Management in the Maldives. Male, Maldives. 16 20 March, 1996 Madras India: BOBP

Abstract: Integrated management of coral reef resources is being tested in several Asian countries with useful lessons for the Integrated Reef Resources Management Programme in the Maldives. In the early 1980's several Philippine projects developed coral reef management regimes on small islands which have continued to the present. These management regimes were developed by and for island residents dependent on their coral reef resources. They set up marine reserves and sanctuaries around their islands which have continued to the present. These management regimes were developed by and for island residents dependent on their coral reef resources. They set up marine reserves and sanctuaries around their islands in a manner which stopped all destructive and illegal fishing and so that sanctuary areas were declared off limits to all fishing. Monitoring of the effects of the sanctuaries documented improvements in the abundance and diversity of fishes on the coral reef and in fish yields to the island fishermen. The process for implementation of the management regime included several steps: integration into the community; education; core resource management group building; and formalizing and strengthening organizations for sustainable resources management. In Sri Lanka, a similar process is being adapted to more comprehensive coastal resources management in "Special Area Management" sites. Communities, local and national government are working together to develop and implement management plans for sustainable use of their coastal resources. "Special Area Management Coordinating Committees" for the site include all stakeholders in the process of planning and taking responsible action for implementation. Monitoring of physical and socio-economic effects on the environment and human community is performed by several research organizations and through local participation. Results from the Philippine and Sri Lankan examples include stewardship of coral reef and other coastal resources, and functioning formal management organizations comprised of both community members and government. Also, both national governments recognize the value of locally-based action and decision-making in coral reef conservation.

Wolanski, E., & Sarsenski, J. (1997). Larvae dispersion in coral reefs and mangroves. *In: Am. Sci.*, (85), 236-243.

Zeller, D. C. (1997). Home range and activity patterns of the coral trout *Plectropomus leopardus* (Serranidae). *In: Marine Ecology Progress Series*, 154, 65-77.

Adams, T. J. H. (1998). The interface between traditional and modern methods of fishery management in the Pacific Islands. *In: Ocean & Coastal Management*, 40(2-3), 127-142.

Abstract: The interactions between government and community in the management of reef and lagoon fisheries in the Pacific Islands region are described, and recommendations made concerning the types of interaction that are most constructive, and which should be encouraged in future. The argument is illustrated with three examples of positive government-community actions from the Pacific Islands - a Cook Islands community-moderated individual transferable quota system, a flexible arrangement in Fiji leading to an effective marine protected area, and a community-initiated gillnet ban in Fiji - and by a general discussion of negative interactions. The tendency of biologically trained fishery researchers to discount the role of the fishing community itself when describing and quantifying fisheries should be avoided, and there is a need to distinguish between those local initiatives arising from views that have evolved over centuries, and those arising from modern entrepreneurialism. It is suggested that a major advantage of community-mediated management is its diversity

Adams, T. J. H., & Ledua, E. (1998). Inshore resources management and conservation: Current trends and alternate strategies. Fisheries and marine resources Papers presented at Symposium 8, VIIIth Pacific Science Inter Congress [s. l.]: University of the South Pacific

Abstract: The management of living marine resources associated with reefs and lagoons of the

Pacific Islands is discussed. Following an account of the current status of the Pacific Islands inshore fishery resources, an examination is made of coastal fishery management issues considering traditional fishery philosophy, marine protected areas, gillnets, and conservation needs. Some alternative strategies for fishery management policies are also considered

Appeldoorn, R. S., & Creswell, R. L. (1998). Ecological goals for Marine Fishery Reserve design: Workshop summary. Vol. 50 (pp. 294-303). [s. l.]: [s. n.].

Abstract: The use of "no-take" Marine Fishery Reserves (MFRs), as a management tool has gained acceptance in recent years. In 1995, two seminal workshops were conducted concerning MFRs, which have direct relevance to the Caribbean region. The first was sponsored by the Center for Marine Conservation and the Caribbean Marine Research Center and identified the many potential fishery and non-fishery benefits of MFRs. Many of these benefits are not readily achievable through current stock management approaches based on population dynamics. The second workshop, sponsored by the U.S. South Atlantic Fishery Management Council, concluded that, indeed, MFRs could achieve many management goals, and when combined with other management measures can be an effective tool for managing reef fish resources if the biological, economic and social objectives are clearly identified. Ballantine (1996) outlined the necessary principles guiding the use of MFRs, and his methodological approach is a null basis for MFR design, that is, an approach that can be used in the absence of detailed information. The question follows, then, as to what approaches exist that might enhance or facilitate the design of MFRs beyond Ballantine's basic approach. The purpose of the present workshop was to consider and, if possible, define the biological objectives of a marine reserve, and given the objectives, identify what ecological characteristics would be desired such that design criteria could be specified to achieve these goals. These were viewed specifically within the context of Caribbean reef fisheries

Ault, J. S., & Jiangang Luo. (1998). Coastal bays to coral reefs: Systems use of scientific data visualisation in reef fishery management. (p. 15). Copenhagen Denmark : ICES.

Abstract: Contemporary focus on sustainable resource management requires broadening the bases of fisheries assessment to encompass understanding of ecosystem structure, function and dynamics, and how biology and physics couple to affect spatial and temporal production dynamics for multispecies communities. But such "new" foci have placed many assessment scientists on overload because of explosive technological growth and expanded sensor capabilities that produce a plethora of real-time data streams. Data proliferation continues to produce bottlenecks in the management process due to persistent limitations in analysis and interpretation using traditional assessment methods. To address these problems, we use scientific data visualization in a quantitative systems framework that integrates sampling, data assimilation, visualization, statistics, and mathematical modeling with modern fishery management theory to show how visualization tools are effective for maximizing researcher efficiency and conveying complex technical information about data and models to decision makers. We focus our analyses on a tropical multispecies coral reef fishery and develop spatial models of multistock dynamics that use a bioenergetic framework to explicitly couple fish ontogenetic behavior with the biological-physical ocean environment extending from coastal bays to coral reefs. We use these models to determine the 'spatial growth rate potential' of reef fishes, and are now employing the concept as a strategic basis for the design of marine protected areas in the Florida Keys National Marine Sanctuary

Bohnsack, J. A. (1998). Application of marine reserves to reef fisheries management. *In: Australian Journal of Ecology*, 23(3), 298-304.

Abstract: Establishing permanent 'no-take' marine reserves, areas where fishing and all other extractive activities are prohibited, is an attractive but under-utilized tool for fisheries

management. Marine reserves could potentially deal with many fishery problems that are not effectively addressed by other traditional management measures; they also offer numerous social, economic, and scientific benefits not directly related to fisheries. Limited but growing research has shown beneficial biological and economic effects of marine reserves on fisheries. More research is needed, especially at larger scales, to determine the ideal marine reserve size, number and location necessary to optimize fisheries productivity and resource conservation. Sufficient evidence is available to justify the expanded use of marine reserves in an adaptive approach to fisheries management.

Bohnsack, J. A. (1998). Reef fish response to divers in two 'no-take' marine reserves in Hawaii. *In: Reef Encounter*, (23), 22-24.

Breen, M. (1998). QCFO opposes unwarranted fishing bans proposed for new CQ marine park. *In: Queensland Fisherman*, 16(12), 18-20.

Abstract: The Queensland Commercial Fishermen's Organisation has vigorously opposed commercial fishing bans proposed by environmentalists for the planned Gumoo Woorabudee section of the Great Barrier Reef Marine Park, north of Yeppoon, Queensland (Australia). The QCFO describes these bans as serving no significant conservation purpose and having a major socio-economic impact on long established fishing businesses and communities in the region, where commercial fishing provides established jobs and a secure income source. Recommendations address: conducting a socio-economic impact study of marine park management on the fishing industry, the legal and political precedents for compensation to commercial fishers over access to fisheries resources and the need for peer review of the literature which informs decision making about zoning.

Buchan, K. C. (1998). Saba, Netherlands Antilles. *In: UNESCOCARICOMP - Caribbean coral reef, seagrass and mangrove sites*, Chap. 3, (pp. 187-193). Paris: UNESCO.

Cuthill, M. (1998). Managing the Yongala Historic Shipwreck. *In: Coastal Management*, 26(1), 33-46.

Abstract: The Yongala Historic Shipwreck lies within the Great Barrier Reef Marine Park in northeastern Australia. A draft management plan, produced by the Queensland Museum in 1992, provided primarily for the management of the historical and archaeological values of the wreck. The plan did not outline comprehensive strategies for management of either the special ecological values of the site or an increasing demand by recreational divers to dive the wreck. This article outlines the processes involved in integrating management of the social, ecological, and historical values of the wreck into a format that is acceptable to all stakeholders associated with the site

Edwards, M. S. (1998). Effects of long-term kelp canopy exclusion on the abundance of the annual alga *Desmarestia ligulata* (Light F). *In: Journal of Experimental Marine Biology and Ecology*, 228(2), 309-326.

Abstract: Experiments in a central California *Macrocystis pyrifera* (L.) C.A. Agardh forest examined the effects of long-term (six year) kelp canopy exclusion on the abundance of the annual brown alga *Desmarestia ligulata* (Light F). Exclusion of both surface and subsurface kelp canopies from replicate clearings within Stillwater Cove, CA, USA showed that *D. ligulata* sporophyte recruitment is opportunistic, with more sporophytes occurring in areas where canopies were excluded than under control canopies. Kelp canopy exclusion also increased spring and summer bottom irradiances, and resulted in a steady increase of perennial turf algae over the six-year study. This, in turn, led to a decrease in the availability of nongeniculate coralline algae (the primary substratum on which *D. ligulata* recruits). Subsequently, the annual

maximum abundance of *D. ligulata* sporophytes decreased in the canopy clearings, but did not change under control canopies. Removal of turf algae from experimental plots further increased bottom irradiances and significantly enhanced *D. ligulata* recruitment. When released from apparent competition for light and space, *D. ligulata* sporophytes exhibited an annual life history, with recruitment occurring during a two-week period (April 4–April 17) in the spring, and maximum bottom cover occurring in the summer (July). The onset of *Desmarestia* sporophyte recruitment was closely associated with seasonal increases in daylength and rapid decreases in ocean temperature. These results indicate that the *Desmarestia* sporophyte life history is both annual and opportunistic, with the onset of recruitment stimulated by predictable, seasonal changes in environmental conditions, and the magnitude of recruitment modified by stochastic processes that affect the availability of light and space. Comparison of these results with those from similar studies indicate that they are robust and suggest that they may be generalized over broad temporal and spatial scales.

Environmental Information Syst. Cent., P. T. N. I. (1998). Coral reefs of India: State-of-the-art report. *In: Envis Publ Ser*, 2(98), 52.

Abstract: Coral reefs are familiar for their impressive biodiversity, productivity and scenic beauty. In India coral reefs are distributed in the six regions viz., Gulf of Kachchh, Gulf of Mannar, Palk Bay, Lakshadweep, Andaman and Nicobar Islands and recently discovered table reefs of Ratnagiri Coast of Maharashtra. Fringing reefs Atoll reefs, Platform reefs, Patchy reefs and barrier reefs are major reef types found in these regions of India. The physico-chemical characters, coral distribution, biodiversity and their current status are studied in these reef regions. A total of 155 hermatypic coral species belonging to 50 genera and 44 ahermatypic species belonging to 21 genera have been recorded and the check list of coral distribution around Indian seas and their classification is given. A total of 180 species of benthic algae, 14 species of seaweeds, 12 species of seagrasses, 4 species of lobsters, 108 species of finfishes and good number of other crustacean and molluscan species are recorded. The nationwide project on the coastal ocean monitoring and prediction system provided data on water quality, hydrographical characters and productivity of these regions. Increasing human population and anthropogenic pressures have severely affected coral distribution and its biodiversity. Natural calamities also affect on the health and damage of the coral reefs directly and indirectly. Some endangered coral reef ecosystems have now been offered protection by declaring them as marine parks.

Gabrie, C., & Moyne-Picard, M. (1998). L'Etat des Récifs Coralliens en France Outre-Mer: Nouvelle Calédonie, Wallis et Futuna, Polynésie Française, Clipperton, Guadeloupe, Martinique, Mayotte, La Réunion, Iles Eparses de l'Océan Indien. (p. 136). Paris-France: Ministère de l' Aménagement du Territoire et de l' Environnement.

Notes: This book exists as an english translation 37 pp.

Abstract: The International Coral Reef Initiative (ICRI) is a partnership among nations and organisations to mobilise government and stakeholder support for vigorous and effective actions to address threats to the worlds coral reef ecosystems, by promoting their protection and sustainable development. This document on the state of coral reefs in the French Overseas Departments and Territories (DOM-TOM) was drawn up as part of French undertakings as a member of the ICRI, on request from the French Ministry of Spatial Planning and Environment and with the support of the Secretariat for Overseas Affairs and the French Institute of the Environment (IFEN). Overseas Departments and Territories are located in three of the worlds oceans. Their geographical distribution account for the wide variety of coral reef types, and hence their outstanding natural diversity. Cultural, historical, political and administrative differences between the DOM-TOM have also given rise to a range of different management tools and methods. This brochure is the executive summary of a larger document containing a

chapter on each of the DOM-TOM, to be published in English and French. The document was commissioned from C. GABRIE (Consultant in Tropical Marine and Coastal Environments) as a preliminary and as yet incomplete assessment of the state of DOM-TOM coral reefs. The assessment was made in collaboration with a large number of managers and researchers. The resulting document is intended as an aid for policy-makers, by describing the specific features of the various coral reefs and explaining why they need to be preserved, and also for scientists, by outlining the management and conservation tools available at national and international level. The document describes the current state of coral reefs, their importance, the pressures being exerted on those ecosystems and the responses made by the various parties involved (types of coral reefs: fringing reefs, barrier reefs, atolls, platform reef, heritage value and social and economic importance, species diversity, consequences of coral reef damage, causes of coral reef degradation: natural pressures with global change, cyclones, coral bleaching, *Acanthaster* infestations, coral diseases, human pressures (land management, mining, agriculture and sediment run-off, water pollution, aggregate extraction and dredging, coastal reclamation, exploitation of biological resources, potentially harmful fishing methods) responses to the problems with the relevant organisations, regional arrangements, legislation and regulations, international conventions, land use management and planning, planning and management tools (integrated coastal area management, water management, local environment charter, management of biological resources), conservation measures (marine protected areas, ZNIEFF areas, RAMSAR sites, Biosphere Reserves, Coastal and Lakeshore Conservation Agency CRLRL), coral reefs and development policy, monitoring networks (Worldwide Coral Reef Monitoring: Global Coral Reef Monitoring Network GCRMN, Reef Check...), research, sources of funding European funding, private funding

Gibson, J., McField, M., & Wells, S. (1998). Coral reef management in Belize: an approach through Integrated Coastal Zone Management. *In: Ocean & Coastal Management*, 39(3), 229-244.

Gingras, M. L. et al. (1998). First observations of vermilion rockfish courtship are from a harvest refuge. *In: Calif. Fish Game*, 84(4), 176-179 .

Abstract: We videotaped courtship displays of vermilion rockfish, *Sebastes miniatus*, on a single reef in the Point Lobos Ecological Reserve, Monterey County, California. Three courtship sequences involving 6 different fish took place between 1100 and 1500 hours on 28 October 1997 and another sequence occurred at 1145 hours on 24 June 1998. From a literature review, observations of rockfish courtship and mating are very rare and our observations are unique. Courtship observations were serendipitous and coincidental to our work to collect fish length data using in situ laser-scaled videographic methods (Gingras et al. 1998). Each observation was brief (26-142 seconds). Although we did not observe copulation, the sequences are distinctly different from agonistic behaviors of rockfishes that we have observed and those described by Haaker (1978) and Shinomiya and Ezaki (1991). We did not capture any of the fish and attributed gender based on consistent and differential size, behavior, and color patterns and/or the presence of an extended urogenital papilla, characteristic only of male rockfishes. Two fish were involved in each courtship sequence, although a conspecific was within 4 m of the courting fish during the most recent observation. Each male was substantially larger, and thus older, than the courted female. Males usually displayed an extended papilla and often displayed erected pectoral and pelvic fins. Lateral oscillation and lateral display (Shinomiya and Ezaki 1991) were characteristic male courtship behaviors. Lateral oscillation is a very conspicuous side-to-side rolling motion about the long axis of the body (up to plus or minus 60 degree) with a period of 2-5 seconds. A male oscillated laterally when swimming parallel and relatively close to a female. Lateral display was a conspicuous maneuver that brought the ventral surface of a male very close to the snout of a slowly swimming female and only

occurred when a male could approach on a near-parallel course and swim abreast of the female. If successful in gaining front position, the male would slowly turn in front of the female. Females generally swam away or slowly altered course in reaction to attempts by the male to move abreast or in front of them.

Gjerde, K. M., & Pullen, J. S. H. (1998). Current Legal Developments. International Maritime Organization. Cuba's Sabana-Camaguey Archipelago: The Second Internationally Recognized Particularly Sensitive Sea Area. *In: International Journal of Marine and Coastal Law*, 13(2), 246-262.

Abstract: The Marine Environment Protection Committee of the International Maritime Organization officially recognized the Sabana-Camaguey archipelago off the north coast of Cuba as a Particularly Sensitive Sea Area (PSSA) in September 1997. Australia is the only other nation with a recognized PSSA, the Great Barrier Reef. The Sabana-Camaguey archipelago encompasses 465 kilometers of islands, keys and coral reefs, featuring beautiful beaches, a well-developed reef system, remarkable biodiversity and important commercial fisheries and fish farms. It also hosts a regionally important scientific research and environmental monitoring center. Most significant for Cuba's economic development is its potential for tourism. Sustainable tourism in the archipelago is a major component of an ongoing project funded by the Global Environment Facility and the government of Cuba. This article discusses the concept of PSSAs in general and the Sabana-Camaguey archipelago in particular. It also contains three appendices reproducing Cuba's legislation designating the Sabana-Camaguey archipelago as a Particularly Sensitive Sea Area.

Gribble, N. A., & Robertson, J. (1998). Fishing effort in the far northern section cross shelf closure area of the Great Barrier Reef Marine Park: the effectiveness of area-closures. *In: Journal of Environmental Management*, 52(1), 53-67.

Abstract: A meta-analysis of available information on the intensity and distribution of illegal prawn (shrimp) trawling is reported from a 10 000 square kilometre cross shelf area-closure in the tropical Great Barrier Reef Marine Park. Northern and southern borders of the closure were subject to edge effects as trawlers over-ran their hauls, legally started in the adjacent open zones. There was considerable illegal trawling inshore along a north-south navigation channel running through the area-closure. The middle and outer regions of the closure were originally denied to trawlers because of 'rough ground' but this is probably no longer the case since the general adoption of advanced navigation aids (GPS). The area least likely to have been heavily trawled is the central mid-shelf section of the closure in a region of uncharted shoal reefs. Many trawlers fish in the accessible sections of the closure on a casual or incidental basis but approximately 47 boats do so on a consistent basis. An estimated yearly total of 3260 days illegal trawling occurs, giving an approximate estimate of 69 days illegal trawling per regular offender. The implications of this level of noncompliance are the probable invalidation of the original objectives of conservation and maintenance of a pristine reference area in all but the central section of the closure. Management of marine world heritage areas requires the acknowledgement that the harvesting of fish, prawns and other living resources may be an established use of the Marine Park but it also requires a combination of education plus the adoption of effective monitoring technology, such as satellite vessel monitoring systems, to stop or at least reduce unauthorized fishing.

Guzman, H. M., & Guevara, C. A. (1998). Arrecifes coralinos de Bocas del Toro, Panama: II. Distribucion, estructura y estado de conservacion de los arrecifes de las Islas Bastimentos, Solarte, Carenero y Colon. *In: Revista De Biologia Tropical*, 46(4), 889-912.

Abstract: The distribution and conservation status of coral reefs along the northern section of the archipelago of Bocas del Toro were evaluated, and the structure of 18 reefs around the

Bastimentos, Solarte, Carenero and Colon Islands was described. Reef habitats located on the seaward side of the islands exhibited the lowest coral cover (8%) and coral diversity, while leeward reefs showed the highest living coral cover (32%) and diversity. Macroalgae coverage was similar in both habitats but high (50%) if compared with other continental reefs described in the Ensenada Grande of Almirante Bay (4%). A total of 54 coral species was recorded, representing a 35% increase from previous studies for the region and 88% of the total species described for Panama. The diversity of reef organisms and habitats in the archipelago was greater outside the National Park of Bastimentos Island, the only marine protected area in western Panama. Some recommendations were provided for an integrated management of marine-terrestrial natural resources.

Hagman, D. K., Gittings, S. R., & Vize, P. D. (1998). Fertilization in Broadcast-Spawning Corals of the Flower Garden Banks National Marine Sanctuary. *In: Gulf of Mexico Science*, 16(2), 180-187.

Abstract: Broadcast spawning is considered to be the dominant reproductive strategy for reef corals, but little is known about two critical postspawning processes, fertilization and early larval development. Instead, most efforts have focused on dispersal and recruitment. Since 1993, we have examined coral fertilization and development at the Flower Garden Banks, which contain two isolated reefs with predictable and dramatic annual mass spawning events in the northwestern Gulf of Mexico. Observations of *in vitro* fertilization indicate that the hermaphroditic scleractinian species *Colpophyllia natans*, *Diploria strigosa*, *Montastraea faveolata*, and *M. franksi* all have high fertilization potentials when outcrossing. However, although *D. strigosa* can self-fertilize readily, self-fertilization levels within *C. natans* and the *Montastraea* species are low. In addition, interspecific crossing attempts among the hermaphroditic species of *Montastraea* (*M. franksi*, *M. faveolata*, and *M. annularis*) yielded low levels of fertilization. The differences observed in the timing of spawning and the low hybridization success between the *Montastraea* siblings lend additional support to their recent reclassification as separate species. Spawning egg samples collected immediately upon release from female colonies of the gonochoric species *M. cavernosa* and *Stephanocoenia intersepta* produced an unexpected observation - very high levels of fertilization. This suggests internal fertilization prior to egg release, a process that has not heretofore been observed in a broadcast-spawning scleractinian.

Hannan, J., & Smith, A. (1998). Rocky reef habitats. *In: Fish NSW*, 3(Winter), 29.

Abstract: Rocky reefs are generally areas of rocky bottom occurring within estuarine and marine waters below low tide level. Along the coastline of New South Wales (Australia), prominent areas of rocky reef occur seaward of most headlands and rock platforms. Rocky reefs support a great variety of marine life, typically including hundreds of species of fish, invertebrates and algae. Diverse assemblages of brown, red and green macroalgae, along with sponges, ascidians and other sessile invertebrates enhance habitat complexity. A number of marine parks, aquatic reserves and intertidal protected areas provide for the protection of rocky reefs and their associated animals and plants in New South Wales. Potentially damaging activities such as fishing, collecting, anchoring and discharging pollutants are variously restricted or banned within these areas. Managers and planners at all levels of government are also becoming more conscious of the impacts of land-based activities on aquatic habitats such as rocky reefs. Controls on urban and rural development now routinely address issues relating to runoff, pollution and sediment.

Hatcher, B. G., & Creswell, R. L. (1998). Can marine protected areas optimize fishery production and biodiversity preservation in the same ecosystem ? Proceedings of the Gulf and Caribbean Fisheries Institute. Merida (Mexico), Nov 1997 Vol. 50 (pp. 493-502). [s. l.]: [s. n.].

Abstract: Marine Protected Areas are becoming a method of choice for managing the living marine resources of coastal marine ecosystems in the Caribbean. Their popularity stems in part from the assumption that MPAs reconcile the competing needs of stakeholders to optimize extractive and non-extractive resource usage. Typically the greatest conflict in management exists between the need to sustain or increase fishery yields, and the need to preserve habitat and species diversity in shallow reef and near shore environments (in part for sustained tourism, and in part for long term ecological survival). No evidence is available to demonstrate that MPAs preserve marine biodiversity: but common sense suggests they will help do so. There is unequivocal evidence that MPAs of adequate size and protection do conserve and even enhance fish biomass on Caribbean coral reefs. No adequate time series exist to demonstrate that MPAs sustain or increase production in characteristic near shore fisheries, although theory predicts that spill over and reproductive export may do so. Results from empirical studies of reef fish movement demonstrate that spill over will rarely be sufficient to offset the immediate loss of harvest suffered by a fishery after MPA creation. The delay before putative yield enhancement resulting from increased recruitment exceeds two years in reef fish communities. Artisanal fishers often lack the reserve capital required to absorb the accompanying loss of income, and increase effort to maintain catches. This response can further delay the development of the MPA. Both the biology and economics of Caribbean reef fisheries create a mismatch of investment and benefit that works against joint optimization of biodiversity preservation and resource conservation. External compensation for lost income during the development of MPAs may be required to reconcile management goals.

Hill, R. L., & Creswell, R. L. (1998). Using knowledge of microhabitat selection to maximize recruitment to marine fishery reserves (MFR). Vol. 50 (pp. 417-426). [s. l.]: [s. n.].

Abstract: Marine fishery reserves (MFRs) offer advantages for the management of tropical and temperate fisheries that can effectively augment conventional management programs. The effectiveness of MFRs to support fisheries in surrounding environments depends 1) on their ability to maintain or rebuild spawning stock biomass; and 2) upon the rate of export of propagules and/or adults out of the reserve. Inherent protection of important fish habitats within the reserve should help sustain ecological structure and function. Various ontogenetic stages of both fishery and non-fishery species have been shown to use particular habitats, presumably because they offer some evolutionary advantage. Habitat characteristics have been shown to influence settlement rates and control post-settlement survivorship by affecting growth and predation rates. In this study, newly settled white grunts, *Haemulon plumieri*, are shown to select natural habitats composed of small *Acropora cervicornis* coral heads in a shallow seagrass bed rather than either artificial reefs in the same seagrass bed or natural substrates available in the surrounding areas. These preferred microhabitats should be identified for other fishery species and included within MFR boundaries to preserve these habitats and to hasten the rate of increase in the spawning stock biomass within the reserve.

Horrill, J. C. (1998). A case study of collaborative management of marine protected areas in partnership with communities. *In: Partnership for Conservation Report of the Regional Workshop on Marine Protected Areas, Tourism and Communities.* Nairobi Kenya: IUCN EARO.

Abstract: Collaborative management plans were formulated by villagers and local government officers in two villages of the Tanga region, Tanzania. The area includes fringe of mangroves, coral reefs, extensive seagrass beds and sand flats. These plans recognise the need to increase reef fish stocks through conservation measures and reduction of fishing pressure on reef stocks. It should be achieved through diversification of fishing activities and reduction in the numbers of fishers. The process of management plan development started with a series of workshops where villagers and government personnel together identified critical issues, their perceived

causes, and possible solutions to resolve them. At the same time, participatory socioeconomic and coral reef surveys and a study of existing traditional management systems were undertaken. The villagers formed village committees to deal with fisheries related issues. The management plans of both villages have been implemented fully for less than a year only, and the communities are still learning what their likely implementation problems are and how to resolve them.

Horwood, J. (1998). Evaluation of the effects of closed areas on fish stocks. (p. 7). Copenhagen Denmark: ICES.

Abstract: There is increasing international interest in the use of closed areas or no-take-zones (NTZs) to protect fish stocks. Examples are given of the evaluation of European closed areas, as mathematical exercises and as empirical investigations. Models for the evaluation of closed areas are described. Generally the results show that it is beneficial to protect nursery areas. In contrast, protection of spawning areas is of limited use if the catch of fish is taken elsewhere. The results are compared with positive claims for the use of NTZs. It is argued that most benefits have been seen in reef fisheries. It is the different biology and management that gives the different results. A wider range of uses for NTZs is presented.

Jaffe, R. et al. (1998). Baseline study on the levels of organic pollutants and heavy metals in bivalves from the Morrocoy National Park, Venezuela. *In: Marine Pollution Bulletin*, 36(11), 925-929.

Abstract: Bivalves have been extensively used as bioindicators of pollution in aquatic environments, particularly in coastal areas worldwide. The rationale behind the use of bivalves in monitoring programmes has been discussed in several scientific reports since the introduction of the 'Mussel Watch' concept. The present study reports the concentrations of selected organic and inorganic contaminants in the flat tree-oyster (*Isognomon alatus*) from one of the largest marine parks in Venezuela, the Morrocoy National Park, as an initial step to determine the present levels of contaminants and establish a baseline reference for future monitoring efforts. The Morrocoy National Park (Fig. 1) covers an area of about 32000 acres, most of which comprises aquatic habitats such as mangrove forests, seagrass beds and coral reefs. The Park is composed of a series of small islands that provide a natural habitat for many endangered species of birds and constitute excellent nursery environments for numerous fish species. Its beauty has made this Park one of the primary tourist attractions in Venezuela

Jagtap, T. G. (1998). Structure of major seagrass beds from three coral reef atolls of Lakshadweep, Arabian Sea, India. *In: Aquatic Botany*, 60(4), 397-408.

Abstract: Detritus-based marine ecosystems such as mangrove and seagrass are of immense ecological importance. Major seagrass meadows from three coral atolls of the Lakshadweep group (Arabian Sea) were studied for their floral components. Seagrass beds were heterogeneous, comprising mainly of *Thalassia hemprichii* and *Cymodocea rotundata*, in Agatti and Kavaratti and it was observed to be monospecific (*T. hemprichii*) in the Kalpeni lagoon. Maximum (0.34 km²) and minimum (0.005 km²) extent of seagrass beds were observed in Kavaratti and Agatti lagoons, respectively. Seagrass weight (dry) of 43.97, 30.88 and 0.74 t were estimated from Kavaratti, Kalpeni, and Agatti, respectively. Maximum biomass occurred from 0-2 m depth, mainly contributed by the aboveground shoots, and was found to be negatively correlated with depth ($r=0.71$, preserves indicating seagrass growth mainly by vegetative propagation. Epiphytes, on an average, contributed 7.5% of the seagrass biomass and were dominated by algae such as *Melobesia* spp., *Microcoleus lyngbyaceus* and *Ceramium* spp. Epiphytic biomass, too, decreased with increasing depth. Associated marine algae were represented by 66 species, dominated by rhodophytes.

Jameson, S. C. (1998). Rapid ecological assessment of the Cayos Miskitos Marine Reserve with notes on the shallow-water stony corals from Nicaragua. *In: Atoll Research Bulletin*, (15), 450-458.

Abstract: At the present time, most of the coral reef ecosystem of the Miskito Coast Marine Reserve is in good condition. However, increased sedimentation and eutrophication, as well as a reduction in fish abundance, could easily tip the balance toward an unhealthy condition. Sedimentation and eutrophication are stressing reefs closest to the Honduran border (northwest reefs). Other reefs are experiencing higher than normal sedimentation but are viable. The abundant and diverse herbivorous fish populations help keep algal overgrowth in check. High lobster and turtle fishing pressure is severely stressing these populations. While lobster populations seem to be maintaining themselves, albeit at a young age-class population structure, this is probably not the case for turtle populations. The remote location of the Cayos Miskitos reefs has saved them from the fate of most Caribbean reefs near large population centers. Natural storm damage, has caused most of the physical change on the reefs, but this in turn has provided new habitat for the abundant coral recruits and is part of the natural evolution of the coral reef ecosystem. Twenty-seven shallow-water stony coral species were collected during the survey. This list could be increased with more field effort. Considering the habitat availability and favorable environmental conditions all Caribbean coral species should be found in the Cayos Miskitos Marine Reserve. This is the first listing of stony coral species from the Caribbean coast of Nicaragua.

Kamukuru, A. T. (1998). Assessment of biological status of the Dar es Salaam designated marine reserves off the Tanzanian coast. Advances in marine science in eastern Africa: application of scientific knowledge in marine and coastal resources management. 1. Western Indian Ocean Marine Science Association (WIOMSA) Scientific Symposium on Advances in Marine Science in Eastern Africa, Mombasa (Kenya), 2 3 May 1997 Zanzibar Tanzania : Western Indian Ocean Marine Science Association WIOMSA

Notes: Summary only.

Abstract: This study is a contribution towards the protection of Dar es Salaam, Tanzania designated marine reserves. It consists of a preliminary assessment to determine the health status and potential of these reefs for future marine protected area management. The island coral reefs located at Kunduchi coast of Dar es Salaam city, were surveyed with the aim of assessing their biological status. The coast of eastern Africa is lined with well developed and biologically diverse fringing and barrier coral reefs. These reefs are essential ecosystems for fishery resources, shoreline protection, and as tourist attractions.

Karczmarski, L. et al. (1998). Recommendations for the conservation and management of humpback dolphins *Sousa chinensis* in the Algoa Bay region, South Africa. *In: Koedoe*, 41(2), 121-129.

Abstract: The natural history of humpback dolphins *Sousa chinensis* inhabiting the Algoa Bay region, Eastern Cape, South Africa, was investigated by means of land- and sea-based surveys undertaken between May 1991 and May 1994. This article reviews the findings which are relevant to the conservation of humpback dolphins and provides recommendations for both the conservation and management of this species in Eastern Cape waters. In general, humpback dolphins appear to be typical coastal dolphins which occur in small numbers, have low population growth and depend on restricted inshore resources. Establishment of protected areas where human impact could be limited or controlled seems to be the most effective conservation management approach. Habitats critical for humpback dolphins in Eastern Cape waters (inshore rocky reefs) and the dolphin's core areas in the Algoa Bay region have been identified. It is recommended that a conservation and management zone (marine sanctuary) in the Algoa Bay region be established and a suitable site for it is identified. Given adequate legislation and

proper management, this area could be used for the development of ecotourism, including dolphin-watch operations, which would further stimulate interest in coastal conservation

Kim, E. et al. (1998). The Great Barrier Reef Marine Park training package: a participant evaluation. (p. 20). Townsville (Australia): Cooperative Research Cent. for the Ecologically Sustainable Development of the Great Barrier Reef.

Abstract: Sustainable tourism requires quality experiences for visitors as well as effective management of negative visitor impacts. Visitor education or interpretation can play a key role in achieving both these requirements. The Great Barrier Reef Marine Park Authority (GBRMPA) has developed a manual and an associated training scheme for reef tourism staff to enhance the quality of interpretation provided for tourists visiting the Great Barrier Reef (GBR), Queensland (Australia). The results of an evaluation of the first training session run in March and April 1996 are presented. Overall, evaluations of the training were very positive and 93% of the participants said that they would recommend the training session to other reef tourism staff. The most commonly listed best feature of the training programs was the information on reef ecology. The small sample size means that the results must be interpreted with some caution, particularly with respect to their applicability to all reef tourism staff. The broader population of reef tourism personnel may not share the same motivation or enthusiasm as those surveyed in the present study.

King, M., & Faasili, U. (1998). Community based management of fisheries and the marine environment. Fisheries and marine resources Papers presented at Symposium 8, VIIIth Pacific Science Inter Congress, the University of the South Pacific, Fiji, 13 19 July, 1997 Suva Fiji: USP

Abstract: Although declining stocks of fish in lagoons and inshore reefs are of particular concern in tropical, seafood dependent countries, direct action by government agencies has been largely effective in addressing these problems. However, many subsistence fishers in tropical regions live in discrete communities which have some degree of control of adjacent waters and a high level of awareness of the marine environment. These factors provide an ideal basis on which to motivate communities to manage their own marine resources. A fisheries extension program in Samoa encouraged each village community to define its key problems, discuss causes, propose solutions, and take appropriate actions. Various village groups, including women's and untitled men's groups, provided information which was recorded (as problemsolution trees) on portable white boards. The extension process culminated in a community owned Fisheries Management Plan which listed the resource management and conservation undertakings of the community. Undertakings have ranged from enforcing laws banning destructive fishing methods to protecting critical marine habitats. Within the first seventeen months, the extension process was commenced in 56 villages, of which 38 have produced Village Fisheries Management Plans so far. An unexpectedly large number (32) of these villages chose to establish community owned Marine Protected Areas.

Kjerfve, B. et al. (1998). CARICOMP: A Caribbean network of marine laboratories, parks, and reserves for coastal monitoring and scientific collaboration. *In:* B. Kjerfve Caricomp: Caribbean Coral Reef, Seagrass and Mangrove Sites (pp. 1-16). 7 Place de Fontenoy/75700 Paris/France: Unesco.

Koslow, J. A., & Gowlett-Holmes, K. (1998). The seamount fauna off southern Tasmania: benthic communities, their conservation and impacts of trawling: final report to Environment Australia and the Fisheries Research and Development Corporation. (p. 104). Hobart (Australia): CSIRO Marine Research.

Abstract: Approximately 70 seamounts, the remnants of extinct volcanoes, arise from water

depths between 1,000-2,000 m on the continental slope, between 50-100 km off southern Tasmania (Australia). These seamounts, which are typically cone shaped, 200-500 m high and several kilometres across at the base, create a distinct deep sea environment, with little sediment deposition and benthic communities dominated by corals and other filter feeders, with orange roughy and some deep water oreos adapted to this environment. Fauna are extensively damaged by normal trawl operations and are likely to have extremely limited regenerative capacity, so it is recommended that a substantial area of the newly mapped seamounts should be set aside as an interim conservation measure and the diversity and distribution of benthic communities on seamounts between 700-2,000 m should be assessed to establish a biological basis for informed decisions on creating a marine reserve.

Lim, L. C. (1998). Carrying capacity assessment of Pulau Payar Marine Park, Malaysia. (p. 129). Madras-India : BOBP.

Abstract: This document assesses a few critical aspects of the 'carrying capacity' of the Pulau Payar Marine Park, a marine resource sanctuary and tourist attraction off the west coast of Kedah state, in the northwest of Peninsular Malaysia. It is based on a survey of the park's coral reefs which are popular dive sites, and a land-based survey for which interviews were conducted with tourists, tour operators, divers and dive operators. It is concluded that, given the increasing number of tourists to the park, further expansion of tourism development is not desirable. Improving the 'carrying capacity' of the park means taking appropriate management action to prevent degradation of the coral reefs and provide adequate facilities to cope with tourist use, demands and requirements. Several recommendations are made concerning the reefs, the marine park, its facilities and socio-economics.

Luhrs, T. C., & Creswell, R. L. (1998). Manejo y administracion del Parque Marino Nacional "costa occidental de Isla Mujeres, punta Cancun y punta nizuc". Vol. 50 (pp. 1152-1157). [s. l.]: [s. n.].

Abstract: Original Abstract: Este area natural protegida, decretada el 19 de julio de 1996, tiene una superficie total de 8,672 Ha. dividida en tres poligonos con la finalidad de proteger especificamente las comunidades coralinas aledanas a Isla Mujeres y Cancun. La vocacion de uso es marcadamente turistica y ello ha motivado el exito de Cancun, que se ha consolidado como uno de los principales destinos turisticos en el Mar Caribe a solo 25 anos de su establecimiento. Se estima que el Parque Marino recibe un millon de visitantes anualmente, que pueden realizar practicamente todas las actividades nautico-recreativas conocidas. La transicion entre una zona de uso publico intensivo sin restricciones especificas convertida en area natural protegida, afecta actividades economicas establecidas al margen de la prevencion del deterioro que pueda ocasionarse a los recursos, por lo que genera renuencia, respuestas lentas y, en ocasiones, franca inconformidad con las medidas de manejo que se implementan.

Mcmanus, J. (1998). Marine reserves and biodiversity: toward 20% by 2020. In: J. Mcmanus, C. Van Zwol, L. R. Garces, & D. Sadacharan A framework for future training in marine and coastal protected area management, Manila (Philippines), 3-7 Nov 1997, Chap. 57, (pp. 25-29). Makati-City-Philippines: ICLARM.

Abstract: The author gave a background on global biodiversity patterns which show high diversity in tropics, especially in Southeast Asia. Causes of degradation of coral reefs and the concept of overfishing were discussed. The need for establishing marine protected areas (MPAs) with a mixed strategy of single large or several small (SLOSS) MPAs was noted. A global call to set aside 20% of the world's marine waters as reserves by the year 2020 was also emphasized. The establishment of large reserves covering thousand of kilometers of ocean and waters will require setting of priorities and establishment criteria for reserves.

Motongwa, H. (1998). Poissons et Pêches Africains Diversité et Utilisation. African Fishes and Fisheries Diversity and Utilisation. International Conference for the Paradi Association and The Fisheries Society of Africa, Grahamstown (South Africa), 13-18 Sept 1998 Grahamstown South Africa: FISA; PARADI

Notes: Summary only.

Abstract: Marine fisheries provide food protein, employment and income for the coastal population and the surrounding inhabitants. Both an artisanal and commercial fishery are carried out although the artisanal fishery dominates and supports approximately 6,500 fishermen. Fishing is done in shallow waters using beach seines, traps, fishing lines and cast nets as major gears. During the last decade the total annual marine fish output has varied from 5,000 to 8,000 tons. Approximately 80 percent of the total fish landing come from shallow coastal waters and 18 percent from offshore trawlers. Inshore reef fisheries are at or near maximum sustainable yields, while offshore areas are considered under-exploited. The fisheries have been overshadowed by shoreline and water-dependent tourism activities and the development of residential and commercial establishments. In addition to the traditional fisheries for food production, sport fishing has increased. A small amount of aquarium fish collected for export has been reported in the marine reserves. Marketing of fish is majorly done by middlemen on whom the fishermen also depend for vessels for a price resulting in poor returns. The bulk of the fish landed along the Kenyan coast is to a greater extent consumed locally. Generally, the production of the marine fish and other products has declined in the last two years due to lack of adequate capacity to effectively utilize the Exclusive economic Zone (EEZ) in the Indian Ocean and the inefficiency in transforming semi-processed fish products to standard finished outputs. In order to assist in fish marketing, fishermen's co-operatives have been encouraged. They are aimed at ensuring fair practices and reasonable returns to the fishermen for their landings

Musso, B., & Inglis, G. (1998). Developing reliable coral reef monitoring programs for marine tourism operators and community volunteers. Vol. 24 (p. 134). Townsville (Australia): Cooperative Research Cent. for the Ecologically Sustainable Development of the Great Barrier Reef.

Notes: Incl. 102 refs.

Abstract: Growing interest by community groups and the marine tourism industry in the Great Barrier Reef (GBR) region, Queensland (Australia) to become directly involved in monitoring the state of coral reef sites they visit on a regular basis resulted in this project. A feasibility study was conducted to develop quantitative methods that could be used by non-experts to monitor the condition of coral reef sites in the Great Barrier Reef Marine Park (GBRMP). The sampling methodology chosen used point-intercept transects to measure the abundance of reef organisms, pilot studies assessed the suitability of the technique for volunteers and concurrently, a training program was developed. The results indicate that, with limited training, non-experts can collect reliable, quantitative information on the state of coral reefs, provided quality control procedures are incorporated in the sampling methodology, the training and the interpretative materials

Muthiga, N. (1998). National perspective of marine protected areas management in Kenya. *In: Partnership for Conservation Report of the Regional Workshop on Marine Protected Areas, Tourism and Communities.* Nairobi Kenya: IUCN EARO.

Abstract: There are four marine national parks and six marine national reserves in Kenya, which encompass a diverse selection of marine habitats including coral reefs, mangrove forests, and seagrass beds. Endangered species occur in the waters of all marine protected areas (MPAs). Some lie adjacent to the most heavily developed tourist beaches in Kenya, and the Mombasa Marine Reserve is next to the port of Mombasa, which raises concerns about the

threat of pollution. Even with government subsidy, there would still be a need to develop ways to enhance the management of MPAs. Several programmes are running with the aim to develop integrated MPA management plans that will incorporate a framework for collaboration among stakeholders. Finding alternative resource uses for the communities utilising marine reserves has also been initiated at the Mpunguti Marine National Reserve. The development of other alternatives, including aquaculture, reef restoration, and artificial reefs, are also being explored

Nassor, M. (1998). National perspective of marine protected area management in Zanzibar. *In: Partnership for Conservation Report of the Regional Workshop on Marine Protected Areas, Tourism and Communities*. Nairobi Kenya: IUCN EARO.

Abstract: Zanzibar has a variety of productive and attractive marine ecosystems, such as mangroves, seagrass beds, and coral reefs that provide protection, feeding, and breeding habitats for a variety of organisms, including fishes. Four marine protected areas (MPAs) have been established so far, two of them are managed by private investors under special management agreements with the government. In 1993 it was decided that the MPAs would be managed by a section of the newly formed Commission for Natural Resources. Problems facing protected areas under management by private investors include delicate relations with other stakeholders and inadequate capacity to deal effectively with cases of destructive fishing on behalf of the enforcement authority. Problems facing protected areas under the control of the Commission for Natural Resources include disappointment by local communities with the way law enforcement institutions treat cases of destructive fishing and lack of effective mechanisms for revenue collection and expenditure to support management of protected areas.

National Parks Service. (1998). Coral Reefs Under National Parks Service Jurisdiction: Overview of Areas, Protection, and Management Issues. Washington, DC: U.S. Department of the Interior, Water Resources Division.

Nelson, V. M., & Mapstone, B. D. (1998). A review of environmental impact monitoring of pontoon installations in the Great Barrier Reef Marine Park. (p. 85). Townsville (Australia): Cooperative Research Cent. for the Ecologically Sustainable Development of the Great Barrier Reef.

Abstract: Tourism is an economically and socially valuable activity in the Great Barrier Reef Marine Park, Queensland (Australia) and pontoons moored offshore provide a stable and convenient platform from which tourists can experience remote areas of the Reef in comfort. This study, based solely on documented evidence, aimed to review pontoon monitoring programs, to synthesize the data from them and to make recommendations about the design and implementation of future monitoring programs at pontoons. The Great Barrier Reef Marine Park was among the earliest agencies to implement the Before-After, Control-Impact (BACI) design for pontoon monitoring programs but the 11 monitoring programs reviewed all differed in fundamental ways. It was clear that early pontoons had some major impacts on reef biota, particularly when moored over reef substrata with early mooring systems, but changes to mooring technology and mooring pontoons over sediment substrata have reduced or eliminated these impacts. It is recommended that pontoon monitoring should continue but it should be streamlined and more specifically targeted at known activities and their most likely impacts.

Nickerson, D. J., Chong, G., & Hiew, K. (1998). Balancing tourism and resource conservation in Malaysia's Pulau Payar Marine Park. *In: Intercoast Network*, 31, 8-9 .

Abstract: In Malaysia, the Department of Fisheries (DOFM) established a system of marine parks to protect important marine resources including coral reefs, which contribute to biodiversity and fisheries production. Tourism has been a natural development of the marine parks and also one of the reasons for expanding the scope of marine park management. DOFM

is establishing a Special Area Management Plan (SAMP) for Pulau Payar Marine Park and the surrounding area. The SAMP project is being implemented by DOFM in collaboration with the Bay of Bengal Programme of the Food and Agriculture Organization (FAO). The goal of the SAMP is to promote the conservation and sustained production and use of the area's reef resources. Building on existing marine park management, the SAMP will be used as a model for other marine park islands in Peninsular Malaysia and to develop a national integrated coastal management (ICM) framework

Ohman, M. C., & Rajasuriya, A. (1998). Relationships between habitat structure and fish communities on coral and sandstone reefs. *In: Environmental Biology of Fishes*, 53(1), 19-31.
Abstract: The influence of habitat structure on reef-fish communities at Bar Reef Marine Sanctuary, Sri Lanka, was investigated. The relationship between habitat characteristics and the distribution and abundance of 135 species of fishes was examined on two reef types: coral and sandstone reefs. Results suggested that the reef-fish communities were strongly influenced by various aspects of reef structure. However, relationships between habitat variables and fish communities structure, varied between the two reef types. Fish species diversity was correlated with a number of habitat variables on the sandstone reefs, although structural complexity seemed to play the dominant role. There were no correlations between habitat structure and fish diversity on the coral reefs. Total abundance was not related to any one habitat parameter on either reef type. However, abundances of some species, families and trophic groups were correlated with habitat features. These specific correlations were commonly related to food or shelter availability. For example, coral feeders were correlated with live coral cover, and pomacentrid species, which used branching corals for protection, showed a significant relationship with the density of *Acropora* colonies. This shows that a summary statistic such as total abundance may hide important information. Effects of habitat structure on the distribution patterns of the fish communities was further investigated using multi-dimensional scaling ordination (MDS) and the RELATE-procedure. With the MDS ordinations for both habitat and fish-community composition it was possible to show that the multivariate pattern between the two ecological components was clearly correlated.

Paddack, M. J. (1998). Results of a temperate reef marine reserve study and implications for use of marine reserves in nearshore fisheries management. *In: O. Magoon, H. Converse, B. Baird, & M. Miller-Henson (eds), Taking a Look at California's Ocean Resources: An Agenda for the Future. vol. 1* (p. 856). Reston: ASCE.

Abstract: Within the Monterey Bay National Marine Sanctuary, there are several marine reserves, yet none have been studied extensively for their effects on the local populations of benthic fishes. This study addresses three main questions: Does protection from fishing allow higher densities of fishes to persist in an area? Does fishing create a size selective pressure on a population? What is the relevance of these effects to fisheries management? Three marine reserves in central California were compared to adjacent, fished areas and ten species of benthic reef fish were assessed (most in the genus *Sebastes*). Slightly higher numbers of benthic fishes were observed in all of these marine reserves. Additionally, two of the three reserves had significant differences in both mean length and length frequency distributions, with larger fish inside marine reserves. The lengths were converted to biomass and to egg production to compare the possible contribution of these increased populations to the local fishery. The findings indicate differences among populations of benthic reef fishes along our coast, and that these differences may be either created or augmented by fishing pressure. These results are relevant to fisheries managers, providing partial support for the use of marine reserves as an alternative management strategy for management of nearshore fishes. This paper is a summary, more detailed analysis and discussion of this work can be found in Paddack (1996).

Pattengill-Semmens, C., & Semmens, B. X. (1998). An Analysis of Fish Survey Data Generated by Nonexpert Volunteers in the Flower Garden Banks National Marine Sanctuary. *In: Gulf of Mexico Science*, 16(2), 196-207.

Abstract: Using nonexpert volunteers in monitoring programs increases the data available for use in resource management. Both scientists and resource managers have expressed concerns about the value and accuracy of nonexpert data. We examined the quality of fish census data generated by Reef Environmental Education Foundation (REEF) volunteers of varying experience levels (nonexperts) and compared these data to data generated by experts. Analyses were done using data from three REEF field survey cruises conducted in the Flower Garden Banks National Marine Sanctuary. Species composition and structure were comparable between the skill levels. Nonexpert data sets were similar to expert data sets, although expert data were more statistically powerful when the amount of data collected was equivalent between skill levels. The amount of REEF survey experience was positively correlated with the power of the data collected. The statistical power of abundance estimates varied between species. These results provide support for the use of nonexpert data by resource managers and scientists to supplement and enhance monitoring programs.

Pet-Soede, L., & Erdmann, M. V. (1998). Blast fishing in southwest Sulawesi, Indonesia. *In : Naga*, 21(2), 4-9.

Abstract: Blast fishing has been a widespread and accepted fishing technique in Indonesia for over 50 years. The largest coral reef fishery in Indonesia is around the Spermonde archipelago in southwest Sulawesi. With the expanding population and the increasing demand for fish for export, fishing has intensified and fish catches per unit effort are stable or declining. The use of bombs made with a mixture of kerosene and fertilizer is widely prevalent. In the market of the city of Ujung Pendang, an estimated 10-40% of the fish from capture fisheries are caught through blast fishing. This is destroying the hard corals. Blast fishing is seen by the fishers as being much easier and results in higher catches than with other traditional methods. They believe that the only way to limit this practice is with stricter policing and higher fines. An effective management option could be to establish national marine reserves within the archipelago, supported by other income-generating activities.

Rajasuriya, A., Oehman, M. C., & Johnstone, R. W. (1998). Coral and sandstone reef-habitats in north-western Sri Lanka: patterns in the distribution of coral communities. *In: Hydrobiologia*, 362(1-3), 31-43.

Abstract: Coral and sandstone reefs cover a significant part of Sri Lanka's continental shelf and contain in comparison unique reef structures. Despite this, reefs in this region of the northern Indian Ocean have received little research attention. In an attempt to better understand these ecosystems and their innate character, this study describes the variety of reef types and habitats that are found in this area. The study concentrated on four major reef areas: the Bar Reef Marine Sanctuary (BRMS), Kandakuliya Reefs, Talawila Reef, and Mampuri Reef. These reefs showed apparent differences in habitat structure in terms of the proportion coral cover, coral species composition and structural complexity. Two reef types were present within the continental shelf of BRMS: coral and sandstone patch-reefs. *Acropora* was the most dominant coral genera however in total 118 madreporarian species and 50 coral genera were recorded in the sanctuary. Distinct habitats were identified within reef types including shallow reef flat, shallow patch reef, deep reef flat and *Porites* dome habitats for the coral-reef patches while the sandstone-reef patches were divided into structured and flat sandstone reef habitats. Kandakuliya Reef south of BRMS was by large dominated by coral rubble. Talawila Reef and Mampuri Reef showed unique structures with the former being dominated by massive corals and the latter mainly containing sandstone structures. In addition to factors such as bio-erosion, sedimentation, hydrodynamics, and recruitment or colonisation processes, some reefs were

clearly under significant direct human impact which appeared to play a dominant role in habitat structuring. However, type and degree of human disturbance varied among the reefs. Habitat alteration at Kandakuliya Reef was the result of intense fishing using destructive fishing methods. Talawila Reef and Mampuri Reef was also influenced by fishing activities though reef structure seemed less affected.

Rao, P. S. N., & Tigga, M. (1998). Extended distribution and conservation of the rare seaweed *Tydemanina expeditionis* Weber van Bosse (Chlorophyceae) in the Indian region. *In: J. Bombay Nat. Hist. Soc.* 95(1), 144-145.

Abstract: The rare seaweed *Tydemanina expeditionis* was collected on coralline rocks from Red Skin Island of Marine National Park near Port-Blair, Andaman Island, India. Brief taxonomic description and distribution of species is given. The excavation of coralline rocks for limestone has threatened rare marine flora. The need to declare this natural habitat as the Marine National Parks for conserving many such rare species and marine biological diversity is highlighted.

Reina, A. (1998). Bazaruto project. A brief overview May 1998. *In: Partnership for Conservation Report of the Regional Workshop on Marine Protected Areas, Tourism and Communities*. Nairobi Kenya: IUCN EARO.

Abstract: The Bazaruto archipelago in Mozambique is one of the country's most valuable marine areas, is rich in resources, and is among its most vulnerable and fragile ecosystems. It includes magnificent coral reefs, mangroves, and seagrass beds, supports the largest remaining population of the endangered dugong, *Dugong dugon*, along the East African coast, and the unique marine national park in Mozambique. A project is being developed with the aim to utilise the resources of the archipelago sustainably for the long term benefit of the local communities, the region and the country through: tourism (in particular ecotourism) and artisanal forms of resources use. After several years of development, tourism enterprises are not yet in a position to make contributions to conservation and the island communities, there is still uncontrolled fishing by mainlanders especially, and semi industrial and industrial fishing. Inappropriate technologies, such as gill nets for shark fishing and over harvesting, have had an impact on the stocks of certain species of high economic value, in particular lobster and sea cucumbers, and on the survival of threatened species, such as turtles, dolphins, and dugongs. To control resource use and potential development, guarantee resource custody by the island communities, and retain income generated by the activities in the Park, it is imperative to have supportive legislation formulated and approved as soon as possible.

Riedmiller, S. (1998). The Chumbe Island coral park project. A case study of private marine protected area management. *In: Partnership for Conservation Report of the Regional Workshop on Marine Protected Areas, Tourism and Communities*. Nairobi Kenya: IUCN EARO.

Abstract: Chumbe is a small coral island which became the Chumbe Reef Sanctuary in 1994. A company was created in 1992 for the establishment and management of the reserve, the whole island and the reef sanctuary. A management plan was produced in 1995 that included the definition of roles and responsibilities for the company, Chumbe island Coral Park Ltd (CHICOP), and government. Pressures on the sanctuary are numerous in particular from the increasing shipping traffic as it borders the shipping channel from Zanzibar to Dar es Salaam, and from the fishers from adjacent villages. CHICOP is also meeting difficulties in developing innovative architectural design for its headquarters and visitors' accommodation, and in trying to generate revenue from tourism activities. However crucial conservation services are provided to the population of Zanzibar, including fishers, schoolchildren, and the population in general. The Chumbe experience suggests that private management of marine protected areas is technically feasible and efficient, even when the enforcement machinery of the State is not available or is ineffective. The costs of private management are probably considerably lower

and, a point often overlooked, the incentives to struggle for commercial survival much stronger, that would be the case with a donor funded project.

Russ, G., & Alcala, A. C. (1998). Natural fishing experiments in marine reserves 1983-1993: roles of life history and fishing intensity in family responses. *In: Coral Reefs*, 17(4), 399-416.
Abstract: This study examined the effect of fishing on the abundance and species richness of families of coral reef fish at two islands (Sumilon and Apo) in the Philippines from 1983 to 1993. Natural fishing experiments occurred in marine reserves at each island, where long term estimates of fishing intensity were available. Responses to fishing were interpreted in terms of life histories of fish. The intensity of fishing and fish life histories were generally good predictors of the differential rates of decline and recovery of abundance in response to fishing. Large predators had vulnerable life histories (low rates of natural mortality, growth and recruitment) and were subjected to high intensity fishing. They declined significantly in density when fished and increased significantly but slowly when protected from fishing. Caesionidae, a family with a life history resilient to fishing (high rates of natural mortality, growth and recruitment) but fished intensively also declined rapidly in abundance when fished. Thus, knowledge of life history alone was insufficient to predict response to fishing. Acanthuridae were fished relatively hard and had a life history of intermediate vulnerability but displayed weak responses to fishing. Thus level of fishing intensity alone was also not sufficient to predict response to fishing. For Chaetodontidae, effects of fishing conformed to expectations based on life history and fishing intensity at one island but not the other. Three families with intermediate vulnerability and subjected to intermediate to light fishing (F. Scaridae, Labridae and Mullidae) displayed predictably weak responses to fishing, or counter-intuitive responses (e.g., increasing in abundance following fishing). These counter-intuitive responses were unlikely to be secondary effects of increase in prey in response to declines of predators. Two lightly-fished families with resilient life histories (F. Pomacentridae, Sub F. Anthiinae) predictably displayed weak numerical responses to fishing except during a period of use of explosives and drive nets

Russ, G. et al. (1998). Mortality rate of a cohort of the coral trout, *Plectropomus leopardus*, in zones of the Great Barrier Reef Marine Park closed to fishing. *In: Marine and Freshwater Research*, 49(6), 507-511 .

Abstract: From 1990 to 1993, samples of coral trout, *Plectropomus leopardus*, were collected at two coral reefs closed to fishing since 1987 in the central Great Barrier Reef (GBR). The age structure was dominated by a strong cohort which settled in early 1984 and which accounted for 54%, 45%, 42% and 36% of the experimental hook-and-line catches at Glow and Yankee reefs. Catch rates (fish/ person/ hour) per age class per reef per year provide the first reliable estimates of the exponential rate of mortality of coral trout in zones of the GBR Marine Park closed to fishing. The annual mortality rate between the ages of 6 and 9 years was 0.115 (s.e. 0.040) at Glow reef and 0.189 (s.e. 0.100) at Yankee reef. The annual mortality rate between ages 6 and 9 years was 0.147 (s.e. 0.028) at the two reefs combined. Age-specific estimates of annual mortality ranged from 0.024 (age 7-8 at Glow) to 0.442 (age 6-7 at Yankee) but were unreliable because of small sample sizes. This is one of the first estimates of mortality rate of an exploited species in an area closed to fishing in the tropics.

Russell, D. (1998). Saving a Coral Reef: Grassroots Effort in Baja Pays Off. *In: E-The Environmental Magazine*, 9(6), 15-17.

Salazar-Murguía, R. et al. (ed). (1998). Efectos de un area semiprottegida y no protegida del sur del Caribe Mexicano, sobre la estructura comunitaria de peces arrecifales. Proceedings of the Gulf and Caribbean Fisheries Institute , Chap. 50, (pp. 354-371).

Abstract: The structure of reef fish communities of three sites located in the southern Mexican Caribbean was characterized; two sites (Boca Paila y Tampalam) are located within and one site (Mahahual) is located outside a protected area (Biosphere Reserve "Sian Ka'an"). Based on visual censuses and geomorphological characterization of each reef, the differences in the composition of the ichthyofauna between associated groups in determined reef zones as well as between each of the sites were compared. A total of 116 species was registered highest species richness in Tampalam Reef (97 species), followed by Boca Paila (86 species) and Mahahual (73 species). Highest species diversity was found in Tampalam ($H' = 3.548$), followed by Mahahual ($H' = 3.395$) and Boca Paila ($H' = 3.053$); Tampalam Reef also showed the highest biomass values (444 gm super(2)), and they were mainly found on the lagoon zone and the crest reef. By comparing the reef we were able to draw conclusions about the effects of a possible loss of biodiversity due to differences in the management of these systems, especially concerning some important by species for fisheries. It is left to say that the creation of a protected area will, among other things, ensure reasonable fishery activities without overfishing of certain species without any control mechanism, fishery activities result in changes in species composition, in the abundance of population and in sizes of the individuals. Original Abstract: Se caracterizo la estructura de las comunidades de peces de arrecife de coral en tres sitios ubicados al sur del Caribe Mexicano: dos de ellos (Boca Paila y Tampalam), ubicados dentro de un area de reserva (Reserva de la Biosfera de Sian Ka'an), y uno fuera del area de reserva (Mahahual). En base a la aplicacion de censos visuales en peces y la caracterizacion geomorfologica de cada arrecife, se compararon las diferencias en la composicion ictiofaunistica de cada asociacion de grupos en determinadas zonas del arrecife, asi como de cada sitio. Se registraron un total de 116 especies, de las cuales la mayor riqueza se dio en el arrecife Tampalam con 97 especies, Boca Paila con 86 especies y 73 especies en el arrecife de Mahahual; la mayor diversidad se presento en Tampalam ($H' = 3.548$), seguida por Mahahual ($H' = 3.395$) y Boca Paila ($H' = 3.053$); asi mismo la mayor biomasa reportada fue en el arrecife Tampalam (444 gm super(2)) y principalmente se encontraron en la zona de la laguna y la cresta arrecifal. La comparacion entre arrecifes, nos permitio hacer inferencias sobre los efectos de una posible perdida de biodiversidad, debido al diferente manejo de estos sistemas, especialmente por algunas especies clave importantes en la actividad pesquera. Cabe destacar que la creacion de un area protegida permite, entre otras cosas, garantizar la pesca de manera racional, sin llegar a la sobreexplotacion de especies. En caso contrario, la actividad pesquera provocaria cambios en la composicion de especies, en la abundancia de las poblaciones y en la talla de los individuos.

Schafer, C. S. et al. (1998). Visitor experiences and perceived conditions on day trips to the Great Barrier Reef. *Tech Rep CRC Reef Res Cent* Vol. 21 (p. 76). Townsville (Australia): Cooperative Research Cent. for the Ecologically Sustainable Development of the Great Barrier Reef.

Abstract: The Great Barrier Reef Marine Park (GBRMP), Queensland (Australia) is the world's largest marine protected area and is among the world's first marine protected areas. Large growth in tourism and associated infrastructure development within the GBRMP over the past ten years has prompted calls for research into the carrying capacity of coral reefs for recreation and tourism. Few studies to date have attempted to identify specific conditions which could be used to develop standards for determining acceptable change in coral reef environments. The types of experiences that day-trip visitors to the Great Barrier Reef (GBR) enjoy and the conditions that influence them are described. The purpose of this study was to examine the range of qualities (or benefits) that visitors seek from a reef trip and how the attainment of these qualities is modified by the natural and social environments experienced on the trips and by the characteristics of the respondents themselves. A range of reef experiences within and among different types of day visits to the GBRMP was reported, but natural

conditions were overwhelmingly the most important influence on enjoyment. Reef and industry managers require a greater understanding of the range of opportunities and experiences sought by visitors.

Schutter, J. d. (1998). Recommendations for curricula, training materials and tools. *In*: J. Mcmanus, C. V. Zwol, L. R. Garces, & D. Sadacharan A framework for future training in marine and coastal protected area management, Chap. 57, (pp. 18-24). Makati City Philippines : ICLARM.

Abstract: This paper compares material from the South Asia Co-operative Environment Programme (SACEP) Workshop on Regional Training for the Management of Protected Areas and Coral Island Ecosystems (Sri Lanka, July 1997) which was financed by the Norwegian Agency for Development Co-operation (NORAD) and from a UNEPCOBSEA publication on staff training for the management of marine protected areas (MPAs) published in 1993.

Sedberry, G. R. et al. (ed). (1998). A comparison of fish populations in Gray's Reef National Marine Sanctuary to similar habitats off the southeastern U.S.: Implications for reef fish and sanctuary management. Proceedings of the Gulf and Caribbean Fisheries Institute, Chap. 50, (pp. 452-481).

Abstract: Gray's Reef National Marine Sanctuary (GRNMS) is a large (5,822 ha) expanse of live-bottom reef habitat located in 18-22 m of water, 32 km off the coast of Sapelo Island, Georgia. Designated in January 1981 as a "Sanctuary" that prohibited commercial trawling and fish trapping, GRNMS continues to be one of the most popular near-shore live-bottom reefs for sportfishing on the southeastern U.S. Atlantic coast. In 1993, we initiated a three-year sampling program to use trapping gear to determine species composition and length frequency, to compare catch-per-unit-effort (CPUE) at GRNMS with results from similar habitats and to tag fishes to estimate population abundance and detect movements. Fewer fishes and smaller black sea bass (*Centropomus striata*) were taken at GRNMS than at other similar, but slightly deeper (26 m) reefs. From 1993-1995, as CPUE of black sea bass increased at GRNMS, there was a decrease in the mean length. The CPUE of black sea bass > 20 cm increased from 1993-1994, perhaps reflecting the effect of a regional minimum size (20.3 cm TL) imposed in 1993. In 1995, however, CPUE of fish > 20 cm decreased, indicating that there may have been a loss of the larger sea bass at GRNMS despite good recruitment of juveniles, and that minimum size regulations imposed on heavily fished reefs has the same temporary and negligible effect on Gray's Reef as it does on other overfished reefs of the region. The increase in abundance of black sea bass at GRNMS determined by the Petersen mark-recapture method from 1993-1995 showed trends similar to trap CPUE. Tagging results indicated that black sea bass are highly resident in the Sanctuary, as 94% of the tag returns of fish at large for more than one month were recaptured in the same area that they were tagged. Fishery-independent survey data collected by MARMAP indicate declines in abundance of many exploited species and a change in community structure on reefs of the southeastern continental shelf.

Slater, J. (1998). Protecting Dugong from Commercial Fish Netting in the Great Barrier Reef World Heritage Area: The Legal and Policy Issues. *In*: Asia Pacific Journal of Environmental Law, 3(2), 127.

Abstract: This Article examines the struggle to protect the threatened dugong (*Dugong dugon*) from incidental capture in fishing nets in the southern region of the Great Barrier Reef World Heritage Area, Queensland, Australia. In 1995, research data indicated that the dugong population had declined by up to 80 per cent in the southern region of the Great Barrier Reef. The findings coincided with increasing reports of dugongs being captured in fishing nets in the Shoalwater Bay area of the Park. The protection of dugong in this area illustrates the inadequacies of current legislation to respond to urgent species conservation issues, and the

fragility of federal cooperation in Australia on agreements for protecting the World Heritage Area and meeting Australia's responsibilities under international law. At issue is the political will of the respective governments to act on their policies and legislative obligations.

Spring, C. S., & Pike, D. (1998). Tag Recovery Supports Satellite Tracking of a Green Turtle. *In: Marine Turtle Newsletter*, (82), 8.

Abstract: On 7 June 1990, a Platform Terminal Transmitter (PTT 5347) was attached to a post-nesting green turtle at West Island in the remote Ashmore Reef National Nature Reserve which lies in the Timor Sea off the North West Coast of Australia. The turtle was also tagged with two titanium tags from the Western Australian Department of Conservation and Land Management (WACALM). The aim was to track the movements of green turtles from the nesting beach on Ashmore Reef to provide a better understanding of post-nesting migration for management purposes. The turtle's movements were tracked over a period of 3 months before transmissions ceased. During this time, satellite data indicated that the turtle travelled over 900 km from Ashmore Reef to Melville Island in the Northern Territory. The turtle remained at Melville Island for 48 days with the last message recorded on 17 September 1990. Positions were calculated using class 0 locations or better.

Sweatman, H. et al. (1998). Long-term monitoring of the Great Barrier Reef.(Report No. 3). Cape Ferguson (Australia): Australian Inst. of Marine Science.

Abstract : In 1992, the Australian Institute of Marine Science initiated a Long-Term Monitoring Program for the Great Barrier Reef (GBR) (Australia) in conjunction with the Great Barrier Reef Marine Park Authority. In 1993, the program was included as a task of the newly formed Cooperative Research Centre for Ecologically Sustainable Development of the Great Barrier Reef. Monitoring data collected over the last six years are synthesized to provide the first integrated pattern of changes in numbers of crown-of-thorns starfish (COTS) (*Acanthaster planci*), abundances of reef fish and cover of benthic organisms over most of the GBR. The percentage of reefs with outbreaks of COTS is increasing and a similar pattern is seen in the overall density of COTS on the GBR. The salient changes on the GBR over the last six years reflect the impact of cyclones and COTS on reef communities and their subsequent recovery from such disturbances. While many groups of fish showed significant long term and current trends in various regions, there were only a few instances where a majority of groups showed a consistent trend in a region.

Tanzer, J. (1998). Fisheries in the Great Barrier Reef Marine Park - seeking the balance. *In: Parks*, 8(2), 41-46.

Uku, J. N. et al. (1998). Macroalgae and sea grasses of Mida Creek. *In: G. K. Mwatha, E. Fondo, J. N. Uku, & J. U. Kitheka* (eds), Biodiversity of Mida creek: final technical report (pp. 99-113). Mombasa Kenya : Kenya Marine and Fisheries Research Institute.

Abstract: A survey of Mida Creek (Kenya), which forms part of the Watamu Marine National Reserve (WMNR), revealed a rich and diverse assemblage of seagrasses and macroalgae. A long the Kenyan Coast, baseline information on the distribution and composition of marine flora is still inadequate hence the aim of this project was to map the distribution patterns of the submerged marine flora in the creek. Eleven species of seagrasses were identified and the most dominant species in the creek were *Thalassia hemprichii*, *Halodule wrightii* and *Cymodocea rotundata*. These species were found on a wide range of sediment types. Some 33 species of macroalgae were dominant in the creek. Chlorophytes were found primarily on the sandy substrates while most Rhodophytes were epiphytic. The Phaeophyta were found attached on rocky coralline substrates. Several unidentified Cyanophytes were also encountered on sand flats that serve as feeding sites for birds. The distribution of plants varied with depth. The diversity

of seagrass species was highest in areas exposed during low water. The number of species decreased with depth due to turbidity within the creek. The macroalga, *Halimeda* sp., was found at a depth of 10 m indicating its prevalence in turbid areas and tolerance to the hydrostatic pressure associated with depth. This paper discusses the overall distribution of the marine flora, in view of the management and the conservation of Mida Creek.

Venkataraman, K., & Rajan, P. T. (1998). Coral reefs of Mahatma Gandhi Marine National Park and crown-of-thorn starfish phenomenon . Island Ecosystem and Sustainable Development (pp. 124-132). [s. l.]: Andaman Science Association

Abstract: The Mahatma Gandhi Marine National Park of South Andaman has 15 islands falling in the Labyrinth group covering an area of 281 sq km. The main feature of the Park is the occurrence of corals. Coral reefs have been identified at Jolly Buoys, Red Skin, Gurb, New Wandoor, Boat Island, Tarmugi, Snob, Chester and Twin Islands, About 78 species of corals have been identified from this region. The crown-of-thorn starfish *Acanthaster planci* is either purplish blue with red tipped spines or has a green body with yellow tipped spines. The crown-of-thorn starfish phenomenon is a complex one. Studies on population of crown-of-thorn starfish, possible causes for outbreaks, with suggestions on the management of the outbreaks are dealt.

Villela, L. (1998). Proceedings of the workshop on sustainable conservation of marine biodiversity. (p. 166). San Jose (Costa Rica): UICN-ORMA.

Abstract: Many littoral ecosystems of the world are represented in Central America, mainly mangroves, coral reefs, coastal lagoons and large marine phanerogam meadows. The coasts are flat and sandy or with cliffs and rocks. Around 21% of the population live in the coastal areas. Central America, particularly rich from biological, cultural and esthetical points of view, with a privileged climate, is attractive to tourism development. All countries of the region have set up or are developing their main tourist activities and infrastructures in the coastal areas. With respect to sustainable development as well as to the protection of the coasts, several countries have recently created marine protected areas. Information on these areas and on their potential for tourism development is presented. The bases for a working network on tourism and protected areas are laid out.

Vogt, H. P. (1998). The economic benefits of tourism in the marine reserve of Apo Island, Philippines. *In: Intercoast Network*, (31), 13-14.

Abstract: Apo Island is located in Negros Oriental in the central Philippines. It is a volcanic island covering 72 hectares (ha), with a population of 460. Fishing is the main source of income. In 1979 Silliman University, in the provincial capital of Dumaguete, focused its coral reef conservation program on the fishing community of Apo. The underlying principle was that only the primary reef users could provide effective protection for small-sized reserves. Since 1985, when the marine reserve of Apo was formally established, it has developed into a model site, attracting scientists, reef managers and an increasing number of tourists. Tourism in Negros Oriental is still in its infancy; however, it has a real potential to flourish.

Weru, S. (1998). Marine conservation areas in Kenya. *In: K. Sherman, E. Okemwa, & M. J. Ntiba* Large marine ecosystems of the Indian Ocean: Assessment, sustainability, and management (pp. 353-359). Malden, MA-USA : Blackwell Science.

Abstract: The Kenyan coastline is protected from the open sea by a fringing reef that runs along the entire coastline except at the mouths of the Sabaki and Tana rivers. This reef has created highly productive reef lagoons that are placed under three levels of management: protected, partially protected, and unprotected. Nine marine conservation areas covering a total of 760 km² have been created under the first two management levels. This has arisen

out of the realization that a community's state of development is a significant variable affecting the coastal resources of Kenya. Research has shown that protected and partially protected areas have higher total finfish and coral abundance than unprotected areas. Finfish are also reported to be much smaller in size in unprotected areas. It has become necessary, now more than ever, to address the optimal size of marine parks and reserves, referred to in this chapter as the single large or several small argument. Ecologic and socioeconomic considerations are becoming increasingly important prerequisites in decision making.

White, A., Barker, V., & Tantrigama, G. (1998). Using ICM and economics to conserve coastal tourism resources in Sri Lanka. *In: Intercoast Network*, 31, 6-7, 28.

Abstract: Hikkaduwa and its marine sanctuary are representative of the issues facing many coastal areas in tropical Asia where tourism and coastal development have nearly ruined valuable coastal resources. For Sri Lanka, the Hikkaduwa Marine Sanctuary is the only accessible coral reef on the south coast. The 4-km coastal strip (about 100 hectares) is known for its coral reef, clean water and beaches. Tourists continue to come despite increasing environmental degradation, primarily because the damage is not obvious to new visitors. However, tourists are beginning to recognize the problems and threaten to go elsewhere.

Zeller, D. C., & Russ, G. (1998). Marine reserves: Patterns of adult movement of the coral trout (*Plectropomus leopardus* (Serranidae)). *In: Canadian Journal of Fisheries and Aquatic Sciences*, 55(4), 917-924.

Abstract: Movements of *Plectropomus leopardus* (Serranidae), a major fisheries species, across marine reserve boundaries were investigated on the Great Barrier Reef, Australia. Mark-release-recapture and ultrasonic telemetry were used to assess movements. Mark-release-recapture used hook and line as the method of capture and underwater visual census (UVC) as the 'recapture tool'. Catch rates were significantly higher in zones closed to fishing, despite UVC indicating no significant differences in density between closed and open zones. Of 183 fish marked with numerical freeze brands, 93 estimates of movements of branded fish were obtained. No branded fish was recorded to cross the reserve boundaries during the 2-month study, probably due to the initial decision to allocate capture effort evenly across the study area, rather than concentrating it on reserve boundaries. Fish carrying ultrasonic transmitters, and having home ranges straddling reserve boundaries, crossed boundaries on average 15.3 times month⁻¹. The mean distance moved by freeze branded specimens between capture and recapture was significantly larger in areas closed to fishing than in those open to fishing. Mean distance moved per day determined by ultrasonic telemetry did not differ between areas closed and open to fishery. This study suggests low flux rates of adult *P. leopardus* across marine reserve boundaries.

[Anon.]. (1999). Federal Environment Department moving to take over the Queensland trawl fishery. *In: Queensland Fisherman*, 17(2), 18-24.

Abstract: Media statements by the Australian Federal Minister of the Environment, Senator Robert Hill, have been widely interpreted as a move by Federal bureaucrats to take over the management of most of the State-controlled east coast prawn fisheries of Queensland (Australia). It is felt that this move has been justified by a deliberate misinterpretation of the CSIRO report, 'Effects of trawling', which actually indicates that the Great Barrier Reef region is lightly trawled and that there is little obvious sign of trawling. The recommendations of the report, as well as other outcomes of the study, were discussed in two separate workshops convened by the Queensland Fisheries Management Authority (QFMA) and the Great Barrier Reef Marine Park Authority in 1998 and are already being progressed by QFMA in the finalization in draft form for public comment of the management plan for the Queensland trawl fishery. The Queensland Commercial Fishermen's Organisation has reacted very positively to

the report, which was accepted as being a valuable tool in helping to shape the new trawl management plan

[Anon.]. (1999). GBRMPA pushes devastating new E.C. trawl management plan. *In: Queensland Fisherman*, 17(9), 8-11.

Abstract: The Queensland Government (Australia) is currently finalizing a new management plan that will implement the most significant reform for the east coast trawl fishery for over 20 years. The trawling industry supports the implementation of the plan in the realization that a long term management plan is needed to ensure the future viability of the industry. The Great Barrier Reef Marine Park Authority (GBRMPA), which has been fully involved in the five year consultation process initiated by the Queensland Government, has now provided the Federal Minister of the Environment with a new east coast trawl plan. The Queensland Commercial Fishermen's Organisation (QCFO) is encouraging close scrutiny of the GBRMPA plan, particularly focusing on recommendations in relation to effort capping and reduction, closures and bycatch. The QCFO is especially concerned about the economic and social impacts of the GBRMPA plan, which it states would have a devastating impact on the trawling industry and regional jobs in Queensland

[Anon.]. (1999). Permanent monitoring methods employed by Frontier Tanzania in southern Tanzania. Conference on Advances on Marine Sciences in Tanzania, Zanzibar (Tanzania), 28 Jun - 1 Jul 1999 Zanzibar (Tanzania): Inst. of Marine Sciences

Notes: Summary only

Abstract: Frontier Tanzania has been collecting baseline data from along the Tanzania coastline since 1989. First based on Mafia Island, Frontier spent 6 years surveying the region with over 200,000 hours of research and 6,000 dives, Next Frontier, moved to the Songo Songo Islands and then on to Mnazi Bay during 1996. Over the last 10 years Frontier have developed a set of survey methods that include benthic cover, reef and commercial fish census and invertebrate surveys. These can not only be applied for baseline mapping of the coastline but also for the purpose of environmental monitoring. Such ecological baseline surveys and monitoring should play an integral role in the management of marine resources and, in light of Mnazi Bay being proposed as a Marine Park, Frontier Tanzania returned to the bay in August 1998 to conduct further baseline surveys and establish some permanent monitoring sites. The aim of such surveys and monitoring approaches not only provides valuable information on the current status of the coral reefs and use of marine resources, but may also highlight potential environmental problems. This paper outlines some biological survey approaches that were utilized by the Frontier Tanzania survey dive team. The methods employed involved visual censuses of habitats, benthos and fish populations using SCUBA (Self Contained Underwater Breathing Apparatus) at five sites within the Bay. In addition to the work conducted in Mnazi Bay, Frontier has also initiated some approaches towards both coral growth and sedimentation within Mtwara Bay. Diverse monitoring methods such as these provide Tanzania with valuable information on the state of change of the local coral reefs

[Anon.]. (1999). Proposed changes to zoning plan for the State Cape York Marine Park. *In: Queensland Fisherman*, 17(9), 17-18.

Abstract: The Queensland Commercial Fishermen's Organisation (QCFO) has recently been notified that the Queensland Parks and Wildlife Service is proposing to close further areas to commercial fishing under the zoning plan currently being developed for the Cape York Marine Park (CYMP), Queensland (Australia). These zoning arrangements are significantly more restrictive than the arrangements in the draft CYMP zoning plan, which was released in December 1997. QCFO has been unsuccessful in convincing the Great Barrier Reef Marine Park Authority (GBRMPA) and Senator Robert Hill, the Federal Minister of the Environment,

to reconsider the zoning arrangements currently proposed for the far northern section of the Great Barrier Reef Marine Park, adjacent to the CYMP

[Anon.]. (1999). Review of dugong conservation strategies. *In: Reef Research*, 9(2), 14-15.

Abstract: In July 1999, the Great Barrier Reef Ministerial Council endorsed the recommendations of a review of all dugong conservation strategies currently in place in the regions of the Great Barrier Reef (GBR) and Hervey Bay, Queensland (Australia). The Council, made up of Commonwealth and State Ministers of Environment and Tourism, is committed to not only halting the decline in dugong numbers but actually restoring populations and it commissioned the review because of its concern about the continuing decline of dugong numbers in the southern GBR. Recommendations included further restrictions on the use of commercial fishing nets in Dugong Protection Areas, cooperative agreements with indigenous communities to implement hunting moratoria, implementing a 40 knot boat speed limit in the Hinchinbrook Channel, phasing out the use of high explosive ordnance by the Department of Defence within the Great Barrier Reef World Heritage Area, pursuance of legislative protection of riparian zones and wetlands, progression of codes of practice from voluntary to mandatory and upgrading procedures for responding to reports of stranded dugongs.

Arnold, P., & Birtles, R. A. (1999). Towards sustainable management of the developing minke whale tourism industry in North Queensland. (p. 30). Townsville (Australia): Reef Research Cent.

Abstract: Though generally larger than other marine animals, little is known of most cetaceans (whales and dolphins) in world waters. Of about 80 species described so far worldwide, 43 occur in Australian waters and over 30 within the Great Barrier Reef Marine Park (GBRMP), Queensland (Australia). The dwarf minke whale (*Balaenoptera acutorostrata*) was not described until 1985 and its taxonomic status remains unresolved. The close approach of the minke to vessels and swimmers in northern Great Barrier Reef waters provides a unique experience for tourists, a research opportunity for scientists and a challenge for park managers. The development and extent of the whale watching industry is outlined, Australian legislation and codes of practice are reviewed and initial observations based on the 1996 and 1997 field seasons are presented. Given the unique attributes of the minke whale-swimmer interactions, the existing codes of practice are of limited relevance, so guidelines are proposed which are based on experience in the field

Babcock, R. C. et al. (1999). Changes in community structure in temperate marine reserves. *In: Marine Ecology Progress Series*, 189, 125-134.

Abstract: 'No-take' marine reserves provide a valuable tool for managing marine resources as well as for providing relatively undisturbed habitat with which to assess modifications to ecosystems. We studied 2 marine reserves in northeastern New Zealand, the Leigh Marine Reserve (established 1975) and Tawharanui Marine Park (established 1982) in order to assess whether changes in protected predator populations had resulted in other indirect changes to grazers and consequently to algal abundance. Estimates of abundance of the most common demersal predatory fish *Pagrus auratus* indicated that adults of this species (i.e. large enough to prey upon urchins) were at least 5.75 and 8.70 times more abundant inside reserves than in adjacent unprotected areas. Overall, *P. auratus* were also much larger inside reserves with mean total lengths of 316 mm compared with 186 mm in fished areas. The spiny lobster *Jasus edwardsii* displayed similar trends, and was approximately 1.6 to 3.7 times more abundant inside the reserves than outside. Lobsters within the reserves had a mean carapace length of 109.9 mm, compared with 93.5 mm outside the reserves. In one of the reserves, densities of the sea urchin *Evechinus chloroticus* had declined from 4.9 to 1.4 m⁻² since 1978 in areas formerly dominated by it. Consequently, kelp forests were more extensive in 1998 than they

were at the time of reserve creation. Urchin-dominated barrens occupied only 14% of available reef substratum in reserves as opposed to 40% in unprotected areas. These changes in community structure, which have persisted since at least 1994, demonstrate not only higher trophic complexity than anticipated in Australasian ecosystems but also increased primary and secondary productivity in marine reserves as a consequence of protection. Trends inside reserves indicate large-scale reduction of benthic primary production as an indirect result of fishing activity in unprotected areas

Baker, B. (1999). First Aid for an Ailing Reef. *In: BioScience*, 49(3), 173-178.

Bartlett, A. (1999). Marine fighting fund to sink government inaction. *In: Australas Sci Inc Search*, 20(3), 25-26 .

Abstract: In an unusual and controversial move, two leading conservation groups, the Australian Conservation Foundation and the Humane Society International, have teamed up with the Australian Democrats to form a Marine Legal Fighting Fund. The parties to this fund have had recourse to the law, which has been one of the most successful ways in the past to break the cycle of governments responding to problems only by commissioning an endless succession of inquiries, reports and advisory committees. Particular areas where Australia's Minister of the Environment, Senator Robert Hill, seems to have taken note include \$A50 million being spent on ocean policy and some areas previously excluded from the Great Barrier Reef Marine Park now being included, making the laws that apply to the reef applicable over a wider area. In response to the recent CSIRO scientific report, 'Effects of trawling', Senator Hill has threatened to take over fishing regulation from Queensland if it continues not to take enforcement action against illegal trawling.

Berkelmans, R., & Oliver, J. K. (1999). Large-scale bleaching of corals on the Great Barrier Reef. *In: Coral Reefs*, 18(1), 55-60.

Abstract: The Great Barrier Reef (GBR) experienced its most intensive and extensive coral bleaching event on record in early 1998. Mild bleaching commenced in late January and intensified by late February early March 1998. Broad-scale aerial surveys conducted of 654 reefs (similar to 23% of reefs on the GBR) in March and April 1998, showed that 87% of inshore reefs were bleached at least to some extent (>1% of coral cover) compared to 28% of offshore (mid- and outer-shelf) reefs. Of inshore reefs 67% had high levels of bleaching (>10% of coral) and 25% of inshore reefs had extreme levels of bleaching (>60% of coral). Fewer offshore reefs (14%) showed high levels of bleaching while none showed extreme levels of bleaching. Ground-truth surveys of 23 reefs, which experienced bleaching in intensities ranging from none to extreme, showed that the aerial survey data are likely to be underestimates of the true extent and intensity of bleaching on the GBR. The primary cause of this bleaching event is likely to be elevated sea temperature and solar radiation, exacerbated by lowered salinity on inshore and some offshore reefs in the central GBR.

Berkelmans, R., & Willis, B. L. (1999). Seasonal and local spatial patterns in the upper thermal limits of corals on the inshore Central Great Barrier Reef. *In: Coral Reefs*, 18(3), 219-228.

Abstract: Experimental studies of the upper thermal limits of corals from Orpheus Island, an inshore reef in the central Great Barrier Reef, show that *Acropora formosa* has a 5-day 50%-bleaching threshold of between 31 and 32 degree C in summer, only 2 to 3 degree C higher than local mean summer temperatures (29 degree C). Summer bleaching thresholds for *Pocillopora damicornis* and *A. elseyi* were 1 degree C higher (between 32 and 33 degree C). The winter bleaching threshold of *Pocillopora damicornis* was 1 degree C lower than its summer threshold, indicating that seasonal acclimatisation may take place. This seasonal

difference raises the possibility that at least some corals may be capable of short-term thermal acclimatisation. Neither *P. damicornis* nor *A. eleyi* showed habitat-specific (reef flat versus reef slope) differences in bleaching thresholds. Further, colonies of *P. damicornis* collected from sites 3 km apart also showed no difference in bleaching threshold despite populations of this species responding differently at these two sites during a natural bleaching event. The bleaching thresholds determined in this study are best considered as the maximum tolerable temperatures for local populations of these species because they were determined in the absence of additional stressors (e.g. high light) which often co-occur during natural bleaching events. We consider the 5-day 50% bleaching thresholds determined in these experiments to be fair indicators of upper thermal limits, because > 50% of a sample population died when allowed to recover in situ. We found a delay of up to a month in the bleaching response of corals following thermal stress, a result that has implications for identifying the timing of stressful conditions in natural bleaching events.

Brown, P. J., & Taylor, R. (1999). Effects of trampling by humans on animals inhabiting coralline algal turf in the rocky intertidal. *In: Journal of Experimental Marine Biology and Ecology*, 235(1), 45-53.

Abstract: This paper investigates the effects of trampling by humans on the fauna associated with articulated coralline algal turf. Patches of intertidal turf in a low-use area of the Cape Rodney to Okakari Point Marine Reserve (in north-eastern New Zealand) were experimentally trampled over 5 days at three levels that fell within those measured in a part of the reserve subject to heavy visitor use. Two days after trampling ended there were ~2.105 individual macrofauna (>500 [μ m]) per m² in control plots, but densities declined with increasing trampling intensity in the treatment plots, and were reduced to 50% of control values at the highest trampling intensity. Densities of five of the eight commonest taxa were negatively correlated with trampling intensity, with polychaetes being particularly susceptible to low levels of trampling. Three months after trampling ended densities of all taxa had returned to control values, with the exception of polychaetes. Reductions in animal densities are tentatively attributed to the loss of turf and associated sand caused by trampling, rather than direct destruction of the organisms. Given the likely importance of these abundant and productive animals in the rocky reef ecosystem, and their vulnerability to low levels of trampling by humans, we conclude that the effective management of marine protected areas may necessitate total exclusion of humans in some cases.

Bunce, L. et al. (1999). The human side of reef management: a case study analysis of the socioeconomic framework of Montego Bay Marine Park. *In: Coral-Reefs*, 18(4), 369-380.

Abstract: This study furthers our understanding of the role of socioeconomics in coral reef management by demonstrating the importance, as well as means, of incorporating socioeconomic information into coral reef management. A case study analysis was made of the socioeconomic context of the three primary user groups in Montego Bay Marine Park, Jamaica: fishers, hoteliers and watersports operators. The primary means of data collection were document analysis, interviews with individuals representative of user groups, focus groups and participant observation. The results regarding user's awareness, user groups' relations with the managing agency, relations among and within user groups, resource use patterns, and sociocultural values demonstrate the need to: increase public awareness of the benefits of the Park, increase user awareness of Park management activities, increase user involvement in Park management, and develop intersectoral coordination. These findings provide useful guidance for future Park management and, in a more general context, illustrate the importance of socioeconomic assessments for reef management.

Carter, E. (1999). Sustainable management of marine park resource using eco tourism.

Conference on Advances on Marine Sciences in Tanzania, Zanzibar (Tanzania), 28 Jun - 1 Jul 1999 Zanzibar Tanzania: Inst. of Marine Sciences

Notes: Summary only.

Abstract: Whether a Marine Protected Area (MPA) is initiated with financial support from large donor agencies, or if they are privately managed, the key word in today's management strategies is Sustainability. Preservation of the environment must be long term by definition and areas of natural beauty must inevitably finance themselves and be self sustaining in order to be protected for future generations. Using Chumbe Island Coral Park as an example, this paper discusses the use of eco tourism as tool for revenue generation and the difficulties associated with managing the impact of these tourists on the protected resource. To have Conservation and Tourism working in harmony is a challenge that many protected areas are facing and one that will be encountered increasingly as more agencies around the world incorporate sustainability into their management plans. Unlike many other tourist ventures, eco tourism within MPAs must be strictly managed and monitored to ensure that visitors have no impact on the environment. On Chumbe unique eco bungalows have been developed for guest accommodation. The paper will discuss the use of state of the art eco architecture and technology in these bungalows. It will examine the incorporation of solar water heating, solar photovoltaic electricity, and rainwater catchment systems. Greywater filtration and composting toilets in the infrastructure of the eco tourist destination. As there are only 7 eco bungalows numbers of guests are limited; in itself a component to ensure that impact on the island environment is avoided. This paper examines the development of these unique buildings and explores the other obstacles encountered with the sustainability of self funding MPAs. It will also briefly discuss the ways in which other potentially destructive tourism destinations around Tanzania can learn from the experiences and developments on Chumbe in becoming more environmentally sensitive.

Chaloupka, M., & Osmond, M. (1999). Spatial and Seasonal Distribution of Humpback Whales in the Great Barrier Reef Region. Life in the Slow Lane: Ecology and Conservation of Long Lived Marine Animals (pp. 89-106). American Fisheries Society *American Fisheries Society Symposium*: Vol. 23.

Abstract: The spatial and seasonal distribution of humpback whales in the Great Barrier Reef Marine Park (GBRMP) was defined using data from a systematic aerial surveillance program. The data comprised 414 pod sightings (812 individuals) recorded from July 1982 to March 1996. These sightings were supposedly of humpbacks from the east Australian Group V substock that migrates during the austral autumn from Antarctic feeding grounds to winter breeding grounds in GBR waters. Humpbacks were sighted in all months and throughout the GBRMP. However, most pods (75%) were sighted in southern GBR waters (below 19 degree S) and mainly during winter and spring (July to September). Occasional sightings of humpbacks in northern GBR waters (above 16 degree S) in summer supports previous claims of a substock resident year-round in northern Australian tropical waters. Mother-calf sightings were rare with most recorded below 21 degree S and mainly in August and September. These limited sightings suggest that the main calving grounds for the east Australian Group V substock occur in the extensive southern GBR lagoonal waters defined northward by the Whitsunday Group of islands and reefs and eastward by the PompeySwains reef complex. An estimate of the crude birth rate was 0.072 (95% confidence interval [CI]: 0.06-0.11) with Monte Carlo estimates of the median calving rate at 0.3 calves per mature female per year (95% CI: 0.22-0.43) and the median interbirth interval at 3.4 years (95% CI: 2.3-4.5) indicating low and variable juvenile recruitment. Nonparametric time series analysis (seasonal and trend decomposition using loess, STL) of monthly humpback sightings showed that the long-term trend in sightings was increasing but that there was significant inter-annual variability in the seasonal abundance of humpbacks in the GBRMP. The STL analysis also suggested that the

frequency of sightings increased earlier in winter (June) and later in the season during spring/summer (October to December). Time series regression analysis of the STL-derived trend in sightings suggested that the east Australian Group V substock increased slowly in abundance over the 14 years from 1982 to 1996 at about 3.9% per year (95% CI: 1.9% to 5.7%)--a finding consistent with an estimate of low and variable juvenile recruitment.

Chapman, M. R., & Kramer, D. L. (1999). Gradients in coral reef fish density and size across the Barbados Marine Reserve boundary: Effects of reserve protection and habitat characteristics. *In: Marine Ecology Progress Series*, 181, 81-96.

Notes: Incl. bibliogr.: 54 refs.

Abstract: Reductions in fishing mortality within no-take coral reef marine reserves can produce gradients in the density and size of fishes across reserve boundaries. Such gradients may be affected by other factors, however, including differences in habitat quality between reserve and non-reserve areas and the movement of fish across reserve boundaries. To examine the effects of protection from fishing mortality and of habitat quality on an assemblage of exploited reef fishes, we measured the spatial patterns of fish density and size on fringing reefs near the boundary of the Barbados Marine Reserve (Barbados, West Indies) and statistically controlled for habitat correlates of fish density and size. Reserve sites supported a higher total density and size of fishes than non-reserve sites. Most species had a non-significantly higher mean density and size at reserve sites. The density and/or size of many species were correlated with the depth, rugosity, and/or substrate composition of sites. After statistically controlling for the effects of habitat correlates, the difference in total density between reserve and non-reserve sites remained significant, and the mean density and size of most species remained nonsignificantly higher at reserve sites. Neither the mobility of species nor their vulnerability to capture by Antillean fish traps was correlated with their relative difference in density or size between reserve and non-reserve sites. Spearfishing target species had a significantly higher relative difference in size between reserve and non-reserve sites than non-target species. Protection from fishing mortality and higher habitat quality appear to contribute to the increased density and size of fishes on study reefs in the Barbados Marine Reserve, and this difference is not compromised by emigration from the reserve.

Charton, J. A. G., & Ruzafa, A. P. (1999). Ecological heterogeneity and the evaluation of the effects of marine reserves. *In: Fisheries Research*, 42(1-2), 1-20.

Abstract: In recent decades marine reserves have been established throughout the world as a management tool for compensating the effects of overfishing on coastal marine stocks. Despite the growing literature about the expected response of populations and communities to protection from fisheries, and the number of studies measuring some of these effects, most of the mechanisms supposed to work in a marine reserve have not yet been empirically demonstrated. One of the main difficulties ecologists have to face when approaching this problem is the inherent spatial and temporal heterogeneity of ecosystems. This paper reviews the relevant literature and addresses the influence of physical environment (or habitat structure) on ecological processes occurring at the individual, population, and community & ecosystem levels of organization. It evaluates how the responses confound the "reserve effect" with some aspect of the "habitat effect". Finally, it proposes some practical considerations for improving the methods aiming to evaluate the effect of protection in the face of heterogeneity, illustrated with some examples taken from our studies on Mediterranean rocky reef fish assemblages, and argues that a multiscaled, hierarchical approach to this problem (the seascape perspective) should be adopted as an integrating principle when designing a research program aiming to understand the way marine reserves work as fisheries management tools.

Cole, R. G. (1999). Trophic relationships between fishes and benthic organisms on Northeastern New Zealand reefs. *In: Vie Et Milieu*, 49(4), 201-212.

Abstract: The influence of fish feeding on New Zealand reefs is reviewed. Assemblages of seaweeds, grazers and fishes vary over latitudinal gradients and along gradients of wave exposure, and patterns in northeastern New Zealand may be distinct from those elsewhere in the North Island, and the remainder of New Zealand. There is little evidence of broadscale effects of feeding by fishes on seaweeds. At one marine reserve site, predation by fishes and or spiny lobsters may limit the abundances of sea urchins. Further experimentation is needed to clarify the geographic consistency of predatory effects of fishes throughout New Zealand. Small mobile invertebrates which occupy seaweeds are thought to be important prey of young fishes, and perhaps to be major contributors to secondary productivity. The presence of seaweeds and harvesting by humans are thought to be major influences on the fish fauna of reefs. The conflicting requirements of replication and realism in experiments concerning the trophic impact of fishes is noted.

Devlin, M., & Taylor, J. (1999). Impacts of rivers and plumes on the Great Barrier Reef Lagoon. *In: Rivers Future*, 10(12-19).

Edgar, G. J., & Barrett, N. S. (1999). Effects of the declaration of marine reserves on Tasmanian reef fishes, invertebrates and plants. *In: Journal of Experimental Marine Biology and Ecology*, 242(1), 107-144.

Abstract: The reef biota in four Tasmanian marine reserves and at associated unprotected reference sites was investigated over a 6-year period following protection from fishing. The largest reserve at Maria Island (7 km coastline length) proved the most effective at achieving species conservation and resource enhancement. The number of fish, invertebrate and algal species, the densities of large fishes (>325 mm length), bastard trumpeter (*Latridopsis forsteri*) and rock lobsters (*Jasus edwardsii*), and the mean size of blue-throated wrasse (*Notolabrus tetricus*) and abalone (*Haliotis rubra*), all increased significantly within the Maria Island reserve relative to external reference sites. Increases of an order of magnitude in the biomass of rock lobsters and two orders of magnitude in the abundance of trumpeter were particularly noticeable. Small abalone declined in density within the reserve, while large abalone became more numerous. The effectiveness of marine reserves corresponded with reserve size. Changes in species richness of fishes, invertebrates or plants were not detected in any of the three smaller reserves, other than an increase in number of fish species greater than 325 mm size within the Tinderbox marine reserve (2 km reserve length). Although patterns were partly obscured by the low power of statistical tests, trends were generally evident at the Tinderbox reserve for increasing densities of large fishes and rock lobsters, and for increases in the mean size of rock lobsters, abalone and blue-throated wrasse. Most of these trends were not apparent in the reserves with small reef areas at Governor Island (1 km reserve length) and Ninepin Point (1 km length). Rock lobsters above the legal size limit nevertheless became abundant in all reserves by the end of the study while remaining rare outside. Indirect changes to reef assemblages were also detected following the declaration of the Maria Island marine reserve. Accompanying the increase in macroalgal species richness was a change in predominant plant species from *Cystophora retroflexa* to *Ecklonia radiata*. Results of this study provide the first clear evidence that shallow Tasmanian reef ecosystems are overfished, and that unfished coastal ecosystems differ substantially from those where fishing occurs. The most noticeable changes caused by fishing were the virtual elimination of net-susceptible and heavily targeted species, which may otherwise be common, plus indirect changes to algal communities. We suggest that ecosystem change associated with fishing of shallow coastal reefs may be a widespread phenomenon worldwide.

Edwards, A., & Clark, S. (1999). Coral Transplantation: A Useful Management Tool or Misguided Meddling? *In: Marine Pollution Bulletin* , 37(8-12), 474-487.

Abstract: The primary objectives of coral transplantation are to improve reef 'quality' in terms of live coral cover, biodiversity and topographic complexity. Stated reasons for transplanting corals have been to: (1) accelerate reef recovery after ship groundings, (2) replace corals killed by sewage, thermal effluents or other pollutants, (3) save coral communities or locally rare species threatened by pollution, land reclamation or pier construction, (4) accelerate recovery of reefs after damage by Crown-of-thorns starfish or red tides, (5) aid recovery of reefs following dynamite fishing or coral quarrying, (6) mitigate damage caused by tourists engaged in water-based recreational activities, and (7) enhance the attractiveness of underwater habitat in tourism areas. Whether coral transplantation is likely to be effective from a biological standpoint depends on, among other factors, the water quality, exposure, and degree of substrate consolidation of the receiving area. Whether it is necessary (apart from cases related to reason 3 above), depends primarily on whether the receiving area is failing to recruit naturally. The potential benefits and dis-benefits of coral transplantation are examined in the light of the results of research on both coral transplantation and recruitment with particular reference to a 4.5 year study in the Maldives. We suggest that in general, unless receiving areas are failing to recruit juvenile corals, natural recovery processes are likely to be sufficient in the medium to long term and that transplantation should be viewed as a tool of last resort. We argue that there has been too much focus on transplanting fast-growing branching corals, which in general naturally recruit well but tend to survive transplantation and re-location relatively poorly, to create short-term increases in live coral cover, at the expense of slow-growing massive corals, which generally survive transplantation well but often recruit slowly. In those cases where transplantation is justified, we advocate that a reversed stance, which focuses on early addition of slowly recruiting massive species to the recovering community, rather than a short-term and sometimes short-lived increase in coral cover, may be more appropriate in many cases.

Epstein, N., Bak, R. P. M., & Rinkevich, B. (1999). Implementation of a small-scale "no-use zone" policy in a reef ecosystem: Eilat's reef lagoon six years later. *In: Coral Reefs*, 18(4), 327-332.

Fernandes, L., Ridgley, M., & Hof, T. v. t. (1999). Multiple criteria analysis integrates economic, ecological and social objectives for coral reef managers. *In: Coral-Reefs* , 18(4), 393-402.

Abstract: Managing a coral reef in a small island state is a difficult task. Apart from having conflicting objectives and few data there is the added problem of how to evaluate the less tangible benefits of management. This study reports the successful use of multiple criteria analysis to help the managers of a coral reef to make "good" decisions. "Good" decisions are consistent with the community's desires to, in this case, preserve social and ecological values while simultaneously maintaining the economic benefits of dive tourism and maintaining the park as a global model of successful management. Multiple criteria analysis provides a systematic framework for evaluating management options. This study presents one of the first times multiple criteria analysis has been used in coral reef management, let alone in a non-industrialised setting. The results suggest that the method may be more widely useful than previously thought.

Green, A., Birkeland, C., & Randall, R. H. (1999). Twenty Years of Disturbance and Change in Fagatele Bay National Marine Sanctuary, American Samoa. *In: Pacific Science*, 53(4), 376-400 .

Abstract: Fagatele Bay National Marine Sanctuary contains a moderately diverse coral reef community (150 coral species, 259 fish species) that is protected from most human activities.

The coral community was devastated by a crown-of-thorns starfish invasion in 1979 and has recently been affected by two major hurricanes (1990 and 1991) and a period of unusually high water temperature (1994). Long-term monitoring of the sanctuary allows for description of the effects of these disturbances in the absence of anthropogenic processes. The crown-of-thorns damaged deeper portions of the coral communities most severely, whereas the hurricanes and warm water affected shallower portions to a greater degree. Soon after these disturbances, corals started recruiting abundantly and the reefs began to recover. This is in contrast to some other areas in American Samoa, where chronic anthropogenic effects seem to have inhibited coral recruitment and reef recovery. Fish communities were affected by the habitat degradation associated with the crown-of-thorns outbreak, but have remained relatively unchanged ever since.

Green, A., & Craig, P. (1999). Population size and structure of giant clams at Rose Atoll, an important refuge in the Samoan Archipelago. *In: Coral Reefs*, 18(3), 205-211.

Abstract: Rose Atoll is an important refuge for giant clams (*Tridacna maxima*) that have been heavily exploited elsewhere in Samoa. During an extensive survey of six islands in the archipelago (50.5 ha surveyed in 420 transects), 97% of a total of 2853 clams were recorded at the atoll (42% of area surveyed). Clam densities were highest in the atoll lagoon, especially around the bases of the pinnacle (mean density = 8870 ha super(-1)). Estimated population size for the small atoll (615 ha) was approximately 27800 clams. Twenty four percent of the population consisted of mature clams (greater than or equal to 12 cm), 70% of which occupied the pinnacles and shallow lagoon habitat. Estimated mortality was low ($Z = 0.3$) and primarily due to natural mortality ($M = 0.3$). Maximum recorded size ($L_{sub(max)}$) and asymptotic mean size ($L_{sub(infinity)}$) were 25.0 cm and 27.8 cm respectively.

Hamilton, M., & Innes, J. (1999). Monitoring aircraft usage of the Marine Park: a case study from Whitehaven Beach, Whitsunday Island. *In: Reef Research*, 9(2), 26-28.

Abstract: Aircraft overflights and associated noise in national parks is an environmental management issue which has attracted the attention of researchers in the USA and Australia for at least the last ten years. The Great Barrier Reef Marine Park Authority (GBRMPA) recognizes that sound from aircraft operations is a management issue and has developed guidelines for particular areas. However, accurate information on the impact of aircraft activity on the natural and cultural values on locations such as Whitehaven Beach, Whitsunday Island, Queensland (Australia) is lacking. A research project was commissioned, comprising two studies into the impact on visitor use, amenity and values. The finding that most aircraft events (88%) registered above background sound levels and affected the study sites will be compared with the results on the values, use and amenity study. Results from both studies will provide GBRMPA with information to allow a more detailed evaluation of aircraft and other activities on Whitehaven Bay which could have applications for the management of other locations in the Great Barrier Reef.

Harriott, V. J. (1999). Coral recruitment at a high latitude Pacific site: A comparison with Atlantic reefs. *In: Bulletin of Marine Science*, 65(3), 881-891.

Abstract: Reports of coral recruitment in subtropical Australia have indicated low recruitment rates of broadcast-spawning species, and higher but variable rates for brooded larvae. Hypotheses have suggested that coral biogeographical patterns and population dynamics on these subtropical reefs are a function of sporadic episodes of high recruitment by tropical coral larvae, on a time scale in the order of decades. In a study of coral recruitment in the Solitary Islands Marine Park in eastern Australia spanning an eight year period, recruitment was consistently low at two islands, and low to moderate at another three. Recruitment at each site varied interannually by a factor of four to seven times. For acroporid corals, the dominant

broadcast-spawned recruit in tropical eastern Australia, only 34 recruits were recorded from 370 pairs of settlement panels collected over the 8 yrs, indicating either that the temporal scale of recruitment events for this species is greater than the time scale of the study, or that the local population is maintained by a lower level of recruitment than previously assumed. While the coral recruitment rates at the Solitary Islands were low relative to tropical Australian sites, they were comparable with rates reported from both tropical and subtropical sites in the western Atlantic Ocean. This suggests that the relatively low levels of larval settlement reported for these sites are sufficient to maintain coral communities, and that the sporadic episodes of recruitment of tropical larvae hypothesized for high latitude sites, while potentially significant biogeographically, are not necessary for population maintenance.

Harriott, V. J. et al. (1999). Ecological and conservation significance of the subtidal rocky reef communities of northern New South Wales, Australia. *In: Marine and Freshwater Research*, 50(4), 299-306 .

Abstract: The subtropical rocky reefs of Cook Island, Julian Rocks and the South West Rocks area form part of a chain of islands and reefs with significant coral cover from the Queensland border (28 degree S) to the southern extent of extensive coral communities in coastal Australia (31 degree S). Benthic communities at 18 subtidal sites at the three localities were surveyed quantitatively by video-transects, and coral species lists were compiled. Twenty-eight coral species previously unrecorded for these localities were identified, increasing the species richness of hermatypic corals reported for the northern NSW region (excluding the Solitary Islands) from 14 to 43. Coral species richness declined with latitude. Benthic communities were generally dominated by turfing and macroalgal species, with *Pyura*, sponges, and barnacles locally abundant. Scleractinian coral cover ranged from 0% to 42.6% per site, with highest coral cover at the most southern site. Julian Rocks is a designated Aquatic Reserve, and Marine Parks have been suggested for all three localities. Selection of Marine Protected Areas requires information on their ecological significance. These surveys report the first quantitative information on the shallow-water, rocky-reef communities in the region, which is a vital step in assessing their ecological significance.

Hastings, A., & Botsford, L. W. (1999). Equivalence in yield from marine reserves and traditional fisheries management. *In: Science Washington*, 284(5419), 1537-1538.

Abstract: Marine reserves have been proposed as a remedy for overfishing and declining marine biodiversity, but concern that reserves would inherently reduce yields has impeded their implementation. It was found that management of fisheries through reserves and management through effort control produce identical yields under a reasonable set of simplifying assumptions corresponding to a broad range of biological conditions. Indeed, for populations with sedentary adults (invertebrates and reef fishes), reserves have important advantages for sustainability, making marine reserves the preferred management approach.

Haynes, D., Mueller, J. F., & McLachlan, M. S. (1999). Polychlorinated dibenzo-p-dioxins and dibenzofurans in Great Barrier Reef (Australia) dugongs (*Dugong dugon*). *In: Chemosphère*, 38(2), 255-262 .

Abstract: Fat tissue samples from dugong (*Dugong dugon*) carcasses stranded at three sites along the Great Barrier Reef were analysed for polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs). Relatively high levels of PCDDs were determined in all three dugongs. In particular OCDD, the PCDDF congener that is usually considered the least bioavailable of all 2,3,7,8 substituted congeners, was found at levels higher than reported for other marine mammals. Tissue accumulation of PCDDs by dugongs may be a consequence of sediment and/or seagrass ingestion during feeding, microbial biotransformation of PCDD precursors in the animal's hindgut or, alternatively, the possession of a selective degradation

capability for PCDFs.

Hodgson, G. (1999). A Global Assessment of Human Effects on Coral Reefs. *In: Marine Pollution Bulletin*, 38(5), 345-355.

Abstract: Coral reefs have been used by humans as recreation areas and as a source of food and other products for thousands of years. The effects of humans on coral reefs are not well understood, especially on a regional or global scale. A special survey protocol called "Reef Check" was designed to be used by volunteer recreational divers, trained and led by marine scientists, and based on the use of high value, easily identified indicator organisms. During a period of 2.5 months, a global survey of over 300 reefs in 31 countries and territories indicates that few reefs remain unaffected by man, even very remote sites. Overfishing has reduced fish and invertebrate indicator organisms to low levels at most reefs, including those within marine protected areas. The ratio of live to dead coral cover was higher in the Red Sea than in other regions, indicating that reef corals are in the best condition there. In future years, by increasing the number of reefs and the frequency of surveys, the Reef Check program could provide a valuable method to detect broad-brush changes on a local, regional and global scale, as well as increasing public support for coral reef conservation.

Huber, R., & Jameson, S. C. (1999). Montego Bay, Jamaica: A case study in public-private partnerships for pollution prevention and management of a valuable coral reef ecosystem. *In: Tropical Coasts*, 5(2)(6(1)), 22-27.

Huntsman, G. R. et al. (1999). Groupers (Serranidae, Epinephelinae): Endangered Apex Predators of Reef Communities. *Life in the Slow Lane: Ecology and Conservation of Long Lived Marine Animals* (pp. 217-231). Bethesda USA: American Fisheries Society *American Fisheries Society Symposium: Vol. 23*.

Abstract: Distributed worldwide in warm water reef systems, groupers display ecological and biological characteristics that engender overharvest and, in extreme cases, endangerment to particular species. Most of the larger groupers have low natural mortality rates, reach maturity and maximum size slowly, are inherently rare, move little as adults, often aggregate to spawn at locations known to fishers, and are protogynous. The larger groupers of the Atlantic coast of the southeastern United States illustrate the vulnerability of groupers in general and offer reasonable proxies for the condition of many grouper populations throughout the world. The interaction of fishing mortality and protogyny has reduced the frequency of male gag *Mycteroperca microlepis* to 6% from more than 20% in 1973 and the spawning potential ratio (SPR) based on male biomass to 0.03 (from 1.0 in the unfished population). Reproduction in the protogynous red porgy *Pagrus pagrus* failed when the male SPR fell below 0.10. For the speckled hind *Epinephelus drummondhayi* in 1990 the numerical population was 10%, the population biomass was 5%, and the biomass of mature fish was 2% of that existing in 1973. The warsaw grouper *E. nigrilus* is now so rare that too few individuals are measured to assess the population status. Jewfish *E. itajara* and Nassau grouper *E. striatus* are so rare as to be totally protected from harvest. The marbled grouper *E. (Dermatolepis) inermis* may not be overfished but is so inherently rare that its population status is a mystery. Of the several potential management schemes for groupers only the implementation of a system of marine reserves solves all the complex problems of managing these valuable fishes.

Johnson, A. K. L., Ebert, S. P., & Murray, A. E. (1999). Distribution of coastal freshwater wetlands and riparian forests in the Herbert River catchment and implications for management of catchments adjacent the Great Barrier Reef Marine Park. *In: Environmental Conservation*, 26(3), 229-235, 20 ref.

Abstract: Because coral reefs are sensitive to land derived inputs of nutrient and sediment,

there is concern worldwide for the effects of anthropogenic change in river catchments on reefs. Thirty-one river catchments drain directly into the waters of the Great Barrier Reef, NE Australia. This case study was undertaken on the floodplain of the Herbert River catchment in north Queensland, utilizing remote sensing and GIS to assess both spatial and temporal changes in freshwater wetlands and riparian forests. It is demonstrated that there has been a very large reduction in the area of these ecosystems since European settlement in the mid nineteenth century, with an 80% decline in their extent since 1943. A range of quantitative measures show that the landscape diversity of these ecosystems has also declined. These changes are of importance in terms of regional, national and international trends. It is argued that policy, planning and management reform is required if the remaining ecological, economic and social values of these systems and the adjacent Great Barrier Reef Marine Park are to be maintained.

Kunzmann, A. (1999). Corals, fishermen and tourists. Actual problems of the marine environment Lectures at the 9th Scientific Symposium 26 27 May 1999 in Hamburg Aktuelle Probleme der Meeresumwelt Vortraege des 9 Symposiums 26 bis 27 Mai 1999 in Hamburg 1999 (p. 10).

Notes: ORIGINAL TITLE: Korallen, Fisher und Touristen

Abstract: As a result of natural and anthropogenic disturbance coral reefs are endangered across the world. This presentation addresses the effects of fishing and tourism on coral reefs. Although reefs are important in a global context for fisheries and tourism, more than 60% of all reefs are endangered through human activities. The use of explosives and poison for fishing is banned since 1972. Nevertheless, up to 50% of small-scale fishermen use bombs and poison, at least temporarily. Both methods cause long-term destruction of corals and reef structure leaving behind only coral rubble or rather mile-long "coral cemeteries" whose assertion of skeletal dead corals are a sad reminder of the beautiful reefs before the destruction. The trade with ornamental fish for aquarium and live reef fish for consumption in Hongkong is worth more than 1 billion US Dollar annually. Uncontrolled tourism also destroys reefs in many ways -- rapid coastal development with corals as building material, sedimentation, eutrophication and last not least many divers disturb coral reefs. This also true for the booming trade with souvenirs from the sea, as is the case for ornamental fish trade, the Philippines are the main export nation. In addition, natural disturbance factors such as climatically induced temperature variations or storms frequently act as the final straw for already stressed reefs. Fortunately, the number of marine parks and marine protected areas is increasing worldwide and several large international projects for reef protection and rehabilitation have begun. It remains to be seen whether decision-makers will discover that reefs which are managed in an encompassing and sustainable manner can provide economically viable returns. It must be realised that in order to achieve this, developing countries in the tropics must be substantially supported with true partnership projects.

Lally, K., & Berkelmans, R. (1999). Coral bleaching and climate change on the Great Barrier Reef: an update. *In: Reef Research*, 9(2), 4-5.

Abstract: In early 1998, a mass coral bleaching event took place on the Great Barrier Reef (GBR), Queensland (Australia) and broad scale aerial surveys of 654 reefs in March and April 1998 indicated that 87% of inshore reefs showed at least some bleaching, compared to 28% of offshore reefs. The 1998 coral bleaching event was not confined to the GBR and coincided with an unusual meteorological year, being the warmest year on record globally, the most extreme year for sea temperatures on the GBR, based on a 95 year record, and the end of a long El Nino event. To what extent climate change is caused by Greenhouse gas emissions or is simply an existing natural trend, is still being debated by climatologists, but it is certain that coral bleaching is connected to climate extremes. Although management agencies such as the Great Barrier Reef Marine Park Authority can do nothing about climate change itself, the importance

of documenting potential links between climate change and bleaching is recognized. Factors such as sediment runoff, nutrients, pollutants and dredging may also contribute to, or exacerbate, coral bleaching and mortality.

Letourneur, Y., Labrosse, P., & Kulbicki, M. (1999). Commercial fish assemblages on New Caledonian fringing reefs submitted to different levels of ground erosion. *In: Oceanologica Acta*, 22(6), 609-621.

Abstract: A comparative study was conducted in two zones of the Northern Province of New Caledonia, one located windward (east coast) and the other located leeward (west coast). In each zone, three major sectors were investigated: fringing reefs close to areas of important mining activities, fringing reefs close to areas of moderate mining activities, and fringing reefs close to areas free of mining activities. In addition, on the west coast, fringing reefs close to areas of high natural ground erosion were also studied. Only commercial fish species sensus late were censused on a total of 163 stations, concerning 165 fish species. Substrate characteristics were not different between zones and sectors. However, significant differences were observed for living organisms: live coral cover was higher in non-mining sectors than in mining ones, and algal cover increased with increasing mining activities. The three main descriptors of the commercial fish communities (e.g. mean species richness, density and biomass) have all shown lower values in sectors submitted to the lowest ground erosion levels, although these trends were not all statistically significant. Similar results were found for some of the major fish families, such as the Acanthuridae and Siganidae, whereas other families had no specific pattern, such as the Lut-janidae, or a 'partial' pattern (i.e. on only one coast), such as the Serranidae, Lethrinidae, Mullidae, Labridae and Scaridae. (C) 1999 Ifremer / CNRS / IRD / Editions scientifiques et medicales Elsevier SAS.

Malcolm, H. A., Cheal, A., & Thompson, A. (1999). Fishes of the Yongala historic shipwreck. (p. 29). Townsville (Australia): Cooperative Research Cent. for the Ecologically Sustainable Development of the Great Barrier Reef.

Abstract: The wreck of the S.S. Yongala is regarded as one of the top ten dive sites of the world, not only because of the size, structural integrity and proximity to Townsville, Queensland (Australia) but also because of the uniqueness of the fish community that makes the Yongala historic shipwreck its home base. The sheer abundance, variety and large size of predators (especially snapper, cod and trevally) is extraordinary on the Great Barrier Reef. The attachment of fish to the wreck has been shown by documenting the stability of fish numbers and composition on five occasions over 15 months. This confirms both the wreck and the 'no fish' Marine Park B zone for 500 m around the wreck as a significant fish refuge which needs to be protected from fishing pressure. The relative stability of the fish community around the Yongala over the study period and the similarity of this community to that reported in 1981 suggests that the management of the site is effective for fish protection, despite thousands of diver days documented on the wreck each year. However, observations of resident fish with obvious damage indicates that care needs to be taken to ensure increasing numbers of divers do not have a detrimental effect on fish behaviour and residency. This study provides a crucial baseline against which to monitor the fish community of Yongala in the future.

McClanahan, T. (1999). Is there a future for coral reef parks in poor tropical countries? *In: Coral Reefs*, 18(4), 321-325. Notes: English Editorial

McClanahan, T. et al. (1999). The effects of marine parks and fishing on coral reefs of northern Tanzania. *In: Biological Conservation*, 89(2), 161-182.

Abstract: The macrobenthic (coral, algae, and sea urchins) and fish communities in 15 back-reef sites on the patch and rock-island reefs of southern Kenya and northern Tanzania (~250 km

of coastline) were studied in order to (1) test an overfishing model developed in Kenya's fringing reef (, A coral reef ecosystem-fisheries model: impacts of fishing intensity and catch selection on reef structure and processes. *Ecol. Model.* 80, 1-19.), (2) develop a baseline of information on Tanzanian coral reef ecosystems, and (3) determine if some of the government gazetted but unprotected marine reserves were still deserving of protective management. The overfishing model was tested by comparing five sites in two fully protected reefs--one in southern Kenya (Kisite Marine National Park) and the other in Zanzibar (Chumbe Island Coral Park)--with 10 sites in eight fished reefs, and by comparing coral surveys conducted in reefs off of Dar es Salaam in 1974 with present-day studies. These comparisons suggest that fishing is primarily reducing the abundance of angelfish, butterflyfish, parrotfish, scavengers, surgeonfish, and triggerfish groups while some species of small-bodied damselfish and wrasse appear to have benefited. The total fish wet weight estimate was 3.5 times higher in protected than unprotected sites. Sea urchin abundance was six times higher, and predation rates on tethered sea urchin *Echinometra mathaei* were two times lower, in unprotected compared to protected sites. This is largely attributable to the reduction of the red-lined triggerfish *Balistapus undulatus* and other sea urchin predators by fishing. Loss of coral cover and changes in coral generic composition had occurred in four of the five sites visited in the Dar es Salaam area after the 22-year period. There was no evidence for species losses. One site appeared to be severely damaged over this time. Some reefs were dominated by fleshy brown algae, such as *Sargassum* and *Dictyota*, which may result from a loss of grazers and coral cover. Reduced fishing effort, elimination of destructive gear (dynamite and beach seines), protection of vulnerable species and, in some cases, sea urchin reductions could rectify the problems of overfishing. Despite the damage, the gazetted but unprotected reefs of Mbudya and Bongoyo still have high potential as marine protected areas due to the persistence of species and reef structure.

Moberg, F., & Folke, C. (1999). Ecological goods and services of coral reef ecosystems. *In* : *Ecological Economics*, 29(2), 215-233.

Abstract: This article identifies ecological goods and services of coral reef ecosystems, with special emphasis on how they are generated. Goods are divided into renewable resources and reef mining. Ecological services are classified into physical structure services, biotic services, biogeochemical services, information services, and socialcultural services. A review of economic valuation studies reveals that only a few of the goods and services of reefs have been captured. We synthesize current understanding of the relationships between ecological services and functional groups of species and biological communities of coral reefs in different regions of the world. The consequences of human impacts on coral reefs are also discussed, including loss of resilience, or buffer capacity. Such loss may impair the capacity for recovery of coral reefs and as a consequence the quality and quantity of their delivery of ecological goods and services. Conserving the capacity of reefs to generate essential services requires that they are managed as components of a larger seascape-landscape of which human activities are seen as integrated parts.

Morgenstern, H. L. (1999). Clouds over the Coral. *In*: *E-The Environmental Magazine*, 10(2), 36-41.

Morrison, R. J., & Naqasima, M. R. (1999). Fiji's Great Astrolabe Lagoon: baseline study and management issues for a pristine marine environment. *In*: *Ocean & Coastal Management*, 42(6-7), 617-636.

Abstract: The Great Astrolabe Lagoon (18[deg]45'S, 178[deg]32'E), located some 70 km south of Suva, the capital of Fiji, is a marine environment in relatively pristine condition, impacted only by low human populations on small islands. The Great Astrolabe Reef

which encloses the Lagoon is a barrier reef composed of oceanic ribbon reefs. A baseline study of the Lagoon was carried out in 1989-92 which consisted of two components: (1) biological monitoring of permanent reef transects, and (2) water and sediment quality monitoring. Twelve study sites encompassing different habitats were visited regularly during the study period. Substrate cover, hard coral cover, plant cover and counts of selected motile invertebrates were taken. Fish counts were also conducted. The water quality studies included temperature, dissolved oxygen and nutrients, trace metal analyses and microbiological examination of edible bivalves. Sediment samples were also analysed for a range of macro- and micro-elements. The reefs that were relatively inaccessible to the local villagers were found to be in a healthier state than those in close proximity to the islands. There were several problems encountered in the reef monitoring studies which exemplify the constraints of conducting research in a relatively isolated location. Water analyses indicated that the Lagoon is relatively free from pollution with pH, dissolved oxygen, temperature and salinity data close to open ocean values. Apart from nitrate, all nutrient values were below detection limits. Nitrate values averaged 0.74 $\mu\text{mol/L}$, but varied from 0.2 to 1.9 $\mu\text{mol/L}$. Data for trace metals in water were consistent with no contamination. Shellfish samples showed no contamination by trace metals and minimal faecal coliform contamination. Sediments showed no contamination by trace metals and were dominated by high magnesium calcite and aragonite, with minor amounts of low magnesium calcite. There are increasing pressures on this area, both from local residents who wish to move to a more cash oriented economy through increased fishing and tourism, and from external tourism interests. The Lagoon has also been suggested as a marine national park. Some of the management issues associated with these alternatives are discussed.

Mumby, P. J., & Harborne, A. R. (1999). Development of a systematic classification scheme of marine habitats to facilitate regional management and mapping of Caribbean coral reefs. *In: Biological Conservation*, 88(2), 155-163.

Abstract: Most coastal habitat mapping is conducted on an ad hoc basis with little consistency in terminology and ambiguous documentation. These limitations obstruct interpretation and integration of maps for coral reef science and management, particularly at regional (international) scales where standardisation is urgently required. This paper advocates an objective, systematic approach to habitat classification which couples coastal geomorphology and benthic cover. Benthic classes are derived and described objectively using agglomerative hierarchical classification of field data and Similarity Percentage analysis of resulting clusters. The scheme has a hierarchical structure to accommodate various user requirements, variable availability of data, and the spatial scales of most remote sensing methods. We illustrate our approach with a scheme based on extensive field data from the Turks and Caicos Islands and Belize. While the scheme will not represent all habitats of the Caribbean, it provides a useful basis for a regional classification and illustrates the systematic approach. Standardised regional maps of coastal habitats will help development of predictive models of coral metapopulation dynamics, aid the identification of larval source and sink areas, and facilitate strategic transboundary planning of protected areas to maximise species, habitat, and ecosystem conservation. Habitats might also be interpreted to reflect ecosystem processes such as productivity and trophic guild structure, thereby allowing the ecosystem function to be examined at larger scales. (c)

Murray, S. N. et al. (1999). Human visitation and the frequency and potential effects of collecting on rocky intertidal populations in southern California marine reserves. *In: California Cooperative Oceanic Fisheries Investigations Reports*, 40, 100-106.

Abstract: Humans intensely use southern California rocky shores for recreational activities such as fishing, exploration, walking, enjoyment of the out-of-doors, and educational field trips. People also collect intertidal organisms for consumption, fish bait, home aquariums, and other

purposes. In Orange County, visitors concentrate their activities on a few rocky headlands and reefs. Many of these shores have been designated as California Marine Life Refuges (CMLRs) or State Ecological Reserves (SERs), where the removal of most intertidal organisms, except for scientific purposes, has been unlawful for 30 years. In a yearlong study of eight Orange County shores, unlawful collecting of organisms was often observed. In addition, lifeguards have frequently observed unlawful collecting on these and other shores. The CMLR or SER designation did not deter collecting. Mussels, trochid snails, limpets, urchins, and octopuses were the most commonly collected organisms, primarily for food or fish bait. Several of the gastropod species targeted by human collectors had low population densities and population structures dominated by smaller and less fecund individuals, characteristics that often occur in populations exploited by humans. Most collected invertebrates were broadcast spawners that require high densities of fertile individuals to optimize reproduction. The cascading effects of collecting on community structure and the reproductive success of exploited populations are unknown. Except for state park rangers at one site, no state enforcement personnel were seen during 768 hours of low-tide observations throughout the year. Without effective enforcement, adequate signage, and educational programs to increase public awareness, CMLRs and SERs are not protecting rocky intertidal populations on heavily visited southern California shores. Improved management practices are needed if CMLRs and SERs are to protect rocky intertidal populations and to serve as benchmark sites where changes in populations due to regional climatic events or chronic human disturbances can be measured and evaluated in the absence of exploitation.

Mwaipopo, O. U. (1999). The hydrography of the south Mafia Channel, Tanzania. Conference on Advances on Marine Sciences in Tanzania, Zanzibar (Tanzania), 28 Jun - 1 Jul 1999
Zanzibar Tanzania: Inst. of Marine Sciences

Notes: Summary only.

Abstract: The hydrographic work done during the southeast and northeast monsoon periods for the South Mafia Channel for marine park conservation is presented. It is observed that the study area has clear water and therefore suitable for the growth of corals which serve as important habitat for fish breeding. The currents in the area are basically tidal and current strengths of up about 2 knots are experienced. Currents feeding or draining Jujima Bay converge or diverge at the middle of the bay producing considerable turbulence resulting in downwelling and upwelling effects.

Ochieng, C. A., & Erftemeijer, P. L. A. (1999). Accumulation of seagrass beach cast along the Kenyan coast: a quantitative assessment. *In: Aquatic Botany*, 65(1-4), 221-238.

Abstract: Accumulation of seagrass beach cast material was monitored along the beaches of the Mombasa Marine National Park and Reserve, Kenya between September 1995 and August 1996. Weekly surveys using a rapid visual assessment technique revealed an average total of 93,000 kg dry weight of beach cast material along a 9.5 km stretch of beaches in this area. An average of 88% of the beach cast dry weight consisted of seagrass material (88% leaves) while the remainder was composed of the seaweeds *Sargassum* sp. and *Ulva* sp. The seagrass *Thalassodendron ciliatum* (Forsskal) den Hartog constituted the major part (76%) of the seagrass tissue on the beach, followed by *Syringodium isoetifolium* (Ascherson) Dandy (15%). An average of 19.7% (n=90; SE=0.27) of the beach cast consisted of freshly-detached (green) seagrass material. The beach cast material was part of a pool of detached macrophytes in the intertidal zone washed back and forth between the beach and the adjacent reef lagoon with the ebb and flood tides. An average net diffusion factor (DF) of 29.1 g 24 h⁻¹ was measured in the lagoon using blocks of plaster of Paris, indicating a relatively high degree of exposure to waves and currents. Significantly (p=0.006) larger amounts of

beach cast were recorded during spring tide periods compared to neap tide periods. Weekly monitoring at three beach sites (Nyali, Bamburi, Reef) revealed that accumulation of beach cast was markedly seasonal with largest amounts observed during the South-East (SE) monsoon (March to October) and minimal amounts during the North-East (NE) monsoon (November to March). Extrapolation of the monitoring results indicated that the total amount of beach cast along the entire beach (9.5 km) varied between a minimum of 14,700 kg dry weight (or 31 g m⁻²) during the NE monsoon to a maximum of 1.2 million kg dry weight (or 2.5 kg m⁻²) during the SE monsoon. Decomposition of the beach cast material was measured by litter bag experiments. *T. ciliatum* leaves in litter bags lying on the beach surface showed a decomposition rate (k) of 0.017 day⁻¹ ash-free dry weight (AFDW). The material in the litterbags took 42 days to lose 50% of its initial ash-free dry weight. Burial of litterbags under the sand did not result in a significant reduction of the decomposition rate. Large numbers of amphipods, isopods, nematodes and oligochaetes were associated with the beach cast material. Most dominant were amphipods which had an average density of 23,182 ± 10,697 animals m⁻². A positive correlation (r = 0.4) was found between faunal density and amount of beach cast material. Above-ground biomass and primary production of seagrass meadows in the adjacent lagoon were 760 ± 96 g dry weight m⁻² and 8.2 ± 2.8 g dry weight m⁻² day⁻¹, respectively. The total net production by the seagrass beds covering 60% of the 20 km² lagoon was estimated to be 36 million kg dry weight year⁻¹ (or 14.7 million kg C year⁻¹). The turn-over of the beach cast material was in the order of 73 times per year, implying that approximately 6.8 million kg dry weight of seagrass material is being casted on the beach annually. This indicates that approximately 19% of the total seagrass productivity in the lagoon passes through the beach, where exposure to wind and sun, fragmentation, leaching and decomposition contribute to efficient recycling of nutrients.

Ohman, M. C. (1999). Coral bleaching and reef fish communities. Conference on Advances on Marine Sciences in Tanzania, Zanzibar (Tanzania), 28 Jun - 1 Jul 1999 Zanzibar Tanzania: Inst. of Marine Sciences

Notes: Summary only.

Abstract: In 1988 coral reefs of Tanzania were severely affected by bleaching. The coral mortality that followed caused a concern for coral reef degradation and overall resource depletion. In this study we investigated coral bleaching effects on reef fish communities at Tutia reef in Mafia Island Marine Park, Tanzania. Corals of *Acropora formosa* were transplanted into quadrates and reef structure and associated fish assemblages were examined before and after the bleaching event. 88% of all corals died following the coral bleaching and fish communities changed in composition. Fish abundance increased while species diversity was less affected. There was a correlation between structural complexity and fish densities after disturbance, which indicates that the reef may uphold an abundant, fish population as long as the architectural is intact. The impact the coral bleaching event may have on fisheries is difficult to anticipate. Reef fishery at Tutia reef is multispecific and a variety of techniques are used. As a broad range of species is targeted, including smaller fishes, catches may not be reduced as long as the reef structure is sustained. However, if reef degradation follows, fish abundances are most likely to decrease.

Ohman, M. C., Lindahl, U., & Schelten, C. K. (1999). Influence of coral bleaching on the fauna of Tutia Reef, Tanzania. *In:* O. Linden, & N. Sporrang Coral reef degradation in the Indian Ocean: Status reports and project presentations (pp. 48-52). Stockholm-Sweden : CORDIO.

Abstract: In 1998, coral reefs off Tanzania were severely affected by bleaching. The coral mortality that followed caused a concern for coral reef degradation and overall resource

depletion. In this study, coral bleaching effects on the coral reef fauna at Tutia Reef in Mafia Island Marine Park, Tanzania were investigated. Corals from adjacent reef patches of the species *Acropora formosa* were transplanted into plots, and reef structure and associated fish assemblages were examined before and after the bleaching event. Following the coral bleaching, 88% of all corals died. A year after the event, large proportion of all the dead corals were still standing. As surviving and dead corals were from different clones, results suggested that genetic variation might influence bleaching tolerance. After the bleaching event, a change in fish community composition, with an increase in fish abundance, could be seen. Species diversity, however, was less affected. There was a correlation between structural complexity and fish densities after disturbance. This indicates that the reef may uphold an abundant fish population as long as the architectural structure is intact. The impact that the coral-bleaching event may have on fisheries is difficult to anticipate. The Tutia Reef supports a multi-species fishery and a variety of techniques are used. As a broad range of species are targeted, including smaller fishes, catches may not be reduced as long as the reef structure is sustained. If reef degradation follows, however, fish abundance is likely to decrease.

Ormsby, J., & Innes, J. (1999). A preliminary report on the social and motivational aspects of recreational fishing in the Great Barrier Reef region. *In: Reef Research*, 9(2), 23-25 .

Abstract: Recreational fishing is a frequent, yet still to be understood, activity in terms of motivation, effort and effect on the environment of the Great Barrier Reef (GBR), Queensland (Australia). The Great Barrier Reef Marine Park Authority has undertaken a preliminary investigation into the sociomotivational aspects of recreational fishing, as distinct from economic and catch effort studies, comparable with studies undertaken in USA and a recent study of recreational boating in the area of Shoalhaven Bay, New South Wales. During 1997-1998, 2,061 surveys were completed by recreational anglers from Queensland, 85% of whom had at least ten years' fishing experience, while 50% had at least 30 years' fishing experience. The majority of anglers were male, aged between 30 and 49, rated their fishing ability as average and spent less than a quarter of their leisure time fishing. The strongest motivations for recreational fishing were for rest and relaxation, being outdoors, enjoying nature and although catching fish to eat was important to 77%, almost 70% felt a fishing trip could be successful even if no fish were caught. The results of this study should be considered as a first step in developing a more holistic range of information to draw upon in the management of the Great Barrier Reef Marine Park.

Otto, J. C. (1999). Four new species of Agaue (Acarina: Halacaridae) from the Great Barrier Reef Marine Park. *In: Cahiers De Biologie Marine*, 40(3), 273-281 .

Abstract: Four new species of Agaue (Acarina: Halacaridae) are described from the Great Barrier Reef Marine Park, namely *Agaue aliena*, *Agaue bella*, *Agaue galatea*, and *Agaue reichelti*. These species, collected from algae, dead coral, and coarse sediment, bring the total number of Agaue species known from Australia to seven and the number of Agaue species known from tropical regions to ten.

Otto, J. C. (1999). Halacarid fauna of the Great Barrier Reef and Coral Sea: the genera *Agauopsis* and *Halacaropsis* (Acarina: Halacaridae). *In: Memoirs of the Queensland Museum*, 43(2), 797-817.

Pattengill, C. V. (1999). The Structure and Persistence of Reef Fish Assemblages of the Flower Garden Banks National Marine Sanctuary. *In: Diss. Abst. Int.* 59(12), 6168 .

Notes: Degree: PhD. Thesis Publ. Date: 1998, 164 pp. Source: UMI, 300 N Zeeb Rd, POB 1346, Ann Arbor, MI 48106. (800-521-0600), www.umi.com.

Abstract: The purpose of this study was to assess the reef fish populations of the Flower

Garden Banks (FGB) and Stetson Bank (SB) above 30 m and to establish a database of information for long-term use in the Flower Garden Banks National Marine Sanctuary (FGBNMS). Data generated from two different visual census methods collected semi-annually for three years were used to evaluate diurnal fish assemblage structure and persistence. Species presence, species abundance, and trophic structure were used to describe and compare the FGB and SB. The stability in species presence, species abundance, and trophic structure was examined. The suitability of data collected by nonexperts and the role volunteers play in monitoring programs were also evaluated. Through the course of this study, 789 visual fish surveys were completed and 177 species were documented. Forty-five species were new records for the FGBNMS, including a unique color phase of one species. Similarity in the fish assemblages of the FGB and SB indicated a common species pool. Differential recruitment success, settlement success and seasonal attrition occurred between the banks, and most likely were driven by food and habitat availability and the physical environment. Analyses revealed relatively high levels of stability in species abundance, despite the variable presence of many rare species. Trophic structure was more stable than species abundance. Recruitment variability and post-recruitment factors likely controlled the fish communities and species persistence. These data provide a benchmark for future assessments of disturbance and recovery, and provide insight into the stability of an assemblage measured at a large spatial scale. Non-expert volunteers were able to produce survey results comparable to those of experts. The larger sample size of non-experts increased the statistical power for many species' estimates of abundance. Volunteer monitoring can provide a valuable source of data, and also invokes a sense of ownership in the resource. Future FGBNMS fish monitoring should include annual or bi-annual surveys following the field survey design outlined in this study. Methodology comparisons highlighted the advantages and biases of visual census methods and led to recommendations for changes to improve survey design.

Pattengill Semmens, C. (1999). Occurrence of a unique color morph in the smooth trunkfish (*Lactophrys triqueter* L.) at the Flower Garden Banks and Stetson Bank, northwest Gulf of Mexico. *In: Bulletin of Marine Science*, 65(2), 587-591 .

Abstract: The Flower Garden Banks National Marine Sanctuary consists of three isolated banks located on the outer continental shelf of the northwest Gulf of Mexico: the East Flower Garden Bank (EFG), the West Flower Garden Bank (WFG) and Stetson Bank (SB). All three banks have an approximate minimum depth of 20 m. The EFG and WFG (collectively referred to as the FGB) are 175 km SSE of Galveston, Texas, and support coral reef communities (Bright et al., 1984). The banks are topographic expressions of seafloor uplift caused by vertically migrating salt originating from a Jurassic evaporite deposit 15 km below the seafloor (Rezak et al., 1985). Stetson Bank is 112 km SSE of Galveston, Texas, and is an outcrop of consolidated sedimentary rock (sandstone, siltstone and claystone) thrust upward by an underlying salt dome (Bright and Pequegnat, 1974). Benthic cover at SB is primarily sponges, algae and fire coral (*Millepora alcicornis* Linnaeus). All three banks support tropical reef fish assemblages (Bright and Pequegnat, 1974; Boland et al., 1983; Rezak et al., 1985; Dennis and Bright, 1988; Pattengill et al., 1997). The nearest coral reefs to these isolated banks are over 600 km to the south in the Gulf of Campeche.

Pickering, H., Whitmarsh, D., & Jensen, A. (1999). Artificial Reefs as a Tool to Aid Rehabilitation of Coastal Ecosystems: Investigating the Potential. *In: Marine Pollution Bulletin*, 37(8-12), 505-514.

Abstract: Utilising case studies, the paper identifies the potential of artificial reefs as a tool to aid the rehabilitation of coastal ecosystems from an ecological perspective. It goes on to discuss how this potential can be constrained by the action of a complex array of legal frameworks and political processes which are not necessarily attuned to or supportive of the needs of habitat

restoration (whether based on artificial reefs or other technologies). Apart from institutional inertia, one of the main reasons why support for habitat restoration projects may be lacking is that, while their costs may be expressed in monetary terms, their benefits rarely are. The paper concludes by exploring techniques by which both the benefits and costs of coastal rehabilitation may be monetised, thereby placing them on the same footing as other programmes whose economic returns are more easily quantified.

Pimoljinda, J., & Supongpan, S. (1999). Thailand: Coastal fisheries management in Thailand. Report Of The Regional Workshop On The Precautionary Approach To Fishery Management 25 28 February, 1997, Medan Indonesia Chennai India BOBP

Abstract: An overview is provided of coastal fisheries management in Thailand, examining the various problems to be addressed. The policies and strategies developed by the Department of Fisheries to ensure better marine fisheries resources management are listed. The strategies and plans for coastal fisheries resources management include: 1) bettering the living standards of small-scale fishermen; 2) awareness-building in marine resources conservation; 3) community-based resources management; 4) artificial reefs installation; 5) establishment of marine reserves; and, 6) enforcement of fisheries laws and regulations.

Porter, J. W., Lewis, S. K., & Porter, K. G. (1999). The effect of multiple stressors on the Florida Keys coral reef ecosystem: A landscape hypothesis and a physiological test. *In: Limnology and Oceanography*, 44(3, Supp. 2), 941-949.

Abstract: Changes in land use and water management practices in south Florida have altered the quality and quantity of freshwater flowing into Florida Bay. By the 1980s, reduced inflow and drought led to an extensive hypersaline phase in the bay. This phase had a drastic effect on benthic communities within the bay and possibly also on coral communities within the bay and the Florida Keys National Marine Sanctuary. Physical oceanographic measurements demonstrate the presence of warm, hypersaline, and turbid water on coral reefs offshore from the Florida Keys, especially near passes which conduct water from Florida Bay to the Atlantic Ocean. To examine the effect of Florida Bay water intrusions on coral reefs, we tested for significant effects of two stressors, elevated temperature and salinity, on coral production, respiration, and survival. Elevated temperatures produce significant reductions in photosynthesis, respiration, and net P : R ratios after 6 h of exposure, and elevated salinities produce similar results after 30 h. Exposure to both elevated temperature and salinity produces a highly significant ($P > 0.01$), but short-term, mitigative interactive effect. The combination of the two stressors was less stressful (for the response variables measured) than the sum of the stressors acting independently. After 36 h of exposure, however, the mitigating effect disappeared and corals exposed to the combined stresses did not survive. A three-dimensional response surface, which predicts P : R ratios as a function of varying salinity and temperature, is used to construct a testable hypothesis to explain recent declines in coral cover on some reefs within Florida Bay and the Florida Keys. We chose salinity and temperature to test a multiple stressor model because they are relatively easy to manipulate. However, any environmentally realistic model must include other potential stressors, such as turbidity, elevated nutrients, and environmental contaminants.

Ravindran, J., Raghukumar, C., & Raghukumar, S. (1999). Disease and stress-induced mortality of corals in Indian reefs and observations on bleaching of corals in the Andamans. *In: Curr Sci*, 76(2), 233-237.

Abstract: A study was carried out in the Lakshadweep and Andaman islands and the Gulf of Kutch to assess the health of corals in Indian reefs. Disease, predation and stress were the major factors of coral mortality. Death caused by diseases - the black band disease (BBD), the white band disease (WBD) - necrotic lesions, and bleaching was observed in Kavaratti and Kadamat

islands of Lakshadweep. The predatory starfish, *Acanthaster planci*, grazing on coral polyps was also noticed in these reefs. Large-scale silt deposition in the intertidal zone of Paga, Boria, Vadinar and Mangunda reefs in the Gulf of Kutch buried the coral colonies and appeared to be the main cause of coral mortality. A severe incidence of coral bleaching was observed during July 1998 in some reefs in the Andamans. While more than 85% of corals near Ross island and Marine Park exhibited partial bleaching, up to 10% were totally bleached.

Robichaud, D., Hunte, W., & Oxenford, H. A. (1999). Effects of increased mesh size on catch and fishing power of coral reef fish traps. *In: Fisheries Research*, 39(3), 275-294.

Abstract: Effects of increased mesh size on catch and fishing power of coral reef fish traps (Antillean design) were investigated in the Barbados west coast trap fishery by experimental fishing with commercial traps (maximum aperture 4.1 cm) and large mesh traps (maximum aperture 5.5 cm). Large mesh traps caught 53-63% less fish by number and 51% less by weight than the commercial traps. The fish in the commercial traps were significantly smaller by length, body depth and weight than those in large mesh traps, and a significantly higher percentage were immature. The effect of mesh size on fishing power of traps was investigated by comparing the catch rates of fish large enough to be retained by both trap types (i.e., body depths >5.5 cm; termed adjusted catch). The adjusted catch of large mesh traps was 24-35% lower by number and about 30% lower by weight than that of commercial traps, indicating that the fishing power of large mesh traps is substantially lower than that of commercial traps. The squeezability hypothesis and the visual image hypothesis were tested as explanations for the reduced fishing power of large mesh traps by comparing catches of commercial traps, large mesh traps and experimental traps (where experimental traps were designed to have a similar visual image as commercial traps but similar fish retention capacity as large mesh traps). The higher fishing power of commercial traps is generated primarily by a difference in catch rates in the 5.5-6.0 cm body depth size class; i.e., the size class which might feasibly squeeze through the 5.5 cm maximum aperture of large mesh traps. This strongly supports the squeezability hypothesis as an explanation for the higher fishing power of small mesh traps. We could find no definitive evidence indicating that reduced visual image of traps, whether created by structural differences (trap construction) or biotic differences (number of fish already in a trap), decreases ingress rates to traps and hence explains the lower fishing power of large mesh traps. These results will facilitate the incorporation of the reduced fishing power effect into yield per recruit models which can be used to predict catch rate changes in fisheries in which the minimum trap mesh size is increased.

Rodriguez-Martinez, R., & Ortiz, L. (1999). Coral reef education in schools of Quintana Roo, Mexico. *In: Ocean & Coastal Management*, 42(12), 1061-1068.

Abstract: Coral reefs are vital to the livelihood of coastal communities in Quintana Roo, Mexico and the preservation of these ecosystems relies on the establishment of protected areas. Education should be one of the most important management tools in coral reef preservation. Surveys were made among primary and secondary school students of Quintana Roo to determine the level of education regarding coral reefs and their importance. Students had little awareness about reefs. Coverage of coral reef issues is insufficient in school curricula and information media. Many students will leave school and become users of the reef with little understanding of it and of the consequences of exploitation of the reef. Creation of marine parks has not increased education and public awareness. There is an immediate need to establish appropriate and continuously available educational programs in order to preserve coral reefs. Education should encourage codes of behavior and community support to management issues.

Ronnback, P. (1999). The ecological basis for economic value of seafood production supported by mangrove ecosystems. *In: Ecological Economics*, 29(2), 235-252.

Abstract: The undervaluation of natural products and ecological services generated by mangrove ecosystems is a major driving force behind the conversion of this system into alternative uses. This trend of undervaluation is partly due to the difficulty involved in placing a monetary value on all relevant factors, but lack of ecological knowledge and a holistic approach among those performing the evaluation may be even more important determinants. This article identifies and synthesizes ecological and biophysical links of mangroves that sustain capture fisheries and aquaculture production. Fish, crustacean and mollusc species associated with mangroves are presented and the ecology of their direct use of this system is reviewed. Through a coastal seascape perspective, biophysical interactions among mangroves, seagrass beds and coral reefs are illustrated. The life-support functions of mangrove ecosystems also set the framework for sustainable aquaculture in these environments. Estimates of the annual market value of capture fisheries supported by mangroves ranges from US\$750 to 16750 per hectare, which illustrates the potential support value of mangroves. The value of mangroves in seafood production would further increase by additional research on subsistence fisheries, biophysical support to other ecosystems, and the mechanisms which sustain aquaculture production.

Ruitenbeek, J. et al. (1999). Optimisation of economic policies and investment projects using a fuzzy logic based cost-effectiveness model of coral reef quality: empirical results for Montego Bay, Jamaica. *In: Coral-Reefs*, 18(4), 381-392.

Abstract: For effective mitigation of human impacts, quantitative models are required that facilitate a comprehensive analysis of the effects of human activity on reefs. Fuzzy logic procedures generate a complex dose-response surface that models the relationships among coral abundance and various inputs (e.g., physical damage, sedimentation, nutrient influx), within the context of the abiotic marine environment. This is linked to a nonlinear economic structure incorporating technical interventions (e.g., pollution treatment) and policy interventions (e.g., taxation) in eight economic sectors. Optimization provides insights into the most cost-effective means for protecting coral reefs under different reef quality targets. The research demonstrates that: (1) it is feasible to use fuzzy logic to model complex interactions in coral reef ecosystems; and, (2) conventional economic procedures for modeling cost-effectiveness can result in sub-optimal policy choices when applied to complex systems such as coral reefs. In Montego Bay, Jamaica, up to a 20% increase in coral abundance may be achievable through using appropriate policy measures having a present value cost of US\$153 million over 25 years; a 10% increase is achievable at a cost of US\$12 million.

Russ, G., & Alcala, A. C. (1999). Management histories of Sumilon and Apo Marine Reserves, Philippines, and their influence on national marine resource policy. *In: Coral Reefs*, 18(4), 307-319.

Abstract: The histories of management of the Sumilon and Apo marine reserves in the Philippines provide a stark contrast. Both began with marine conservation and education programs at the community level, initiated by the Marine Laboratory of Silliman University in 1973 at Sumilon, and in 1976 at Apo. At both islands community support for the "no take" reserve concept evolved gradually, via perceived benefits of increased local fish yields and income from tourism. However, Sumilon reserve has been fished down twice (in 1984, 1992); and was still being fished in December 1998. Apo reserve has been protected from fishing successfully for 16 y (1982-1998). The management histories of these two marine reserves are the longest and most detailed available for coral reefs. Scientific data spanning 1976-1993 for Sumilon and 1980-1993 for Apo have provided some of the best available evidence of the utility of such reserves as management tools in coral reef fisheries. At Sumilon, collapse of reserve protection in 1984, after 9.5 y of restrictions on fishing, led to significant declines in

reef fisheries yields in areas adjacent to the reserve. At Apo, continuous protection from 1982 to 1993 has led to consistent build up of fish in the reserve and some evidence that local fish yields have increased. The unique time series of scientific data obtained from Sumilon and Apo islands are the result of their distinct management histories. The greater success of management at Apo was due to community support for the reserve concept being actively maintained: for the past 16 y. Socio-political factors caused the level of community support for the Sumilon reserve to wax and wane over this period. Both case histories have had a profound effect on marine resource management in the Philippines. As marine reserve models they had substantial influence on the design of the National Integrated Protected Area System (NIPAS). Policy now encourages co-management between the National government and local communities, with a strong emphasis on decentralization of decision making and recognition of local territorial use rights in fisheries.

Scarlett, A. et al. (1999). Occurrence of the Antifouling Herbicide, Irgarol 1051, within Coastal-water Seagrasses from Queensland, Australia. *In: Marine Pollution Bulletin*, 38(8), 687-691.

Abstract: The s-triazine herbicide Irgarol 1051 is now widely distributed throughout European coastal waters. In Australia, the compound is not registered for use as a biocide in antifouling paints. To investigate contamination, seagrasses were sampled from the east coast of Queensland and within the Great Barrier Reef Marine Park. A green alga was also sampled from the Outer Barrier Reef. Tissues were analysed for the presence of Irgarol 1051 using solvent extraction followed by quantification with GC-MS and confirmation by GC-MS-MS. Irgarol 1051 was detected at nine of the ten locations sampled. Concentrations of up to 118 ng g⁻¹ wet weight leaf tissue were recorded in samples from the Gold Coast (near Brisbane) which is the highest plant tissue concentration yet reported. Antifouling paint purchased within Australia was analysed by GC-MS (full scan) and found to contain Irgarol 1051. The concentrations of Irgarol 1051 reported within the Australian coastal environment are potentially toxic and the possible consequences for long-lived herbivores (such as the dugong) and for endosymbiotic algae of corals, are discussed.

Scovazzi, T. (1999). Marine specially protected areas : the general aspects and the Mediterranean regional system. (pp. xi, 281 : maps ; 31 cm, Includes bibliographical references ([279]-281)). The Hague ; Boston [Mass.]: Kluwer Law International.

Abstract: In the last few decades the concept of marine protected areas has emerged as a viable tool for the protection and conservation of marine and coastal species and ecosystems. Marine protected areas designated under national law have not only increased in number, but the scope of the concept has been broadened as well. Moreover, there are now quite a few international instruments that promote the establishment of such areas. This book examines some of the most recent developments in this field, viewed from both a national and international legal perspective, with particular emphasis on the Mediterranean Sea. The first part deals with marine specially protected areas under national law and international law in general. The second part contains a more detailed overview and analysis of the legal regime existing in the Mediterranean Sea. The remainder consists of the texts of the amended Barcelona Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean, all related Protocols and some other relevant regional and subregional instruments. The book also contains a selection of maps displaying the boundaries of marine protected areas established in Italy, and one map of the Great Barrier Reef Marine Park

Swearer, S. E. et al. (1999). Larval retention and recruitment in an island population of a coral-reef fish. *In: Nature*, 402(6763), 799-802.

Abstract: For close to a century, recruitment of larvae to a local population has been widely

accepted as a primary determinant of marine population dynamics. However, progress in elucidating the causes of recruitment variability has been greatly impeded by our ignorance of the sources of recruits. Although it is often assumed that recruitment is independent of local reproduction, there is increasing circumstantial evidence that physical and behavioural mechanisms could facilitate larval retention near source populations. To develop a direct method for reconstructing the dispersal history of recruiting larvae, we put forward the hypothesis that differences in nutrient and trace-element concentrations between coastal and open oceans could result in quantifiable differences in growth rate and elemental composition between larvae developing in coastal waters (locally retained) and larvae developing in open ocean waters (produced in distant locations). Using this method, we show that recruitment to an island population of a widely distributed coral-reef fish may often result from local retention on leeward reefs. This result has implications for fisheries management and marine reserve design, because rates of dispersal between marine populations--and thus recruitment to exploited populations--could be much lower than currently assumed

Tuyen, H. T. (1999). Checklist of marine molluscs of Con Dao National Park, Vietnam. Proceedings of the ninth Workshop of the Tropical Marine Mollusc Programme TMMP (p. 403-406).

Abstract: The Con Dao islands (Vietnam) have the highest diversity of marine molluscs. A total of 153 species were recorded at these islands. The highest diversity was found in coral reef areas. *Tridacna crocea* was the most abundant species. The population of *Tridacna squamosa* had decreased significantly during the last decade because of over-catching. In general, human activities have damaged the fringing reefs indicating a need for better conservation and management actions.

Wolff, N. et al. (1999). Management implications of fish trap effectiveness in adjacent coral reef and gorgonian habitats. *In: Environmental Biology of Fishes*, 55(1-2), 81-90.

Zann, L. (1999). A new (old) approach to inshore resources management in Samoa. *In: Ocean & Coastal Management*, 42(6-7), 569-590.

Abstract: Increasing populations and development in many of the small Pacific Island nations have placed heavy pressures on coastal environments and on inshore fisheries. The population of Samoa, in the Southwestern Pacific, has increased 5-6-fold in the past 150 years. Wetlands, lagoons and coral reefs have been seriously degraded because of inappropriate land-use and fisheries practices and recent catastrophic cyclones, and many fish and invertebrate stocks have declined in the past 10-15 years. A research program was established in 1990 to determine the status of the coastal and inshore environments, to monitor inshore subsistence and commercial fisheries, to determine the status of stocks, and to identify potential management actions. An inventory of inshore resources was produced using aerial photography and ground and underwater surveys. Fisheries catch and effort were established through a national census, questionnaire surveys in households and schools, and creel and market surveys. A major aid program was commenced in 1995 by the Australian government (AusAID) to assist Samoa to establish an effective inshore fisheries and environment management program. A key strategy was the devolution of powers in inshore fisheries management back from the national government to the villages and local fishers. A culturally appropriate co-management model was developed and tested, and has now been adopted by many villages. An inshore fisheries extension capability was developed within Samoa's Fisheries Division to assist villagers to undertake their own environmental and fisheries surveys; identify major factors affecting fisheries; identify ways of reducing these factors; establish an agreed (between village council and national government) plan of management and regulations; and establish their own fisheries management bodies. By the end of 1997 the Inshore Fisheries Extension Service had

been established and trained; 26 villages had entered the co-management program and established their own plans of management; and 20 fisheries reserves had been established. The techniques for inshore environmental and fisheries assessment and management developed for Samoa are applicable, with appropriate modification, to subsistence fishing communities elsewhere in the South Pacific.

Zeller, D. C. (1999). Ultrasonic telemetry: its application to coral reef fisheries research. *In: Fishery Bulletin*, 97(4), 1058-1065.

Abstract: The importance to fisheries research of understanding movement patterns of fishes is increasingly being recognized (Hilborn and Walters, 1992). Traditionally, mark-recapture studies with external tags constituted the major method of examining movements in fishes (Shepherd, 1988). However, external tagging techniques are known to have several limitations (reviewed by Kearney, 1989) that often cannot be addressed adequately. In particular, data obtained through conventional tagging studies are usually limited to knowledge of a single point of capture, point of recapture, and the straight line distance and time interval between these two events. Such data can be misleading because the exact distance traveled and the patterns of movement are unknown. However, such patterns are of major importance to current research efforts in tropical reef fisheries, including investigations of spawning aggregation events (Samoilys and Squire, 1994; Zeller, 1998), and to the assessment of movements in relation to marine reserves (e.g. Russ and Alcala, 1996).

Zobrist, E. (1999). Coral reef restoration and protection from vessel groundings. *In: Gulf Research Reports*, 10, 85 .

Abstract: Major vessel groundings in the Florida Keys National Marine Sanctuary such as the MV Alec Owen Maitland (Carysfort Reef), the MV Elpis (The Elbow reef) in 1989 and the RV Iselin in 1994 (Looe Key) have demonstrated the need for quick response when restoring injured coral reef habitat. The Maitland and Elpis sites were not restored until 1995. During the intervening period, waves and currents enlarged the injury and required major physical reconstruction of the reefs. While highly successful, the value of quick response was learned. While under litigation with the Iselin Potential Responsible Party (PRP), NOAA directed an operation which removed several hundred tons of loose coral rubble which threatened adjacent undisturbed coral habitat within a year of the grounding. Recently, NOAA had the opportunity to take actions to restore injured coral reef habitat quickly. The 600-foot Contship Houston ran aground near Key West in February, 1997. Coral heads were toppled and scattered on the sea floor generating a large volume of loose rubble. NOAA and the State of Florida were able to work with a cooperative PRP and completed an emergency restoration phase in Spring, 1997 which reattached live coral heads and fragments. Five rubble berms were stabilize with a non-toxic marine epoxy

Adams, S. et al. (2000). Geographic variation in the sex ratio, sex specific size, and age structure of *Plectropomus leopardus* (Serranidae) between reefs open and closed to fishing on the Great Barrier Reef. *In: Canadian Journal of Fisheries and Aquatic Sciences*, 57(7), 1448-1458.

Carbone, F., & Accordi, G. (2000). The Indian Ocean Coast of Somalia. *In: Marine Pollution Bulletin*, 41(1-6), 141-159.

Abstract: Somalia has the longest national coastline (3025 km) in Africa with an estimated shelf area (depth 0-200 m) of 32 500 km². The country is divided into the northern coastal plain of Guban, which has a semi-arid terrain; the northern highlands with rugged mountain ranges containing the country's highest peak (2407 m); and the Ogaden region which descends to the south from the highlands and which consists of shallow plateau valleys, wadis

and broken mountains. The latter region continues to the Mudug plain in central Somalia. From Ras Caseyr to the Kenya border, the coast runs north-east to south-west, coinciding with the displacement caused by the Mesozoic marginal subsidence. This general structure is complicated by sedimentary troughs crossing the Horn of Africa, and by large sedimentary basins, cutting the coastline and extending inland into Southern Somalia and Northern Kenya (Juba-Lamu embayment, Mogadishu basin). Offshore, the western Somali Basin extends from Socotra to the Comores. The open shelf environments developed along the Somali coast are a consequence of an extensive marine transgression, connected to coastal subsidence or inland uplift. The rocks along the southern coastal belt are Pliocene-Pleistocene, and are characterized by a sequence of both marine and continental deposits of skeletal sands, coral build-ups, eolian sands and paleosols. As well as eolian and biogenic sedimentary processes, sea-level fluctuations, Holocene climatic changes and neotectonic movements have combined to produce the modern coastline. A notable feature is an ancient dune ridge complex, known as the Merka red dune, which rims the coast extending beyond the Kenyan border and which separates the narrow coastal belt from the Uebi Shebeli alluvial plain. Two features of note are the Bajuni Archipelago, which consists of islands, islets and skerries, forming a barrier island separated from the coast by a narrow marine sound, and a braided, channelized coastal area, which originated from the drowning of a paleofluvial net. The southern Somali coast, with that of Kenya and Tanzania, forms part of the Somali Current Large Marine Ecosystem, encompassing 700 000 km², and extending 800 km between Dar es Salaam and Ras Hafun. Abundant biomass develops here due to upwelling. The shelf area has a wide variety of coral reefs, mangroves, seagrass meadows, beaches and estuaries. In shallow water areas the abraded flats are colonized by scattered coral communities with variable cover. A true fringing reef is achieved in places only in the Bajuni archipelago. All along the southern Somali coastal shelf there are spreading meadows of *Thalassodendron* seagrass, and benthic communities typical of mobile sandy substrates are limited to beach ridges and shoals developed along the coastline. Around the Bajuni barrier island and the channelized area there is more diversity. Mangroves grow on the tidal belts of the channels, and there are expanses of salt flats. Large-scale alteration produced by man on the Somali coast is relatively recent, but has accelerated in the last few decades, especially around major cities. This alteration affects especially backshore areas where the Pleistocene coral reefs are quarried. At present, the continental shelf is not adequately monitored or protected, so coastal habitats are being degraded, living marine resources are overexploited, and pollution levels are increasing, all of which affect natural resources and biodiversity. Somalia is one of the world's poorest and least developed countries, with few resources and devastated by civil war, but since 1993 it has been part of the Common Market for Eastern and Southern Africa (COMESA). This will affect fisheries and aquaculture in terms of the investment, production, trade and fish consumption of the member states. There are currently no marine protected areas and no legislation concerning their establishment and management, although the World Conservation Monitoring Centre (WCMC) Protected Areas Database lists Busc Busc Game Reserve as an MPA. In 1992, The WCMC also listed the following coastal sites as proposed protected areas: Zeila (important sea bird colonies on offshore islets), Jowhar-Warshek, Awdhegle-Gandershe. The area from Kisimayo to Ras Chiambone is probably of highest priority, as it is important for coral reefs, marine turtles, and mangrove resources, although it is still poorly known.

Chapman, M. R., & Kramer, D. L. (2000). Movements of fishes within and among fringing coral reefs in barbados. *In: Environmental Biology of Fishes*, 57(1), 11-24.

Abstract: Movement of coral reef fishes across marine reserve boundaries subsequent to their initial settlement from the plankton will affect the ability of no-take reserves to conserve stocks and to benefit adjacent fisheries. However, the mobility of most exploited reef species is poorly known. We tagged 1443 individuals of 35 reef fish species captured in Antillean fish traps in

the Barbados Marine Reserve and adjacent non-reserve over a two-month period. Trapping and visual surveys were used to monitor the movements of these fish during the trapping period and the subsequent two months. Estimates of distances moved were corrected for the spatial distribution of sampling effort and for the number of recaptures of individual fish. Recapture rates for individual species ranged from 0-100% (median=38%). Species mobility estimated by recapture and resighting were highly correlated. Most species were strongly site attached, with the majority of recaptures and resightings occurring at the site of tagging. However, only one of 59 tagged jacks (*Caranx latus*, *C. ruber*) was ever resighted, suggesting emigration from the study area. All species were occasionally recorded away from the sites where they had been tagged (20-500 m), and several species, including surgeonfish, *Acanthurus bahianus*, *A. coeruleus*, filefish, *Cantherhines pullus*, butterflyfish, *Chaetodon striatus*, angelfish *Holocanthus tricolor* and parrotfish, *Sparisoma viride*, ranged widely within reefs. In contrast, few movements were observed between reefs separated by more than 20 m of sand and rubble, and no emigration from the Reserve was recorded. Most reef fishes vulnerable to Antillean traps appear sufficiently site-attached to benefit from reserves. However, many species move over a wide enough area to take them out of small reserves on continuous reef. Use of natural home range boundaries could minimize exposure of fishes in reserves to mortality from adjacent fisheries.

Charbonnel, E. et al. (2000). Effects of artificial reef design on associated fish assemblages in the Cote Bleue marine park (Mediterranean Sea, France). *In: A. Jensen, K. J. Collins, & A. P. M. Lockwood* *Artificial Reefs in European Seas* (pp. 365-377). Dordrecht/Netherlands: Kluwer Academic Publ.

Coleman, F. C. et al. (2000). Long-lived Reef Fishes: The Grouper-Snapper Complex. *In: Fisheries*, 25(3), 14-21.

Abstract: The American Fisheries Society (AFS) recognizes that reef fishes must be conservatively managed to avoid rapid overfishing and stock collapse because reef fish communities comprise slow-growing, late maturing fishes such as groupers and snappers. Therefore, the Society recommends that for such species, fishing mortality should be maintained at or near natural mortality. In addition, AFS cautions that an imbalance in the normal sex ratio may occur rapidly during harvesting of many reef fishes, thus leading to stock collapse because many reef fish species mature first as female but then become male later in life; most of the older, larger individuals in the population are male. Thus, conventional management modeling tools such as Spawner Biomass Per Recruit may lead to overly optimistic conclusions and should be used with caution. Many reef fish species form predictable, localized, seasonal spawning aggregations that are very vulnerable to overharvesting. Such aggregations should be protected. The AFS supports the establishment of networks of large Marine Protected Areas and the development of individual transferable quotas, along with more conventional management measures to help maintain and restore reef fish populations and their habitats. The AFS encourages its members to become involved by providing technical information needed for protection of long-lived reef fishes to international, federal, state, and provincial policy makers so decisions are made on a scientific, rather than emotional or political, basis.

Edinger, E. N., & Risk, M. J. (2000). Reef classification by coral morphology predicts coral reef conservation value. *In: Biological Conservation*, 92(1), 1-13.

Abstract: Coral reefs can be classified using triangular diagrams based on coral morphology; these taxonomy-independent classes predict several aspects of conservation value for coral reefs. Conservation classes (CC's) of 1, 2, 3 or 4 were assigned to reef sites dominated by massive and submassive corals (CC 1), foliose or branching non-Acropora corals (CC 2),

Acropora corals (CC 3), or approximately equal mixes of these three end-members (CC 4). When applied to 15 Indonesian coral reefs, aggregate conservation class, the average of the conservation class of all sites on that reef, was a reliable predictor of coral species richness, habitat complexity, and rare coral species occurrence. Aggregate conservation class predicted these aspects of conservation value more reliably than the reef condition index currently used in southeast Asia, live coral cover, or coral mortality. Definitions of reef status based solely on percentage of live coral cover should be supplemented with other indices such as conservation class that more accurately predict biodiversity value and fisheries potential. Coral morphology triangles and conservation class can be used in zoning marine protected areas and other coral reef biodiversity conservation efforts

Enmar, R. et al. (2000). Diagenesis in live corals from the Gulf of Aqaba. I. The effect on paleo-oceanography tracers. *In: Geochimica Et Cosmochimica Acta*, 64(18), 3123-3132.

Abstract: The effect of early diagenesis on trace element abundance in coral skeleton was studied in live coral heads (Porites) from the Nature Reserve Reef (NRR), Elat, Gulf of Aqaba, northern Red Sea. Petrography of the corals shows diagenetic features of dissolution, recrystallization, and secondary aragonite precipitation (pore filling), which are most extensive in the oldest part of the coral. Coral porewaters were extracted with a special setup and were analyzed for chemical composition. The total alkalinity and Sr deficit in pore water as compared to reef water is consistent with both precipitation of secondary aragonite and recrystallization of primary skeleton. The present rate constant of pore filling by secondary aragonite was estimated by a water replacement experiment to be 0.0015 y⁻¹, which equals to pore filling rate of 1.5 +/- 0.3 kg aragonite per year. The corals show clear seasonal fluctuations in SrCa ratios that are interpreted as reflecting changes in sea surface temperature (SST). Yet, the secondary aragonite is characterized by a significantly higher SrCa ratio than the average ratio in primary aragonite. Thus, measuring a mixed sample of pristine and secondary aragonite may produce erroneous (about 2[deg]C lower) SST estimates by the SrCa thermometers. It appears that the SrCa ratio, a major proxy for paleo-environmental marine studies, is sensitive to subtle pore-filling and replacement of the original coral matrix by secondary aragonite in the marine environment.

Esslemont, G. (2000). Heavy metals in seawater, marine sediments and corals from the Townsville section, Great Barrier Reef Marine Park, Queensland. *In: Marine Chemistry*, 71(3-4), 215-231.

Furst, E. et al. (2000). The costs and benefits of reef conservation in the Bonaire Marine Park, in the Netherlands Antilles. Environmental-valuation: -a-worldwide-compendium-of-case-studies (pp. 162-171, 8 ref.). [s. l.]: [s. n.].

Abstract: The paper reviews a study by Fallon Scura and van't Hof (1993) which examined the joint ecological and economic objectives of coral reef conservation in the Bonaire Marine Park, Netherlands Antilles. Using quantitative and qualitative reef and diver surveys, the paper concludes that reef degradation has taken place a result of increasing recreational scuba diving. A threshold level is identified of 4000-6000 dives per site per year, after which reef cover and diversity declines with increasing visitation

Gischler, E. et al. (2000). Last interglacial reef growth beneath Belize barrier and isolated platform reefs. *In: Geology*, 28(5), 387-390.

Abstract: We report the first radiometric dates (thermal-ionization mass spectrometry) from late Pleistocene reef deposits from offshore Belize, the location of the largest modern reef complex in the Atlantic Ocean. The results presented here can be used to explain significant differences in bathymetry, sedimentary facies, and reef development of this major reef area, and

the results are significant because they contribute to the knowledge of the regional geology of the eastern Yucatan. The previously held concept of a neotectonically stable eastern Yucatan is challenged. The dates indicate that Pleistocene reefs and shallow-water Limestones, which form the basement of modern reefs in the area, accumulated ca. 125-130 ka. Significant differences in elevation of the samples relative to present sea level (>10 m) have several possible causes. Differential subsidence along a series of continental margin fault blocks in combination with variation in karstification are probably the prime causes. Differential subsidence is presumably related to initial extension and later left-lateral movements along the adjacent active boundary between the North American and Caribbean plates. Increasing dissolution toward the south during Pleistocene sea-level lowstands is probably a consequence of higher precipitation rates in mountainous southern Belize.

Gladstone, W. (2000). The ecological and social basis for management of a Red Sea marine-protected area. *In: Ocean & Coastal Management*, 43(12), 1015-1032.

Abstract: The Farasan Islands in the southern Red Sea of Saudi Arabia have nationally and internationally significant conservation values, and are important for a range of marine-based resource uses. In preparation for the establishment of a marine protected area around the Farasan Islands and its management, surveys were undertaken to assess the state of the coastal and marine resources, and the issues associated with human activities. Stakeholders were interviewed about issues and their attitudes towards the proposed protected area, and constraints to planning and management were identified. Marine habitats included seagrass beds, mangroves, and extensive areas of fringing reef dominated by a diverse coral community or a mixture of coral and macroalgae. Although used for a diverse range of human activities (fishing, shipping, transport, military purposes, recreation, waste dumping, sand extraction) impacts were minimal and localized. The most immediate threat to the marine resources was over-exploitation by fisheries. The types of management activities appropriate to the MPA, and the scale of management, were constrained by a number of unique and important factors: declines in national financial support for conservation efforts, a lack of trained personnel, difficulties in attracting staff to this remote location, loss of community support, the absence of a tourist base from which economic instruments could be developed, and the lack of local non-governmental organizations. Management recommended for the Farasan Islands Marine-Protected Area included zoning, community participation in management, public awareness, and training as a first step, followed by site-specific management actions, research and monitoring, and infrastructure development.

Gourbesville, P., & Thomassin, B. A. (2000). Coastal environment assessment procedure for sustainable wastewater management in tropical islands: the Mayotte example. *In: Ocean & Coastal Management*, 43(12), 997-1014.

Abstract: The recent evolution of the coastal environment is characterized by an increase of human potential impacts: coastal zone is located at the cross-road of sectoral issues which give rise to a number of often competing uses. Today, the main challenges in the coastal environment management are not derived from "technical problems" but correspond to the global coastal management and to the means to harmonize the different uses. This new approach has generated the need to apply systemic concepts which are able to describe and analyze large and complex systems. In the coastal zone -- and especially in sensitive environments such as tropical island surrounded by coral reefs, lagoons or boat channels -- one of the major challenges is to conciliate the waste waters and pipe outfalls management and the ecological preservation. The paper presents the results which have been obtained with a global approach for the definition of a sustainable wastewater management strategy in highly sensitive coastal areas located in Mayotte, (Comoros archip, Indian Ocean). This example allows to explain and identify the necessary tools and essential procedures as hydrodynamic modelling or

public participation. From this application, a procedure for a coastal environment assessment procedure is formulated and proposed.

Haynes, D., & Johnson, J. E. (2000). Organochlorine, Heavy Metal and Polyaromatic Hydrocarbon Pollutant Concentrations in the Great Barrier Reef (Australia) Environment: a Review. *In: Marine Pollution Bulletin*, 41(7-12), 267-278.

Abstract: Past monitoring of heavy metals, organochlorine compounds and polyaromatic hydrocarbons (PAHs) has found that pollutant concentrations are generally low within the Great Barrier Reef Marine Park and World Heritage Area and are indicative of a relatively unpolluted environment. The exceptions are sites that are adjacent to human activity such as ports and harbours, urban centres and areas adjacent to intensive agricultural activity. These sites have elevated concentrations of a range of pollutants. Concentrations of dioxins have also been found to be elevated in marine park sediments. Elevated pollutant concentrations are generally the consequence of effluent discharge, urban stormwater, and agricultural and industrial runoff. However, a majority of Great Barrier Reef pollutant data are now dated, and contemporary information is required concerning the distribution and impact of pollutants in the Queensland marine environment. The utility of specialized monitoring tools such as biomarkers for tropical marine environments urgently needs to be examined. With this information, appropriate risk assessment and monitoring can be implemented and effective management strategies developed to protect tropical marine ecosystems including the Great Barrier Reef.

Haynes, D., & Michalek-Wagner, K. (2000). Water Quality in the Great Barrier Reef World Heritage Area: Past Perspectives, Current Issues and New Research Directions. *In: Marine Pollution Bulletin*, 41(7-12), 428-434.

Abstract: Elevated sediment and nutrient concentrations have long been regarded as the pre-eminent water quality threats to the Great Barrier Reef, with the potential risk posed by other pollutants such as heavy metals, persistent chlorohydrocarbons, PCBs and petroleum related compounds considered to be of lesser consequence. However, the management focus on these latter types of pollutants has recently shifted to acknowledge the potential impact posed by diuron, dioxins, dieldrin, and mercury and cadmium concentrations detected in sediments and biota along the Great Barrier Reef and southern Queensland coastline. In general, these threats originate from areas dominated by intensive cropping agriculture and are exacerbated by high rainfall and erosion rates in the wet tropics region of the Queensland coast. Maintenance of long-term monitoring programmes, which utilize innovative data acquisition techniques will enable assessment of change in environmentally relevant pollutant concentrations over time. However, improved land management practices, which include an immediate minimization of vegetation clearance and responsible use of pesticides and fertilizers in Queensland are essential if water quality in the Great Barrier Reef World Heritage Area is to be maintained and protected

Haynes, D., Muller, J., & Carter, S. (2000). Pesticide and herbicide residues in sediments and seagrasses from the Great Barrier Reef world heritage area and Queensland coast. *In: Marine Pollution Bulletin*, 41(7-12), 279-287.

Hudson, J. H. (2000). First aid for massive corals infected with black band disease, *Phormidium coral lyticum*: an underwater aspirator and post-treatment sealant to curtail reinfection. *Diving for Science in the 21st Century* (pp. 10-11). Nahant MA USA: American Academy of Underwater Sciences.

Johnson, A. K. L., & Ebert, S. P. (2000). Quantifying Inputs of Pesticides to the Great Barrier

Reef Marine Park - A Case Study in the Herbert River Catchment of North-East Queensland. *In: Marine Pollution Bulletin*, 41(7-12), 302-309.

Abstract: The Great Barrier Reef Marine Park (GBRMP) is an ecosystem whose ecological features are recognized internationally. There is a need to evaluate the impacts of historical and contemporary changes in land use on the GBRMP. This paper quantifies pesticide inputs in the Herbert River catchment of North Queensland in the context of changes in land use over the last 100 years. We show that three major phases of rural land use and land cover change have occurred, with large areas of native vegetation converted to agricultural production. The increase in agricultural land has seen a corresponding increase in the area receiving pesticides. We present data showing application histories for organochlorine, organophosphate, phenoxy, triazine, urea, mercurial and azole group pesticides. While the fate of these pesticides in aquatic and marine systems is largely unknown, these trends pose a significant challenge for agricultural industries in complying with the principles of ecologically sustainable development (ESD)

Kalangi, P. N. I., Heron, M. L., & Prytz, A. (2000). Mesoscale structure in coastal ocean waters inside the Great Barrier Reef. The Fifth Pacific Ocean Remote Sensing Conference (PORSEC), 5-8 December 2000. Proceedings Dona Paula, Goa (India): NIO

Koenig, C. C. et al. (2000). Protection of fish spawning habitat for the conservation of warm-temperate reef-fish fisheries of shelf-edge reefs of Florida. *In: Bulletin of Marine Science*, 66(3), 593-616.

Lam, K. (2000). Early growth of a pioneer recruited coral *Oulastrea crispata* (Scleractinia, Faviidae) on PFA-concrete blocks in a marine park in Hong Kong, China. *In: Marine Ecology Progress Series*, 205, 113-121.

Letourneur, Y., Kulbicki, M., & Labrosse, P. (2000). Fish stock assessment of the northern New Caledonian lagoons: 1 - Structure and stocks of coral reef fish communities. *In: Aquatic Living Resources*, 13(2), 65-76.

Abstract: Lagoon fish in New Caledonia are mainly caught by artisanal fisheries and subsistence fishing. Reef fish are the major component of this catch. The present study aimed at estimating these reef fish standing stocks and at finding the main factors influencing the distribution of these fish. Sampling of 904 stations was stratified according to three zones (north, east and west) and three reef types (barrier, intermediate and fringing). Fish communities exhibited strong heterogeneity in their distribution, showing higher biomass (maximum of 447 g.m⁻²) and total standing stock (43 000 tonnes) in the north zone than in the east and west zones. Similarly, observed patterns were dependent on reef types: higher biomass and total standing stock being observed on barrier reefs than on intermediate or fringing reefs. The total standing stocks, which were about 65 000 t, were mainly composed of herbivorous fish families such as the Acanthuridae and Scaridae. The differences in the patterns of distribution of species, individuals and standing stocks between reef types may be explained by variations in terrestrial influences and reef morphology, whereas differences among zones were most likely due to accessibility of fishing areas and fishing pressure. The latter is almost non-existent in the north zone, which can thus be considered to be almost unexploited commercially. This most likely explains the high proportion, 77 %, of long-lived species in the biomass of this zone. The results might have implications in management of reefs elsewhere in the South Pacific, for which similar data are only scarcely available. (C) 2000 Ifremer/Cnrs/Inra/Ird/Cemagref/Editions scientifiques et médicales Elsevier SAS.

Martell, S. J. D., Walters, C., & Wallace, S. S. (2000). The use of marine protected areas for

conservation of lingcod (*Ophiodon elongatus*). In: *Bulletin of Marine Science*, 66(3), 729-743.
Abstract: Recreational and commercial overharvesting has led to a 90% reduction in the Strait of Georgia lingcod (*Ophiodon elongatus*) population. Two small marine protected areas (MPAs), accounting for less than 1% of the area, in Howe Sound attract spawning lingcod. Densities of large spawning animals are higher in both of the MPAs than on surrounding reefs that are open to fishing and are significantly higher in the MPA with artificial habitat. An in-situ tagging study indicates animals leave the shallow study sites, at least seasonally. Such small-scale movements must be taken into consideration when the size and location of marine reserves are selected. Fishes with high exchange rates, large home ranges, or seasonal migrations for spawning (such as lingcod) require large marine reserves. We have developed a general spatial model for estimating effects of age-dependent seasonal migration and dispersal on harvest mortality rates, including the effects of fishing effort movement in response to local abundance changes. Simulations suggest the MPAs are too small to provide year-round protection of lingcod from anglers.

McClanahan, T. (2000). Recovery of a coral reef keystone predator, *Balistapus undulatus*, in East African marine parks. In: *Biological Conservation*, 94(2), 191-198.

Abstract: The red-lined triggerfish (*Balistapus undulatus*) is a major predator of sea urchins and the loss of this species, along with other less influential sea urchin predators, has resulted in the proliferation of sea urchin populations on the coral reefs of East Africa. I studied the recovery of *B. undulatus* and the associated demise in their sea urchin prey in five Marine Protected Areas (MPAs) which differed in their age, such that the data collected spanned a 30-year range in the age of protection. Results suggest that predation on sea urchins and *B. undulatus* dominance recovered on a time scale of 5-10 years, but sea urchin populations were not reduced below 1000 kg/ha for more than 10 years, and *B. undulatus* populations may require > 30 years to recover. In a new MPA, *B. undulatus* competitively excluded a subordinate wrasse predator, *Cheilinus trilobatus*, at baited sites in *Balistoides viridescens*, was the competitive dominant to *B. undulatus* in direct interference interactions, but *B. viridescens* was not found in 2.7 ha of sampling and rarely seen eating sea urchins at baited sites. An even longer estimate of top predator recovery would occur if *B. viridescens* is the dominant sea urchin predator. This study suggests that short and temporary closures of <10 years will not fully restore reef ecology, and that fully protected and permanent MPAs are a necessary part of coral reef conservation programs.

McClanahan, T., & Mangi, S. (2000). Spillover of exploitable fishes from a marine park and its effect on the adjacent fishery. In: *Ecological Applications*, 10(6), 1792-1805.

Abstract: The role of a marine protected area in enhancing local fisheries, through the emigration or spillover of exploitable fishes, was studied in a coral reef park (Mombasa Marine Park, Kenya) and fishery over a seven-year period during a time when the park's border changed and pull seines were eliminated. We measured catches before and after the park's establishment and during the management changes and compared these catches with the unmanaged side of the park. Additionally, we placed baited traps on both sides of the park over a full tidal cycle which allowed us to measure the spillover from the park compared to the deeper, rougher, and less fished reef edge. The total wet mass of catches per trap, the mean size of the trapped fish, and the number of fish species caught per trap declined as a function of the distance away from the park edge on both the southern and northern sides. However, this relationship was truncated on the unmanaged side which also had smaller catches, smaller fish, and fewer species than the managed side. Trap fishers on the managed side adapted to the spillover by increasing the traps per fisher, which had the effect of reducing the catch per trap. Tides and reef morphology also appeared to interact and influenced catches, but we found no relationships between catches and benthic substratum cover, which was usually dominated by

seagrass and sand. Spillover from the deeper reef edge was evident for the managed but not the unmanaged side of the park, but may be due to differences in reef morphology interacting with tidal patterns rather than management. On the managed side, the park significantly increased the catch per fisher and catch per area by >50%, but even after the park's size was reduced, the total catch was reduced by similar to 30%. The reduced park was still similar to 50% of the total area. Consequently, the catch per area increase was insufficient to compensate for the lost area over this early period of the park's establishment. Spillover was greatest for the dominant fisheries species. These were moderately vagile species in the rabbitfish (Siganidae; herbivores), emperors (Lethrinidae; carnivores), and surgeonfish (Acanthuridae; herbivores) families, which had instantaneous emigration rates from the park to the reserve fishing ground of similar to 0.5. Our field survey, combined with previous modeling studies, based on adult emigration rates from marine reserves, suggests that tropical fisheries dominated by rabbitfish, emperors, and surgeonfish should be enhanced by closed areas of similar to 10-15% of the total area. The optimal protected area may increase if larval export is important, but the predicted response should not be measurable for >10 years, beyond the length of our study, as breeding stock develop inside protected areas.

Peterson, C. H. et al. (2000). Synthesis of linkages between benthic and fish communities as a key to protecting essential fish habitat. *In: Bulletin-of-Marine-Science*, 66(3), 759-774.

Abstract: Several essential fish habitats lack the protections necessary to prevent degradation because of failure to integrate the scientific disciplines required to understand the causes of the degradation and failure to integrate the fragmented state and federal management authorities that each hold only a piece of the solution. Improved protection of essential habitat for demersal fishes requires much better synthesis of benthic ecology, fisheries oceanography, and traditional fisheries biology. Three examples of degraded habitat for demersal fishes and shellfishes are high-energy intertidal beaches, subtidal oyster reefs, and estuarine soft bottoms. In each case, both scientific understanding of and management response to the problem require a holistic approach. Intertidal beach habitat for surf fishes could be protected by constraints on the character of sediments used in beach nourishment and restriction of nourishment activity to biologically inactive seasons. Subtidal oyster-reef habitat for numerous crabs, shrimps, and finfishes could be protected and restored by reduction of nitrogen loading to the estuary and elimination of dredge damage to reefs. Estuarine soft-bottom habitat for demersal fin- and shellfishes could also be protected by reduction of the nutrient loading of the estuary, which could prevent associated problems of nuisance blooms and low dissolved oxygen. Although a broad general understanding of the nature of habitat degradation exists for each of these three examples, the interdisciplinary science needed to sort out the separate and interactive contributions of all major contributing factors is incomplete. Adopting the holistic approach embodied in the principles of ecosystem management sets a course for addressing both the scientific inadequacies and the management inaction.

Pezzey, J. C. V., Roberts, C., & Urdal, B. T. (2000). A simple bioeconomic model of a marine reserve. *In: Ecological Economics*, 33(1), 77-91.

Abstract: We model the effect of a no-take reserve in a marine fishery management area, such as on a coral reef. Implicitly, eggs and larvae are mobile but adults are not; and there is open access fishing outside the reserve. A reserve is found to increase equilibrium catch if the prior ratio of stock to carrying capacity is less than a half, and the catch-maximising reserve proportion rises towards a half as this ratio falls towards zero. After initial adjustment, long-run stability is improved by a reserve. We estimate that coral reef reserves could increase world wide annual catches by about a billion dollars.

Pitcher, T. J. et al. (2000). Marine reserves and the restoration of fisheries and marine

ecosystems in the South China Sea. *In: Bulletin of Marine Science*, 66(3), 543-566.

Abstract: The South China Sea has been devastated by human fishing. This paper reports an initiative to restore Hong Kong's marine ecosystems and fisheries through the deployment of artificial reefs (ARs) within marine protected areas (MPAs). Current catch and biomass data by species and fishery sector were available. Quasi-spatial ecosystem simulations, using a modified ECOSIM method, have been employed to forecast benefits from a successful MPA/AR system. Results indicate that, despite increasing fishing power in the Hong Kong fleet, a 10-20% MPA/AR system could provide significant benefits within 10 yrs, and shifts to low-value pelagic fish could be reversed. Approximate scores, expressing how species benefit from protected ARs, suggest that results are not biased by changes in species composition. The design of MPA/ARs balances island biogeographic theory with the needs of monitoring and compliance: minimizing perimeter losses and establishing colonizing corridors are trade-offs with statistical replication and monitoring, whereas sacrifice of some ARs to fishing encourages compliance and learning. In Hong Kong, workshops with fishing communities encouraged support. Bioeconomic analysis shows an MPA/AR system increasing fishery value, but noncompliance rapidly erodes benefits. The benefits of this approach are assessed together with problems and difficulties that have arisen.

Plathong, S., Inglis, G., & Huber, M. E. (2000). Effects of self-guided snorkeling trails on corals in a tropical marine park. *In: Conservation Biology*, 14(6), 1821-1830.

Abstract: Underwater trails are intended as interpretative tools in marine parks, but concentrating divers and snorkelers in defined areas may negatively affect the surrounding environment. We examined spatial and temporal patterns in the effects of use of underwater trails on coral reef flats in the Great Barrier Reef Marine Park, Australia. Changes in benthic assemblages were assessed on two new trails used by snorkelers, two unused (control) trails, and two undisturbed areas. Total percent coral cover, numbers of broken colonies, and living coral fragments were counted 6 months before and 6 months after the new trails began to be used. Spatial patterns of effects around concentrated nodes of use were determined by stratified sampling around and away from the interpretative signs within each trail. Despite comparatively low levels of use (approximately 15 snorkelers per trail per week), snorkelers caused significant damage to corals along the trails. Branching corals (non-Acropora branching corals and *Millepora* spp.) were most affected. More damage occurred near the interpretative signs than elsewhere on the trails. The numbers of broken branches and damaged coral colonies in the snorkeling trails increased rapidly but stabilized within 2 months of the commencement of use. There was no significant change in overall benthic assemblages within the trails after 6 months of use by snorkelers. Although concentrating snorkelers within confined trails caused increased damage to corals, the effects can be mitigated by appropriate design and placement of the trails and by managing the behavior of snorkelers. Interpretative information should warn users about the damage they may cause when swimming along the trails. Managing the behavior of snorkelers in the water is likely to be more effective in reducing damage than simply applying fixed limits to the amount of use the trails receive.

Reaser, J. K., Pomerance, R., & Thomas, P. (2000). Coral bleaching and global climate change: Scientific findings and policy recommendations. *In: Conservation Biology*, 14(5), 1500-1511.

Abstract: In 1998, tropical sea surface temperatures were the highest on record, topping off a 50-year trend for some tropical oceans. In the same year, coral reefs around the world suffered the most extensive and severe bleaching (loss of symbiotic algae) and subsequent mortality on record. These events may not be attributable to local stressors or natural variability alone but were likely induced by an underlying global phenomenon. It is probable that anthropogenic global warming has contributed to the extensive coral bleaching that has occurred

simultaneously throughout the reef regions of the world. The geographic extent, increasing frequency, and regional severity of mass bleaching events are an apparent result of a steadily rising baseline of marine temperatures, combined with regionally specific El Niño and La Niña events. The repercussions of the 1998 mass bleaching and mortality events will be far-reaching. Human populations dependent on reef services face losses of marine biodiversity, fisheries, and shoreline protection. Coral bleaching events may become more frequent and severe as the climate continues to warm, exposing coral reefs to an increasingly hostile environment. This global threat to corals compounds the effects of more localized anthropogenic factors that already place reefs at risk. Significant attention needs to be given to the monitoring of coral reef ecosystems, research on the projected and realized effects of global climate change, and measures to curtail greenhouse gas emissions. Even those reefs with well-enforced legal protection as marine sanctuaries, or those managed for sustainable use, are threatened by global climate change.

Schleyer, M. H., & Tomalin, B. J. (2000). Damage on South African coral reefs and an assessment of their sustainable diving capacity using a fisheries approach. *In: Bulletin of Marine Science*, 67(3), 1025-1042.

Shivlani, M., & Suman, D. (2000). Dive operator use patterns in the designated no-take zones of the Florida Keys National Marine Sanctuary (FKNMS). *In: Environmental Management*, 25(6), 647-659.

Abstract: The Florida Keys National Marine Sanctuary (FKNMS), created by Congress in 1990, addressed the issue of resource protection partly by proposing 26 "no-take" zones. These areas, discussed in the 1995 Draft Management Plan, disallowed all extractive activities, and four of the zones also prohibited diving and snorkeling. Furthermore, the Draft Management Plan considered recreational carrying capacity, proposing that use densities be studied and eventually limited in high-use and sensitive areas. Conducted with 62 commercial dive operators from the Florida Keys in 1995-96, this study uses geographic information systems (GIS) to determine the extent of FKNMS zone use by dive operators, assess the regional importance of FKNMS zones to operators, and compare management strategies by which to allow use while minimizing impacts to the coral reef resource. Dive operators took almost 70% of their total trips and 77% of their total divers to FKNMS zones in 1995. Although zone use is generally related to the proximity of dive locations, dive operators do rely disproportionately on single sites in certain regions. The resulting profiles demonstrate that management strategies need to consider disproportionate use, as well as the average number of users per trip, to effectively protect the region's environmental resources. In addition to implementing a carrying capacity plan, the FKNMS should consider a limited-entry system for dive operators.

Souter, D. W., & Linden, O. (2000). The health and future of coral reef systems. *In: Ocean & Coastal Management*, 43(8-9), 657-688.

Abstract: Coral reefs are among the most productive and diverse ecosystems on earth and provide a multitude of valuable ecosystem services. Moreover, the resources derived from coral reefs are essential to the food security of millions of people living within tropical coastal communities. Unfortunately, burgeoning human populations in coastal regions are placing an unsustainable burden on these resources such that degradation of coral reefs is common. In addition, during 1998, El Niño driven increases in sea temperature caused a mass bleaching event that further degraded many of the world's coral reefs. This article provides a brief review of the status of the world's coral reefs and highlights their value to society. Also, the anthropogenic and natural disturbances that threaten the future of coral reefs are discussed and finally, this article offers some potential remedies that promote sustainable use of coral reef resources thus ensuring their future survival.

Stejskal, I. V. (2000). Obtaining Approvals for Oil and Gas Projects in Shallow Water Marine Areas in Western Australia using an Environmental Risk Assessment Framework. *In: Spill Science & Technology Bulletin*, 6(1), 69-76.

Abstract: The oil and gas industry is of major economic importance to the state of Western Australia. The majority of its activities are offshore, some occurring in shallow marine areas adjacent to sensitive resources such as coral reefs and mangroves. One of the main issues for the oil and gas industry is continued access to marine acreage. Increasing public concern about the environmental protection of the coastal and marine environment has increased the focus on the various users. This has resulted in the development of statutory and administrative processes, more stringent environmental assessment and operating conditions, and greater scrutiny on the issue of access of proposals to some areas. Detailed environmental assessment and management plans are generated for all drilling and development projects. An environmental risk assessment approach utilising computer modelling, habitat mapping, research and monitoring is used to evaluate the risk of a project on adjacent resources and to obtain government approval. The Wonnich appraisal drilling program, which consisted of two wells drilled from the same surface location situated one kilometre away from an area of high conservation value, will be used as a case study of the risk assessment procedure used by one oil and gas company.

Thorburn, C. C. (2000). Changing Customary Marine Resource Management Practice and Institutions: The Case of Sasi Lola in the Kei Islands, Indonesia. *In: World Development*, 28(8), 1461-1479.

Abstract: Sasi, the spatial and temporal closure of fields, forests, reefs and fishing grounds, is a conspicuous feature of many Moluccan societies. Despite increasing domestic and international awareness and praise of what is considered by many analysts to be an exemplary indigenous resource conservation tradition, the practice is in decline in many parts of the Thousand Island province, and in many villages has disappeared altogether. This study examines the practice of managing *Trochus niloticus* (Topshell) harvests in Ohoirenan, a village on the eastern coast of Kei Besar in the District of Southeast Maluku. *Trochus* is one of the most important sources of cash income for Kei villagers, and until recently, for the district government as well. Since 1987, trochus has been classified as a protected species in Indonesia, and regulations have been issued to regulate the cultivation, harvest and transport of this and other protected species. This article briefly introduces Kei customary law and property relations, followed by a description of sasi and its application to reef habitats and trochus harvests. Examining a territorial conflict between Ohoirenan and a neighboring village, and more recent contention arising from government efforts to protect the species, the article explores issues of society-nature and state-society relations as pertain to natural resource management in Indonesia. Sasi continues to function as an exemplary common property resource (CPR) management institution in Ohoirenan, assuring equitable distribution of the benefits deriving from controlled extraction of a local resource. But, erratic and uneven enforcement of "one-size-fits-all" centralized conservation policy and law, combined with collusion and self-interest on the part of various parties, combine to threaten both the resource and the institutions that have successfully and sustainably managed it in this region. Within the context of a centralized, state-led natural resource management system, the national species protection precludes the establishment of sensible, mutually beneficial co-management regimes that could serve the interests and employ the inherent knowledge and capabilities of local communities, traders, and government agents

Trexler, J., & Travis, J. (2000). Can marine protected areas restore and conserve stock attributes of reef fishes ? *In: Bulletin of Marine Science*, 66(3), 853-873.

Werner, T. B. et al. (2000). Abrolhos 2000: Conserving the Southern Atlantic's richest coastal

biodiversity into the next century. *In: Coastal Management*, 28(1), 99-108.

Abstract: The Abrolhos bank, an area of continental shelf off the coast of Bahia, Brazil, has the most biologically diverse coral reefs in the entire southern Atlantic Ocean. The coral reefs and nearby coastal ecosystems constitute a global conservation priority and are the target of the Abrolhos 2000 project, initiated by Conservation International as part of its global marine conservation strategy. Although portions of the Abrolhos reefs are located within a marine park, they are not afforded adequate protection due to insufficient conservation resources and a failure to be part of a broader integrated coastal management program. Through partnerships with government agencies, nongovernmental organizations, local communities, the private sector, and other stakeholders, Abrolhos 2000 is working to provide these needs while establishing local capacity for conserving coastal and marine ecosystems. The project's initial successes provide examples of useful strategies for making integrated coastal management work in the context of emerging economies

White, A., & Vogt, H. P. (2000). Philippine Coral Reefs Under Threat: Lessons Learned After 25 Years of Community-Based Reef Conservation. *In: Marine Pollution Bulletin*, 40(6), 537-550.

Abstract: The Philippine archipelago consists of more than 7000 islands. Most of these islands have extensive coral reefs or coral communities. For centuries, reefs and their associated resources have provided the livelihood for a large portion of the coastal population. However, reefs as sources of income are threatened by over-exploitation and by the use of destructive fishing methods. The scientific community, natural resource managers and many of the small-scale fishermen are aware that catches are falling rapidly while the fast growing population requires increasing amounts of fish. Since the early 1970s, various programs have tried to counter the decline of Philippine coastal resources. This article reports about successful examples of reef conservation in the provinces of Negros Oriental, Batangas and the Tubbataha Reef National Marine Park, Palawan. In all three localities, significant areas of reefs are legally protected and sustainable management regimes are working effectively. In Negros and Batangas this success is partly a result of intensive education programs that contributed to the active involvement of the traditional fishermen and the larger coastal community. Community participation and co-operation of all institutions involved in resource management are regarded as the key elements of sustainable reef management in these areas. This paper presents the objectives, programs and achievements as well as the fruitful networking of the participating organizations. Particular emphasis is placed on the experiences and lessons emanating from 25 years of reef conservation while showing the overall objective of sustainable use is still far on the horizon. It is suggested that more integrated forms of management, involving various stakeholders, and that address the numerous intertwined issues, will save Philippine reefs.

White, A., Vogt, H. P., & Arin, T. (2000). Philippine Coral Reefs Under Threat: The Economic Losses Caused by Reef Destruction. *In: Marine Pollution Bulletin*, 40(7), 598-605.

Abstract: In the Philippines, coral reef fisheries provide livelihood for more than a million small-scale fishers who contribute almost US\$ 1 billion annually to the country's economy. The rapidly growing population needs increasing amounts of fish and other marine organisms. However, overfishing, destructive fishing methods and sedimentation have damaged or destroyed many reef areas. Fish catches have fallen well below the sustainable levels of healthy reefs. The economic losses to the coastal fishing population are considerable. Various programmes have and are trying to counter coral reef decline by establishing sustainable management regimes. The economic benefits of such programmes appear to exceed their investment costs. As an example, the start-up and maintenance costs of a successful island marine reserve project have been compared to the losses caused by reef destruction and the gains from reef management. The results clearly show that the economic benefits from a

managed reef area due to higher catches and revenue from small-scale tourism far exceed costs. Coral reefs are also a major attraction for an increasing number of local and international tourists. In addition to providing income for the tourism industry, these reef visitors are often willing to contribute to the costs for reef management. The annual willingness-to-pay assessed in three popular diving destinations are significant. An estimated US\$ 300,000 could be collected annually as entrance fees or donations in Mabini, Batangas alone. It is estimated that the 27,000 km² of reef in their degraded condition still contribute at least US\$ 1.35 billion annually to the economy. Reef management involving local fishing communities, local governments and other concerned organizations is a cost-effective way to alleviate the pressure on the numerous threatened coral reefs. In addition, economic valuation and cost-benefit analysis can provide essential information to support more investment in reef conservation.

Williams, I. D., & Polunin, N. (2000). Differences between protected and unprotected reefs of the western Caribbean in attributes preferred by dive tourists. *In: Environmental Conservation*, 27(4), 382-391.

Abstract: Tropical marine protected areas (MPAs) may promote conditions that are attractive to dive tourists, but a systematic basis for assessing their effectiveness in this regard is currently lacking. We therefore interviewed 195 dive tourists in Jamaica to determine which reef attributes they most preferred to see on dives. Attributes relating to fishes and other large animals ('big fishes', 'other large animals', 'variety of fishes', 'abundance of fishes', and 'unusual fishes') were more appreciated than those relating to reef structure and benthos ('reef structure e.g., drop-offs', 'variety of corals', 'large corals', 'coral cover', 'unusual corals', 'sponges', 'unusual algae', 'lobsters, crabs etc.'). We then surveyed reef condition with regard to those aspects (abundance and variety of fishes, number of 'unusual', and number of 'large' fish) at four Caribbean MPAs and reference areas. In two cases, Hol Chan Marine Reserve in Belize and Parque Nacional Punta Frances in Cuba, these fish attributes were more pronounced in the MPAs than in the reference areas. Differences between the Montego Bay Marine Park in Jamaica (MBMP) and adjacent reference areas were mainly restricted to shallow sites (<6m), while at Grand Cayman no differences between fully protected and partially protected areas were detected. Management had not been fully effective in the MBMP in the preceding months, while fishing pressure in the partially protected areas on Grand Cayman was very light. We conclude that, if fishing restrictions are well enforced, western Caribbean MPAs can be expected to be effective in ways appreciated by dive tourists.

Willis, T. J., & Babcock, R. C. (2000). A baited underwater video system for the determination of relative density of carnivorous reef fish. *In: Marine and Freshwater Research*, 51(8), 755-763.

Abstract: Estimates of the relative density of fishes form the basis of many marine ecological studies as well as the assessment of effects of fishing or pollution. Plasticity in the behavioural response of large reef fishes to SCUBA divers means that commonly used underwater visual census (UVC) techniques do not always provide reliable estimates of relative density. The paper describes the system configuration, deployment methods, testing and use of a remotely deployed baited underwater video (BUV) system for the survey of carnivorous reef fishes (snapper, *Pagrus auratus* and blue cod, *Parapercis colias*) in marine reserves of northern New Zealand. Concurrent UVC and BUV surveys inside and outside a marine reserve showed that, whereas UVC detected few snapper in either area (resulting in little confidence in statistically significant results), BUV demonstrated significant differences in relative density. Conversely, blue cod were found to occur at significantly higher densities within the reserve by UVC, but not by BUV. The provision of accurate estimates of fish size (<20 mm error) from video footage also illustrated differences in size structure between protected and fished populations. The data suggest that a combination of survey techniques is likely to be necessary where

multispecies assemblages are being assessed.

Yap, H. T. (2000). The case for restoration of tropical coastal ecosystems. *In: Ocean & Coastal Management*, 43(8-9), 841-851.

Abstract: At no time have humans so altered their natural environment than the present. Marine ecosystems have not been spared, and the degradation of coastal habitats has reached severe proportions in many parts of the world. The mere setting aside of areas for protection may not be enough to ensure adequate production and provision of services for a growing global human population. Hence, the active restoration of habitats, in addition to protection and preservation, is probably the more desirable conservation strategy. Accumulated experience over several decades has demonstrated that the rehabilitation or even restoration of damaged coastal ecosystems is feasible. However, the degree of difficulty and expense involved vary, with coral reefs being the most complicated habitats to restore, followed by seagrass beds and then mangrove forests. In ecosystem restoration, a comprehensive strategy based on sound biological and ecological principles, and proven techniques must be developed. A concrete, achievable goal must be articulated. Because of the dynamic nature of ecosystems, and the inability to accurately predict pathways of succession after a community is established through artificial means, subsequent modifications to a project must proceed within a flexible framework of adaptive management. Finally, for restoration efforts to be successful, local communities must participate actively in cooperation with local governments in accordance with the principle of co-management.

Zann, L. (2000). The Eastern Australian Region: a Dynamic Tropical/Temperate Biotone. *In: Marine Pollution Bulletin*, 41(1-6), 188-203.

Abstract: Eastern Australia lies in an overlap of tropical Indo-Pacific and temperate bioregions because of the influence of the southward-flowing East Australian Current. It has a very high biodiversity, from tropical coral reef and seagrass in the north, to coastal lakes and kelp communities in the south. Offshore, Norfolk and Lord Howe Islands and Elizabeth and Middleton Reefs, are the highest latitude coral reefs in the world. The coastal region includes South-East Queensland and New South Wales (NSW) and supports almost half of Australia's population. Catchments have been extensively cleared for agriculture and water quality in many rivers and estuaries is poor. There has been major loss of wetlands and acid soil runoff causes fish kills and diseases in estuaries. The coastline is exposed, and much has been mined for heavy minerals and is subject to erosion. Urbanization and industrialization, particularly in the Sydney area, has resulted in sewage and heavy metal pollution. Many of the coastal fisheries are declining, largely because of loss of water quality and wetlands habitats, and in some cases overfishing. Marine environmental management (the responsibility of the two states to the 3 mile limit, and the Commonwealth to the boundary of the 200 mile EEZ) is variable, and largely focused on the urban centres. Queensland has a system of marine protected areas (MPAs) while NSW has minimal protected areas. The major issues are declining water quality, loss of estuarine habitats, degradation of coastal lakes, and localized pollution from heavy metals and sewage in the Sydney area.

Acosta, C. A. (2001). Assessment of the Functional Effects of a Harvest Refuge on Spiny Lobster and Queen Conch Populations at Glover's Reef, Belize. *In: Proceedings of the Gulf and Caribbean Fisheries Institute*, (52), 212-221.

Brodie, J. et al. (2001). Catchment management and the Great Barrier Reef. *In: Water Science and Technology*, 43(9), 203-211.

Abstract: Pollution of coastal regions of the Great Barrier Reef is dominated by runoff from the adjacent catchment. Catchment land-use is dominated by beef grazing and cropping, largely

sugarcane cultivation, with relatively minor urban development. Runoff of sediment, nutrients and pesticides is increasing and for nitrogen is now four times the natural amount discharged 150 years ago. Significant effects and potential threats are now evident on inshore reefs, seagrasses and marine animals. There is no effective legislation or processes in place to manage agricultural pollution. The Great Barrier Reef Marine Park Act does not provide effective jurisdiction on the catchment. Queensland legislation relies on voluntary codes and there is no assessment of the effectiveness of the codes. Integrated catchment management strategies, also voluntary, provide some positive outcomes but are of limited success. Pollutant loads are predicted to continue to increase and it is unlikely that current management regimes will prevent this. New mechanisms to prevent continued degradation of inshore ecosystems of the Great Barrier Reef World Heritage Area are urgently needed.

Brown, K. et al. (2001). Trade-off analysis for marine protected area management. *In: Ecological Economics*, 37(3), 417-434.

Abstract: This paper outlines an approach to natural resource management that incorporates multiple objectives for protected area management within a decision-making framework. Both regulators and other major stakeholders are directly incorporated into the approach to enhance decision-making processes. We call this approach trade-off analysis. The approach uses a framework based on multi-criteria analysis (MCA) but involves stakeholders at all stages. This holistic approach is appropriate for multiple use, complex systems such as marine protected areas (MPAs), where many different users are apparently in conflict and where linkages and feedbacks between different aspects of the ecosystem and economy exist. The paper applies trade-off analysis to the case of Buccoo Reef Marine Park (BRMP) in Tobago. Stakeholder analysis is undertaken, and social, economic and ecological criteria identified. The impacts of four different development scenarios are evaluated for these criteria. Stakeholders are asked to weight different criteria and then the outcomes of different stakeholder weightings in the MCA are used to explore different management options. For BRMP, the MCA suggests consensus around development options characterised as limited tourism development for the area surrounding the park in association with the implementation of complementary environmental management. The approach has been used to enhance stakeholder involvement in decision-making and develop consensus-based approaches to management of the MPA.

Carreiro-Silva, M., & McClanahan, T. (2001). Echinoid bioerosion and herbivory on Kenyan coral reefs: the role of protection from fishing. *In: Journal of Experimental Marine Biology and Ecology*, 262(2), 133-153.

Abstract: During feeding, echinoids remove a large proportion of calcium carbonate in addition to the algae growing on dead coral and are consequently of importance in estimating the turnover of organic and inorganic carbon in coral reefs. Rates of herbivory and the erosion of dead coral substratum, referred to as bioerosion, by the most abundant echinoid species in Kenyan reefs, *Echinothrix diadema* (Linnaeus), *Diadema setosum* (Leske), *D. savignyi* (Michelin) and *Echinometra mathaei* (de Blainville), were compared in three different reef categories with different histories of fishing and its exclusion. These were reefs: (i) protected within Marine National Parks, which exclude all forms of fishing, coral and shell collection for more than 25 years; (ii) one reef within a Marine Park, which has received protection from fishing activities for 8 years (referred to as 'newly protected' reef); and (iii) unprotected reefs, which experience heavy fishing and some coral collection. The aim was to investigate the grazing and bioerosion activity by the above echinoid species in these reef categories. We surveyed sea urchin population densities and determined their rates of bioerosion and herbivory per individual and square meter. Individual rates of bioerosion and herbivory, of the species *D. setosum*, *D. savignyi* and *E. diadema* were estimated from laboratory gut content analysis and gut evacuation experiments in the field, using elevated underwater cages. Individual rates of

bioerosion and herbivory of *E. mathaei* were obtained from a previous field study [J. Exp. Mar. Biol. Ecol. 147 (1991) 121]. Sea urchin bioerosion was greater than herbivory for all studied species and proportional to the body size of the sea urchin species. The large-bodied *E. diadema* exhibited the highest bioerosion and herbivory rates (5.5±0.9 and 2.2±0.3 g individual⁻¹ day⁻¹, respectively) followed by *D. setosum* (1.8±0.3 and 1.1±0.2 g individual⁻¹ day⁻¹) and *D. savignyi* (0.7±0.2 and 0.4±0.1 g individual⁻¹ day⁻¹). Highest sea urchin densities were recorded at unprotected reefs (6.2±1.5 individual m⁻²), and therefore, bioerosion and herbivory by sea urchins were also highest in this reef category (1180±230 g CaCO₃ m⁻² year⁻¹ and 450±77 g algae m⁻² year⁻¹). Protected reefs recorded 20 times lower sea urchin bioerosion and herbivory rates (50.3±25.8 g CaCO₃ m⁻² year⁻¹ and 20.7±10.4 g algae m⁻² year⁻¹), due to the low sea urchin population densities in these reefs (0.06±0.01 individual m⁻²). The newly protected reef, with intermediate number of sea urchins (1.2±0.1 individual m⁻²), had intermediate rates of sea urchin bioerosion and herbivory (711±157 g CaCO₃ m⁻² year⁻¹ and 299±63 g algae m⁻² year⁻¹). These findings suggest that echinoids are important in the carbon cycle and reef development, and that fishing can influence these ecological processes.

Cranfield, H. J. et al. (2001). Promising signs of regeneration of blue cod and oyster habitat changed by dredging in Foveaux Strait, southern New Zealand. *In: New Zealand Journal of Marine and Freshwater Research*, 35(5), 897-908.

Abstract: Epifaunal reefs in Foveaux Strait are oyster (*Ostrea chilensis* Philippi, 1845) habitat. One hundred and thirty years of oyster dredging has diminished the complexity and distribution of these reefs. Commercial densities of blue cod (*Paraperca colias* (Forster in Bloch and Schneider, 1801)) were discovered on epifaunal reef habitat in 1989 and became the focus of a major blue cod fishery. We document habitat changes that followed the closing of the oyster fishery in 1993 and interactions between the blue cod and oyster fisheries after the oyster fishery was reopened in 1996. Evidence from blue cod fishers and oyster surveys suggests that the benthic habitat of some oyster beds regenerated in the absence of dredging and that the relative density of blue cod, and then oysters, rebuilt to commercial levels. Benthic habitat was modified once more when oyster dredging restarted and the relative density of blue cod on oyster beds fell again. The observations suggest that rotational fishing of oysters could mitigate the effects of dredging on habitat and that marine protected areas could expedite habitat recovery. Increasing habitat complexity and blue cod density on a reef of oyster shells formed by an oyster fisher suggests that habitat enhancement might remedy effects of dredging. The questions raised by the observations could be answered by management experiments on the scale of the fisheries.

Ebersole, J. P. (2001). Recovery of fish assemblages from ship groundings on coral reefs in the Florida Keys National Marine Sanctuary. *In: Bulletin of Marine Science*, 69(2), 655-671.

Abstract: At three areas in the FKNMS where ships ran aground between 1984 and 1989, microtopographic complexity was eliminated in the areas of impact as octocorallians and corals were killed, toppled, and smashed. Remediation was attempted: hard and soft corals were transplanted to part of one impact area shortly after the accident, debris was removed from part of another, and the substrate was repaired with cast concrete forms at the third area. Few fishes are found immediately after such impacts., but fishes should return to impacted sites along with other life, recovering to resemble either assemblages characteristic of complex reefs, or assemblages of simpler hard ground habitat. During 1995 and 1996, fishes were surveyed at five impact sites dispersed among the three impact areas., three spur-and-groove sites, four natural hard ground sites, and a hard ground site where ships had grounded 100 yrs ago. Patterns of species composition were explored through cluster analysis; diversities and overall abundances of fishes were compared among sites, with subsequent comparisons of paired

remediated and unremediated sites. Irrespective of initial structural complexity of a grounding site, fish assemblages converged to low diversity, low abundance assemblages with species composition typical of natural hard ground. A preponderance of opportunistic wrasses that eat post-larval invertebrates, combined with a lack of large parrotfishes, may prevent recovery of such structurally impoverished sites to a well-developed spur-and-groove formation by hindering recolonization by corals. The remediation efforts seemed ineffective, except that replacing major topographic features may enhance fish species diversity.

Eristhee, N., & Oxenford, H. A. (2001). Home range size and use of space by Bermuda chub *Kyphosus sectatrix* (L.) in two marine reserves in the Soufriere Marine Management Area, St Lucia, West Indies. *In: Journal of Fish Biology*, 59 Suppl. A, 129-151.

Abstract: Marine reserves (MRs) are expected to conserve fish biodiversity and enhance fisheries production of surrounding areas through export of adult fish biomass. However, the extent to which these benefits occur is dependent on movement patterns of fish, for which there is a paucity of data, particularly for coral reef species. Eleven adult *Kyphosus sectatrix* were tracked [five in the Grand Caille marine reserve (MR) and six in the Petit Piton MR within the Soufriere Marine Management Area, St Lucia] from February to April 1999, using acoustic telemetry. Average number of days over which fish were tracked was 21.5 (range 5-51). Home range size of individuals, temporal use of space within the home range, and permeability of MR and habitat boundaries to fish movement were examined. Average minimum home range area of *K. sectatrix* was not significantly different between Grand Caille (30 514 m²) and Petit Piton (39 114 m²). However, the shape of home ranges was conspicuously different between the sites and reflected available reef shape, Individual home ranges overlapped strongly with those of other individuals at the same site, and use of space within the home range was generally restricted to a small number of preferred sites. Preferred sites were often shared among individuals and tended to be occupied at a specific time of day, with some sites were preferred in the morning and or afternoon, whilst others preferred during the middle of the day. Fidelity to a single sleeping-shelter site was high at night. MR boundaries over contiguous reef at Grand Caille were frequently crossed with individuals spending, on average, 63% of their time (range 37-94) outside the MR. This demonstrates the need for the MR boundary at this site to be implemented farther offshore to encompass the reef, if the MR is to better protect *K. sectatrix*. At Petit Piton, where MR boundaries effectively encompass available reef, *K. sectatrix* spent, on average, only 11% of their time (range 0-40) outside the protected area. At Grand Caille boundaries were crossed more readily (individuals spent an average of 18% of their time off reef) than at Petit Piton where individuals spent an average of 0.7% of their time off reef. (C) 2001 The Fisheries Society of the British Isles.

Harvey, E., Fletcher, D., & Shortis, M. (2001). Improving the statistical power of length estimates of reef fish: a comparison of estimates determined visually by divers with estimates produced by a stereo-video system. *In: Journal of Fish Biology*, 99(1), 72-80.

Abstract: We calculated the power of visual length estimates by novice and experienced scientific SCUBA divers and estimates generated by a stereo-video system to detect changes in the mean length of three common species of reef fish from New Zealand. Length estimates from a stereo-video system had much greater power for blue cod (mean length=33.1 cm., range 19.5-50.1 cm.) and snapper (mean length=31.7 cm., range 23-71 cm.). For a third species, red cod (mean length=42.5 cm., range 13-74 cm.), the statistical power of diver and stereo-video estimates was much less for an equivalent number of samples owing to the greater variation in the true mean length of red cod recorded at different sites. At 90% power, a stereo-video system detected a 15% (similar to 5-cm) change in the mean length of blue cod with 63% less samples (10) than those required by the experienced scientific divers (27). Novice scientific divers required 28 samples.

Hudson, J. H., & Goodwin, W. B. (2001). Assessment of vessel grounding injury to coral reef and seagrass habitats in the Florida Keys National Marine Sanctuary, Florida: Protocol and methods. *In: Bulletin of Marine Science*, 69(2), 509-516.

Jaap, W. C., & Hudson, J. H. (2001). Coral reef restoration following anthropogenic disturbances. *In: Bulletin of Marine Science*, 69(2), 333.

Jackson, J. B. C., & Sala, E. (2001). Unnatural oceans. *In: Scientia Marina*, 65 Suppl. 2, 273-281.

Abstract: Ecological understanding of the oceans is based on an unnatural mix of mostly small species whose trophic relations are distorted to an unknown degree by the overfishing of megafauna including sharks, sea turtles, sea cows, seals, and whales. Living habitats like seagrass beds, kelp forests, and coral reefs that once provided critical 3-dimensional habitats for refuge and reproduction of most of the biodiversity of the oceans are also greatly reduced by fishing and other factors. Successful restoration and conservation require a more realistic understanding of the ecology of pristine marine ecosystems that can only be obtained by a combination of retrospective analyses, modeling, and intensive studies of succession in very large marine reserves.

Jeffrey, C. F. G. et al. (2001). Distribution and sighting frequency of reef fishes in the Florida Keys National Marine Sanctuary. Vol. GAUS-S-01-001 (p. 51). [s. l.]: Georgia Sea, Grant.

Koop, K. et al. (2001). Use of a Telemetered Dispensing System for Controlling Nutrient Additions to Experimental Patch Reefs in the ENCORE Study at One Tree Island, Great Barrier Reef, Australia. *In: Marine Pollution Bulletin*, 42(2), 121-126.

Lang, J. C., Deslarzes, K. J. P., & Schmahl, G. P. (2001). The Flower Garden Banks: remarkable reefs in the NW Gulf of Mexico. *In: Coral Reefs*, 20(2), 126.

Masica, M. A. (2001). Designing Effective Coral Reef Marine Protected Areas. A Synthesis Report Based on Presentations Given at the 9th International Coral Reef Symposium, Bali, Indonesia, October 2000. [s. n.]: IUCN World Commission on Protected Areas-Marine.

McClanahan, T., & Arthur, R. (2001). The effect of marine reserves and habitat on populations of east African coral reef fishes. *In: Ecological Applications*, 11(2), 559-569.

Abstract: The effects of fishing, the duration of protection from fishing, features of the reef habitat, including benthic cover and sea urchin abundance, and the distance between reefs were examined to determine the ability of these factors to predict ecological aspects of fish communities. Population density, species richness, and rarity were estimated for 127 species of coral reef fish on 22 patch and fringing reefs along similar to 400 km of East African coastline. The reefs included five protected areas, of which three study sites were protected for more than 25 years, and four sites were protected less than 10 years. Habitat variables were often significantly associated with fish community variables in fringing reefs, but not in patch reefs. Fish diversity was positively correlated with hard coral and coralline algal cover, and negatively correlated with sea urchin and algal turf abundance. However, multiple regression analysis suggests that protection from fishing was the single strongest factor affecting fish abundance and diversity. Consequently, many of the habitat correlations were probably due to direct and indirect effects of fishing on reef ecology, where heavy fishing results in increases in sea urchin and algal turf abundance and reduces hard coral and coralline algal abundance. Protected areas had higher abundances and species richness of commercially important triggerfish, surgeonfish, and parrotfish. There was, however, no relationship between local

rarity in our study sites with rarity at the level of the western Indian Ocean for three well known fish families of angelfish, butterflyfish, and damselfish. Older reserves had more and rarer species than young reserves or fished reefs; and, consequently, the maintenance of reserves older than 10 years may be needed to sustain the full local diversity of fishes.

McClanahan, T., & Mangi, S. (2001). The effect of a closed area and beach seine exclusion on coral reef fish catches. *In: Fisheries Management and Ecology*, 8(2), 107-121.

Abstract: Fish landing data from the Mombasa Marine National Park (MNP) and a marine reserve exploited by various gears were studied over a 5-yr period to determine the influence of the closed area and different gears in fisheries. The number fishing and boats per landing site was constant, but total and catch per unit effort progressively declined in all sites on an annual basis irrespective of the existence of a marine reserve, exclusion of the beach seines or use of gear. Differences between landing sites were most pronounced when analysed on a catch per area as opposed to the more standard catch per fisherman, suggesting compensation in human effort when catches decline. A marine reserve next to a closed area that excluded beach seines had the highest catch per area (5.5 kg ha⁻¹ month⁻¹) despite having the highest density of fishermen (0.07 +/- 0.02 fishermen ha⁻¹ month⁻¹). The annual rate of decline in the catch was lower than the other sites at around 250 g day⁻¹ compared with 310-400 g day⁻¹ in the other sites. One landing site, which excluded beach seine landings for more than 20 yrs, had a high catch per area (similar to 5.3 kg ha⁻¹ month⁻¹), but after experiencing a doubling in the effort of other gears (line, speargun and trap), the catch per fisherman and area were reduced. Environmental or habitat degradation and excessive effort remain the most likely explanation for the overall declines in catch from 1995 to 1999. Closed areas and beach seine exclusion have the potential to increase catch rates, but the first often reduces the total fishing area and possibly leads to a loss of total catch, at least on a time scale of less than 10 yrs. The exclusion of beach seines can lead to an increase in other gear types that can also cause reductions in catch.

McClanahan, T. et al. (2001). Responses of algae, corals and fish to the reduction of macroalgae in fished and unfished patch reefs of Glovers Reef Atoll, Belize. *In: Coral Reefs*, 19(4), 367-379.

McLachlan, M. S., Haynes, D., & Muller, J. (2001). PCDDs in the water/sediment-seagrass-dugong (Dugong dugon) food chain on the Great Barrier Reef (Australia). *In: Environmental Pollution*, 113(2), 129-134.

Abstract: Polychlorinated dibenzo-p-dioxin (PCDD) and dibenzofuran (PCDF) concentrations were measured in sediment and seagrass from five locations in or adjacent to the Great Barrier Reef Marine Park. A full spectrum of C15-8DDs were present in all samples and, in particular, elevated levels of C18DD were found. PCDFs could not be quantified in any samples. The PCDD concentrations ranged over two orders of magnitude between sites, and there was a good correlation between sediment and seagrass levels. There were large quantities of sediment present on the seagrass (20-62% on a dry wt. basis), and it was concluded that this was a primary source of the PCDDs in the seagrass samples. The PCDD levels in the seagrass samples were compared with the levels in the tissue of three dugongs stranded in the same region. The relative accumulation of the 2,3,7,8-substituted PCDD congeners in the dugongs decreased by over two orders of magnitude with increasing degree of chlorination. This was attributed to the reduced absorption of the higher chlorinated congeners in the digestive tract, a behaviour that has been observed in other mammals such as domestic cows.

Obura, D. O. (2001). Kenya. *In: Marine Pollution Bulletin*, 42(12), 1264-1278, many ref.

Abstract: The Kenya coast is bathed by the northward-flowing warm waters of the East Africa

Coastal Current, located between latitudes 1 and 5° S. With a narrow continental shelf, the coastal marine environments are dominated by coral reefs, seagrass beds and mangroves, with large expanses of sandy substrates where river inputs from Kenya's two largest rivers, the Tana and Athi rivers, prevent the growth of coral reefs. The marine environment is characterized by warm tropical conditions varying at the surface between 25 and 31°C during the year, stable salinity regimes, and moderately high nutrient levels from terrestrial runoff and groundwater. The semi-diurnal tidal regime varies from 1.5 to 4 m amplitude from neap to spring tides, creating extensive intertidal platform and rocky-shore communities exposed twice-daily during low tides. Kenya's marine environment faces a number of threats from the growing coastal human population estimated at just under three million in 2000. Extraction of fish and other resources from the narrow continental shelf, coral reef and mangrove ecosystems increases each year with inadequate monitoring and management structures to protect the resource bases. Coastal development in urban and tourist centres proceeds with little regard for environmental and social impacts. With a faltering economy, industrial development in Mombasa proceeds with few checks on pollution and other impacts. In 1998 Kenya's coral reefs suffered 50-80% mortality from the El Nino-related coral bleaching event that affected the entire Indian Ocean. The institutional, human resource and legal infrastructure for managing the coastal environment has in the past been low, however these are rapidly improving with the revitalization of national institutions and the passing in 1999 of an Environment Act. Marine Protected Areas are the key tool currently used in management of marine ecosystems, and focus principally on coral reefs and biodiversity protection. New initiatives are underway to improve application of fisheries regulations, and to use Integrated Coastal Area Management as a framework for protecting marine and coastal environments.

Parras, D. A. (2001). Coastal Resource Management in the Philippines: A Case Study in the Central Visayas Region. *In: Journal of Environment and Development*, 10(1), 80-103.

Abstract: The ongoing destruction of wild coastal resources in the Philippines is rendering vast tracts of coral reef and other marine habitats unable to support productive fisheries. Progressive approaches to coastal resource management integrate local resource users into management plans while seeking support and consistency of regulations from central government. This community-based or co management concept has spurred various interdisciplinary programs, including education in basic ecology, training in resource assessment and monitoring, creation of community-based marine sanctuaries, and research and development of alternate livelihoods. This article describes initiatives taking place in the Visayas region of the Philippines, including the roles of stakeholders, policymakers, educators, nongovernmental organizations, and central government.

Pet Soede, C. et al. (2001). Impact of Indonesian coral reef fisheries on fish community structure and the resultant catch composition. *In: Fisheries Research*, 51(1), 35-51.

Abstract: Species and size composition of fish community structures were studied with underwater visual census (UVC), on Indonesian coral reefs subjected to different levels of fishing intensity. Comparisons were made between reefs within Spermonde Archipelago off SW Sulawesi, between reefs inside and outside a marine park in Komodo coastal area off Vilest Flores, and between the reef areas of Spermonde and Komodo. In Spermonde, the species and size composition of the commercial catch at sites with high and low fishing intensity were recorded to determine how these catches reflected shifts in fish community structure. Overall fishing intensity in Spermonde was 557 boatdays km⁻² reef yr⁻¹, eight times higher than in Komodo (65 boatdays km⁻² reef yr⁻¹), but catch rates were eight times lower in Spermonde (5.6 kg per trip) than at reefs in Komodo (48 kg per trip). Total yield was similar in Spermonde (3.2 t km⁻² reef) and in Komodo (3.1 t km⁻² reef). Mean length of fish in the catch was significantly related to fishing intensity. Spatial patterns in the fish community within

Spermonde as observed with UVC were not significantly related to patterns in fishing intensity. Within Komodo, total fish biomass and biomass of piscivores as observed with WC were significantly higher inside than outside the park. Fish communities at reefs differed largely between Spermonde and Komodo, in mean individual length and in total biomass but numerical densities were similar. Our results indicate that an effect of fishing pressure on the fish community structure can be detected by UVC only when comparing sites which differ greatly in fishing intensity (Spermonde and Komodo) or when comparing sites with low and with medium fishing intensity (inside and outside a marine park). The species and size composition of commercial catches still demonstrate the differential effect of fishing intensity on fish community structures and so on the resultant catches in the on-average intensively fished reef area of Spermonde. (C) 2001 Elsevier Science B.V. All rights reserved.

Precht, W. F., Aronson, R. B., & Swanson, D. W. (2001). Improving scientific decision-making in the restoration of ship-grounding sites on coral reefs. *In: Bulletin of Marine Science*, 69(2), 1001-1012.

Abstract: When ships contact reefs they break and crush coral rock, kill corals and other sessile organisms. open bare space for colonization, and eliminate topographic (habitat) complexity. We explored the ecology of ship groundings and the scope of restoration possibilities. Our guiding hypothesis was that high-relief areas damaged by ship groundings would not recover to their original community structure without restoration, but instead would converge on an alternate community state similar to natural hardground communities. To test this hypothesis, ship-grounding sites in the Florida Keys National Marine Sanctuary (FKNMS) were surveyed repeatedly and compared to surveys of undamaged reference sites at the same depths. In a study of the 1984 MV WELLWOOD ship-grounding, many univariate parameters of the community structure of the ship-grounding site in 1995-1996 resembled a nearby natural hardground reference site more closely than they resembled the spur-and-groove habitat adjacent to the spur-and-groove that had been flattened by the accident. The WELLWOOD site was also more similar to another hardground reference site, a century-old ship grounding at Pickles Reef, than it was to the original spur-and-groove community configuration. The WELLWOOD study suggests that damaged spur-and-groove habitat will not recover rapidly to its former state and that it may not recover at all without substantial restorative engineering. In contrast, the MV ELPIS grounding site, which damaged an existing hardground community, was statistically indistinguishable from adjacent hardground sites less than 10 yrs after the incident. If these results can be generalized, when a ship grounding occurs in a hardground habitat, the community may recover on a decadal time scale. Substrate stabilization and coral transplantation will likely speed this natural recovery. Consideration of ecological setting is important in the design of restoration projects, ensuring preservation of the resource for future generations.

Roberts, R. D., & Lapworth, C. (2001). Effect of delayed metamorphosis on larval competence, and post-larval survival and growth, in the abalone *Haliotis iris* Gmelin. *In: Journal of Experimental Marine Biology and Ecology*, 258(1), 1-13.

Abstract: Marine invertebrate species vary in their ability to delay metamorphosis, and in the degree to which delayed metamorphosis compromises juvenile performance. Abalone (*Haliotis iris*) larvae were deprived of metamorphosis cues and the effects of delayed metamorphosis on larval competence, and post-larval growth and survival were quantified. Larvae were exposed to a metamorphosis inducer (the coralline alga *Phymatolithon repandum* (Foslie) Wilks and Woelkerling) on Days 11, 18, 22, 26, 30 and 34 post-fertilisation (temperature 16-17[deg]C). Post-larvae were reared on diatoms (*Nitzschia longissima* Grunow) for 3-4 weeks post-metamorphosis. Delayed metamorphosis caused progressive negative effects on post-larval performance. Virtually all larvae initiated metamorphosis in response to *P. repandum*,

regardless of larval age. The proportion of post-larvae that developed post-larval shell growth within 2 days of metamorphosis induction dropped only ~20% from Day 11 to Day 26 ($P > 0.05$), but was significantly lower by Day 30 and Day 34 ($P > 0.05$) and growth rates (means of 20-22 μm shell length per day). In contrast, larvae that metamorphosed on Day 26 and Day 30 had poor survival (30-40%) and lower (PH. iris larvae remained competent to metamorphose for at least 3 weeks after they attained competence. Post-larval growth and survival were not reduced if metamorphosis occurred within 3 weeks of fertilisation. This extended period of larval competence implies that H. iris larvae can potentially disperse for up to several weeks before successful metamorphosis.

Rocha, L. A., & Rosa, I. L. (2001). Baseline assessment of reef fish assemblages of Parcel Manuel Luiz Marine State Park, Maranhao, north-east Brazil. *In: Journal of Fish Biology*, 58(4), 985-998.

Rogers Bennett, L., & Pearse, J. S. (2001). Indirect benefits of marine protected areas for juvenile abalone. *In: Conservation Biology*, 15(3), 642-647.

Abstract: Marine protected areas (MPAs) designed to provide harvest refugia for red sea urchins (*Strongylocentrotus franciscanus*) offer a unique opportunity to study the indirect effects of urchin fishing on subtidal communities. Sea urchins may provide important cryptic microhabitat for juvenile abalone sheltering beneath urchin spines in shallow habitats worldwide. We investigated the abundance of juvenile (3-90 mm) red abalone, (*Haliotis rufescens*) and the rare flat (<90 mm) abalone (*H. walallensis*) on protected and fished rocky reefs in California. Abalone abundance surveys were conducted inside 24 x 30 m plots on three protected reefs with red sea urchins present and three fished reefs where red sea urchins were removed by commercial or experimental fishing. Significantly more juvenile abalone were found in 1996 and 1997 on protected reefs with urchins present than on fished reefs ($\chi^2 = 188$, $df = 1$, $p < 0.001$). Juvenile red abalone abundance was not correlated with local adult red abalone abundance or habitat rugosity. One-third of the juveniles inside the MPAs were found under the urchins' spine canopy, as were a suite of unfished marine organisms. In the laboratory, juvenile abalone survived better ($\chi^2 = 7.31$, $df = 1$, $p < 0.01$) in crab predation experiments in which red sea urchins were available as shelter. Fishing red urchins reduced structural complexity, potentially decreasing microhabitat available for juvenile abalone. This example demonstrates how MPAs designed for one fished species may help other species, illustrating their usefulness for ecosystem-based fishery management and marine conservation.

Rogers, C. S., & Beets, J. (2001). Degradation of marine ecosystems and decline of fishery resources in marine protected areas in the US Virgin Islands. *In: Environmental Conservation*, 28(4), 312-322.

Abstract: The large number of marine protected areas (MPAs) in the Caribbean (over 100) gives a misleading impression of the amount of protection the reefs and other marine resources in this region are receiving. This review synthesizes information on marine resources in two of the first MPAs established in the USA, namely Virgin Islands National Park (1962) and Buck Island Reef National Monument (1961), and provides compelling evidence that greater protection is needed, based on data from some of the longest running research projects on coral reefs, reef fish assemblages, and seagrass beds for the Caribbean. Most of the stresses affecting marine resources throughout the Caribbean (e.g. damage from boats, hurricanes and coral diseases) are also causing deterioration in these MPAs. Living coral cover has decreased and macroalgal cover has increased. Seagrass densities have decreased because of storms and anchor damage. Intensive fishing in the US Virgin Islands has caused loss of spawning aggregations and decreases in mean fish size and abundance. Groupers and snappers are far less abundant and herbivorous fishes comprise a greater proportion of samples than in the 1960s.

Effects of intensive fishing are evident even within MPA boundaries. Although only traditional fishing with traps of 'conventional design' is allowed, commercial trap fishing is occurring. Visual samples of fishes inside and outside Virgin Islands National Park showed no significant differences in number of species, biomass, or mean size of fishes. Similarly, the number of fishes per trap was statistically similar inside and outside park waters. These MPAs have not been effective because an unprecedented combination of natural and human factors is assaulting the resources, some of the greatest damage is from stresses outside the control of park managers (e.g. hurricanes), and enforcement of the few regulations has been limited. Fully functioning MPAs which prohibit fishing and other extractive uses (e.g. no-take marine reserves) could reverse some of the degradation, allowing replenishment of the fishery resources and recovery of benthic habitats.

Rouphael, A. B., & Inglis, G. (2001). "Take only photographs and leave only footprints"?: An experimental study of the impacts of underwater photographers on coral reef dive sites. *In: Biological Conservation*, 100(3), 281-287.

Abstract: Impacts caused by recreational scuba diving on coral reefs vary widely among different dive locations and individual divers. Linear modelling was used to explore a range of individual and situational risk factors associated with divers who damaged corals in the Great Barrier Reef Marine Park. Recreational divers were followed for 10-15 min, and all contacts with, and damage to corals were recorded. Information on the dive site, diving experience, gender, and use of an underwater camera were recorded. Thirty-two out of 214 divers (15%) damaged or broke corals, mostly by fin kicks (95%). Impacts were most likely to be caused by male divers, in the first 10 min of the dive, at sites with a large abundance of branching corals. Specialist underwater photographers caused more damage on average (1.6 breaks per 10 min) than divers without cameras (0.3 breaks per 10 min). To explore the effects of gender and use of a camera further, we issued single-use underwater cameras to 31 randomly chosen divers and compared their behaviour to a control group. Use of a camera had no influence on the rate or amount of damage caused by these naive photographers, but male divers were more likely to break corals and caused significantly more damage, on average, (1.4 breaks per 15 min) than female divers (0.3 breaks per 15 min). Variability in the amount of damage caused by divers in our sample reflected the very different underwater behaviours exhibited by specialist and non-specialist photographers, and male and female divers. Greater understanding of the causes of harmful behaviours by these groups will allow better targeting of on-site interpretative and cautionary information and may prove to be a more palatable management strategy than regulation of site use.

Salm, R., & Coles, S. L. (2001). Coral Bleaching and Marine Protected Areas : Proceedings of the Workshop on Mitigation Coral Bleaching Impact through MPA Design, Bishop Museum, Honolulu, Hawaii, May 29-31, 2001. Asia Pacific Coastal Marine Program Report Honolulu, Hawaii: Nature Conservancy

Sarramegna, S. (2001). Contributions to the study of marine protected areas in the south western lagoon of New Caledonia: Influence of different status of protection on fish community structure. *In: Cybium*, 25(3), 200.

Abstract: The impacts of marine protected areas on fish communities were studied on several reefs and islets in the south western lagoon of New Caledonia. The study area located in front of Noumea was of 24 km width and concerned a gradient from the coast to the barrier reef (18-20 km). Comparisons were made, on the one hand between several small islets (a few km(2)) protected and unprotected from fishing, and, on the other hand, on the entire barrier reef (100 km(2)), the status of which was partially modified during this study. The length of commercial reef fish, their density and biomass were calculated using underwater visual censuses and

recreational fishing activity was sampled during 1 year and half. Protected areas were characterised by the return of rare species and species sensitive to fishing. They were also characterised by an increase of biomass, especially for predators (piscivorous and macrocarnivorous). The small reserves appeared to concentrate fish, whereas the larger barrier reef reserve should be a source of adult fish for the fishing zone of this reef. However, there was no variation in overall density with the status of protection, and the density of juveniles is higher in small area unprotected from fishing. In the case of community structure, the biotope characteristics (percentage of living coral, habitat complexity) and terrestrial runoff are important factors, which explain the distribution and the abundance of species censuses in this study. Other factors such as El Niño or variation in recruitment appear to play a major role. At least, the status of protection could modify eventually this structure.

Sheppard, C. (2001). The Main Issues Affecting Coasts of the Indian and Western Pacific Oceans: A Meta-analysis from Seas at the Millennium. *In: Marine Pollution Bulletin*, 42(12), 1199-1207.

Abstract: A review of the world oceans in three volumes by 365 scientists, provides scope for several 'meta-analyses' of the main problems affecting over 100 areas in the year 2000. This article summarises the main issues affecting a sub-set of the reviewed areas, covering Asian, African and Arabian countries dealt with in Volume 2, which included over 50 articles. From all issues raised, assessment is made of the nature of the major ones, including evaluation of reasons why so many of them remain important issues after so much attention to them. These include long standing problems, several problems more newly flagged as becoming particularly important, the issue of global warming and no less than three related issues connected with fishing and over exploitation. One or two issues such as industrial pollution and sewage, previously considered of almost universal concern, almost traditional pollution issues even, continue to feature strongly for some countries, but while these were almost always referred to in Seas chapters, by and large these categories appear not to be the most pressing of issues today, except in localized areas (albeit areas where huge numbers of people live). Perhaps other issues have simply taken over. They are excluded from this article.

St John, J. et al. (2001). The diet of the large coral reef serranid *Plectropomus leopardus* in two fishing zones on the Great Barrier Reef, Australia. *In: Journal of Fish Biology*, 99(1), 180-192.

Abstract: The diet of *Plectropomus leopardus* (Serranidae, Lacepede 1802) was examined on two pairs of reefs in the Cairns Section of the Great Barrier Reef Marine Park, Australia. For both pairs, one reef was open to fishing and the other had been closed to fishing for eight years; however zoning appeared to be ineffective as there was no difference in the size structure of leopard coral grouper populations on either open or closed reefs. Two fishing methods were used to sample reefs concurrently and the size structure and diet of *P. leopardus* that were speared randomly (n=587) were compared to samples caught by line (n=85). Adult *P. leopardus* were highly piscivorous (96% of prey was fish by number), and two families of fishes, Pomacentridae and Labridae, composed approximately half of their diet (relative importance=48.4%). Numerical composition of fish in the diet varied significantly among reefs, but there were no patterns related to reef closures when fish prey were classified by taxa or by their habitat. Fishes categorized as living in the demersal reef habitat were the dominant prey consumed, followed by midwater fishes. When the data from reefs were pooled, the abundance of families in the diet differed between locations (north and south) but not between fishing zones. Dietary overlap was high between the different fishing zones and was very high in relation to naturally occurring spatial and temporal variability in the diet of *P. leopardus* found in other studies. With line fishing larger and hungry fish are caught, and the few data on natural prey suggest tentatively that line catches are biased toward *P. leopardus* feeding on pelagic

fishes. The coral reefs and surrounding waters provide the major food source of *P. leopardus*, whereas sandy areas are much less important. Our data suggest that the coral trout fishery is resilient to changes in abundances of particular prey species because the diet of *P. leopardus* is broad and because the two major prey families are diverse and abundant on coral reefs.

Tratalos, J. A., & Austin, T. (2001). Impacts of recreational SCUBA diving on coral communities of the Caribbean island of Grand Cayman. *In: Biological Conservation*, 102(1), 67-75.

Abstract: The impact of recreational SCUBA diving on coral reefs of the Cayman Islands, British West Indies, was assessed from 63 10-m video transects, filmed on reefs in the West Bay area of Grand Cayman. Three high use and three low use dive sites were sampled at distances of c. 15, 55 and 200 m from mooring buoys, in addition to three sites where no diving occurs. Both diver numbers and distance from buoys were found to show highly significant (PMontastrea annularis. Diver numbers also increased the amount of dead coral and coral rubble. Relative to overall hard coral cover, the proportion of massive corals was smallest at heavily dived sites, but there was a larger proportion of *Agaricia* spp. corals, dead coral and coral rubble at these sites. Our findings suggest the need for a new management approach if the Islands are to conserve the ecological and aesthetic qualities of their most popular dive sites.

Valles, H., Sponaugle, S., & Oxenford, H. A. (2001). Larval supply to a marine reserve and adjacent fished area in the Soufriere Marine Management Area, St Lucia, West Indies. *In: Journal of Fish Biology*, 59, Suppl. A, 152-177.

Abstract: A total of 76 reef fish species from 31 families was collected at two coral reef sites, one in a marine reserve and the other in an adjacent fished area of the Soufriere Marine Management Area (SMMA) in St. Lucia. Five families (Scaridae, Pomacentridae, Synodontidae, Apogonidae and Blennidae) dominated the collections at both sites while species of high commercial value were rare. Monthly patterns of larval supply differed among selected species, but overall trends were similar between the two sites for most species, However, despite the geographical proximity of the two sites, the fished area received a consistently higher abundance and diversity of larvae than the marine reserve throughout the study period. Patterns in larval supply generally were reflected in the settlement patterns of *Stegastes partitus*. Results suggest that local-scale variation in hydrodynamic and or biological features is influencing the arrival and hence settlement of larvae at the reef.

Watson, M., Power, R., & Munro, J. L. (2001). Use of Light-attracted Zooplankton for Rearing Post-settlement Coral Reef Fish. *In: Proceedings of the Gulf and Caribbean Fisheries Institute*, (52), 340-351.

Willis, T. J., Parsons, D. M., & Babcock, R. C. (2001). Evidence for long-term site fidelity of snapper (*Pagrus auratus*) within a marine reserve. *In: New Zealand Journal of Marine and Freshwater Research*, 35(3), 581-590.

Abstract: Increases in the density of exploited species on unfished reefs logically implies that some individuals are at least temporarily resident, or show fidelity to a particular area. We tagged snapper (*Pagrus auratus*) in the Leigh Marine Reserve, New Zealand using visible implant fluorescent elastomer tags, recoverable by diver visual sightings without the need to recapture the fish. Batch tagging of snapper (n = 907) was done during an angling survey in June and December 1996, and individually coded tags were implanted by divers (n = 117) in January 1999. Snapper tagged during both programmes were recovered on irregular intervals from 1997 to 2000. There were 71 recoveries of batch tags within 500 m of their tagging sites, and these recoveries were still being made >3 years after tagging. Of individually coded fish,

49 (42%) were seen, sometimes repeatedly over several months, close to their respective tagging sites. These observations included snapper as small as 23 cm fork length, contradicting the commonly held impression that only large snapper take up long-term residency on reefs. This preliminary evidence suggests that some snapper exhibit site fidelity to areas only a few hundred metres wide, and in the absence of fishing may occupy the same area for years

Yap, H. T. (2001). Another Look at Coral Reef Degradation. *In: Marine Pollution Bulletin*, 42(7), 527.

Benchley, P. (2002). Cuba Reefs: A Last Caribbean Refuge. *In: National Geographic*, 44-67.

Hughes, G. (2002). Environmental indicators. *In: Annals of Tourism Research*, 29(2), 457-477.
Abstract: Many environmental indicators have been accepted within the tourism industry. However while purporting to represent the environment, indicator research fails to evaluate the ecological impact of tourism. There are well-founded reasons for this failure, including the ambiguous character of science, which promises a regulatory regime for managing the environmental impact of tourism, but which cannot be delivered. To illustrate this dilemma, the difficulties involved in developing bio-indicators for a coral reef are discussed. The inconclusiveness of current knowledge is illustrated and attention drawn to the disturbing implication that the present situation offers little protection when called upon in the arbitration of land use decisions.

Maypa, A. P. et al. (2002). Long-term trends in yield and catch rates of the coral reef fishery at Apo Island, central Philippines. *In: Marine and Freshwater Research*, 53(2), 207-213.

Abstract: Fish yields and catch rates recorded in the 1980s were compared with daily roving creel surveys carried out in 1997/98, 2000 and 2001 at Apo Island. Total annual fish yields were measured six times over the period 1980-2001. Total fish yield was 19-25 t km⁻² year⁻¹, with reef and reef-associated fish accounting for 15-20 t km⁻² year⁻¹, for five measurements. A sixth measurement, made in 1986, estimated 36.7 t km⁻² year⁻¹. Annual yield remained stable over the study period. Carangidae and Acanthuridae accounted for 26-47% and 16-27% of the catch, respectively. Non-reef catches declined over time, from 6.21 t year⁻¹ in 1980/81 to 1-2 t year⁻¹ in 2000 and 2001. Estimates of annual hook and line catch per unit effort (CPUE) increased from 0.13-0.17 kg man⁻¹ h⁻¹ in 1980/ 81, to 1-2 kg man⁻¹ h⁻¹ in 1997-2001. For target families, hook and line CPUE was consistently higher in 1997-2001 than in 1980-86. However, hook and line CPUE for Carangidae and Acanthuridae declined significantly between 1997 and 2001. Possible reasons for the long-term patterns of fish yields and catch rates are discussed. Differences in methods used in estimates, and changes in gears and fishing effort over the years, make comparisons difficult.

Shears, N. T., & Babcock, R. C. (2002). Community Ecology. Marine reserves demonstrate top-down control of community structure on temperate reefs. *In: Oecologia*, (132), 131-142.

Abstract: Replicated ecological studies in marine reserves and associated unprotected areas are valuable in examining top-down impacts on communities and the ecosystem-level effects of fishing. We carried out experimental studies in two temperate marine reserves to examine these top-down influences on shallow subtidal reef communities in northeastern New Zealand. Both reserves examined are known to support high densities of predators and tethering experiments showed that the chance of predation on the dominant sea urchin, *Evechinus chloroticus*, within both reserves was approximately 7 times higher relative to outside. Predation was most intense on the smallest size class (30-40 mm) of tethered urchins, the size at which urchins cease to exhibit cryptic behaviour. A high proportion of predation on large urchins could be attributed to the spiny lobster, *Jasus edwardsii*. Predation on the smaller classes was probably by both

lobsters and predatory fish, predominantly the sparid *Pagrus auratus*. The density of adult *Evechinus* actively grazing the substratum in the urchin barrens habitat was found to be significantly lower at marine reserve sites ($2.2 \pm 0.3 \text{ m}^{-2}$) relative to non-reserve sites ($5.5 \pm 0.4 \text{ m}^{-2}$). There was no difference in the density of cryptic juveniles between reserve and non-reserve sites. Reserve populations were more bimodal, with urchins between 40 and 55 mm occurring at very low numbers. Experimental removal of *Evechinus* from the urchin barrens habitat over 12 months lead to a change from a crustose coralline algal habitat to a macroalgal dominated habitat. Such macroalgal habitats were found to be more extensive in both reserves, where urchin densities were lower, relative to the adjacent unprotected areas that were dominated by urchin barrens. The patterns observed provide evidence for a top-down role of predators in structuring shallow reef communities in northeastern New Zealand and demonstrate how marine reserves can reverse the indirect effects of fishing and re-establish community-level trophic cascades.

Zakai, D., & Chadwick-Furman, N. E. (2002). Impacts of intensive recreational diving on reef corals at Eilat, northern Red Sea. *In: Biological Conservation*, 105(2), 179-187.

Abstract: Coral reefs at Eilat, northern Red Sea, are among the most heavily used in the world for recreational diving, with >250,000 dives per year on only 12 km of coastline. We assessed patterns of dive frequency, diver behavior, and coral damage on selected reefs at Eilat, in order to determine impacts of diving tourism. Frequencies and types of recreational SCUBA dives varied widely between 12 coral reef sites, with >30,000 dives per year at the most heavily-used sites. Field observations of diver behavior revealed ca 10 incidents of reef contact per dive, mostly via raising of sediments onto the reef, but also involving direct breakage of corals. The proportion of damaged coral colonies varied significantly with the frequency of SCUBA diving, and did not depend upon site topography. We conclude that current rates of recreational diving on some reefs at Eilat are unsustainable, resulting in damage to the majority of stony coral colonies. This study reveals consequences of diving tourism at extremely high levels of use. Our estimate of diver carrying capacity for reefs at Eilat is similar to levels proposed for other reef sites around the world.

[Anon.] ([s. d.]). Indonesia: components for effective marine conservation. Proceedings of the 7th International Coral Reef Symposium [s. 1.]: [s. n.]

Abstract: The Indonesian Archipelago has a coastline of about 80,000 km, which includes some of the most productive and diverse coastal ecosystems on earth. The Indonesian coastal ecosystems are also among the most heavily exploited, especially where human population densities are high. Three main steps need to be taken in order to execute effective management programs: 1) research the ecological aspects of the reef systems; 2) produce an inventory of adverse human influences; and 3) raise public awareness through participation of communities and politicians. The most effective way to take these steps is by bilateral or multilateral cooperation and a multidisciplinary approach. The components are considered here, using examples from current and proposed activities representing some of the most long term on-going marine conservation programs in Indonesia. ii. This study evaluated a method used by the Republic of France to protect discrete marine areas of shoreline and adjacent coastal waters through designation of sites as marine nature reserves. Although much smaller in size than many national marine sanctuaries in the United States, the reserves in France represent successful efforts to protect and manage coastal marine areas. This is due in part to a high amount of local involvement during the designation process; the use of advisory committees at the reserves, as well as scientific committees that develop and conduct research projects within the sites; and the use of core areas, in which almost all human activities are prohibited or restricted, to promote re-populating of fish communities and to increase species diversity. The initiative for creating the reserves begins at the local level and is coordinated among local

officials, user groups, environmental organizations, and the national government. This study describes the legal framework in which the reserves are created and examines aspects of management, scientific research, and law enforcement of a marine reserve.

It has been hypothesized that nature reserves should be as circular as possible to maximize the total number of species conserved. Using multiple regression, this study examined the relationship between species richness on oceanic islands and island shape for 33 data sets. After accounting for the effect of island area, island shape does not explain a significant amount of the residual variation in species number in more data sets than expected due to chance alone. It is concluded that if the mechanisms controlling species richness on oceanic islands and isolated patches of terrestrial habitat are the same, then shape is not of major concern in the design of nature reserves.

Increased human activities in the coastal zone has brought about an increase in user conflicts and marine resource exploitation. This article discusses the advantages of marine reserves, specifically for the enhancement of fisheries populations. The author discusses life history strategies of coral reef organisms and the susceptibility of fishery target species to over-fishing. An overview of problems associated with creating marine reserves is discussed.

Reef species are vulnerable to over-fishing because of their life history characteristics. Various fisheries for reef species have declined worldwide, including the Caribbean, Gulf of Mexico, and U.S. South Atlantic. Traditional fishery management techniques may not be practical or effectively deal with certain problems, such as by-catch and release mortality. Marine fishery reserves, areas with no consumptive usage, provide an alternative management approach with attractive attributes from a fishery prospective. Marine fishery reserves improve reef fish fisheries by protecting species composition, population age structure, spawning potential, and genetic variability within species. Reproductive output from reserves would help re-supply fished areas by natural egg and larval dispersal. Properly located reserves of adequate size could protect the quantity and quality of reproductive output, reduce recruitment uncertainty due to environmental variation, and ensure against management failure. Substantial empirical evidence shows that protection from fishing has increased fish abundance and availability inside and outside protected areas. A model of the red snapper fishery in the Gulf of Mexico with 20 percent of the habitat protected by reserves, show that total egg production was potentially 1,200 percent greater than under the status quo. Uncertainties remain concerning the ideal number, location, and size of reserves necessary to achieve management objectives

[Anon.]. ([s. d.]). Marine Sanctuary, U.S.A. Protected Areas in Resource-Based Economies: Sustaining Biodiversity & Ecological Integrity. Canadian Council on Ecological Areas National Conference and 14th Annual General Meeting Calgary, Alberta, Canada: [s. n.]

Abstract: The US Congress created the Florida Keys National Marine Sanctuary in recognition of the area's unique and rich natural resources, its economic importance, and its increased anthropogenic stress. A management plan was developed based on principles of integrated coastal management as a cooperative effort by local, state, and federal agencies using a bottom-up, consensus-building approach with extensive public involvement. Unique accomplishments of the plan were the use of no-take zones in approximately 6 percent of the sanctuary, increased public involvement resulting in action concerning important problems, and the establishment of ongoing management that provides a balance between managers, government, and users. Success of the effort was based on shared common goals, clear legislative mandates, continued commitment by stakeholder and agency participants, intensive public involvement, and consensus and compromise by various users. Major drawbacks of this approach are the time and costs needed to develop a plan and the need for professional support to guide the process. Future success will require sufficient program funding, continued cooperation between participants, and the failure of those opposed to the Sanctuary to preempt the process through legislative action.

Marine biodiversity is increasingly threatened by habitat destruction, environmental changes, and overexploitation. Preventing reductions in biodiversity and promoting sustainable resource use requires new management strategies, more effective education, and strong research. There is a need to switch to less destructive and wasteful fishing methods to protect critical and sensitive habitats from development and overexploitation. Marine reserves, areas permanently protected from all extractive uses, are gaining widespread attention as an innovative tool for conserving biodiversity while maintaining healthy sustainable fisheries. This article provides a summary of the issues surrounding the use of marine reserves as a management tool. Specific details of the proposal for marine fisheries reserves in the Florida Keys National Marine Sanctuary is presented. The Sanctuary presents a unique opportunity to elucidate the relative impacts of fisheries exploitation and oceanographic processes in determining the biodiversity and abundance of reef organisms. Cooperative academic and governmental research will test critical hypotheses in order to improve marine resource management.

This article provides a comprehensive summary of commercial, recreational, and marine life fisheries in Monroe County. Results are presented for commercial landings, recreational headboat fishery, and other recreational fishery landings. Landings for some species varied greatly over time. The most conspicuous declines were for pink shrimp, combined grouper, and king mackerel while the most conspicuous increases were for amberjack, stony crab, blue crab, and yellowtail snapper. Landings of spiny lobster have generally remained constant. The article provides a summary of management efforts in the region and problems in data interpretation and information gaps

Australian Institute of Marine Science. ([s. d.]). Science for management of the Great Barrier Reef. (p. 29). [s. l.]: [s. n.].

Cambers, G. ([s. d.]). Planning for coastal erosion / eastern Caribbean islands. (also in French and Spanish). Environment and development in coastal regions and in small islands. APPENDIX III. Forum Contributions up to 30th September 2000

Eghenter, C. ([s. d.]). Mapping peoples' Forests: the role of mapping in planning community based management of conservation areas in Indonesia. Washington, D. C.: Biodiversity support program *Peoples, Forest and Reefs (PeFoR) program discussion paper series:*

Leis, J. M., & Carson-Ewart, B. M. ([s. d.]). In situ swimming speeds of the late pelagic larvae of some IndoPacific coral reef fishes . *In: Marine Ecology Progress Series.*

Mdodo, R. M. ([s. d.]). Reef degradation following mass coral bleaching in Kenya. Proceedings Of Oceans '99 Washington, D.C. (USA): Marine Technology Society (MTS), IEEE

Abstract: Elevated seawater temperature in March and April 1998 caused by the El Niño Southern Oscillation (ENSO) caused mass coral bleaching along the Kenya coast. ENSO event had an effect on the climate of Kenya coast and the Western Indian Ocean region in general, with heavy rains starting in October 1997, and continuing to July 1998. Seawater temperatures in March and April rose to an average 1.5°C above values measured in the same period in 1997, with daytime low-tide highs of over 32 degree C. Coral bleaching is the whitening of corals resulting from the loss of symbiotic zooxanthellae and/or reduction of photosynthetic pigment concentrations in the zooxanthellae. Bleaching was first observed in Kanamai in October 1997 during and after the El Niño rains, most likely due to sedimentation and seawater dilution in the shallow lagoon. In November bleaching was observed in Malindi Marine Park caused by sediment discharge from the Sabaki River. Later, extensive temperature induced bleaching and subsequent coral mortality was observed in mid March 1998 covering the entire

coast of Kenya. Over 90% bleaching and mortality was recorded in Mombasa Marine Park, Malindi Marine Park and Kanamai.

WWF. ([s. d.]) Marine protected areas [Web Page]. URL

<http://www.panda.org/resources/publications/water/mpa/introduction.html>.

Abstract: Introduction. The idea of restricting human activity in the marine environment has flourished for centuries in some parts of the world. Areas closed seasonally or permanently to fishing have been set up and managed by local communities to help maintain fishery resources. During this century, marine protected areas (MPAs), variously called marine parks, reserves, or sanctuaries, have been created to: help protect vulnerable habitats and threatened species increase fishery productivity by protecting critical breeding, nursery, and feeding habitats such as estuaries, mangroves, seagrass beds, and coral reefs protect breeding populations which can help restock and restore overexploited areas reduce the impact of tourism and other direct human activities provide local communities with alternative livelihoods such as well-managed tourism.