UNEP

REGIONAL SEAS

Management and conservation of renewable marine resources in the East Asian Seas region

UNEP Regional Seas Reports and Studies No. 65

Prepared in co-operation with

IUCN

UNEP 1985

PREFACE

Thirteen years ago the United Nations Conference on the Human Environment (Stockholm, 5-16 June 1972) adopted the Action Plan for the Human Environment, including the General Principles for Assessment and Control of Marine Pollution. In the light of the results of the Stockholm Conference, the United Nations General Assembly decided to establish the United Nations Environment Programme (UNEP) to "serve as a focal point for environmental action and co-ordination within the United Nations system" (General Assembly resolution 2997(XXVII) of 15 December 1972). The organisations of the United Nations system were invited "to adopt the measures that may be required to undertake concerted and co-ordinated programmes with regard to international environmental problems", and the "intergovernmental and non-governmental organisations that have an interest in the field of the environment" were also invited "to lend their full support and collaboration to the United Nations with a view to achieving the largest possible degree of co-operation and co-ordination". Subsequently, the Governing Council of UNEP chose "Oceans" as one of the priority areas in which it would focus efforts to fulfil its catalytic and co-ordinating role.

The Regional Seas Programme was initiated by UNEP in 1974. At present, it includes eleven regions (see note 1 below) and has over 120 coastal States participating in it. It is conceived as an action-oriented programme having concern not only for the consequences but also for the causes of environmental degradation and encompassing a comprehensive approach to controlling environmental problems through the management of marine and coastal areas. Each regional action plan is formulated according to the needs of the region as perceived by the Governments concerned. It is designed to link assessment of the quality of the marine environment and the causes of its deterioration with activities for the management and development of the marine and coastal environment. The action plans promote the parallel development of regional legal agreements and of action-oriented programme activities (see note 2 below).

The Regional Seas Programme has always been recognised as a global programme implemented through regional components. Interregional co-operation among the various sea areas on common problems is an important element in assuming the compatibility of the different regional components.

As a contribution to the development of the Action Plan for the East Asian Seas region (UNEP Regional Seas Reports and Studies No. 24) supported by UNEP in the framework of the Regional Seas Programme in the Indian Ocean region, the International Union for Conservation of Nature and Natural Resources (IUCN), in co-operation with UNEP, has prepared this document.

1/ Mediterranean Region, Kuwait Action Plan Region, West and Central African Region, Wider Caribbean Region, East Asian Seas Region, South-East Pacific Region, South-West Pacific Region, Red Sea and Gulf of Aden Region, East African Region and South-West Atlantic Region, South Asian Seas Region.

2/ UNEP: Achievements and planned development of UNEP's Regional Seas Programme and comparable programmes sponsored by other bodies. UNEP

This document reviews past and on-going conservation activities relevant to the East Asian Seas region at the regional and national levels; identifies priority concerns of the Governments bordering the region; and contains recommendations for interregional and regional projects to be undertaken to address these concerns. The assistance of a consultant, E. Wood, in the preparation of this document is gratefully acknowledged. In addition, the sections dealing with fishery aspects of conservation have been prepared by J. Beddington and J.A. Gulland. The report has been compiled and edited by the Tropical Marine Research Unit, University of York, UK.

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INTRODUCTION

The East Asian region lies between Asia and Australia, and between the Pacific and Indian Oceans. It includes the mainland coastline and islands of Thailand, Malaysia, Singapore, Indonesia and the Philippines, and stretches from 20°N to 10°S and 95°E to 142°E. The total area of the South East Asian region is reported to be 8.94million km^2, which represents about 2.5% of the surface of all oceans (Soegiarto, 1978).

Within the area are the Andaman Sea, Strait of Malacca, China Sea, Java Sea, Flores Sea, Banda Sea, Arafura Sea, Timor Sea, Celebes Sea, and Philippine Sea. The terrain of the region is complicated and features shallow continental shelves, deep sea basins, troughs, trenches and numerous coral and volcanic islands.

The islands of Indonesia and the Philippines are the most important in terms of sea area covered and coastline length. Indonesia has approximately 13,677 islands, with a coastline length of about 81,000km. (Soegiarto & Polunin, 1982). The Philippines has 7,107 islands and islets, and a coastline length of approximately 17,500km (de Celis, 1981).

The region has an equatorial climate, modified by the monsoonal wind system. Basically, the northeast monsoon lasts from December to February, and the southwest from June to August. The transition periods have variable winds. The onset, strength and length of the monsoons varies according to geographic location. Cyclones and hurricanes influence the northeast part of the region, in particular the northern and western coastlines of the Philippines and also the northwest, on the northern Burmese border (Couper, 1983).

Rainfall is high throughout the region. In West Malaysia annual rainfall lies between 2,000 to 4,000mm (Chua & Charles, 1980), while in some more northwestern coastal areas it may reach 5,000mm (FAO, 1983). To the west of the region the wettest time of year is during the southwest monsoon, while in central and eastern areas the heaviest rains coincide with the northeast monsoon.

The largest sea in the region is the South China Sea. This is a deep basin, with a maximum depth of about 5,020m. There are extensive shallow areas to the south and west where the seas lies over the Sunda shelf. This is one of the largest continental shelves in the world, and joins the islands of Sumatra, Java and Borneo to mainland Asia. Water depth over the Sunda shelf is between about 40 to 100m. The South China Sea connects to the Java Sea (depth 20-60m) in the south, and through the Malacca Strait, with a sill depth of about 30m, to the Andaman Sea (Soegiarto, 1978).

The Andaman Sea is an extensive basin bounded in the west by a ridge on which the Andaman and Nicobar islands are situated. There is a sill between Nicobar and Sumatra at a depth of about 2,000m, and the deepest part of the Andaman basin (4,360m) is in the west (Soegiarto, 1978).

At the eastern end of the archipelago is the Sahul Shelf which connects Australia with New Guinea. Its waters range in depth from 30 to 90m. There is a deep water connection between the Indian and Pacific Oceans via the Sunda Strait and the narrow passages between the islands east of Java and the Celebes Sea. The Celebes Sea has a maximum depth of 6,200m and its sill to the Pacific

south of Mindanao is 1,400m deep. At its northwest boundary is the Sulu Sea with a sill of about 420m, enclosing a deep basin up to 5,580m deep. The Sulu Sea connects with the South China Sea through the Mindoro channel.

Surface water circulation within the region varies with the monsoons. During the northeast monsoon, water flows from the north along the mainland coast of Asia and into the South East Asian region, and this circulation is essentially reversed during the southwest monsoon. On the western side, however, the main flow in the Malacca Strait is to the northwest (FAO/IPFC, 1976).

The region is influenced by two oceanic currents. The north equatorial current flows westward across the Pacific before being deflected to north and south when it reaches the Philippines. The south equatorial current flows westwards to the Timor Sea and then parallel to the Javan coastline, before entering the Indian Ocean.

The tides of East Asian waters reflect tidal movements in the neighbouring oceans. Semi-diurnal tides are predominant in the Indian Ocean and so occur in the Andaman Sea, the Malacca Strait and the shelf off northwest Australia. Other regions, such as the south coast of Sumatra, Java and the Nusa Tenggara Islands have mixed, but prevailing semi-diurnal tides. In the western Pacific Ocean the diurnal tide is predominant, but it changes as soon as it enters East Asian waters. Almost the entire China Sea, for example, has a mixed prevailing diurnal tide. In other waters, such as the Gulf of Thailand and the Java Sea, an almost pure diurnal tide is observed.

Surface waters are consistently warm and the annual temperature variation is small. The average annual variation is less than $2^{o}C$, but is slightly higher ($3-4^{o}C$) in the Banda Sea, Arafura and Timor Seas, and in the waters south of Java. In the China Sea temperatures are higher and there is a greater annual variation in the north due to increasing inflow of cold water through the Strait of Taiwan during the winter monsoon (Soegiarto, 1978).

In contrast to the uniform temperature in the region, the salinity is extremely variable. The high rainfall causes a lowering in salinity of the surface layer, and this usually follows a seasonal pattern related to the monsoons. The monsoons also influence seasonal water circulation so that interactions between geographic structure, runoff from rivers, evaporation and circulation result in a highly complicated salinity pattern (Soegiarto, 1978). In general there is a lowering of salinity in shallow coastal waters. Thus off the east coast of West Malaysia and the northwest coast of Borneo, the average annual salinity is around 33ppt (Chua & Charles, 1980; Valencia, 1978), while in the Java Sea it falls to 30ppt during the northeast monsoon (Doty & Soegiarto, 1970). In the Gulf of Thailand there is an unusual salinity pattern (Meith & Helmer, 1983). Surface water with a salinity of 30.5ppt to 32.5ppt flows out of the Gulf, while water with a salinity of more than 34ppt flows in beneath it over a 58m sill.

Organic production and nutrient levels are generally high in coastal areas, especially around river mouths. In addition, vertical mixing during the monsoon periods brings nutrients from the bottom to the surface waters. The nutrient content over deeper portions of East Asian waters shows a distribution typical of tropical waters. The surface layer is extremely poor in nutrients, with phosphate levels of less than 0.2ug/l, while in deep water phosphate levels are normally 2.5 to 3.0ug/l (Soegiarto, 1978). Surface layers are replenished in

areas of upwelling, and these have been reported to the north of Sumatra, off the south Javan coastline and at the eastern end of the Indonesia archipelago, in the Arafura Sea (Soegiarto & Polunin, 1982).

The equatorial climate within the region leads to marked stratification in the water column. Mixing occurs in extremely shallow water (e.g. to about 20m) but in deeper shelf areas and in the deep seas a discontinuity layer is formed. Warm, low-salinity surface water lies over denser, colder water, but the depth at which the discontinuity layer is formed varies according to season and location.

GENERAL CONSERVATION AND MANAGEMENT ACTIVITIES

International

Under UNESCO's Man and the Biosphere (MAB) programme all countries, excluding Brunei, have established national MAB committees, but only Indonesia and the Philippines have established Biosphere reserves.

None of the countries in the East Asian region is party to either the Wetlands (RAMSAR) or the World Heritage Conventions, despite the fact that many have sites of particular relevance within their borders.

Thailand, Malaysia, Indonesia and the Philippines are all party to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Regional

In 1981 the five member states of ASEAN (the Association of South-East Asian Nations - Indonesia, Malaysia, the Philippines, Singapore and Thailand) adopted a co-operative programme to ensure that environmental considerations are incorporated into all aspects of economic development within the region. The Action Plan for the Protection and Development of the Marine and Coastal Areas of the East Asian Region is incorporated in the UNEP-sponsored Regional Seas Programme. The foundation for the development of the Action Plan was laid at the International Workshop on Marine Pollution in East Asian waters, held in Penang, Malaysia, in 1976 (IOC/FAO(IPFC)/UNEP, 1976). Since then a large number of workshops, seminars, conferences and consultations have been held in order to advance the Plan.

Steps have been taken by the ASEAN countries, with assistance from UNEP and IUCN to establish a network of ASEAN Heritage Parks and Reserves. One marine park, the Kor Tarutao Marine National Park in Thailand, is included in the list.

National

Thailand. At present there is no single coastal management agency or coastal development plan for Thailand. Responsibilities for the management of specific resources are allocated to different agencies (Mitchell, 1982). For example, the Office of Coastal Land Development, created in 1977, is engaged in a nationwide land management project. The National Economic and Social Development Board is identifying policies and criteria for coastal zone management, and co-ordinated marine pollution control activities are being established. National Parks in Thailand are administered by the Director of the National Parks Division of the Royal Forest Department.

Malaysia. Each of the Malaysian States in Peninsular Malaysia is planning to prepare, or is in the process of preparing, a conservation strategy to provide policy guidance on the management of natural resources. This will include marine and coastal resources. Support has come from WWF Malaysia. A national policy will be developed when the regional studies are complete. The report for Negri Sembilan suggests it would be desirable to establish liaison between all users of coastal resources under the aegis of one co-ordinating body to

regulate and supervise activities and resource exploitation (WWF, 1982). The administration of protected areas in Malaysia is within the state's jurisdiction. In Peninsular Malaysia, the National Parks are administered by the Department of National Parks and Wildlife. In Sarawak, the National Parks are the responsibility of the Director of Forestry, whilst in Sabah the State Government appoints a Board of Trustees to administer the protected area.

Singapore. The development and management of coastal waters is undertaken by the Port of Singapore Authority. There is no authority charged with the sole responsibility of managing coral reefs (Chou, 1984). Protected areas can be designated under the Nature Reserves Ordinance, 1951, but Singapore has no coastal or marine protected areas, and no specific policies with regard to establishing such areas. However, the quality of coastal waters is constantly monitored, and strict laws govern the discharge of oil and effluents into the marine environment (Chou, 1984).

Indonesia. In 1979 a nationwide conservation strategy was launched, funded by Indonesia and international agencies (strong support has come from IUCN, UNEP and WWF). A five-year marine conservation programme was initiated, covering coastal zone management, development of policies and legislation on pollution and reserve areas, identification of critical habitats, sustainable resource utilisation and monitoring and research. The new five-year plan for marine conservation (1984 to 1989) is concentrating on three main tasks:-

a) Strategy formulation, including completion of data atlases.

b) Establishment of protected areas. Survey and management. The goal is to declare 10million hectares of marine protected area by 1989.

c) Establishment of a marine conservation specialist team to advise on the development of a co-ordinated government policy for management of coastal resources.

The Data Atlas and Marine Conservation Plan were completed in 1984 (Salm, 1984a-d; Salm & Halim, 1984a-c).

The Directorate General of Forest Protection and Nature Conservation (PHPA) (formerly the Directorate of Nature Conservation (PPA)) has the mandate to protect, conserve and manage coastal and marine habitats valuable to fisheries and tourism, in addition to strict conservation. The protection of marine organisms in Indonesia is achieved by decree of the Minister of Forestry. Protected areas in the sea are established by ministerial decree, but the law on protected areas is still not finalised and there are no legal categories for marine protected areas (Salm, 1984a). In 1981 a marine conservation section was formed within PPA, and in 1983 the Sub-directorate of Marine Conservation was established.

There are already 95 decreed protected areas in Indonesia which have a marine or littoral component. A further 92 marine protected areas and seaward extensions to terrestrial reserves have been proposed for protection, as well as an additional 71 terrestrial reserves which have a littoral or marine component (Salm, 1984c).

Philippines. About fifty government institutions are directly or indirectly involved with coastal zone research or management in the Philippines, but none has a direct responsibility for management as a whole (Tolentino, 1982). In 1977 an executive order requested the National Environmental Protection Council (NEPC) to organise and co-ordinate an interagency task force to conduct research on the country's coastal areas. This resulted in the Coastal Zone Management (CZM) Task Force composed of 22 agencies whose charge was to co-ordinate all activity in the coastal zone and enforce policies and guidelines to ensure effective management of the coastal area (Tolentino, 1982).

The Task Force has already made a study of coastal resources and utilisation, and coastal zone related legislation. It has also identified and assessed available manpower and institutions with coastal zone research and management capabilities. More recently it has formulated a master plan for coastal zone management which is intended to ensure sustained yield management and environmental protection of the coastal zone. This plan was followed by a framework for implementation (NEPC, 1983).

The administration of the national parks system is an activity within the Bureau of Forest Development, and the Bureau has established the Parks, Range and Wildlife Division to handle the daily administrative affairs (ASEAN/UNEP, 1983).

RESOURCES, HABITATS AND SPECIES

Open Sea

Character

Open sea lies to the seaward side of the continental shelf. These waters are usually highly stratified and considerably less productive than coastal waters, except where upwelling occurs (see Introduction). Communities of the open sea tend to comprise fewer species than shallow coastal habitats.

Occurrence and extent

In terms of total area, open seas constitute a major habitat within the region. For example, of the 3.1million km^2 of Indonesian territorial seas, the vast majority lie beyond the coastal zone (Soegiarto & Polunin, 1982).

Conservational status

No open sea areas are protected and no specific conservation policies for this habitat have been formulated.

Human and economic value

Open sea areas are important for fisheries, although the yields tend to decline with increasing distance from the coastal zone (Soegiarto & Polunin, 1982). In terms of foreign commerce and national economic value, open sea areas are particularly important for their non-living resources such as oil and minerals. They are also a source of sand and gravel.

Targeted exploitation

Fisheries in the open sea are generally less diverse than in coastal waters. Nevertheless, in the relatively shallow waters of the Sunda Shelf, trawlers are able to take some 200 species of sharks, rays, and bony food fish. Mid-shelf catch rates average 250kg fish per hour (in comparison, catch rates in coastal waters may reach as high as 650kg fish per hour).

Large tuna species, such as skipjack, are taken in the deeper-water areas (for example, off the eastern Philippines and in the Banda Sea, eastern Indonesia. Smaller species are taken in the shallower water areas such as the south China and Java Seas. Expoitation of these open water fisheries is mainly by local boats and foreign vessels are, in general, strictly licenced. The types of fishing methods employed include purse-seines, longlines and ring nets.

Incidental exploitation

Most of the catch is utilized but trawlers bring up large numbers of sea snakes which are killed by fishing crews; there are numerous mortalities to fishermen from sea snake bites. As yet, no by-catches of dolphins have been recorded in seine nets or on long lines.

Human impact

Although considerable areas within the East Asian region can be classed as open sea, it is important to recognise that these sea areas are, in fact, relatively enclosed. The major human impact, apart from over-exploitation of fish stocks, would appear to be from pollution. There is a danger of direct

pollution from oil-well blow outs, shipping accidents and intentional discharges, but most pollutants in the open sea probably derive from activities on land or in the coastal zone. This problem is discussed elsewhere; data concerning pollution in the open sea are few.

Management and conservation

Fisheries policies apply to open sea areas and the seabed is leased for oil and mineral exploration, but there are no specific management and conservation measures. The Philippines have defined their coastal zone as extending to a sea depth of 200m, so embracing the entire continental shelf, and including some open sea areas. However, like other East Asian countries, they are concentrating their management and conservation efforts on nearshore waters. In Indonesia, the policy is to devote marine conservation activities in the fourth of their five-year plans (1984-1989) to nearshore land and sea areas. In the fifth and sixth five-year plans, attention may swing further offshore. At present, a proposal for a whale sanctuary encompassing all Indonesian teritorial seas and seas under their jurisdiction is under consideration (Salm, 1984d; Salm & Halim, 1984b).

Concerns and recommendations

As indicated above, little attention is being given to conservation in the open sea. Monitoring schemes could be instigated to investigate pollution and the environmental effects of seabed exploration and extraction of non-living resources.

Some open sea areas are beyond territorial limits and thus fall outside the responsibilities of individual governments. In some areas, especially the South China Sea, matters are complicated by territorial disputes. Conservation action in open seas will therefore require international co-operation.

Deep Sea

Character and extent

Deep sea areas are concentrated in the northwest and northeast, and towards the southern end of the archipelago (see Introduction). The Philippine trough (depth 10,500m) borders the archipelago to the east, while the Sundra trench and trough lie off the western coastline of Sumatra and Java.

Conservational status

No deep sea areas are protected, and no specific conservation policies for this habitat have been formulated.

Human and economic value

Deep sea areas are not directly utilised for fisheries although they have an indirect link with coastal and open sea fisheries because of the role they play in renewal of nutrients through upwelling (see Introduction). The major potential economic value of deep sea areas is as a source for oil, gas and mineral deposits.

Targeted exploitation

Although a number of deep sea areas are found near to Java, eastern Indonesia and the Philippines, there are no existing deep water fisheries. Mesopelagic fish are not found in high enough densities anywhere to warrant their exploitation (Gjøsaeter & Kawaguchi, 1980).

Human impact

There are no reports of impact in deep sea areas, but problems may arise with the anticipated escalation in exploitation of natural resources.

Concerns and recommendations

Little attention is being given to conservation of deep sea habitats and concerns and recommendations are similar to those described for the open sea (see above). Salm (1984a) urges that Indonesia should recognise the special problems associated with dumping at sea, and that their policy should be to prohibit the dumping of hazardous wastes in deep sea areas (see Introduction).

Open Soft Bottom Habitats

Character

Open soft bottom habitats include bays and open areas within the coastal zone. The seabed profile is relatively flat and sediments range from mud and silt through to coral sand and other coarser deposits. These areas are generally productive and well supplied with nutrients, especially near river mouths (see Introduction). Plant and animal communities are richer in species and total biomass than in deeper, offshore waters (Soegiarto & Polunin, 1982).

Occurrence and extent

Open soft bottom habitats are widespread throughout the region and occur particularly in relatively sheltered areas where the substrata or other conditions are unsuitable for coral growth.

Conservational status

Open soft bottom habitats are included in various reserve areas, and may occasionally be a major component. However, this is not in recognition of their overall importance as a habitat (e.g. as with coral reefs) but by virtue of the fact that they harbour certain vulnerable resource species (e.g. turtles, dugongs).

Human and economic value

Open soft bottom habitats are particularly important for fisheries. For example, in the Philippines 'municipal marine fisheries' (roughly equivalent to artisanal fisheries) operating within about 7km of the coastline amounted to about 50% of total fish production in 1978 (NEPC, 1983). Shallow waters off beaches and bays in Indonesia are also reported to be productive in fisheries, including crabs and molluscs (Soegiarto & Polunin, 1982). Bays have potential as mariculture areas, for fish such as snappers (Lutjanus) and groupers (Epinephelus) (Ismail, 1977).

Soft bottom areas are a source of minerals (e.g. tin) and other non-living resources (e.g. oil), and of construction materials such as gravel and sand. Sandy beaches and bays are important recreational areas.

Targeted exploitation

Coastal trawl fisheries are intensive through much of the area, although trawling has recently been banned in Indonesia. A variety of artisanal gears including keelongs, gill nets, lift nets and hook and line fisheries ensure that exploitation of these environments is kept at a high level. In inshore areas of Indonesia, catch rates may range from 150 to 650kg of catch per hour of trawling, with lower figures in the most heavily fished areas. In offshore areas, trawls may yield less than 250kg per hour.

Incidental exploitation

Inshore, heavily exploited, areas are most likely to take small cetaceans, dugongs and sea snakes as incidental catches. No catch statistics are available, but dugongs at least are known to be consumed when caught. Sea snakes are apparently killed whenever found.

Oil industry

Much of the oil pollution in Thailand and Singapore is associated with their refineries, while in the Philippines only the major harbours show occasional moderate levels of oil pollution (Gomez, 1980a). In Indonesia, however, where there is considerable extraction and transportation of oil, oil pollution (e.g. tarballs) occurs along many of the country's beaches (FAO/IPFC, 1976). The Strait of Malacca has already been subjected to oil spills and is particularly at risk because of the volume of traffic which passes through it.

Waste discharge

The proximity of open soft bottom habitats to the coast inevitably leads to increased risks from wastes and pollutants. A preliminary assessment of land-based sources of pollution in East Asian Seas has been carried out (WHO/PEPAS, 1981). The major findings of this and other studies are:-

a) There is every indication that the pollutant loads discharged to water courses and eventually reaching coastal waters are substantial.

b) Coastal waters in the vicinity of major population centres are significantly polluted, as indicated by figures for Biological Oxygen Demand (BOD) reported in WHO/PEPAS (1981). Manila Bay, Jakarta Bay, East Java, the east coast of Peninsular Malaysia and the northern Gulf of Thailand are particularly affected.

c) The BOD contribution from domestic sources is generally much greater than that from industrial sources. In areas around Jakarta pathogenic organisms have been reported from water, mud, oysters (Saccostrea), clams (Anadara), and fish (Ilahude et al, 1979).

d) The extent of heavy metal pollution (e.g. from cadmium, lead, mercury and copper) along the coastal zone appears to be quite significant (WHO/PEPAS, 1981). Inland mining for gold and copper in the Philippines has contributed heavy silt loads to coastal bays. The silt is suspected to be toxic, and reduced fish catches are reported (Mitchell, 1982). Heavy metals in Gulf of Thailand waters and biota have been reported by Heungspreug and Yuangthong (1983).

Sedimentation

Inshore waters in the region are receiving increased amounts of silt and sediment which have been eroded from the land as a result of agricultural development, logging and other activities.

In addition, some sediments derive from sea-based activities such as tin dredging, where tailings are deposited directly into the sea. For example, off the southwest coast of Thailand and northeast Sumatra, 16 major dredgers and up to 3,000 small illegal vessels are operating in coastal waters, mostly at depths less than 50m (Cruickshank, 1979).

Direct habitat destruction

The major physical disturbance to soft bottom habitats and communities is probably from fishing (e.g. trawling), mineral extraction (e.g. dredging for tin), removal of sand and gravel for the construction industry, and dredging of harbours and ship and boat channels. No data have been found on the environmental effects of these activities.

Recreation and tourism

The major impact of these activities around open soft bottom habitats is probably an indirect one, resulting from development of adjacent coastal areas for visitor facilities. Tourists also disturb wildlife such as birds and turtles that frequent beaches and open sea areas.

Management and conservation

Various broadly-based policies, for example in relation to fisheries and pollution, have a bearing on the management and conservation of soft bottom habitats in the coastal zone, but no specific policies for the habitat itself have been recommended.

Priority concerns

There is a tendency in coastal zone management and conservation programmes (where they exist) for attention to be drawn to habitats such as coral reefs, mangroves and seagrasses. This is partly because they are the most productive ecosystems, but also because they are heavily exploited (except for seagrasses) and known to be vulnerable to degradation. Little is known about the way open soft bottom habitats function, and whether or not they are being degraded by pollution and activities such as mining and dredging. There is a possibility that the character of sediments may be altered, that organisms will be smothered or that accumulation of toxic compounds will occur. In addition, overloading by organic substances can lead to eutrophic conditions and damage to seabed communities.

Priority recommendations

a) Research and monitoring programmes should be broadened to include studies on the functioning of open soft bottom habitats, and the effects of resource utilisation.

b) Studies on the effects of pollution and sedimentation in these areas are urgently required.

c) Extraction of non-living resources should be more strictly controlled and licenced. Environmental impact studies should be conducted before licences are given. In Thailand urgent consideration should be given to the, often illegal, operation of tin dredgers.

d) Stricter pollution control is required, to avoid degradation of open soft bottom habitats.

e) More effective watershed management is required to avoid sedimentation in coastal waters.

Enclosed Soft Bottom Habitats

Character and extent

Enclosed soft bottom habitats include coastal lagoons, mudflats, sandflats and estuaries, and lagoons associated with coral reefs. The enclosed coastal habitats may be closely associated with, and grade into, mangroves. They are found in areas where rainfall is high and there are gently sloping or low-lying plains adjacent to the sea. Small lagoons associated with coral reefs occur sporadically throughout the region.

Conservational status

Enclosed soft bottom habitats are often included in coastal reserves where the major element is mangrove forest (see below). There are also several mudflats and estuaries which have conservational status as bird reserves (see below). In Thailand, extensive coastal mudflats occur at Khao Sam Roi Yot.

Human and economic value

Enclosed soft bottom habitats are rich in edible species, particularly bivalve molluscs, crabs, and fish such as pomfrets and mullet. Lagoons are suitable for culture of fish, crustaceans and molluscs.

Targeted exploitation

Estuaries in particular provide areas of high productivity, and are associated with a high fishing effort. Hanson and Koesoebiono (1979) report that in estuarine waters downstream from Palembang in Sumatra, one third of all family income is derived from fisheries. Four fish species have been mentioned as being of particular importance in estuarine fisheries. These are Hilsa toli, Ilisha elongata, Setipinna taty and Lutjanus lutjanus.

In some areas, notably north Java, south Sulawesi and Sumatra, tambaks or coastal empoundments, are important for fish production, especially Chanos chanos and more recently, Tilapia, as well as the catfish Puntius javanicus. In these fisheries, the fry are generally wild caught for stocking the ponds. Fry

may suffer 80 - 90% mortality during transport from their places of capture to the tambaks. It is not clear to what extent wild stocks are over-exploited, if they are at all, for this fry production. Much of the management of these ponds is devoted to promoting the algal mat growth on the pond bottoms for food (Soegiarto & Polunin, 1982).

Incidental exploitation

In general, it is difficult to distinguish between incidental and deliberate catches in such areas. In tambaks, there are one or two crustacean species (e.g. Scylla serratus) which are naturally occurring, and are taken when found. Estuaries also play an important role as nursery grounds for many commercially caught fish species, notably Lates calcarifer and Mugil sp..

Waste discharge and sedimentation

Enclosed soft bottom habitats suffer similar problems to open soft bottom habitats and mangrove areas, but these will probably be compounded by the accumulation of wastes and toxic compounds which is more likely to occur. In the Petchburi river, Thailand, an indication of the extent of damage due to pollutants is that now only 10% of the cockle farms produce yields within the normal range (Piyakarnchana, 1980).

Direct habitat destruction

Considerable areas of enclosed soft bottom habitats have probably been lost as a result of drainage, reclamation and dredging of harbours, but precise data are not available (see mangroves, below).

Management and conservation

There appear to be no specific policies or projects concerning this habitat.

Priority concerns

The major impacts on enclosed coastal habitats derive from land based activities. Habitat degradation through pollution and habitat destruction from reclamation and change of use appear to be the major problems.

Priority recommendations

a) Research and monitoring programmes on mangroves should include studies on enclosed soft bottom habitats.

b) Important mudflats, estuaries and lagoons should be identified, and conservation measures taken to ensure they are protected and managed.

c) Stricter pollution control is required, to avoid degradation of enclosed, soft bottom habitats.

d) More effective watershed management is required to avoid sedimentation in these vulnerable habitats.

Mangroves

Character

The mangrove forest is a complex and diverse ecosystem in which live a wide range of plants and animals. For example, 38 species of mangrove tree have been recorded in Indonesia, 80 species of large crustacea, and 65 species of mollusc (Soegiarto & Polunin, 1982). A list of mangrove and associated species found in ASEAN countries is included in the FAO/UNEP regional report on mangroves (Gomez, 1980b).

Mangroves show distinct zonation patterns from the seaward to the landward edge, and the communities are generally named after the dominant species. A typical zonation from sea to land in Peninsular Malaysia is Avicennia followed by Sonneratia, then Rhizophora and finally Bruguiera mixed forest (Gong et al., 1980). There are, however, many regional variations. No specific classificatory scheme has been universally adopted by the East Asian countries (Gomez, 1980b).

Occurrence and extent

Mangrove forests occur in estuaries and deltas, and also form narrow strips along the mainland coast or on islands, often to the landward side of fringing coral reefs. Distribution of mangrove is shown in Figure 1. The area of intact or relatively undisturbed mangrove in each country is estimated as follows:-

Thailand	312,714ha	(Piyakarnchana, 1980)
Malaysia		
Peninsular	113,260ha	(Sasekumar, 1980)
East	538,959ha	(Sasekumar, 1980)
Singapore	1,800ha	(MNS, 1984)
Indonesia	3,806,119ha (77% in Irian Jaya)	(Salm & Halim, 1984c)
Philippines	146,139ha	(NEPC, 1983).

Conservational status

Thailand: Mangrove is an important element in the Tarutao National Park in southwest Thailand, and is found in 9 other parks and reserves.

Malaysia (Peninsular): Two reserves were set up around 1969, and are administered by the Forest Department. These are Sg Miang Forest Reserve, Pahang and Pu Kecil Forest Reserve, Perak.

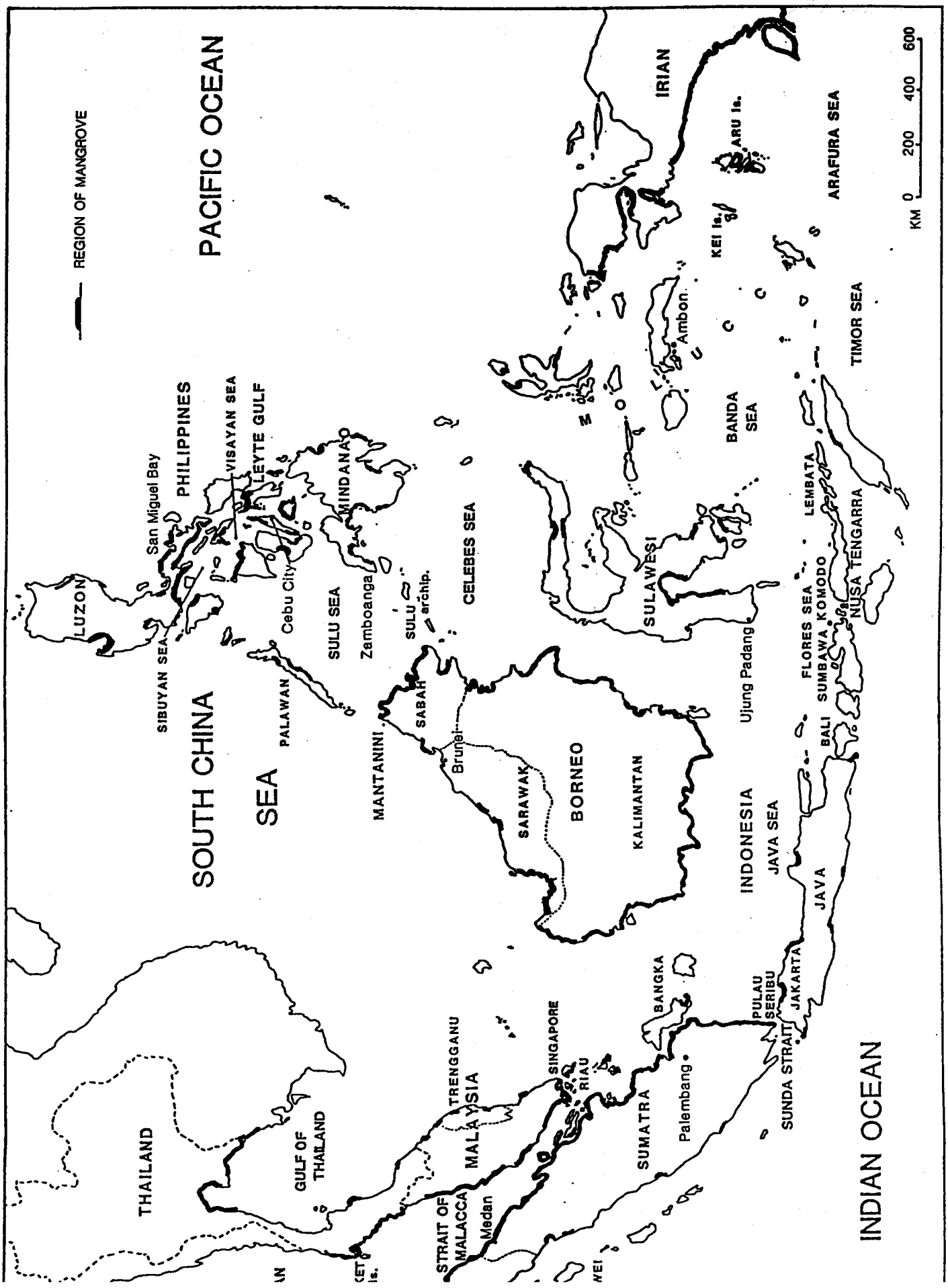
Malaysia (Sabah): The Klias National Park was gazetted in 1978 (an area of 38,900ha), administered by Sabah National Parks. This was degazetted in 1980 for timber exploitation and regazetted in 1981 as a commercial forest reserve (pulp and paper mill, plantation forest).

Malaysia (Sarawak): Mangrove is included in the Bako National Park, administered by the Forest Department.

Singapore: In 1951, when the Nature Reserves Ordinance was enacted there were two mangrove reserves (total 240ha), but these areas have subsequently been released for industrial development and the construction of a reservoir. Efforts are being made to set aside an area of mangrove as a Nature reserve/public park "before it is all gone" (Wee, 1984).

Figure 1.

Distribution of major mangrove areas in the East Asian Seas region.



Brunei: Selirong Forest Reserve (Strict Nature Reserve), established in 1948, and Labu Forest Reserve (Strict Nature Reserve), established in 1954.

Indonesia: There are 31 reserves which have the protection of mangroves as a principle aim (Salm & Halim, 1984c), and a further 9 proposals for mangrove reserves have been approved by regional governors. 58 of the proposed marine protected areas will include mangrove (Salm & Halim, 1984b).

Philippines: There are apparently no fully protected mangrove areas in the Philippines.

Human and economic value

Mangroves are of immediate value to many coastal dwellers, and of economic importance for a wide variety of commercial enterprises. For example:

Forestry production: mangrove trees are a source of timber/chipwood/pulpwood for the home market and for export (e.g. to Japan). Trees are utilised for firewood, fishing stakes, house posts, thatch, etc., by local people (Krishnamra & Prachaksilp, 1979). In Indonesia the combined export and domestic value of mangrove forestry products in 1978 was about US$26 million (Salm & Halim, 1984c).

Fisheries: mangrove is a source for prawns, crabs and other shellfish, and a spawning and nursery area for many commercially important species of fish and prawn. In the Philippines, the major fishing grounds are generally located near areas bordering mangrove swamps (Gomez, 1980b), thus suggesting that the presence of mangroves enhances fish production. Mangroves are ideal areas for aquaculture (especially of molluscs, crustaceans and fish). In the Philippines, aquaculture is reported to generate a higher income than any of the other activities utilising mangrove directly (NEPC, 1983). In Indonesia, the combined exports and domestic value of mangrove-linked fisheries products in 1978 was at least US$194 million (Salm & Halim, 1984c).

Recreation/tourism/education: mangrove habitats are characterised by an interesting and unusual array of plants and animals, which are of unique interest.

Coastal protection: mangrove trees consolidate soft substrata and reduce riverbank and coastal erosion.

Sediment traps: mangroves trap silt, thereby reducing sedimentation in nearby coastal waters e.g. on coral reefs (Soegiarto, 1980a).

Targeted exploitation

Exploitation of mangrove in Thailand is haphazard south of the Bay of Pharignga, but a 30-year silviculture cycle is practiced from Ranong to Takiopa. In Malaysia all mangroves are said to be exploited according to the 'Dixon' 30-year cycle plan. In Indonesia, Riau is the centre of a charcoal industry, exporting to Hong Kong and Singapore (McNae, 1974). In 1976, 27,000 tonnes of charcoal were produced in Riau, together with 12,000m^3 of firewood and 63,000m^3 of pulpwood. In Java, few mangroves remain, whilst in the lesser Sunda Islands,

mangroves are restricted and are probably only used for purely local needs (McNae, 1974). Regulations governing the exploitation of mangroves in Indonesia indicate that a 50-200m green belt should be retained along the coast for environmental and fisheries protection. At present many forestry companies in Indonesia follow a 30-year cycle.

In recent years, gas has replaced charcoal as a cooking fuel in some places, but mangroves are now used for other purposes (Soegiarto, 1980b). In 1974, the Chipdeco company started using a 85,000ha mangrove site in East Kalimantan for chipwood production. The Gowa paper mill in South Sulawesi also utilizes mangrove wood for paper production (Soegiarto, 1980b) and in Sabah too, mangroves are being used for chipwood manufacture. Here, Japanese timber companies are said to be practicing a clear felling programme with no respect for silviculture practices (McNae, 1974). A great number of traditional uses have been made of mangrove areas. Bruguiera cylindrica is used for making pilings for tin washing plants in west Malaysia (McNae, 1974). Throughout the area Nypa is also used for alcohol production. Building materials, food and animal fodder have all been derived from mangrove areas.

Sergestid shrimps (Acetes spp.) are an important mangrove-associated resource in southern Thailand, Malaysia and Indonesia. They are caught in large numbers in mangrove creeks, pounded, fermented and spiced, to be made into belachan or shrimp paste. Although the value of this product is difficult to assess, it is clearly an important resource. In addition, the giant swimming crab, Scylla serrata, is found in mangrove swamps and is considered a delicacy. These crabs are caught by fishing them from their burrows by hooks on long wires. Many of the molluscs found in mangroves are also eaten from place to place including the bivalve Geloina and the larger Potamidids.

Incidental exploitation

Incidental exploitation of this resource is difficult to define. In the broadest sense, a number of exploited species are incidentally affected by mangrove exploitation. The freshwater prawn, Macrobrachium rosenbergii, which is exploited in western Malaysia, Thailand and Sumatra spends its juvenile stages in brackish water, such as mangrove swamps. In addition, the marine prawns Penaeus merguiensis, Metapenaeus monoceros and Metapenaeus brevicornis are all partly dependent on mangroves during their juvenile stages, and their productivity has clearly been related to existing mangrove areas (McNae, 1974; Unar & Naamin, 1984). Some fish species such as Chanos chanos, Mugil spp. and Lates calcarifer also rely on mangroves during juvenile stages to some extent (McNae, 1974).

Oil industry

Mangroves are particularly susceptible to oil because it can clog the pneumatophores. Extensive defoliation and death of mangroves occurred in the Strait of Malacca following an oil spill there in 1975 from the 'Showa Maru'. A survey of the area two and a half years after the spill revealed that sheltered bays had been more severely damaged than more exposed shores. Dead mangroves occurred in pockets, suggesting that they had been killed by the stranding of slicks at that particular tide level. The occurrence of dead and damaged mangroves was associated with comparatively low numbers of crabs and snails, and comparatively high petroleum hydrocarbon residues in the sediments. Low levels of seedlings were present, indicating that re-colonisation was at an early stage (Baker, 1982).

Waste discharge

Various types of wastes are known to reach coastal habitats, particularly via rivers and from the land (see 'Open soft bottom habitats' above). The direct and indirect effects of pollution on mangroves in the region are poorly documented, although mangrove areas in Java are reported to be affected by industrial pollution (Soegiarto & Polunin, 1982). It is generally assumed that critical pollutants will accumulate and damage the biota and habitat.

Sedimentation

It is thought that mangroves will be damaged by high levels of man-induced sedimentation, but at present no data are available.

Direct destruction

Mangroves are cleared, drained and filled for human settlements, and commercial, agricultural and industrial development. They are also cleared and converted into fish ponds. For example, in the Philippines, the area of mangrove has decreased from 418,990ha in 1967 to approximately 146,139ha in 1978 (NEPC, 1983), and there are reports that the conversion of mangrove areas to fishponds is growing at an alarming rate (Gomez, 1980b).

In Indonesia, nearly 200,000ha of mangrove forest was converted into agricultural land from 1969-1974, and a further 500,000ha lost during 1974-1979 (Soegiarto, 1980a). In Singapore 10%-12% of the total land area used to be mangrove, but only 3% now remains (MNS, 1984). Tin mining appears to be responsible for most of the mangrove losses in Thailand, followed by conversion for salt production (Piyakarnchana, 1980).

Destruction of mangrove may have secondary effects on other habitats; for example, increased siltation on nearby coral reefs and reduction in coastal fisheries production.

Habitat destruction

Mangrove habitats may be destroyed and degraded in a number of ways:

Forestry related activities: little is known about either the ecological effects of cutting and collection of wood and other mangrove products by villagers for local use, or the long term effects of commercial exploitation, but considerable areas of mangrove forest may be at risk, For example in Sabah (East Malaysia), 40% of the total mangrove area is subject to special licences for the production of wood chips for export to Japan, and there has been interest in exploiting the remaining 60% (MNS, 1984).

Fisheries related activities: normal fishing in undisturbed mangrove does not appear to have any adverse effects on the ecosystem (Gomez, 1980b), but the use of explosives, poisons and fine nets cause damage to juvenile and non-commercial fish as well as other organisms.

Small scale aquaculture projects have localised effects on mangrove habitats.

Poisons are often used to kill predators and other life in fishponds prior to stocking. These may be flushed out and cause damage to tidal flat communities (Velasco, 1979).

Other activities: mineral extraction causes habitat destruction in some places. For example, in Thailand approximately 12% of the mangrove has been utilised for tin mining and this is causing considerable damage to the surrounding mangrove stands (Kongsangchai, 1984).

Management policy

Mangroves fall into a number of management categories, which broadly apply to all East Asian countries:

Strict management policies are developed for pristine forest reserves. These reserves are generally under the jurisdiction of the relevant Forest Department or National Parks Authority, with conservation of wildlife and habitat as the primary objective.

Mangroves considered to be suitable for long term use as productive forest are designated as Forest Reserves and come under the jurisdiction of the Forest Department. Within the reserves, silviculture management programmes are generally imposed on operators, and include measures such as selective cutting, rotation of cutting area, alternate strip cutting, replanting and shelter-tree saving.

Some mangrove is under native rights. Subsistence use of mangrove is generally unregulated.

Areas of mangrove leased for logging and other purposes may be governed by specific policies. For example, the Indonesian government, through the Department of Agriculture and the Directorate General of Forestry, has regulated the felling of mangrove forests. A 50-200m green belt has to be retained along the coast, in order to preserve the ecological function of mangroves and ensure natural regeneration (Soegiarto, 1980a). Similarly, in the Philippines, a belt of not less than 10m facing the sea must be excluded from fishpond construction (NEPC, 1983).

Existing management practice

Where policies for mangrove management have been formulated they are not always successfully implemented. This appears to be partly because of 'rampant violations' by commercial operators (NEPC, 1983) and partly because of the difficulties in restricting access to mangrove areas and preventing unauthorised use of resources.

Recent and current conservation projects

Considerable attention has been given to mangrove ecosystems within the ASEAN region. Detailed national reports and an overall regional report on 'The Present State of Mangrove Ecosystems in South East Asia and the Impact of Pollution' were published by FAO/UNEP in 1980 (see Gomez, 1980b - Regional; Piyakarnchana, 1980 - Thailand; Sasekumar, 1980 - Malaysia; Soegiarto, 1980a - Indonesia). These reports included recommendations for further projects.

Each of the ASEAN countries is carrying out mangrove research projects, but there is generally a bias towards those related to exploitation techniques. Environmental/conservation projects were included in the Draft East Asian Seas Action Plan but have yet to be funded.

Salm (1984c) urges that Indonesia should adopt a wetlands policy, which would include the following elements:-

a) A mangrove 'greenbelt' of 20m width should be declared throughout the country.

b) Mangroves should be classified into deltaic and estuarine mangroves, including those bordering rivers and estuaries, which would be protected in a natural state to safeguard fisheries from 50m inland of the high waterline at spring tides (HWLS); and fringing mangroves including those along sea coasts in association with fringing reefs, which would also be protected for fisheries up to 50m from the HWLS. The remaining mangroves beyond the 20m greenbelt could be allocated for forestry-related activities.

c) Urban, industrial and agricultural developments should be sited not less than 50m from rivers draining into protected wetlands, and they should be subject to stringent pollution controls.

d) Filling, draining or alteration of intertidal lands should not be undertaken without prior survey by PHPA to determine their value to commercial species, such as milkfish fry, or to migratory shorebirds. In cases of conflict precedence should be given to the preservation of natural values.

Priority concerns

a) A high proportion of mangrove forest has been, and continues to be, destroyed for timber extraction, aquaculture, mining, agriculture, housing and other uses. The long term environmental and socio-economic repercussions are predicted to be considerable, but are not given due consideration because of powerful economic forces favouring immediate utilisation of mangrove areas.

b) Loss of productivity and habitat damage may be occurring within forest reserves. Theoretically, the extraction of mangrove forest products does not cause any permanent damage or irreversible imbalance in the mangrove ecosystem, as long as it is done within the limits of conservation programmes (Gomez, 1980b). However, in one of the best managed mangrove areas in the East Asian region (Matang forest, Peninsular Malaysia) there has been a definite decline in timber production (Gong et al., 1980). There are no records to indicate if there has been a decline in the fisheries productivity of the mangrove.

c) Mangroves are probably being degraded by pollution and sedimentation.

Priority recommendations

Management and conservation. In view of the rapid rate at which mangroves are being lost or degraded it is recommended that national governments should:-

a) Take immediate steps to radically reduce the amount of mangrove being released for development until more is known about the state of mangrove resources and the environmental impact of destroying this ecosystem.

b) Seek to establish more fully protected mangrove areas and develop management plans for them.

c) Identify priority degraded areas for re-afforestation.

d) Ensure that existing policies and legislation relating to the mangrove environment are more strictly enforced.

Research projects with environmental emphasis. As a result of the FAO/UNEP study on mangroves, a number of projects were recommended, and priority given for the following (Gomez, 1980b):-

a) Effects of organic effluents on mangrove aquatic communities.

b) Bioassays of pollutants on mangrove biota.

c) Effects of destructive factors on mangrove forests and soil quality.

d) Impact of mangrove forest utilisation on the fisheries in the surrounding waters.

Two projects were included in the draft East Asian Seas Action Plan, but apparently have not yet been funded:-

a) Survey of the state of mangrove resources.

b) Study of the effects of pollutants and destructive factors on mangrove communities and related fisheries.

It is recommended that these studies are carried out, since they will provide invaluable data on which management and conservation plans for mangroves can be based.

Seagrasses

Character

Thirteen species of seagrass have been recorded from Indonesia (Soegiarto & Polunin, 1982). Thalassia hemprichii is cosmopolitan and generally dominant, but species such as Halophila ovalis is also common. Enhalus acoroides grows best bordering mangroves and lagoons, or in bays, and is usually dominant in such situations. Thalassodendron ciliatum is typical of clear water on the outer reef flat (Soegiarto & Polunin, 1982).

Occurrence and extent

The distribution of seagrasses in East Asian countries has not been mapped, but they are known to grow primarily on shallow sandy substrates and reef flats. Plants may be fairly widely scattered or occur in dense stands.

Conservational status

Seagrass areas are included in various reserves, but not as the major element.

Human and economic value

Seagrasses are highly productive. They are mainly of secondary importance, as areas for young fish, and foraging grounds for food fish (e.g. lutjanids and lethrinids), dugongs and turtles (Soegiarto & Polunin, 1982).

Targeted exploitation

Direct exploitation of seagrasses is limited to the seeds of Enhalus acoroides in Indonesia which are eaten by some coastal people (Soegiarto & Polunin, 1982). However, there are a very large number of marine algae (782 species in Indonesian waters) many of which are associated with seagrass beds, and are exploited. Marine algae are widely harvested for food, medicine, agar-agar production and agricultural fertilizers. 5,945 tonnes of seaweeds were harvested in Indonesia in 1979 and in many areas these are thought to be fully exploited already.

Within seagrass beds, a number of fish species and many of the molluscs are directly exploited as food. Such fisheries are small scale in their nature and detailed data are not usually available on catches.

Incidental exploitation

Due to the lack of detailed catch data the nature of incidental catches from seagrass beds is poorly known. However, wherever large meshed nets are used over seagrass beds Green turtles and possibly Dugongs seem likely to be caught to some extent. It is also worth noting that sea grass beds are used by some fish species as nursery grounds (e.g. Siganus, Mulloides and Upeneus).

Oil/waste/sedimentation

Seagrasses require high water quality for optimum production and are known to be vulnerable to increased turbidity, sedimentation and pollution. However, no reports relating to degradation of seagrasses in the East Asian region have been found.

Management and conservation

There are no reports of specific management policies or conservation projects on seagrasses within the East Asian region, but 9 of the proposed protected areas in Indonesia have seagrass beds as a major component (Salm & Halim, 1984b).

Priority concerns

The main concern is the possibility of degradation as a result of sedimentation and pollution.

Priority recommendations

a) National studies on the extent and condition of seagrass beds should be made for incorporation into data altases.

b) A regional group should be set up with a view to identifying priority environmental research topics for seagrass areas, and formulating management policies.

Rocky Substrates and Shores

Character and extent

Various types of rocky substrates occur within the East Asian region, from limestones to hard volcanic rocks. Rocky areas are widespread throughout the region.

Rocky shorelines are relatively impoverished, but subtidal rocks provide a suitable substrate for coral growth. Rocky cliffs are often important nesting and roosting sites for seabirds.

Conservational status

Rocky substrates and shores are included in various coastal and marine reserves, but as an element of minor conservational interest.

Human and economic value

Rocky reefs are fished for crustaceans and fish, and oysters are taken from rocky outcrops.

Targeted exploitation

Specific information on exploitation of rocky areas is lacking. As elsewhere, handlines are likely to be the principal gear type, and groupers and other large perch-like fish the principal species.

Incidental exploitation

There are no specific data on incidental catches on coral reefs. Again, wherever nets are used, Hawksbill turtles may be taken but this is not known to be a particular problem despite being an area in which Hawksbills are deliberately exploited so heavily.

Impacts/management

No data are available on human impacts or conservation activities.

Concerns and recommendations

Rocky substrates and shores do not appear to be in particular need of conservation action.

Coral Reefs

Character

Coral reefs support a wide variety of invertebrates, fish and other marine life. The South East Asian area is generally considered as the faunistic centre of the Indo-Pacific region and, although exhaustive studies have yet to be completed, it is clear that diversity of reef and reef-associated species is higher here than in reef areas to east and west. Over 400 species of hard coral are thought to occur in Philippine waters, while approximately 360 species have been reported from the Great Barrier Reef. There is, however, considerable variation within the East Asian Region according to environmental factors and geographical location. For example, 174 species of hard coral (47 genera) are reported from the southern part of the east coast of Peninsular Malaysia (De Silva et al., 1980), 38 species (20 genera) from the Strait of Malacca (Pillai & Sheer, 1976), 60 species (22 genera) from the Gulf of Thailand, and 250 species from the Spermonde archipelago off Sulawesi (Moll, 1984).

The state of knowledge of the associated reef organisms varies from group to group and country to country. The important taxa have been fairly well studied, particularly the fish, molluscs, crustaceans and echinoderms, but faunistic and floristic studies on coral reefs are in short supply (Gomez, 1980a).

The majority of reefs in the East Asian area are fringing reefs, but bank reefs, patch reefs, barrier reefs and atolls also occur.

Occurrence and extent

The distribution of reefs is shown in Figure 2.

The best developed reefs in Thailand are fringing reefs associated with islands off the west coast which are a southerly extension of the Mergui archipelago. Shallow fringing reefs are found off the Thai coast in the Gulf of Thailand, but coral growth is restricted because of turbid conditions.

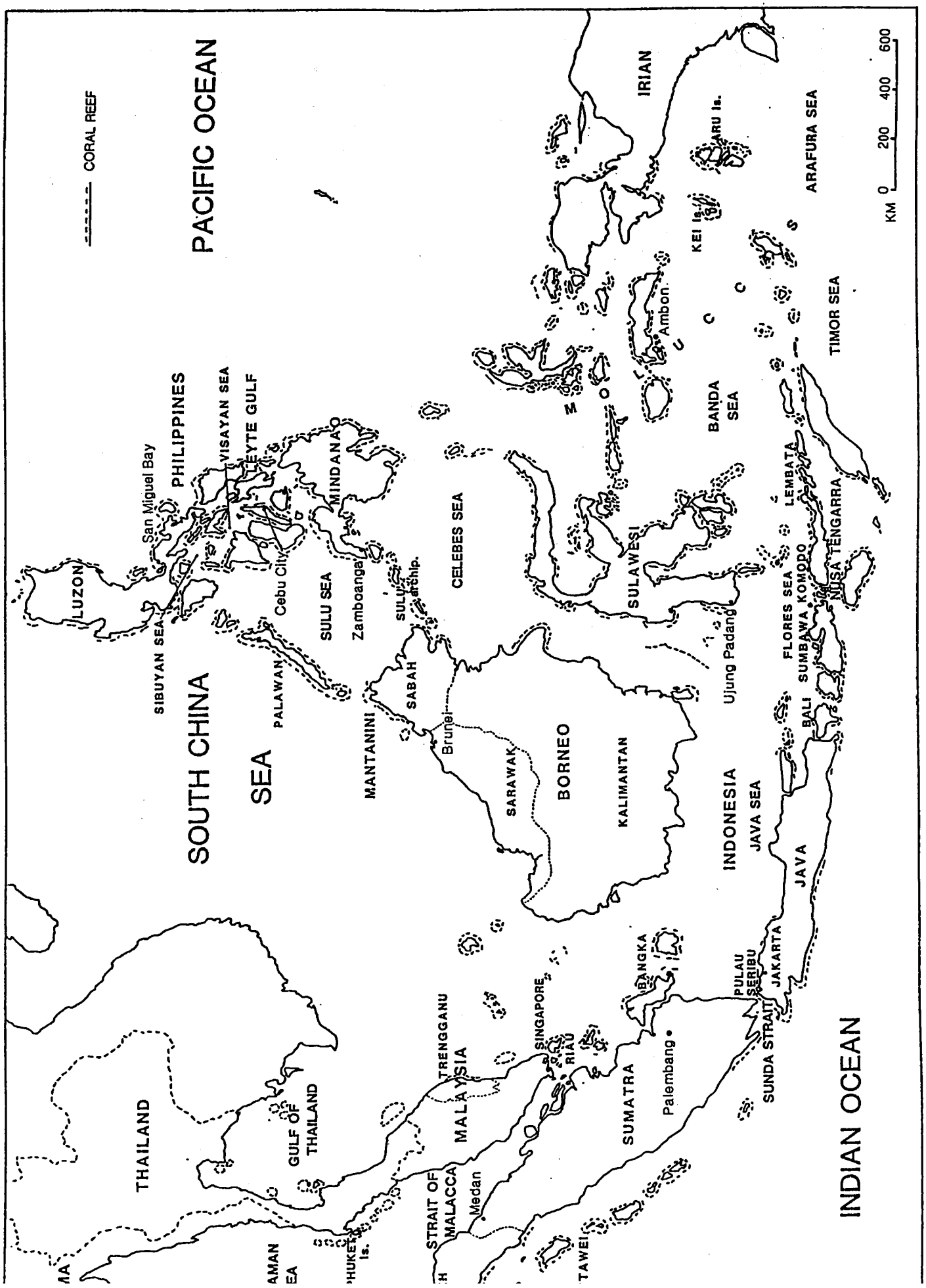
Similarly, most of the reefs of Peninsular Malaysia fringe offshore islands, and there is relatively little development along the mainland coast. The east coast islands have more extensive reefs than those off the west coast in the Strait of Malacca, and reefs in both areas are shallow.

In East Malaysia (Sabah) fringing reefs occur around the 40 or so islands lying in shallow coastal waters off the west coast, and there is restricted reef development along the mainland coastline. Off the southeast coast of Sabah, at the western end of the Sulu archipelago, there are extensive fringing and patch reefs and a small barrier reef associated with offshore islands.

In Indonesia the most prolific reef development is towards the eastern end of the archipelago, but reefs also occur off Sumatra and islands in the Java Sea. In particular they fringe parts of the southern coastline of Java, the chain of islands lying off the west coast of Sumatra, and islands in the Java Sea. The archipelago beyond Java to the east, including Bali and the islands of Nusa Tenggara, support many reefs. In Sulawesi the main reef areas are off the northeastern and eastern coastlines. Taka Bone Rate atoll, the largest atoll in Indonesia and one of the largest in the world, lies between Sulawesi and Flores. It has an area of 2,220km^2 and is a complex system of patch reefs, barrier reefs and faroes (UNDP/FAO, 1982c). The Moluccas consist of numerous islands with a total coastline of about 10,000km, much of it fringed by reefs. Reef development in Irian Jaya is mostly restricted to islands off the north coast.

Figure 2.

Distribution of major coral reef areas in the East Asian Seas region.



In the Philippines fringing reefs are associated with many of the 7,000 islands that occur in the area. Negros and Palawan have particularly good reef development, and there are innumerable reefs to the south of Mindoro and in the Sulu archipelago. These include fringing reefs, patch reefs, barrier reefs and atolls.

Conservational status

Thailand: the main conservation area to include coral reefs is the Tarutao National Park, off the southwest corner of Thailand. It was established in 1974 and covers an area of 149,000ha. It comprises 51 islands and includes a number of fringing reefs. Coral reefs also occur in several other Thai reserves, and in the Similan National Park (Chansang, 1984).

Malaysia (East): two reef areas in Sabah which have fringing reefs and patch reefs as a major element have protected status. Both are off the west coast:

Tunku Abdul Rahman National Park, gazetted in 1974. An area of 4,931ha, including 5 islands.

Pulau Tiga National Park, gazetted in 1978. An area of 15,864ha, including 3 islands.

Singapore: no coral reef areas are protected, and the collection of reef organisms is not prohibited.

Indonesia: there are two terrestrial protected areas that have a seaward extension in which coral reefs are an important element. These are Tangkoko-Batuangus Strict Nature Reserve (Sulawesi) and Ujung Kulon National Park (West Java). Several other terrestrial protected areas with a seaward extension and a number of designated marine protected areas, include coral reefs, but were established primarily to protect other habitats.

Marine protected areas in which coral reefs are a major conservation element are:

Pulau Pombo Marine Park, Moluccas. 1,000ha, established 1973.

Pulau Banda Marine Park, Moluccas. 2,500ha, established 1977.

Pulau Kasa Marine Park, Moluccas. 1,100ha, established 1978.

Bali Barat Marine National Park, Bali. 77,531ha (coral reefs and marine waters 6,662ha), established 1982.

Kepulauan Seribu Marine National Park Java. 108,531ha, established 1982.

Pu Weh Marine Park, established 1982.

Coral reefs are included in at least 9 other decreed protected marine areas (Salm & Halim, 1984b).

Philippines: various marine parks and reserves have been established in the Philippines by Presidential Decree, but there is some confusion as to their status. Many of them are not recognised in the sense in which the IUCN defines them, and they have yet to be included in the system of National Parks within the Parks and Wildlife Division in the Ministry of Natural Resources (Wells, 1982). Sumilon Island Reserve, Cebu, established by Silliman University in 1974 is the only protected area in the Philippines to come under the category of a marine park. Other reserves and sanctuaries which include coral reefs are:

The Hundred Islands, Luzon.
Province and Islands of Palawan.
Puerto Galera marine Biological Station & Reserve, Mindoro.
Santa Cruz Islands, Zamboanga.
Apo Reef Marine Park, Mindoro.

Human and economic value

a) Food production. A major value of coral reefs in the region is for artisanal and commercial fisheries. The relative importance of these two types of fisheries activity varies, but the importance of coral reefs as providers of fish and shellfish for home consumption and local markets is probably underestimated (Gomez, 1980a).

Parts of the reef flat are suitable for aquaculture (e.g. molluscs, algae and fish), and this has been developed in some areas.

b) Source of non-food products. Reefs are a traditional source of limestone for building materials. A growing list of medicinal products are being produced from coral reef organisms, and many ornamental products are collected, from corals to molluscs and fish.

c) Tourism/education. Coral reefs attract visitors and bring employment to local people. At present there are probably relatively few visitors to the region in comparison with other parts of the world, but underwater tourism is well-developed in the Philippines, Indonesia (especially Pu Seribu, Bunaken Islands and Bali), and Thailand (Phuket).

d) Coastal protection. Coral reefs act as a wave buffer, and protect coastlines from erosion and storm damage.

Targeted exploitation

Numerous authors have pointed out that it is impractical to exploit coral reefs with modern fishing gear, but that they may be important in small scale traditional fisheries. Soegiarto and Polunin (1982) provide some statistics on reef fishery production. This accounts for 8-10% of the overall Philippines' fishery production, more than 20% in Sabah, while in Indonesia it may account for less than 5%, although the statistics are inadequate. These authors also found that 32 out of 132 economically important fish were reef-associated. In all, Indonesian reefs provide 156 species of useful fish, 120 of which are ornamental. In addition, molluscs, algae, spiny lobsters and Hawksbill turtles are also harvested from reefs.

A number of fishing techniques are employed for the capture of reef organisms. Many of the sessile organisms are taken by hand. Turtles are harpooned, caught in nets or spear-gunned. One specialised fishing technique is the muroami fishery, in which plankton-feeding caesiodids and herbivorous acanthurid and siganid fishes are driven into large nets by beating the coral with hammers and other metal objects to scare the fish. Explosives have also been used, especially around Pulav Seribu, Ambon and Komodo. Fish which are stunned by the explosion may rise to the surface to be caught by hand. Clearly both of these fishing methods are very destructive, and are serious conservation problems in their own right. Explosives have also been used extensively to provide building materials from reefs especially around Jakarta, southern Bali, Eastern Java and around Ujong Pandang.

The collection of ornamental fish is an important industry in many parts of Indonesia at least. In the Seribu Islands, extensive collection of reef fish has affected the community structure of reefs. This is also true in eastern Java, where poison may be used to collect the fishes. In addition, corals, shells, and black corals are all also exploited for the ornament trade. The Philippines in particular is a large exporter.

Oil industry

At present there have been no reports of major incidents involving oil spillage on coral reefs, although oil pollution is reported to occur on coral reefs in Indonesia (FAO/IPFC, 1976).

There are a number of areas where drilling for oil is taking place on living coral reefs. A study in the Philippines (Hudson et al, 1982) revealed an estimated 70-90% decreased in foliose, branching and plate-like corals in an iron-stained area of about 100m diameter around the well-head. This may be due to mechanical damage, and the influence of drilling muds.

Waste discharge

It is to be expected that corals and reef-associated organisms would be adversely affected by effluents containing sewage, pesticides, fertilisers, heavy metals and other chemical contaminants. The protection of corals and coral reefs throughout the region is provided for to a varying degree under existing legislation (see below). Clearly, coral reefs close to large population centres or industrial activity are particularly at risk, but at present there are few reports of reef damage related specifically to waste discharge.

At Phuket Island, reef invertebrates are reported to have elevated heavy metal concentrations as a result of tin mining residues (Brown & Holley, 1981). Howard and Brown (1984) stress that studies concerning the effects of realistically elevated metal concentrations on aspects of coral physiology, behaviour and reproduction are needed to form a basis from which to minimise the ecological impact of metallic discharge to the tropical marine environment. Pollution probably has a combined effect with siltation at this site and elsewhere.

Sedimentation

Corals are known to be damaged by heavy sedimentation, and silt suspended in the water is also detrimental because it cuts down light penetration and affects coral growth. Large scale siltation from deforestation is believed to be responsible for reef deterioration in much of the ASEAN region (Gomez, 1980a).

Coral reefs in the vicinity of Phuket island in Thailand have been found to be heavily damaged by sedimentation (Chansang et al, 1981), and reef damage off the east coast of Peninsular Malaysia is reported to be especially noticeable in bays adjacent to agricultural development (De Silva et al, 1980). Siltation is also a problem in Jakarta Bay, Java, and is a threat to reefs in the area (Salm, 1984c).

Direct habitat destruction

The main causes of reef destruction are removal of coral for buildings and roads, lime production or curios, and breakage of corals as a result of inappropriate fishing methods or general carelessness.

Removal of coral for construction and especially for lime production appears to be widespread throughout the ASEAN nations (Gomez, 1980a). In East Java, for example, there were reported to be more than 80 lime kilns in operation in 1979, burning at least 800m of coral per month (UNDP/FAO, 1979). Collection of coral for the curio trade occurs widely in the Philippines (Gomez, 1980a).

The prime cause of habitat destruction appears to be from fishing-related activities. Corals are damaged during collection of Tridacna and mother-of-pearl shells. They are smashed by muro-ami fishing techniques (see earlier), and broken off in order to disguise traps or act as bait. However, the most serious and widespread damage is caused by fish blasting, which not only kills fish of no commercial value, but may reduce considerable areas of coral to rubble (Wood, 1977). Damage to vast areas of coral on the Taka Bone Rate atoll in Indonesia (UNDP/FAO, 1982c), to the Tarutao National Park in Thailand (Alexander, 1983) and to reefs in East Malaysia (Wood, 1977), is attributed in part to fish blasting. Another fishing method that causes destruction is trawling too close to reefs. This is reported to have caused considerable damage in the Tarutao National Park (Sudara, 1981).

In Singapore, land reclamation and industrial development have affected almost all the reefs on the mainland shores and many on the 54 offshore islands. For example, those of the Ayer Chawan group have been reclaimed for a large petro-chemical complex (Chou, 1984).

Reef habitats are damaged by boatmen poling their boats and dropping anchors on corals, and by people walking over reefs and collecting curios. Reef encroachment occurs as a result of the construction of stilt houses, for example by Bajou people in Indonesia (Salm, 1984c). Corals are also broken or destroyed as a result of digging boat channels, constructing breakwaters and piers and dredging anchorages.

Recreation and tourism

In terms of overall numbers of visitors and total extent of reef, East Asian reefs are relatively unaffected by tourism, but some problems have arisen. There are reports of reefs being damaged by people standing or walking on coral, and by dive boats dropping anchor on delicate growths. Tourism may also increase the demand for curios.

In some places tourism has led to irresponsible development that is damaging reefs. For example, at Pu Petundang Besar in the Seribu Islands (Indonesia), a boat anchorage has been dredged off this resort island and a breakwater of coral blocks built (Salm et al., 1982a). At Puerto Galera

Biosphere Reserve in the Philippines curios are collected from reefs for sale to visitors, and filling material is collected to 'improve' resort beaches (Mendoza, 1981).

Other impacts

Damage to reefs from the starfish Acanthaster planci have been reported from several areas (Wood, 1977; Aziz & Sukarno, 1977; De Silva et al, 1980). It is not known whether these outbreaks result from human interference or are natural events.

Existing management policy

a) Overall policies. None of the East Asian countries has a detailed overall management policy for its coral reefs, but limited management is possible with regard to specific activities. Coral reefs are generally covered by fisheries legislation, and destructive methods of fishing such as use of explosives and poisons are not permitted. In Indonesia and Malaysia removal of live coral from the sea is restricted and may only be carried out by permit. This includes coral mining. In the Philippines a recent decree (1980) makes it illegal for anyone to possess stony corals for any purpose.

b) Protected areas. Management plans for protected reefs are being developed, but progress varies from country to country. The reef areas are generally designated before management plans have been prepared. At this stage the usual trend is to allow traditional fishing (sometimes only by permit), but to regulate other activities (e.g. collection of shells and coral by visitors).

Management plans have yet to be produced for protected areas in Thailand and Malaysia. In the Philippines there is little management, and tourism has priority over conservation at most sites. However, one of the aims of the National Parks and Reserves Development Programme for the Philippines is to formulate management plans for pilot sites. For example, Apo Reef Marine Park is now being managed by the Bureau of Fisheries and Aquatic Resources (BFAR), and they are implementing the management plan devised in 1979. BFAR are also becoming involved in the management of other sites. The exception is Sumilon Nature Reserve which is managed by Silliman University as a Strict Nature Reserve. Here, the collection of marine products (fish, shells) is prohibited within 100m of the shore.

Management plans have now been produced for some of the protected reef areas in Indonesia. Management policies involve demarcation of zones and limitation of various activities in order to avoid conflict of use (UNDP/FAO, 1982a,d). For example, at the Seribu Marine National Park three sanctuaries have been set aside, one specifically for coral reef (UNDP/FAO 1982a). It is suggested that management plans are reviewed annually to take account of monitoring studies and developing visitor and management needs.

Existing management practice

Overall - some efforts are being made to curtail damaging, and illegal, fishing activities on and around reefs, and unauthorised removal of coral. It appears, however, that authorities responsible for enforcement are not being particularly successful. For example, in Java, coral extraction for lime kilns is regulated to some extent but regulations are not adequately enforced (UNDP/FAO, 1979). Collection of corals occurs widely in the Philippines, even though the export trade is illegal (Gomez, 1980a), and fish bombers operate throughout the region without being apprehended.

Conservation areas - even management within reef conservation areas is proving difficult in practice, especially in remote areas where itinerant fishermen operate. For example, at the Tarutao National Park in Thailand the reefs continue to be degraded by trawling and dynamite fishing. Day-to-day management at Tarutao is carried out by park rangers, but they are few in number, inadequately equipped, and have had to face physical violence on a number of occasions (Alexander, 1983). Similar problems have occurred in the Moluccas reserves where activities such as walking and poling over the reefs, dragging traps over reefs, collecting molluscs and spearfishing have continued. This has apparently been due in part to the lack of regular patrols by park personnel (UNDP/FAO, 1982d).

Management is, however, proving successful at Sumilon National Fish Sanctuary in the Philippines, which is under local jurisdiction and managed by Silliman University. The fish sanctuary serves as a valuable reservoir of fish, and local fishermen's catch has increased since the reserve was established (Russ, 1984).

Recent and current conservation projects

Regional activity. A 'Status Report on Research and Degradation Problems of the Coral Reefs of the East Asian Seas' was produced in 1980 (Gomez, 1980a) as part of a cooperative FAO/UNEP project. Four topics with particular environmental emphasis were selected as future areas of research:

a) Effects of sedimentation from various causes on coral reefs.

b) Effects of blasting on the corals and the regenerative capacity of coral reefs.

c) Comparison of the productivity of stressed reefs with unstressed reefs.

d) Determination of the sustainable yield of coral reefs.

Following on from these recommendations, two projects have been funded as part of the UNEP Regional Seas Programme by UNEP and the East Asian Seas Trust Fund. These are:

a) Survey of the state of coral resources (EAS 4.1). To be implemented by the Philippines. The immediate objectives of this project are:

> To gather information on the location, extent, distribution, type, and dynamics of coral resources.

To determine the present state and rates of degradation of these resources.

To determine the socio-economic aspects of local populations that have a bearing on the state of the coral resources on which they are dependent.

b) Study of the effects of pollutants and destructive factors on coral communities and related fisheries (EAS 4.3). To be implemented by the Philippines. The immediate objectives of this project are:

To assess the nature, extent and levels in coral reef ecosystems of the different destructive factors, including pollution, siltation, excessive exploitation and blasting.

To determine the effects of these stresses on the biology and community structure of the major organisms.

To monitor the important physical and chemical parameters and the changes they may undergo due to the above stresses.

To correlate the degree of destruction of coral reefs with their productivity, with emphasis on fish production.

To consider the possibility of regeneration of these resources under varying stages of degradation.

To compare the responses and resilience of stressed and unstressed ecosystems.

To derive an understanding of the socio-economic profiles of local populations and how these have a bearing on the state of preservation or deterioration of nearby coral reefs.

Full details of these projects are given in the Report of the first meeting of the co-ordinating body on the Seas of East Asia, UNEP/IG.37/10, 1982.

Proposed conservation areas/national activity

Thailand: WWF/IUCN Project 1816 is in the process of gathering information on coral reefs within the Tarutao National Park, in order to formulate a management and protection plan. A proposal to assess the conservational status of coral reefs throughout Thailand was made to WWF in 1981. The work was to be carried out by marine experts at Chulalongkorn University in collaboration with the Fisheries Department and the National Environment Board of Thailand. This project has apparently yet to be funded.

Malaysia (Peninsular): A proposal has been made to establish a marine park at Pu Redang, off the east coast (Green, 1978).

Malaysia (East, Sabah): A proposal has been made to establish a marine park in the Semporna area, off the east coast, and a marine reserve at Pu Sipadan (Wood, 1981).

Singapore: Few undisturbed coral reefs remain in Singapore, and none has been proposed as a conservation area.

Indonesia: The conservational status of many coral reef areas was assessed during the first phase of the nationwide conservation programme from 1979-1984, and this activity is being continued in the next 5-year plan. Proposals have been made for 8 atoll sites, 4 barrier reef sites, 44 fringing reef sites, and 12 patch/platform reef sites to be protected (Salm, 1984c). P.P. Togian, Taka Bone Rata, Bunaken Islands and Karimunjawa have been identified as reef areas in urgent need of protection. An area of unique interest is the Teluk Cenderawasih-Kepulauan Auri region in Irian Jaya. The reefs here (patch, fringing, barrier, atoll, lagoonal) are unique because of their undamaged nature, large populations of giant clam Tridacna gigas, and abundance of commercial fish species which are fished out elsewhere in Indonesia (Salm, 1984c).

Salm (1984c) urges that Indonesia should adopt an overall coral reef policy which should include the following elements:

1. Use of explosives or poisons for fishing or other purposes should be prohibited.

2. Proposals for dredging of channels near or through reefs and the building of groynes, new piers and breakwaters over reefs should be subject to study and approval by PHPA.

3. Coral mining from submerged reefs should be prohibited with provisions for exemption where extenuating circumstances can be shown to warrant this, such as on small uninhabited islands with extensive reefs and no other building materials. Exemption should not extend to building of tourist accommodations or facilities, or for trade.

Philippines: The Marine Parks and Reserves Development Task Force is identifying coral reef conservation sites (NEPC, 1983). In addition, a number of studies are being carried out by the Marine Sciences Center (University of the Philippines), the Bureau of Fisheries and Aquatic Resources, and Silliman University, on topics such as the effect of siltation and blasting on reefs, and the regeneration of coral and development of artificial coral reefs (NEPC, 1980).

Priority concerns

There is considerable concern within the East Asian region about the extent to which coral reefs are being degraded or destroyed (Gomez, 1980a). Universal problems are:

a) Sedimentation.

b) Destructive fishing techniques, especially fish blasting.

c) Removal of coral for building and the curio trade.

d) Overexploitation of reef fauna, especially fish, molluscs and crustaceans (see Other Resource Species, below).

e) Pollution (e.g. oil, sewage); effects probably localised.

Priority recommendations

Management and conservation.

a) More effective watershed management is required to reduced sedimentation.

b) Existing management policies and legislation should be much more strictly enforced. This will require more commitment and resources from national governments.

c) National education/publicity campaigns should be launched to try and involve local communities in managing and protecting their reefs. This has worked successfully on Apo Island in the Philippines, where most of the destructive fishing methods have now ceased (White, 1984).

d) Greater priority should be placed on designation of protected areas, and overall zoning schemes (as on the Great Barrier Reef, which covers an area of 348,700km^2). The importance of coral reefs as resource areas cannot be over-estimated, yet they are almost completely unmanaged in the East Asian region. The experience at Sumilon Island (Philippines) has shown how effective management can be in terms of increased productivity of reef fish and other organisms. Salm (1984c) points out that in Indonesia the largest and least disturbed reef areas offer a good opportunity for the establishment of multiple use reserves along the theme of 'local resources for local people'. Management would be largely entrusted to the heads of local villages with a low level of supervision by PHPA.

Research projects with environmental emphasis.

Priority projects have already been identified and several have been funded, at least for the initial phases. Additional funding and support for these projects is important, and would allow national institutions and governments to commit themselves to the most critical studies. Useful information is contained in the report of the regional UNESCO/UNEP workshop 'Comparing Coral Reef Survey Methods', held in Thailand (UNESCO, 1983).

Demersal and Pelagic Fisheries

Character

The fisheries of the countries in the East Asian Seas are similar on several points. The high diversity of the resource, and the low dominance of any species or species group, results in a non-targeted, multi-species type of fisheries, especially in the demersal sector. For example, in a research trawl survey of the Java Sea, up to 200 species have been landed in a single one-hour haul, and a similar situation prevails in the Gulf of Thailand and the Malaysian waters (Martosubroto, 1982). (It should be noted that, because of the complexity of the fisheries and the great variety of species caught, most catch statistics group many species together, especially trash or low quality fish.)

A predominance of small-sized fish has led to a generalized use of very fine-meshed gears. Another important factor in terms of its repercussions on the fisheries is that the younger fish, which form most of the stock biomass for many species, are found in shallow waters. This implies that it is possible for artisanal fisheries operating in very shallow waters to significantly reduce the stocks, even if this is mainly by impairing recruitment to the stocks of older and longer fish. It also means that the commercial fisheries prefer to fish close to the shore, and to compete directly with the artisanal fishermen (Pauly, 1979). In the whole area, this situation has resulted in violent conflicts between the two groups, leading to governmental decrees that ban commercial trawlers from some inshore areas. In the case of finfish stocks, there is no distinction of habitat between the young and the adults, which makes the management of such fisheries problematic.

The relative importance of pelagic and demersal catches is very variable depending on the region studied, a result of the high geographical complexity of the East Asian Seas region. As an example, the demersal fisheries in the Java Sea (Indonesia) contributes about half of the total catch of this area, (Martosubroto, 1982) whereas in the northern Sulu Sea (Philippines) the anchovy fishery alone accounts for 70% of the catch (SCS, 1977). In Peninsular Malaysia, the demersal fish species constitute a slightly higher proportion of the catch than the pelagic species. On the west coast, in 1980, the demersal fraction was 34% of the total, and the pelagic 29%; on the east coast, the proportions were 50% and 38% respectively (SCS, 1982).

The number of species supporting the pelagic fisheries is quite large, but the main target species groups are the coastal tunas (Euthynnus Thunnus and Auxis spp), the mackerels (Rastrelliger spp), the king mackerels (Scomberomorus spp), the scads (Decapterus spp.), the anchovies (Stolephorus spp.), the sardines (Sardinella spp.) and the carangids.

In the Philippines, out of 65 species or species groups identified as being caught by the commercial boats, eight species account for 70% of the catch: six are pelagics of the list above and two, the Slipmouths and the Lizardfishes, are demersal (FAO, 1980a). In Thailand, half of the total landings are demersal fish of low quality, and pelagic fish production from the Gulf of Thailand contributed another 25%, the balance being composed of shrimps, cephalopods and other molluscs.

Status - PELAGIC FISHERIES

Tuna. In the Philippines, the catches of tuna have increased from 125,000t in 1979 to 240,000t in 1982. A great proportion of the catches by purse-seiners and ringnet vessels is composed of very small fish, including a significant quantity of very small Yellowfin (Thunnus albacares) and Skipjack tunas (Katsuwonus pelamis) (IPTP, 1984a). Since 1982, a decline in catch per unit of effort (CPUE) has caused some of the large purse-seiners to move to other fishing areas. Philippine waters are a nursery area for Skipjack and Yellowfin tunas (SCS, 1978a). Although it appears from international studies that the total stock of Skipjack of the western Pacific is not fully exploited, there are indications that Yellowfin tuna fishing over the whole area is catching close to its maximum sustainable yield (MSY). The relation of the small Skipjack and Yellowfin caught in Philippine waters to the stocks fished by other countries in the western and southwest Pacific is not clear, but there is some concern at the large numbers being caught. The present catches of Frigate (Auxis thazard) and Eastern little tunas (Euthynnus affinis) are considered to be below the potential levels (SCS, 1978a).

In Thailand, catches of small tunas (mainly Longtail (Thunnus tonggol), Frigate and Eastern little tunas) have been increasing rapidly: from 5,500t in 1972 to 40,000t in 1982 in the Gulf of Thailand, and from 1,700t to 9,600t in the Andaman Sea during the same period (IPTP, 1984a). Large tunas are caught occasionally. The increase in catch has been encouraged by the rapid growth of the canning industry. There are also current projects of development for the small-scale fisheries on small tunas in this country (Skillman, 1982).

In Malaysia, there is no fishery targeted on tuna per se, rather these species are caught as part of the multi-species, small-scale fisheries (Skillman, 1982). The catches, mainly of Euthynnus and Thunnus species, increased from 5,300t in 1971 to 17,370t in 1982 (IPTP, 1984b).

The Indonesian tuna catches have also shown a marked increase, from about 42,000t in 1971 to about 144,900t in 1982 (IPTP, 1984b). Most of the increase comes from the small tuna landings (Eastern little, Frigate, Longtail and Bullet (Auxis rochei) tunas); the production of Skipjack tuna has increased slightly, and it has been fairly stable for large tunas (Skillman, 1982). The proportion of juveniles in the catch is very low (White & Yesaki, 1982). From studies in the west Java fisheries, there is no evidence that the stocks of any tuna species are excessively fished. Rather, the catches at present are only limited by weather, gear and vessels (White & Uktolseja, 1983).

Spanish mackerel (Scomberomorus spp). Spanish mackerel are caught throughout the Philippines, and it is probable that the fish on the Pacific coast are all part of the same stock (SCS, 1978a). The catches in this country have been slowly increasing, with fluctuations, from 9,600t in 1970 to about 17,300t in 1982 (IPTP, 1984b). Most fish caught are large sized. It is unlikely that the stock as a whole is heavily fished (SCS, 1978a).

In Thailand, the bulk of the Spanish mackerel catch is landed from the Gulf of Thailand. After an increase in the early 1970's, the annual catch level is now fluctuating around 10-13,000t (IPTP, 1984b). Preliminary estimates of potential yield are now being made (Chillasorn, 1982), but this group of species is not thought to be fully exploited. The Spanish mackerel catch from Malaysia has also been steadily increasing from 7,700t in 1970 to 15,000t in 1980; it is now fluctuating around this last level (IPTP, 1984b). In 1981, about 79% of the catch was landed in Peninsular Malaysia, 13% in Sarawak and 8% in Sabah. The Indonesian production of Scomberomorus increased from about 29,000t in 1971 to 39,000t in 1974; then fell back to the 1971 level until 1980, and was about 42,000t in 1982 (IPTP, 1984b). This species group supports a targeted drift gillnet fishery, although trawls and hook and line boats land a significant amount (Skillman, 1982).

Chub mackerel (Rastrelliger spp). The total Rastrelliger catch from the Philippines has been decreasing progressively from 63,461t in 1976 to 47,387t in 1981 (FAO, 1983), even though the development of high-opening otter trawl in the region has caused an increase in the commercial catch (SCS, 1978b). The commercial fishery accounts for about 20-36% of the total landings. Mackerel fishing occurs mainly in the Sulu Sea, Visayan Sea and Manila Bay, but to a lesser extent throughout the area (SCS, 1976). The potential yield for this group has not been determined due to insufficient data.

Thailand achieves the largest annual catches among the South China Sea countries (SCS, 1978b), which have fluctuated between 70-80,000t in recent years, with a peak of about 118,000t in 1979 (FAO, 1983). Most of the catch is from the Gulf of Thailand, although substantial landings are recorded in the

Andaman Sea and Malacca Strait. It has been estimated that the Andaman Sea and the western part of the Gulf of Thailand have been over-exploited since 1975, whilst the eastern part, at that time, was likely to support increased catches (SCS, 1978b). In the same report, it was estimated that in Malaysia the mackerel stocks in east peninsular Malaysia and in Sabah were nearly fully exploited. The trend of catches since 1976 however has been a steady increase from about 19,000t to about 81,000t in 1981 (FAO, 1983).

The status of mackerel in Indonesia is variable; it has been estimated that it is over-exploited along northeast Sumatra, but only slightly exploited in west Kalimantan (SCS, 1978b). It is caught in most coastal areas with a few exceptions such as the east end of the Bohol Sea (SCS, 1977). The total annual catch has gradually increased from 61,647t in 1976 to 86551t in 1981 (FAO, 1983).

Round scad (Decapterus spp). The scad fisheries in the Philippines is an important one, with annual catch levels varying around 150,000t in the recent years. There appears to be considerable scope for increased catches in most coastal areas of the country, although there is too little data to assess the potential yield (SCS, 1977, 1978a). This fishery is thoroughly dependent on catching immatures; adults are not available, and supposed to live in deeper waters (SCS, 1978b).

In Thailand, the round scad was of minor importance until the mid-1970's, when the annual catch in the Gulf increased from around 500t in 1972 to a peak of 131,000t in 1977; it fell to a more stable 28,000t in 1979 (FAO, 1983; SCS, 1978b). The increase is mostly attributable to the development of luring purse-seining, and partially to the expansion of fishing operations in offshore waters in the Gulf of Thailand. The potential catch is estimated to be over 100,000t in the Gulf, and is undetermined in the Andaman Sea, although higher than the present level.

In recent years, the annual catch level of scad in Malaysia has stayed more or less constant around 20,000t (FAO, 1983). For the whole coastal area of the country, the scad stocks are thought to be moderately exploited, with a potential of 15000t/yr on the east coast of Peninsular Malaysia, and undetermined but higher than present catches elsewhere (SCS, 1978b).

In Indonesia, the only pelagic fisheries that are more or less targeted on one 'species' are those exploiting the round scad and the mackerel (Martosubroto, 1982). The northern Sumatra and Java waters are fished largely for pelagic species, and the scad there is fully exploited (SCS, 1978b; Martosubroto, 1982). In other coastal areas, such as the coasts of Kalimantan, the exploitation is slight, but the potential is unknown. The total annual catch level in Indonesia is currently around 70,000t (FAO, 1983).

Sardines (Sardinella spp) and anchovies (Stolephorus spp). Both species groups are common over the whole area of the Philippines, and high catches are reported from the Visayan Sea and the central regions of the Pacific Coast (SCS, 1976, 1978a). Although more information is needed about the catch and effort levels, there are no indications that the sardine stocks are over-exploited. The catch level has steadily increased since 1976 to about 136,900t in 1981 (FAO, 1983). For the anchovies, the only assessment has been in the Tayabas Bay area, where it is estimated that the MSY was reached at about 6,300t/year, and that the stock there is fully exploited and probably overfished (SCS, 1976). Assessment of other regions was not done, due in part to incomplete data, but an increase in catch seems possible. The total anchovy catch has been fluctuating in recent years around 75,000t.

In Thailand, both sardine and anchovy catches have been fluctuating in the last years, with a peak of 214,000t in 1977 for sardines and of 20,300t in 1980 for anchovies (FAO, 1983). The potential yields for sardines have been estimated at over 150,000t in the Gulf of Thailand and over 5,000t on the Indian Ocean coast; and for the anchovies, the potential is 20,000t and over 7,700t for the same regions (Latif, 1982). There thus seems to be a scope for increased catches, especially in the offshore waters.

Although there are regular surveys of pelagic resources in Malaysia, no assessments of these two species groups were available. However, a regular increase in catch of Stolephorus has been recorded from 14,500t in 1976 to 39,800t in 1981 (FAO, 1983).

In Indonesia main concentration of Sardinella is in the Bali Strait. The introduction of purse-seining in 1973 led to a rapid development of this fishery (Unar & Dwiponggo, 1982). In 1977, a limited number of fishing licences were issued, but by 1981 the catch level was 57,200t, well above the estimated MSY of 36,000t (FAO, 1983). There is other evidence of overfishing including the fact that the mean length of the catch has been decreasing.

Status - DEMERSAL FISHERIES

Demersal fishing on the Pacific coasts of the Philippines is restricted by the limited extent of trawlable areas, there being extensive hard grounds which are unsuitable. There are only two extensive soft-bottomed trawlable grounds in the region: San Miguel Bay and Leyte Gulf (SCS, 1978a). In San Miguel Bay, there had been a steady improvement of fishing methods, both in the municipal and the commercial sector since 1972, accompanied by a steep increase in effort. It would appear that the MSY of the demersal stocks was reached at the effort level of 1977-78, but the effort has continued to increase. Stock assessment models suggest that the Bay is overfished and that any increase in effort would not increase the yield (Smith & Pauly, 1983).

In Leyte Gulf, the commercial trawl catches have increased rapidly recently. However, there have been no data on fishing effort and therefore no potential yield indication for this area (SCS, 1978a). The narrow coastal strip of hard bottom with considerable coral growth probably supports a large quantity of demersal fish, including some highly valued ones. An improvement in fishing methods, for example using mechanical hauling systems for lines and traps, could lead to a considerable increase in catch, to about twice the 1976 level of 49,320t for the whole Pacific Coast (SCS, 1978a).

In the Sulu Sea, Bohol and Moro Gulfs, there are also vast areas of hard bottom where there is no evidence of full exploitation (SCS, 1977). It is thought that the catches of demersal fish on these grounds are very limited, and so is the potential for catch increase. The catch levels have been more or less decreasing in the late 1970's, mainly because of a reduced number of fishing vessels in the Palawan waters which is the most important trawling ground. The MSY does not appear to have been reached, and a production of 40,000t per year is possible.

The Samar Sea is thought to have been overfished since the early 1970's; the MSY level is probably around 8,000t per year (SCS, 1976). The Visayan Sea, a main trawling area, has an estimated MSY of at least 100,000t, which has probably been reached recently. Although the fishing effort has been increasing in the Bohol Strait the potential is not known.

In Indonesia, the Java Sea demersal exploitation has increased from 60,000t in 1970 to 138,000t in 1979 (Martosubroto, 1982). However, this increase has not matched the increase of the pelagic fisheries. The demersal fisheries accounted for 64% of the total catches in 1970, and only 42% in 1979. At that time, there were more than 600 trawlers in the Java Sea. Mechanisation of fishing vessels is responsible for much of the reported rise in production, often at the expense of traditional fishermen (Polunin, 1983). Although an overview of the Indonesian fishery indicates that available resources are not fully exploited, it should be noted that the fishing grounds in highly populated areas are in a serious condition. For example, the rapid development of the fisheries on the north coast of Java has led to exploitation which in 1976 was surpassing the MSY level of 67,000t for the demersal resource in the Java Sea (Martosubroto, 1982). In general, the resources in the Java Sea and the Malacca Strait have undergone a declining trend in yields (SCS, 1982).

The annual landings of demersal fish off the east coast of Peninsular Malaysia are far below the estimated MSY. However, the surplus yield is thought to be taken by foreign vessels (SCS, 1982). In Sarawak waters, there has been an increase in landings from 51,933t in 1974 to 77,070t in 1980. The MSY level was apparently reached in 1978, and the catch has been fluctuating around this level since then. Most of this catch is taken from shallow waters (less than 30m in depth) because the vast majority of the boats are either unmechanised or have small engines (less than 60 HP). The number of fishing crafts in Sarawak has increased from 4372 in 1974 to 7172 in 1980.

The possibility of an increase in demersal catch of the Sunda Shelf area from $2x10^6$t in 1979 to $2.7x10^6$t has been suggested. Such an increase could only be realised by increasing the effort in deeper waters rather than in the already over-exploited nearshore regions (Pauly, 1979). Good fishing grounds for vertical handlines have also been found in the South China Sea on the Vanguard, Riffeman and Prince Consort Banks and off Sabah (Anon, 1977).

Due to the introduction of the otter board trawl fishery to Thailand around 1964, the marine fish catches have experienced considerable increases from half a million tons in 1964 to one million tons in 1968, the catches then peaked at 2 million tons in 1978 and declined thereafter (SCS, 1982).

According to various estimations the total potential yield of demersal resources in the Gulf of Thailand varies between 250,000t and 714,000t, with an average of about 550,000t (Chullasorn, 1982). From demersal survey data in the Gulf, the CPUE has decreased drastically from about 300 kg/hour in 1961 to 50kg/hr in 1977, this trend is expected to persist (SCS, 1982). On the Indian Ocean coast, the standing stock of demersal resources in coastal waters is estimated at around 150,000t within 10-60m depth, and around 200,000t within the 90m depth contour. The best demersal catches in the Andaman Sea are found between 10-39m depths (Pokapunt, 1977).

There is some evidence that the composition of the catches has been changing as exploitation of demersal resources has increased for the area as a whole. The rapid decline of such important fishes as the Leiognathidae (slipmouths), a decline more rapid than that of the total catch, has been reported by Tiews et al., (1967) from the Gulf of Thailand and by Pauly (1979) from the Indonesian waters of the Malacca Strait. In the latter area, the proportion of trash fish in the catch has been increasing, from 28.8% in 1965 to about 50% in 1975 (Pokapunt, 1977).

Human and economic value

Because of the large number of small-scale fishermen in the whole area, the monetary value of the catches will not adequately reflect the economic importance of the marine fishery. In the Philippines, out of 750,000 fishermen, about 690,000 are in the small-scale sector (FAO, 1980a). More than one million people in Indonesia depend upon fishing for their livelihood (FAO, 1980b), and 85,000 in Malaysia (FAO, 1976). In Thailand, 72,000 fishermen were recorded in 1979, and 275,000 people are supported by the fishing industry (FAO, 1979).

With the exception of tuna and shrimp, most of the marine catch in each of these countries is consumed fresh locally, the remainder being dried or salted, and some of the demersal fish are processed as animal feed. The per capita consumption of fish in the whole area varies between 11.7kg/year (Indonesia) and 34.2% (Singapore) - fish is usually the main source of animal protein available (two thirds in Indonesia) (SCS, 1982). All the countries except Singapore are net exporters of fish products. The fishing industry contributes 3-4% of the gross national product in most of these countries, except Thailand (13.7%) and Singapore (about 0.2%). In the Philippines, fish products mainly tuna, are the biggest source of foreign exchange earning for the country, about US$83million in 1982 (SEAFDEC, 1983).

Targeted exploitation - PELAGIC FISHERIES

In the Philippines, the total fish production, which is dominated by pelagic species, has increased from 1.39 million tonnes in 1976 to 1.6 million tonnes in 1980 (SCS, 1982). The municipal sector contributes 55-60% of the total catch. Although disagreement still exists regarding MSY estimates of the total marine fish resource, there is concensus that municipal fisheries have most probably reached or surpassed their MSY (Smith et al., 1980). Most of the tuna is still landed by the municipal sector along all coastal areas which contributed 72% of the landings in 1977 (Gumasing, 1982). The most common gear in this sector is the handline, targeted at deep water and large sized Yellowfin tuna; the catch also consists of Bigeye tuna and billfishes. Other important gears are the gillnet, troll, beach seine and net traps. The commercial fishing is operated by a fleet of over 50 large purse-seiners and an undetermined number of smaller gillnet boats. The fleets are either Filipino-owned, part of a joint venture, or foreign-owned.

Depending on the region and the gear, non-tuna species account for different proportions of the catch. Whereas the handline and the troll catch mostly tunas, the ringnet fishery lands 8-44% of other species, and gillnets catch very few tunas (White & Yesaki, 1982). The main species groups are the scads (Decapterus, Selar spp), the sardines (Sardinella spp) and the rainbow runners (Flagatos bipinnulata). The round scad fishery, which was mainly operated with bagnets and luring until the early 1970's is now based on purse-seining with lights, a method found to be the most productive for these species (SCS, 1978b). The recent annual Round scad catches by purse-seining of about 150,000t are ten times the bagnet catches. The Sardinella catch figures often include from 5-25% of Round herring (Dussumeria sp.) (SCS, 1978a). Basnigs, ringnets and high-opening trawls are the most important gears in general (SCS, 1976). These same methods are also used in the commercial mackerel fishery, with the otter trawls contributing 60-70% of the total catch. Data from the small-scale sector were not available due to difficulties in record-gathering. This problem also applies for anchovy catches. The anchovy stocks are exploited mainly by bagnets and fish corrals in the Sibuya and Visayan Seas area (SCS, 1976). On the Pacific coast, 65% are caught by bagnets, and 11% by beach-

seines; when fishery for anchovies, some commercial trawlers (legally) attach a fine net to the end of their net, a procedure producing an almost pure catch of anchovies (SCS, 1978a).

In Thailand the tuna fishery is a minor component of the fishing industry, but the country is showing interest in expanding it (Skillman, 1982). The catches are dominated by Longtail tuna, although Kawakawa (Eastern little tuna) and Frigates are also important. The drift gillnets and the purse-seines are the main gear used in this region, the latter one having developed in the recent years (IPTP, 1984a). In the fishery, the main gears used in the Gulf are the Thai purse-seine and the encircling gillnet, accounting together for 60% of the catch there; luring techniques with purse-seining are developing rapidly (SCS, 1978b). In the Andaman Sea and the Malacca Strait, 50% of the catch comes from Thai and Chinese type purse-seines. The spread of luring methods with purse-seining also resulted in an increased exploitation of the round scad resources (Decapterus spp) in the Gulf of Thailand (SCS, 1978b).

In Malaysia, the tuna catch is part of a multi-species, small-scale fishery. This catch is a composite of Bonito, Little eastern tuna, Long-tail tuna and some billfishes (Skillman, 1982). The most important gears aimed at pelagic species are the purse-seines, which correspond to about 33% of the total seine units but to 90% of the total seine landings, and 35% of the total marine landings in 1980 (Latif, 1982). Relatively few species are landed, the most abundant being the mackerels (Rastrelliger spp), the anchovies (Stolephorus spp.), the round scads (Decapterus spp), the sardines (Sardinella sp) and the Hardtail scad (Megalapsus cordyla). There is a targeted fishery for king mackerel (Scomberomorus spp) with drift gill nets, although trawls and hook and lines contribute significantly to the catch. Other species caught by gill nets (about 8% of total marine catches) are mackerels, tunas (Thunnus/Euthynnus) and Wolf herrings (Chirocentrus dorab).

The pelagic sector of the Indonesian fisheries is the most important one in terms of catch levels. The tunas, anchovies, mackerels, sardines and round scads each accounted for between 5 and 8% of the total marine catch in 1979 (Polunin, 1983).

In 1979, the tuna landings in Indonesia were composed of 52% eastern little tuna (including Frigates, Bullets and Longtail tunas), 34% Skipjack and 14% of larger tunas (Thunnus spp) and billfishes (White & Yesaki, 1982). A pole and line fishery in the eastern coastal waters is targeted principally on Skipjack, as well as a surface drift gill net fishery in southwest Java; payang boats in southwest Java catch primarily Frigate tunas (White & Uktolseja, 1983). Probably 32% of the total tuna landings comes from trolls, 17% from pole and lines, 2% from long lines and 1% from purse-seines. The longline fishery is expanding, under the action of the government.

The largest catches of mackerel were taken with encircling gill nets in the South China Sea area, with set gill net, lift nets and purse-seines also contributing; the Malacca Strait landings are mostly by purse-seines. The Malacca Strait is where the majority of scad catches are reported, although recording of landings from small-scale fisheries needs to be improved (SCS, 1978b). The oil sardine fishery in the Bali Strait is mostly now a purse-seining activity, despite a wide variety of traditional gear still in use (FAO, 1977).

Targeted exploitation - DEMERSAL FISHERIES

The important reported fish groups in the South Asian Seas demersal catches are the slipmouths (Leiognathidae: 20.1%), the threadfin breams (Nemipteridae: 16.4%), the snappers (Lutjanidae: 10.4%), the lizard fishes (Synodontidae: 7.5%) and the drums (Scianidae: 7.4%) (Pauly, 1979). Reported catches tend to over-emphasize the high value large fish, and small low-value species are often not recorded.

The proportion of catches taken by artisanal fishermen in each country of the region is as follows: Indonesia 98%, Philippines 55%, Malaysia 23%, Singapore 29%, Thailand 13% (Pauly, 1979). Increasing importance of commercial fleets means that these figures are probably declining.

In San Miguel Bay, Philippines, 60% of the demersal catch of 15,000t per year is taken by about 5,100 small scale fishermen; the remaining 40% is attributable to the 95 trawlers in the Bay (Smith & Pauly, 1983). Most of these trawlers are also classified as municipal boats, which complicates the landings statistics. Gill nets are the most prevalent small-scale non-trawl gears in the Bay. Municipal boats fishing outside the bay commonly use hooks and lines (SCS, 1978a). This type of gear is used extensively throughout the Philippines in the large areas of hard grounds not suitable for trawling where it is responsible for over 50% of the catch. Much of the remainder is taken by fish pots and fish corrals (muro-ami) (SCS, 1977). In the Visayan and Sibuyan Seas area, 60-70% of the demersal catch is made by commercial trawlers, although handlining and bottom gill netting are also important (SCS, 1976).

The small-scale sector of the fishery in Indonesia contributes 76% of the total marine catch, most of which is taken from pelagic resources (SCS, 1982). The main gear used in the demersal fisheries, as in the other regions, are otter trawls, hook and lines, and fish traps. The trawl was introduced in 1970 and is responsible for the increase in demersal catch over the last decade. The most recent standing stock estimates from trawl surveys are 2-3.5tkm^{-2} in the Java Sea (Martosubroto, 1982). Fishing for demersal resources is limited to less than 40m depths, and is concentrated on the north coast of Java and in the Malacca Strait. In 1979, there were more than 600 trawlers in the Java Sea. A substantial portion of the inshore, small-scale fish catch consists of juveniles of the stocks whose adults are exploited by the larger offshore boats (Pauly, 1979; Martosubroto, 1982).

The otter trawl fishery accounted for 45% of the marine fish and prawns landed in Peninsular Malaysia in 1980 (Latif, 1982). There were about 6000 trawl units, mostly small boats, out of a total of 61,040 fishing vessels in this state, whereas Sabah had a total of 5,800 boats (SCS, 1982). The demersal catches are highly diversified. The more common species are the Nemipteridae (threadfin breams), the Sciaenidae (croakers) and the Serranidae (seabasses) and the Lutjanidae (snappers) (Latif, 1982). At present, the introduction and expansion of coastal aquaculture is thought to offer a better potential of production increase than the already highly exploited demersal resources in many areas.

Thai fisheries, in contrast to the other countries of the region, are dominated by commercial operations. Some 80% of the total 27,000 vessels are motorised. The most productive sector is the trawl fishery which yields over 60% of the total marine catch. Most of this fraction consists of demersal fish of low quality which are used mainly for fish meal and animal feed (FAO, 1979). The recent severe decline of CPUE in the Gulf of Thailand and the formation of exclusive economic zones by most surrounding countries has caused Thailand to seek joint ventures throughout the Indo-Pacific. These joint ventures are

necessary to supply the high fish demand in the country and the economically important trawler fleet. In the past five years, Thailand has arranged joint ventures with Malaysia, Bangladesh, India and Saudi Arabia (SEAFDEC, 1979, 1980, 1983; Fishing News Int., Feb. 1982). High priority is also given to aquaculture developments.

Existing management policy

In the Philippines, vessels larger than three gross tonnes are banned within 1km of the coastline; baby trawlers must stay in waters deeper than 7 fathoms (Smith & Pauly, 1983). In 1982, a presidential decree banned all commercial trawlers from San Miguel Bay. A closed season for sardines, herrings and mackerel has been declared in the Visayan Sea, from November 15th to March 15th (Smith et al., 1980). The commercial and baby trawlers are indirectly subsidized by the government because their diesel fuel is not taxed, contrary to the highly taxed gasoline used by the small-scale fishermen. The trawlers presently pay only a nominal licensing fee. The development programme of the Filipino government includes the creation of credit programmes, extension services with technical assistance to fishermen for gear and fishing practices improvement, sea farming projects, research on municipal fisheries development and a marketing programme (SCS, 1982).

In 1976, a new statistical system was put into effect on a frame survey procedure, for the estimation of tuna production by gear, species group and fishery effort from commercial and municipal sectors (Skillman, 1982). In 1981, a field study was undertaken on the magnitude and distribution of tuna stocks as well as on the character of the fisheries (White & Yesaki, 1982). Major on-going projects include an ADB project for the development of fisheries in Northern Palawan and aid from Japan for the construction and operation of five fishing ports (FAO, 1980a).

In Indonesia, the existing management regulations and projects are usually aimed at resolving economic and social problems throughout the fishing population rather than problems of conservation (Martosubroto, 1982). In 1976, some regulations were issued delineating the fishing areas according to types of vessels: the inshore 3 miles were reserved for non-motorised boats, and the 3-10 mile zone prohibited for the large otterboard trawl and purse-seine vessels. However due to the absence of fishing patrols many trawlers carried on fishing close to shore. The continuing conflicts resulting from this situation resulted in the issue in 1980 of a decree banning all trawlers from fishing in waters around Java Sumatra and Bali, and has more recently been extended to cover the whole of Indonesia. In Java, a regulation came into force in 1977 banning the fixed liftnets (bagans), for two major reasons. The fixed platforms are a danger to navigation, and their use of very fine meshed nets (3-5mm) damages fish stocks by taking too many juveniles (Fishing News Int., Feb. 1985). In practice, the ban is only enforced around major ports. On both of the South China Seas coasts and the Malacca Strait there is a licensing system limiting the number and the size of purse-seine vessels, and a mesh-size regulation for their nets (SCS, 1978b). The development priorities in this country are similar to those listed for the Philippines. Also given priority are the introduction and improvement of regulatory measures for the resource management of highly exploited areas, and resources development in areas having a potential for further exploitation (SCS, 1982).

Thailand has already established a number of conservation measures for its important mackerel fishery in the Gulf of Thailand, including closure of the fishery during the spawning season, a prohibition to trawling in specific fishing grounds, and a mesh-size regulation for gill nets (SCS, 1978b). Most of

Thailand's management efforts are geared to resolve its two main fisheries problems: the rapid depletion of the coastal marine resources in the Gulf of Thailand and the utilization of its extensive commercial fleet now that the surrounding countries are claiming 200 mile EEZ's. It is thus interested in developing less used resources and the offshore sector of its fisheries. For example, there has been a recent project in collaboration with FAO for the development of small-scale fisheries of small tunas using a pole-and-line method (IPTP, 1984a). Test longline fishing for marlin in a narrow rip area, found about 110km from Thai shores, has given catch rate values higher than most other marlin grounds (SEAFDEC, 1980). Part of the commercial fleet is currently being redirected to other fishing grounds by the creation of joint ventures with several countries of the Indo-Pacific. Increasing attention and financial aid have been given to fisheries research since the early 1960's. Resource management, exploratory fishing using stern trawlers, fishing gear development, coastal aquaculture and marine fishery assessments are all part of the ongoing research programme in this country (FAO, 1979).

In Malaysia, the government outlawed in 1981 the operation of trawlers under 40 tons within 5 miles of the mainland, and of those over 40 tons within 12 miles (SEAFDEC, 1981). However, the problem remains that there is little potential for an increase in production of demersal resources accessible to small-scale fishermen. The expansion of aquaculture and a rural resettlement project to less populated coastal areas are two courses of action in management that have been chosen by the Malaysian government (SCS, 1982). There is also a joint venture agreement between Malaysian and South Korean fishing companies to operate in the deep sea areas of Malaysian waters (SEAFDEC, 1979). This arrangement provides training to local fishermen in deep sea fishing, and the catches are landed in Malaysia. Greater emphasis is being given to increasing the ability of the fishermen and fishery co-operatives to handle various aspects of fish catching, breeding, processing and marketing (Fishing News Int., June 1983). Reports on the systematic trawl surveys on coastal demersal resources and other studies are regularly submitted to fisheries administrators (Latif, 1982). These surveys are used for the estimation of stock densities and biomass. Some acoustic surveys have been carried out in collaboration with FAO to assess the pelagic fish stocks off the East coast of Peninsula Malaysia. Estimations of optimum yield have been done for demersal and pelagic fisheries using the available commercial catch and effort data.

Priority concerns

These arise chiefly from the very high fishing pressure exerted by both artisanal and industrial fisheries on nearly all species occurring in coastal and nearshore waters, and affects all sizes of fish as well as shrimps. This has resulted in big changes in the species composition of demersal fish (including very substantial decreases of some species), decline in catch rates, and conflict between different groups of fishermen for limited resources. Of special concern has been the impact on traditional fishermen of the growth of commercial trawling (which has been banned in some areas), the small sizes of meshes used in many fisheries, and the extremely small size of Yellowfin and Skipjack tuna taken in some areas. Except for the tuna question, these are of concern in all parts of the region.

Two aspects of environmental damage are of concern to the fisheries in the region. Destruction of mangroves and other coastal habitats, causes loss of important nursery grounds of shrimp and other species over much of the northern and western part of the region. Elsewhere (most of Philippines and eastern Indonesia) damage to coral reefs, partly by fishing operations themselves, directly threaten important fisheries on the reefs.

Priority recommendations

a) The problems of over-fishing can only be solved as a result of intensive and long-term fishery research, and the first priority should be given to supporting and strengthening the existing national fishery research institutes in the region. Because of the similarity of the situation in different countries, outside assistance could be effective in this strengthening process by assisting in the exchange of information, and the development of modern computer techniques (e.g. in data handling and processing) that could be used in most countries.

b) Particular attention should be paid to soft-bottom demersal communities, and to coral reefs. In the former there have been changes in species composition that are not easily explained by current population dynamics theory. Most past coral reef reseach has concentrated on localised descriptive studies, and protection of reefs has been restricted to limited areas within marine parks. Greater emphasis needs to be given to assessments of extent and health of reef areas, and to quantitative studies, in order to build up a more complete understanding of the resource for its management as a sustained source of food.

c) More information is needed about the movements of fish between the near-shore zone (exploited mainly by artisanal fishermen), and the deeper off-shore waters (exploited mainly by industrial-scale fishing).

d) An important conservation action in regard to the shrimp fisheries is the protection of nursery areas, namely mangrove and wetland habitats. This subject is dealt with in detail in the mangrove habitat section.

Shrimp Fisheries

Character

Of the 46 species of penaeid shrimps recorded from the landings in the South China Sea area, 31 are frequently found. In any one area, around 90% of the penaeid landings are usually made up on about 9 species, of the genus Penaeus, Metapenaeus and Parapenaeopsis (SCS, 1981). The sergestid and mysid shrimps are also important in terms of production throughout the area.

Eight main shrimp producing areas can be listed in the East Asian Seas: the Gulf of Thailand, the Malacca Strait, the West coast of Sumatra, the Java Sea, the South coast of Java, the Arafura Sea, Northern Borneo and the Philippines (SCS, 1981). However, other localized coastal areas also exist, such as around Sabah, where significant landings are recorded.

In Malaysia and Indonesia, the importance of shallow coastal marshes, mangrove swamps and lagoons as nursery grounds for post-larvae and juveniles of many shrimp species has been reported. On the western side of the Cilacap area (south coast of Java), is situated a brackish water lagoon of about 4,000ha, surrounded by mangroves, tidal forest and wetlands covering 29,500ha, which is considered the most important shrimp nursery ground in south Java. In general, the shrimp larvae are found in greater abundance close to shore, and their

numbers show a gradual decline going offshore. Generally also, in areas where such coastal marshes and mangrove swamps are present, good commercial shrimp catches are recorded (Unar & Naamin, 1984).

A good part of the shrimp landings come from the trawl fisheries. In most areas traditional methods are also used extensively in shallow waters: tidal traps in the Malacca Strait, gillnets in North Java, East Kalimantan and the Philippines, push nets also in the Philippines, danish seines in west Sumatra (SCS, 1981). One exception is the Arafura Sea, where the recently developed fishery uses only large double-rigged trawlers.

Status

In Indonesia, the penaeid shrimp catch between 1972 and 1979 fluctuated between 49,000t and 133,000t (Unar & Naamin, 1984). Due to a ban on trawlers around Java and Sumatra, shrimp landings, processing and marketing activities have declined in these areas. In Kalimantan and eastern Indonesia, where no ban is in effect, the shrimp catches are still increasing. From production models analysis, it has been estimated that the shrimp stocks have been fully or over-exploited on the Malacca Strait, around South and East Kalimantan, Cilacap and the Arafura Sea. It has also been noted that in these last areas the mean size of shrimp has considerably decreased. In these areas, and throughout this region, there might be several stocks involved. Thus using data from a large area might mask the differences between the states of exploitation of the various stocks (SCS, 1981).

In Peninsular Malaysia, the main area for shrimp fishing is along a 1,000km stretch of swamplands in the northern half of the west coast, and the Malacca Strait (SCS, 1981). Although it is felt that an improvement of effort measurements is needed, full or overexploitation of the shrimp resource there is suspected. In Sabah, the shrimp trawl fishery for export has expanded rapidly in the 1960's and is now exploiting four main shrimp grounds: Brunei Bay, Marudu Bay, the northeast coast and Tawau. Catch levels have been rather stable since the early 1970's at around 3,000t per year, which is the estimated MSY value for the whole of Sabah.

For the shrimp stocks in the Thailand waters of the Gulf of Thailand, the total potential yield has been estimated at 124,000t, which is about 20% more than in 1977 which had the highest catch recorded (Chullasorn, 1982; SCS, 1981). The catch and effort data have been further broken down into large and small shrimp categories. It appears that at the 1973 and 1974 effort the large shrimp fishery had been close to its MSY of about 25,000t per year. It is probably over-exploited at present. In the case of the small shrimp, the high variability of the data did not allow any conclusions to be drawn. Even though more information is needed for this assessment, it is felt that a further increase in catch is likely to come from the small shrimp category of the catch. In the Indian Ocean waters of Thailand, a potential of 7,800tyr^{-1} has been estimated from research catch rates, whereas an MSY level of 14,000t is given from commercial catches (Chullasorn, 1982). These shrimp stocks have probably been fully exploited since 1977. The high catches from 1978 onward are thought to be due to the inclusion of the landings from the Bay of Bengal in the Andaman Sea (SCS, 1981).

In the Philippines, several shrimps stocks have been identified so far in the complex island system. In the Visayan and Sibuyan Seas areas, eight separate stocks are known to exist. At Visayas, the annual catches have been rather stable around 4,500t per year since the early 1970's, even though the number of trawlers has increased (SCS, 1976). This decrease in CPUE of shrimp is attributed to the increased fishing in deeper waters and for finfish, rather

than to overfishing. In the Samar Sea, however, the shrimp resources have probably been overexploited since the mid-1970's, as the catches had decreased to 309t in 1974 from about 1,000t in 1968, and the number of baby-trawlers had been increasing. On the Pacific Coast the only sizeable shrimp fishery is in San Miguel Bay and the adjacent waters (SCS, 1978a). Although the commercial and prawn catches increased rapidly from 688t in 1969 to 4,898t in 1977, and the municipal catches (mainly by baby and mini-trawlers) were 7,800t in 1976, the values for 1980-81 were down to 461t for the commercial fisheries and 5,056t for the municipal fisheries (SCS, 1978a; Smith & Pauly, 1983). This last figure includes 4,473t of sergestid shrimps caught exclusively by the small-scale mini-trawlers. Due to problems in getting reliable measures of effort, no firm estimate of MSY has been given.

Human and economic value

Apart from their employment value, which has been described generally in the pelagic and demersal fisheries section, shrimp fisheries are important as sources of foreign exchange for the countries of this region. Shrimps and prawns are highly valued on the international market. For example, the shrimp exports from the Philippines in 1982 amounted to US$3.88million, which represents 25% of the total food fish exports value, but only 6.7% of the total weight (SEAFDEC, 1983). In Indonesia, shrimp exports have decreased after the banning of trawlers from inshore areas; in 1980 these were valued at US$185million (Unar & Naamin, 1984).

Targeted exploitation

The bulk of penaeid shrimp catches in Indonesian waters consist of the Banana prawn Penaeus merguensis, the Endeavour prawn Metapenaeus ensis and the Rainbow prawn Parapenaeopsis caromanaelica (Unar & Naamin, 1984). However, ten other species out of a total of 42 are also very common and the species composition varies between areas. In south and east Kalimantan for example, 88% of the catch is composed of large species, but the composition varies with distance to shore with small species accounting for 40-80% of the catch in shallow waters and near estuaries (SCS, 1981). The sergestid and mysid shrimps caught in significant amounts mostly by the small-scale sector, are also important in the national production and are used in the preparation of shrimp paste.

Total shrimp catches in this country have been more less stationary since 1978 (FAO, 1983). Out of a total of 160,425 in 1981, 28.5% was recorded as P. merguensis, 10% as P. monodon, 14% Metapenaeus sp. and the remaining 47.5% all other shrimps including the sergestids and mysids. About 800 baby trawlers are reported from Kalimantan and South Sulawesi; and 200 large trawlers (90-350GT) are licensed to operate in Kalimantan and Iran Jaya (Unar & Naamin, 1984). Since the 1980 decree banning all trawling operations in Java, Sumatra and Bali waters, their total number has dropped from 3,500 to the present 1,000. A large portion of the vessels stopping operation were baby trawlers fishing in coastal waters. In most regions banned for trawlers, bottom gill netting is now developing for catching shrimp; the number of tidal traps has also increased on the east coast of Sumatra.

In Malaysia, the same species as in Indonesia are found to be the dominant ones in the exploited fisheries. In the Sandakan area of Sabah, based on the record from factories, over 80% of the annual shrimp processed are white shrimp which largely consist of P. merguensis and P. indicus (SCS, 1981). However this proportion might reflect the preferences of the fishing industry for larger shrimps rather than the actual species composition. The recorded landings of sergestid shrimps has shown a very large increase in recent years, from 357t in

1978 to 26,769t in 1981 (FAO, 1983), while the other shrimp catches have declined from around 81,800t in 1978 to 67,718 in 1981. The northern part of the west coast of Peninsular Malaysia is the most productive area for the fisheries, providing 76% of the total national catch in 1978 (SCS, 1981). In Sabah, the biggest landing place is Sandakan on the northeast coast. About 50% of the total prawn landings is attributed to the trawling activities. The traditional fisheries in Sabah which have existed for many years, land about a third of the catch for this province, their main gears are tidal filter nets, cast nets, push nets and gill nets (SCS, 1981).

In Thailand it was noted that not only was the species composition of the large and the small shrimps very different through the Gulf, but that in the inner Gulf, the density of small shrimps was much greater than elsewhere (SCS, 1981). The main species in the commercial catches of the Gulf of Thailand, by weight, are Penaeus paulensis, Trachypenaeus fulvus, and Metapenaeus affinis, M. ensis and M. intermedius. In the Malacca Strait, the Penaeus species are more important. In the country as a whole, recorded landings of P. semisulcatus, P. latisulcatus, Metapenaeus sp. and the sergestid shrimps have all been decreasing since 1978. For the other species the landings have remained more or less stationary (FAO, 1983). From 143,141t in 1978, the total catch decreased to 121,372 in 1981.

In San Miguel Bay, Philippines, about 35% of the shrimp landings in 1976 were from the commercial trawlers, and 55% from the municipal baby-trawlers (SCS, 1978a). However, since the exclusion of commercial trawlers from the Bay, the non-trawl fishery is dominating the shrimp catches. In 1980-81, it has been estimated that 461t and 583t of penaeid shrimps have been caught by the trawl and non-trawl fisheries respectively (Smith & Pauly, 1983). In addition 4,473t of sergestid shrimps have been landed by the non-trawl fishery exclusively. In the Visayan and Samar Seas, most of the shrimps (usually more than 90%) are caught by trawlers. In these regions, the trawlers are commercial vessels fishing also for finfish (SCS, 1976). For the whole of the Philippines, the landings of Penaeus sp. have been quite stationary, and those of Metapenaeus and sergestid shrimps have increased. The catch level of these three groups in 1981 were respectively 15,062t, 2,182t and 19,563t (FAO, 1983). The 1981 sergestid level is three times its 1977 level.

Incidental exploitation

The main by-catch species of the shrimp fishery in Indonesia are Bombay duck, pomfrets, croakers, spanish mackerel, rays, sharks, hairtails, seaperches, snappers, squids, and swimming crabs (Unar & Naamin, 1984). The proportion of fish in the catch varies tremendously. Inshore and near estuaries and lagoons, the ratio of shrimp to fish is between 1:0.3 and 1:1 - it decreases going offshore to 1:20 or 1:30. The density of by-catch has been computed for various regions, and varies between 0.97 and 8.5t per trawler per day.

Off Java and south east Sumatra, before the banning of trawlers, most of the by-catch was kept except the extremely low-valued fish. The most prized fish were kept on ice, and the others were salted and dried (Martosubroto, 1982). However, off Kalimantan, due mainly to a lack of marketing infrastructure onshore and the high demand of shrimp for export, many trawlers discard their by-catch.

The by-catch of the shrimp fishery in Thailand is increasingly being used for human consumption. The annual production of by-catch has fluctuated between 620,000t in 1971 and 85,000t in 1980. For the same period, the proportion of this catch converted into fishmeal increased from 46% to 99% (Saisithi, 1982).

It has been noted that the small pelagic species, mostly Sardinella, are becoming more important. From 11,000t in 1972, this production has increased to 21,000t in 1977.

Sedimentation

Shrimp stocks could be affected by sedimentation, especially in their nursery habitats, the mangroves and coastal lagoons (see Enclosed Soft Bottomed Habitats).

Direct destruction

In most countries of this region, priority is given to the expansion of aquaculture. It has been observed that substantial areas of tidal swampland in places such as Sumatra and Kalimantan can be brought into fish culture production (Polunin, 1983). Because these areas are used by larval and juvenile stages of several species of shrimps and fishes, such developments could lead to a loss of productivity of the natural stocks, and would eventually affect the small-scale fisheries.

One other possible adverse interaction of aquaculture with the capture fisheries is the use and dependency of brackish water aquaculture on the collection of natural seed. The extent to which these operations affect the natural productivity is unknown (Kapetsky, 1981).

Existing management policy

The Indonesian authorities have taken management measures to regulate trawling activities, mainly in relation to the widespread conflicts between small-scale fishermen and commercial trawlers (for details, see p.42). The government has also decreed that joint-venture trawlers must distribute the fish by-catch from shrimping operations to traditional fishermen (Martosubroto, 1982). The total number of trawlers is now limited to 1,000 (SCS, 1981).

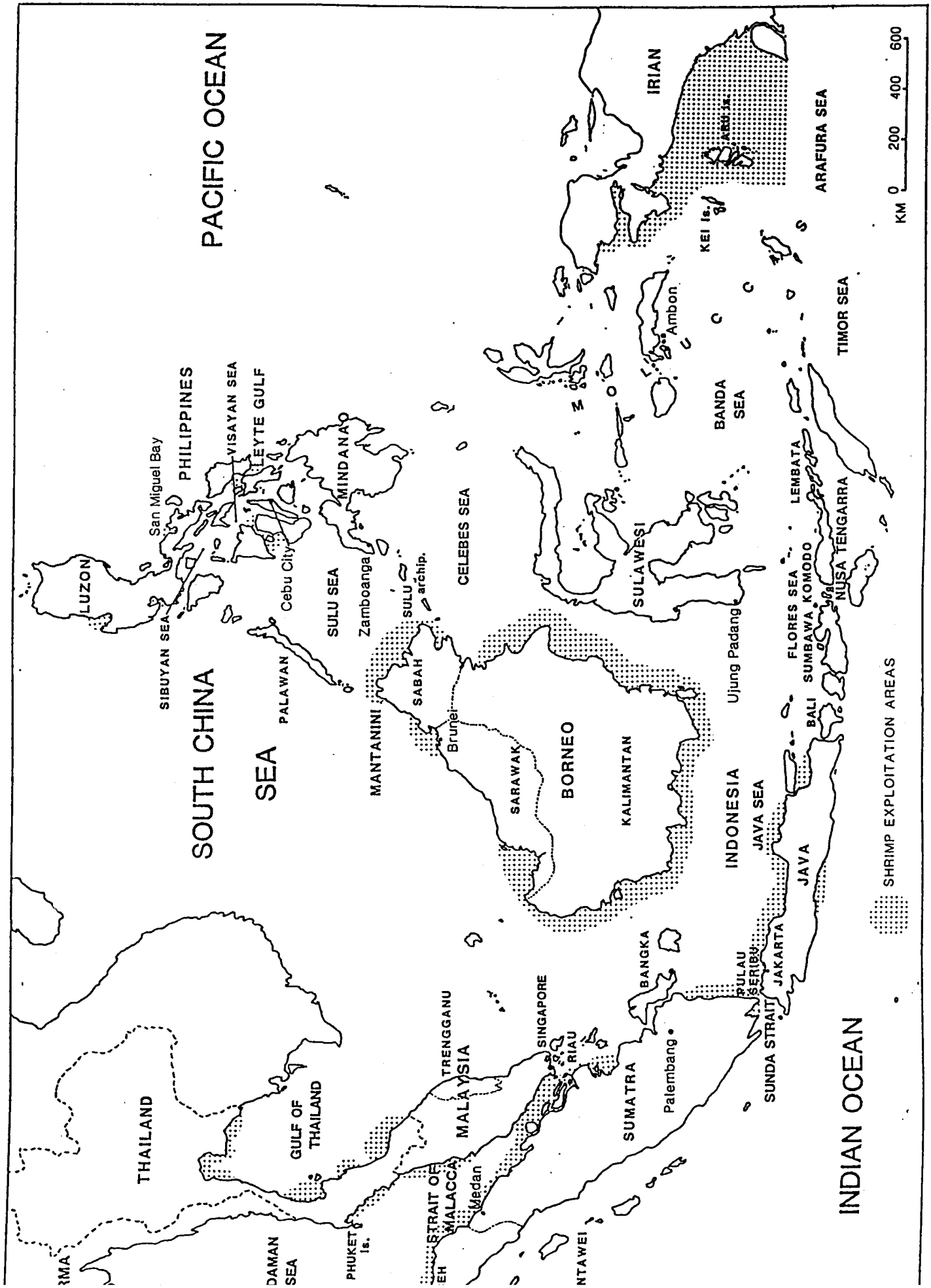
Indonesia's current research programmes related to shrimp stocks are: exploratory fishing surveys, a stock density and assessment programme, statistical data collection programmes, and shrimp biology including studies of nursery areas. More specifically, surveys are carried out in areas where trawling has been banned to observe new development in gears, landings and the socio-economics of the industry. Some experimental fishing is being done in South Java. Research is being conducted on the role of mangrove forests as shrimp nursery grounds and their effects on the distribution of the stocks. A shrimp tagging programme is also planned (Unar & Naamin, 1984).

In 1981, a regulation was issued in Malaysia restricting trawlers under 40GT from fishing within 5 miles of the mainland, and those greater than 40GT from fishing within 12 miles from shore (SEAFDEC, 1981). The issuing of additional trawler licenses on the west coast of Malaysia has been stopped (SCS, 1981). Current research projects centred around shrimp biology, include taxonomy, distributional studies, and life-history characteristics. Fishery data on catch, effort and by-catch are collected. Systematic prawn research surveys are also planned.

In Thailand no management measures for the shrimp fishery were in place in 1981 (SCS, 1981). The value of closed seasons is under study. Several research surveys have been carried out on both the Gulf of Thailand and the Indian Ocean coast, including a comparison between fishing gears, tagging experiments and

Figure 3

Pelagic, demersal and shrimp fisheries in the East Asian Seas region.



basic biology of shrimps. An extensive research programme integrating survey work, biological research, fishery data and socio-economic aspects has been planned for the 1981 - 86 period.

In the Philippines, fishing vessels larger than 3GT are not allowed to operate in waters shallower than 7 fathoms, and are totally banned from some specific areas, such as San Miguel Bay (SCS, 1981). Baby trawlers can fish legally in waters deeper than 4 fathoms with permission from municipal authorities (Smith & Pauly, 1983). A review of the fish and shrimp nursery grounds is being made with a view to the possible closure of chosen areas for conservation. Observations are being made on the catches of shrimp and trash fish using different gears in Manila Bay and San Miguel Bay.

Marine Mammals

Character

Soegiarto and Polunin (1982) state that at least 24 species of cetacean are recorded from Indonesian waters, but it seems likely that at least 29 cetacean species may occur in the wider waters of this region, and at least 2 more beaked whales may also occur.

Of the baleen whales, Fin whales (Balaenoptera physalus), Blue (B. musculus), Bryde's (B. edeni), Minke (B. acutorostrata), Sei (B. borealis) and Humpback (Megaptera novaeangliae) whales have all been recorded, although very little is known of their movements or behaviour in this region. Both Longman's beaked whale (Mesoplodon pacificus) and the Straptoothed beaked whale (M. layardii) are recorded from Queensland and presumably occur further north. Blainville's baleen whale (M. densirostris) too seems very likely to occur throughout south east Asia. Of less certain distribution are Andrew's beaked whale (M. bowdoini) and the Gingko toothed whale (M. ginkgodens), both of which have been recorded in Japan, and in areas to the east of south east Asia. They may well occur in deep water areas, but, as with all the beaked whales, probably in small numbers. The final beaked whale known to occur here is the ubiquitous Cuvier's beaked whale (Ziphius cavirostris), the most cosmopolitan of its family.

The Sperm whale (Physeter macrocephalus), and its relatives, the Pygmy (Kogia breviceps) and Dwarf (K. simus) sperm whales have all been recorded from Nusu Tenggara (Soegiarto & Polunin, 1982), while the Rough-toothed dolphin (Steno bredanensis) has been recorded from northern Java (Tas'an & Leatherwood, 1984). Other species which have been recorded include Fraser's (Lagenodelphis hosei) and Risso's (Grampus griseus) dolphins, the Finless porpoise (Neophocaena phocaenoides), Common (Delphinus delphis), Spotted (Stenella attenuata), Striped (S. coeruleoalba), Spinner (S. longirostris), Bottlenose (Tursiops truncatus) and Irrawaddy (Orcaella brevirostris) dolphins, Melon-headed whales (Peponocephala electra), Pygmy killer whales (Feresa attenuata), False killer whales (Pseudorca crassidens), and Short-finned pilot whales (Globicephala macrorhynchus). The only non-cetacean marine mammal known from these waters is the Dugong (Dugong dugon).

Status

The status of most marine mammals in this area is unknown. The baleen whales are assumed to belong to the depleted or reduced stocks of the North Pacific or the Antarctic Oceans, but as yet the relationship between the whales found in polar waters, and those in equatorial waters is far from clear. Even

less is known with regard to the numbers of most of the baleen whales which might be present in these waters. Some population estimates do exist for Bryde's whales in Philippine waters. The International Whaling Commission (IWC) considers these to belong to the western North Pacific stock, which has been exploited by Japanese whalers at the northern end of its migration for a number of years. Current population estimates for this stock range from 14,400 to 23,400 (Anon, 1985). The relationship between Bryde's whales in Philippine waters and those elsewhere in the region is unknown.

A similar lack of information exists for Sperm whales whose stock identities and population sizes are entirely unknown. Of the smaller cetaceans, beaked whales, Pygmy and Dwarf sperm whales and Pygmy killer whales have all been recorded so infrequently that nothing can be ascertained about their status. On the other hand, Irrawaddy dolphins, Melon headed whales, Fraser's dolphins, Bottlenose dolphins, Spotted, Spinner and Common dolphins all appear to be relatively common in this area. Of the remaining cetacean species, again, they are too poorly known for their status to be determined.

Dugongs are believed to be more common in this region and in Northern Australia, than any other part of their range. Indeed, Soegiarto and Polunin (1982) describe Indonesia as an important refuge of the species.

Human and economic value

Soegiarto and Polunin (1982) state that the hunting of dolphins is traditionally proscribed in many areas, and indeed the only records of traditional exploitation of cetaceans by the people of this area appear to be those of the 2 whaling villages in Nusu Tenggara, where whale meat is evidently an important component of the local diet (WWF, 1980). Dugongs, however, may be a more valuable resource. To the people of the Aru Islands, which may be where the Dugong is most numerous, Dugong meat has certainly made an important contribution to the human diet through part of the year (Compost, 1980). In contrast, the recent whaling efforts of the Philippines may have generated some foreign currency, but can have had little impact on the local diets.

Targeted exploitation

The only 'commercial' exploitation of marine mammals in recent years has been the catches by the Philippines, who, in 1982, took 200 Bryde's Whales in Philippine waters, and stated their intention to keep to this self-imposed catch quota until the 1986 ban on whaling comes into effect (IWC, 1984). The effect of catches by Japan and the Philippines on the western North Pacific stock of Bryde's whales is being monitored by the IWC.

In addition to these catches there are several traditional 'fisheries', and some live captures have been made for the Jaya Ancol Oceanarium in Jakarta. On the island of Lembata in Nusu Tenggara, eastern Indonesia, 2 whaling villages annually take by harpoon 20-25 Sperm whales, and at least 2 baleen whales respectively (WWF, 1980). There is some indication that small whales may also be taken, but no recent records of this are available (Mitchell, 1975). These catches are an important part of the local economy and of the local protein resources.

In the Aru Islands, around 1,000 Dugongs are caught annually in coastal waters, and form an important part of the local food resources. The effect that this catch is having on the local population is unclear, as is the identity of the stock being hunted. Hendrokusomo et al. (1979) report that Dugongs are occasionally caught deliberately for food in south Sulawesi, and that on the

Island of Bangka, Dugong meat was on sale in the market in Belinyu in 1976. They also state that although many fishermen regard the meat as being delicious, they may avoid taking Dugongs deliberately as they consider them to be sacred.

Finally, a number of small cetaceans have been taken for the Jakarta Oceanarium in recent years. 9 spinner dolphins were taken in the Java Sea in 1976, 31 bottlenose dolphins in the same area between 1975 and 1982, and 20 Irrawaddy river dolphins have been taken from the Mahakan river in Kalimantan in 1974 and 1978 (Tas'an & Leatherwood, 1984).

Incidental exploitation

Reports of the level of incidental captures of small cetaceans have been sporadic and, given the intensity and nature of the fisheries in the countries of this area, it seems very likely that far more dolphins, at least of those species found in coastal waters, are caught than are recorded. 2 Finless porpoises have been reported in gill nets in Northern Java, and a Bottlenose dolphin is reported to have been accidentally netted in northern Sulawesi. These two species, as well as Humpbacked and Irrawaddy dolphins are probably the cetaceans most likely to become entangled in coastal fishing gear.

Dugongs are also prone to net entanglement and Hendrokusomo et al. (1979) report that they are caught in nets in South Sulawesi and west Java at least, but catches are probably widespread wherever Dugongs and coastal fisheries overlap.

Oil industry

The oil industry has not yet been reported to impinge on the marine mammal fauna of south East Asia, but oil installations and coastal oil wells, as well as tar and oil spills, could all be considered threats to local Dugong populations.

Water discharge

Heavy pollution loads have been reported around some urbanised areas, for example in Jakarta Bay. However, no ill effects have yet been demonstrated on marine mammal populations of the area. This is probably due more to a lack of such studies than to any absence of effect.

Sedimentation

Sedimentation is an important problem in areas of seagrass beds, where mangroves or other forested areas have been logged and siltation has increased. Although no study has yet been made to link sedimentation to Dugong populations, it is clear that any siltation of seagrass beds in areas of Dugong populations is liable to affect those populations adversely.

Direct destruction

Deliberate killing of marine mammals, other than for exploitation has not been recorded.

Recreation and tourism

So far there are no documented benefits or problems associated with the tourist or recreation industries.

Existing management policy and management practice

In relation to whaling, the Philippines has joined the International Whaling Commission, and recent stock assessments of the western North Pacific Bryde's stock by the IWC have led to a total catch limit of 357 individuals, which will be shared by Japan and the Philippines. The Filipinos have indicated that they will observe their obligations to cease whaling in 1986.

Most other management policies are not readily enforced. For example, all Dugongs and cetaceans are legally protected in Indonesia, with exceptions for the whaling villages on Lembata, and yet Dugongs are apparently often taken throughout the Indonesian archipelago (Soegiarto & Polunin, 1982).

Priority concerns

The most pressing marine mammal problem, here as elsewhere in the Indian Ocean, is probably the situation regarding the Dugong population. Little is known of the population size, its status, or the extent to which catches and environmental stresses are affecting the population.

Although at present information on cetaceans is limited from this region, it is clear that by-catches of small cetaceans must occur more frequently than records today might suggest. While there is no information on the extent of these by-catches, they cannot be considered a priority concern, yet there is clearly a need to determine whether or not there is an extensive by-catch.

Priority recommendations

Considering the paucity of records on small cetaceans, there is a need for more information on this group. In particular it would be useful to determine the extent to which small cetaceans occur in fishing nets.

Information on Dugongs is likewise limited. Not only is there a need to determine where there are local Dugong densities, but also a clearer picture of the effects of human impact is required, both from fisheries, and from environmental deterioration.

Turtles

Character and occurrence

There are seven species of marine turtle, of which six are reported from the East Asian region. The Green (Chelonia mydas), Hawksbill (Eretmochelys imbricata), Leatherback (Dermochelys coriacea) and Olive ridley (Lepidochelys olivacea) occur throughout the region, but the Loggerhead (Caretta caretta) appears to be restricted to Malaysia and Indonesia, and the Flatback (Chelonia depressa) appears to occur only in Indonesia.

The major nesting areas that have been reported are:-

Thailand: Tarutao, Ko Phuket and Phangngna Provinces (West Thailand); Ko Khram (Gulf of Thailand (Polunin & Nuitja, 1981).

Malaysia: Peninsular Malaysia: west coast islands and mainland beaches (Leong & Siow, 1980). Sabah, east coast.

Indonesia: Sumatra and Java (especially west and south coasts); Kalimantan (east coast); Nusa Tenggara and Irian Jaya (north coast) (Polunin & Nuitja, 1981). Recent surveys on Irian Jaya have revealed what is believed to be the world's largest Leatherback turtle nesting beach (Anon, 1985). The estimated number of turtle nests for all known sites in Indonesia is given in Salm and Halim (1984b), together with details of population sizes for individual species.

Philippines: Turtle populations are low in the northern part of the country, and dense in the southern part, especially around the Turtle Islands in the southwest, where there are approximately 1,000 km. of sandy beaches suitable for nesting (de Celis, 1981).

Conservational status

Protection of species: sea turtles are threatened worldwide and the Green, Hawksbill, Olive ridley and Leatherback are listed in the IUCN Red Data Book as endangered. The Loggerhead is listed as vulnerable. Export of turtle products is prohibited by regulations of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Indonesia, Malaysia, Thailand and the Philippines are all signatories to the Convention, yet all these countries still trade in turtle shell.

The conservational status of turtles within the East Asian region varies according to the species and country.

Thailand: No specific status.

Malaysia: Under the Malaysian Constitution turtle conservation is a State matter, and each State constitutes its own legislation. In some States the hunting of turtles is prohibited (e.g. Sabah and Trengganu) (de Silva, 1981; Tow & Moll, 1981).

Indonesia: The Loggerhead, Leatherback and Olive ridley are completely protected by Ministerial Decree; Green and Hawksbills are unprotected (Salm et al., 1982b). Indonesia made a proposal to the fifth meeting of the Conference of the Parties to CITES to transfer its local populations of Green and Hawksbill turtles from Appendix I to Appendix II, with the intention of legalising the trade that is already going on.

Philippines: The Green turtle was listed in 1970 by the Parks and Wildlife Office as one of the 20 wildlife species in the Philippines on the verge of extinction, but there is no conservational status for this or other species.

Protection of critical habitats:

Thailand: Turtle nesting beaches are included in the Tarutao National Park in southwest Thailand, and a turtle conservation project is being run by the Phuket Marine Biological Centre.

Malaysia: In Sabah, the Turtle Islands National Park, off the east coast, was established in 1971. In Sarawak, a reserve incorporating three islands has been established.

Singapore: There are no nesting sites for turtles in Singapore.

Indonesia: Turtle nesting beaches are included in 21 protected areas (Salm & Halim, 1984c).

Philippines: No nesting sites are fully protected.

Human and economic value

Turtle eggs are harvested throughout the East Asian region, both for home consumption and for export. In some countries, especially Indonesia and the Philippines, adults are taken for food and the animal then stuffed or the shell and other parts worked into combs, ornaments and other souvenirs. The value of turtle products exported from Indonesia in 1980 was US$928,539 and in 1981, US$407,542 (Salm & Halim, 1984b).

Targeted exploitation

The Green turtle, Chelonia mydas, is the most widespread of the species found in this area, and is also the species most extensively hunted. The Hawksbill, Eretmochelys imbricata is also exploited, mainly for its shell. Turtles are taken by trawlers at sea, in the nets or by shooting, in coastal zones and on nesting beaches.

Green turtle meat is not consumed to any great extent in Muslim areas such as Malaysia and most of Indonesia. However, in the Philippines and parts of Indonesia such as Bali and North Sulawesi green turtles have been hunted to the brink of local extinction for their meat (de Celis, 1981; Soegiarto & Polunin, 1982).

Green turtle eggs and meat are consumed throughout the Philippines, and in recent years there has been a marked decline in both green and hawksbill numbers, with turtle hunters reporting poor returns. Statistics on Green turtle captures are not available, but the situation is a little clearer for Hawksbills. The high demand for tortoiseshell in the international market has caused indiscriminate hunting in recent years. Between 1974 and 1978 an annual average of around 22,000kg of tortoiseshell was exported. In addition, worked pieces of tortoiseshell are exported, and in 1978 these totalled 7,800 pieces. Most of these tortoiseshell products are exported to Japan, but smaller amounts have also been exported to the USA and Europe (de Celis, 1981).

Hawksbills, and to a lesser extent Green turtles, are also stuffed and sold as curios. At least 3 centres of turtle stuffing exist in the Philippines. Zamboanga city is reported to process around 2,000 per year and Cebu city around 400 Hawksbills and 100 Green turtles annually (de Celis, 1981).

In neighbouring Sabah under the Fauna Conservation Ordinance (turtle farms) regulations of 1964, eight islands were made into turtle farms, whereby exclusive rights to gather turtle eggs were granted to the tenderer. More recently, in 1977 three of these islands were converted into National Parks so that there is no turtle exploitation. There are also regulations enabling native peoples to collect eggs in a number of areas by right. In addition, Malays may collect eggs, but do not kill adults, whereas the Chinese regard turtle meat as a delicacy, and the Rungus Dusons of Kudat are said to treat game laws with contempt, killing adults for consumption (de Silva, 1981). In Sabah waters only the Green and Hawksbill turtles nest, and although no adequate statistics are available, in the years prior to 1972, the 3 turtle nesting islands which were subsequently converted to National Parks yielded around half a million eggs a year.

No data on turtle exploitation are available from Brunei, but in Sarawak there are 3 major turtle nesting islands where Green, Hawksbill and Olive ridley turtles all nest. The eggs are said to be taken indiscriminately from these islands, but there has been a dramatic decline in production from millions per annum to an average of 272,000 in 1971-1977. Most of these are Green turtle eggs (de Silva, 1981).

In addition to excessive egg harvesting in Sabah and Sarawak, and the illegal hunting by Dusuns, the decline in turtle numbers witnessed in both areas has been attributed to a number of factors, one of which is the 'large scale slaughter of turtles outside Sabah waters by Filipino fishing vessels' and the deliberate take of turtles in the South China seas by vessels from other nations. Japanese vessels in particular are said to be 'raping the seas' outside but near East Malaysian waters (de Silva, 1981).

In Indonesian waters Hawksbill turtles are exploited heavily for their shells. The export of tortoiseshell has been an important industry in Indonesia since ancient times, and currently Indonesia is the world's largest tortoiseshell producer. Both Hawksbill and Green turtles suffer heavy and unregulated exploitation throughout Indonesian waters, particularly around Bali, where more than 30,000 turtles are consumed annually. This fishery is said to have expanded from about 5,000 Green turtles 20 years ago to about 36,000 per year now (C. Limpus, pers. comm.). The turtle fishery for the Balinese market is covering a wider and wider range, as turtles become more and more scarce in the vicinity. In addition to the Balinese fishery, a further 25-30,000 turtles are caught around Ujung Pandang in Sulawesi and in Sumatra. Around 6,000 turtles are recorded as having been exported from Indonesia in the late 1970's (Polunin & Nuitja, 1981) and, in addition, up to 200t of raw tortoiseshell is exported per annum, mostly to Singapore and Japan (Canin & Luxmoore, in prep.). In general turtle exploitation in Indonesia is intense and apparently also includes the protected Leatherback (C. Limpus, pers. comm.).

Once again, the influence of the Muslim faith seems to some extent to have limited turtle exploitation, which is heaviest in the Hindu region of Bali, and in Christian areas. In Sumatra, for example, turtles are caught in the Mentawei Islands off west Sumatra, processed by Christian peoples in central Sumatra, through Sibolga and Medan, and exported largely to Singapore, where a large number of stuffed Hawksbills are on sale (Robinson & Northridge, in prep.).

The collection of eggs in Indonesia is often regulated by local government concessions, where there are important nesting beaches, but such regulations are difficult to enforce. Turtle eggs are widely collected and eaten even in Muslim areas. Sub-adult and adult turtles are taken in traditional nets off Mentawei and elsewhere, or are harpooned in the sea, nowadays even with home-made spear guns. They are also collected on nesting beaches. Hawksbills are even said to be reared on fish in the Pulau Seribu in the Java Sea, so that they may be eaten (Soegiarto & Polunin, 1982).

Although Hawksbills and Green turtles are the main species caught, in Irian Jaya, Mentawei, and Lembata and Kei Islands Leatherbacks are also known to be consumed, even though this species is protected. The eggs of this and other protected species are almost certainly taken indiscriminately with those of Hawksbills and Green turtles (Soegiarto & Polunin, 1982).

The situation in Singapore has already been alluded to in that it is a major outlet for stuffed Hawksbill turtles, mainly sub-adult ones. There is apparently no local exploitation, and turtles are imported from Indonesia and Malaysia.

There are very few nesting sites off the west coast of Peninsular Malaysia, which is mainly mangrove-forested, but several important rookeries still exist on the east coast, notably the Leatherback nesting beaches of Trengganu. Although not much turtle meat is eaten here, nearly all the turtle eggs laid are collected, and a serious decline in egg production has been noted. In the 1950's egg production was estimated at around 2 million, and it has since fallen to around 1 million. The market value of this resource is estimated to be around US$240,000, but turtles are also an important source of tourist revenue. About 50,000 tourists per annum visit the Leatherback nesting beaches, in Trengganu to watch Leatherback turtles laying. There has been an estimated 34% reduction in Leatherback eggs laid since the 1950's, whilst the figure for Green turtles is around 43% (Tow & Moll, 1981).

Currently 5 turtle hatcheries are in operation on the east coast and various turtle sanctuaries have been made. It is also illegal to kill turtles in all east coast states. In west coast states, turtle populations are too depleted to be of any economic significance.

Incidental exploitation

Although trawlers, and shrimp trawlers in particular, are known to take turtles incidentally, there are no statistics collected or published, and opinions differ as to the importance of the effect of this by-catch.

On the east coast of Malaysia, Tow and Moll (1981) report that more efficient fishing methods including monofilament gill nets and shrimp trawlers have taken a heavy toll on turtles. Local people blame the decline in turtle numbers on trawling and drift netting. De Silva (1981) also lists incidental catches in trawl nets as a contributing factor in turtle population declines in Sabah and Sarawak. In Indonesian waters incidental catch rates are unknown, but individual trawlers have reported low catch rates. This is not to suggest the overall catch may not be significant too (Polunin & Nuitja, 1981).

Oil/waste/sedimentation

Oil spills could damage turtles directly, but pollution and siltation will generally have an indirect effect by degrading or destroying the feeding and breeding grounds of adult turtles.

Recreation and tourism

Adult turtles are easily disturbed and prevented from nesting by noise and lights from people, hotels and boats. For example, large nesting aggregations have ceased to occur on much of the west coast of Peninsular Malaysia (Leong & Siow, 1980).

Tourism also causes an increased demand for souvenirs made out of turtleshell and, in Bali and other parts of Indonesia, a demand for turtle meat (Polunin & Nuitja, 1981).

Other impacts

Adult turtles are often caught accidentally in trawl nets. Heavy mortalities have been reported off the east coast of Peninsular Malaysia.

Existing management policy

There are no specific management policies for adult turtles. They are either protected or exploited, and in the latter case the exploitation is

unregulated. Turtle collectors in Indonesia and the Philippines have to be licenced, but there is no quota policy. Indonesia intends to formulate plans to achieve sustainable harvest of the Green and Hawksbill (Suwelo et al., 1981).

In most areas collection of turtle eggs is under government licence; elsewhere native rights allow collection of eggs without licence. Licences are usually given to the highest bidder, and there do not appear to be any regulations imposed on the numbers of eggs taken.

In protected areas collection of eggs is prohibited or regulated. A certain proportion of the eggs may be collected and placed in hatcheries, and the hatchlings then released to the wild. For example, in Malaysia the Green, Leatherback and Olive ridley turtles are actively conserved by hatchery programmes run by the Fisheries Department (Tow & Moll, 1981). In Indonesia the Directorate of Nature Conservation (PPA) intends to develop turtle populations by raising turtles in hatcheries (Suwelo et al., 1981).

Existing management practice

Conservation and management policies for adult and juvenile turtles (where they exist) are often inadequately implemented. Species with protected status are still captured and export of turtle products is allowed to continue, despite CITES regulations. Many turtle collectors are probably unlicenced.

At some of the reserves and sanctuaries the nesting sites are strictly protected and eggs are not poached. For example, in East Malaysia (Sabah), the hatcheries are well established and young turtles are regularly released to the wild. However, this is not the case throughout the region.

Recent and current conservation projects

At present turtle conservation projects are mostly restricted to national activities.

Thailand: A conservation programme has been initiated at Tarutao National Park (1091) (WWF/IUCN Project 1816).

Malaysia: In an effort to unify all State legislations and to impose stricter controls, the Fisheries Department has drafted new legislation (1975), but this has, so far, only been adopted by a few State governments (Leong & Siow, 1980). Proposals have been made for the establishment of a number of turtle sanctuaries in Peninsular Malaysia (Tow & Moll, 1981).

Singapore: No conservation programme exists for turtles (there are no nesting sites in Singapore).

Indonesia: 37 sites have been proposed as protected nesting areas (Salm & Halim, 1984c). A detailed study of the sea turtle trade in Indonesia has recently been completed (IUCN/WWF, 1984), and an experimental training course on turtle research and conservation management has been successfully completed in Java (Salm, 1984e). The government conservation authority (PHPA) is now formulating a plan which calls for a reduction in the turtle egg harvest; limits on the number of wild-caught turtles entering the Bali market; development of turtle ranches stocked with hatchlings of eggs from concession beach quotas; eventual replacement of wild-caught turtles by reared ones in

all major markets; and strict control over turtle exports pending a proposal to CITES to have Green and Hawksbill turtles revised to Appendix II for Indonesia (Salm, 1984e).

Philippines: The authorities have recognised the threat to turtles and in the late 1970s a conservation programme known as Task Force Turtle was set up. This included a long-term hatchery and tagging project although there was no systematic recovery scheme for tagged individuals. Halog Island and the Cuyo Islands of Palawan are protected for research purposes, and some active management of the resource is carried out. Some breeding and release of juveniles is occurring on a small scale.

Priority concerns

Pressures on adult turtles, eggs and nest sites are high and likely to increase, despite the existence of various reserves for nesting turtles, and regulations to control removal of eggs and capture of adults. There is little doubt that populations of sea turtles and numbers of nesting sites have declined dramatically. In Peninsular Malaysia egg yields have nearly halved since 1956 (Tow & Moll, 1981). Reasons for the decline include:

a) Over-exploitation of eggs for food or rearing in hatcheries.

b) Over-exploitation of juveniles and adults. For example, an estimated 55,000 are captured annually in Indonesia (Salm & Halim, 1984b). Many of the juveniles are reared in captivity as part of mariculture programmes, but it is feared that this practice may put increasing pressure on already overexploited stocks, and cause further declines in population (Salm & Halim, 1984b).

c) Disturbance of nesting turtles and loss or degradation of nesting areas.

d) Accidental catch of adult turtles in trawl nets.

Priority recommendations

Much stricter management of turtle populations is required. This could be achieved through various regional and national activities.

Regional activities

a) A working group should be established with a view to initiating a co-ordinated programme of regional research on turtle populations (to include a census of each species, and their migratory patterns), and formulating broad conservation strategies. At present there are few data on which management policies can be based.

b) Pressure should be put on importing countries to reduce international trade in turtles and their products. Under CITES, such trade is prohibited, except when the turtles are bred in captivity under specified conditions, or were acquired before the provisions of the Convention came into force for the particular specimens. However, it should be noted that no captive-breeding operations for sea turtles

are currently recognised by the CITES Secretariat. All turtle products from this region come from wild-caught animals, even if they pass through so-called 'farms' or 'ranches'.

National activities

a) National governments should be urged to take note of the threatened status of sea turtles and put more manpower, research and resources into turtle conservation.

b) In terms of national legislation, the basis for control of egg collection and capture of adult turtles already exists. National governments should seek to ensure that existing regulations are enforced more effectively. Turtle landings need to be rigorously monitored in order to enforce restrictions on protected species (e.g. in Indonesia) (UNDP/FAO, 1982a). Stricter controls are required at nesting beaches to prevent unauthorised poaching of eggs.

c) National governments should identify the major nesting and feeding sites of turtles, and take measures to protect them. Identification of nesting sites has already been achieved to some extent in Indonesia.

d) Reserves and sanctuaries should be effectively managed to ensure that no eggs are removed and that adults are not caught in trawl nets or disturbed by visitors.

e) Publicity and education campaigns should be launched to emphasise the need for and benefits of turtle conservation. There should be incentives for fishing communities to develop local management programmes. The Green Indonesia Foundation (YIH) has carried out such a campaign on Bali.

Birds

Character and occurrence

There are two broad categories of birds associated with coastal and marine habitats in the East Asian region. A large number of species (e.g. gulls, terns, plovers, herons, kingfishers) feed in nearshore areas or forage just inland. Others (e.g. boobies, petrels, shearwaters, frigate birds, albatrosses, sea eagles) dive for fish in offshore waters, and may spend a considerable time on the wing. In addition, species such as the Megapode and Pied imperial pigeon, are not strictly marine but are considered here because they are found on offshore islands. 155 species of marine birds have been recorded from Indonesia (Soegiarto & Polunin, 1982).

All seabirds nest on land, and make use of a variety of habitats, from cliff ledges to soft ground and mangrove. Mangroves and mudflats are especially important feeding grounds, both for resident and migratory species.

The Banda Sea, together with the neighbouring Flores Sea, are probably the best seabird areas in Indonesia because they have a relatively high marine productivity and because human exploitation only started to affect colonies of

Pelacaniformes seriously as late as the 1970s, whilst elsewhere in southeast Asia such colonies were destroyed in the first half of this century (De Korte, 1984).

Conservational status

Several sanctuaries and reserves have been set aside specifically to protect birds. The two major seabird nesting islands in Indonesia are protected, as well as six other nesting areas (Salm & Halim, 1984c). Three island reserves are in existence in Malaysia, and a bird sanctuary has recently been incorporated in the Apo Reef Island Marine Park in the Philippines.

Various seabird species are protected by law. For example, in Indonesia 45 species are protected (Salm, 1984d).

Human and economic value

The value of sea-going birds is well known to fishermen, who follow the flocks to locate schools of tuna (Salm & Halim, 1984c). Seabirds are also hunted for food, and their eggs are harvested.

Targeted exploitation

Soegiarto and Polunin (1982) state that predation by man on seabirds has undoubtedly been heavy. Great crested tern and Megapode eggs are collected from many sites, bu concession to the highest bidder. Shorebirds, too, are taken in nets along the north coast of Java at least (Salm, pers. comm.).

However, no recent records of bird exploitation have been located, apart from the collecting of birds' nests for the Chinese delicacy, birds' nest soup. The cave swiftlet (Collocalia white-headi) nests in the sea cliffs of the Philippines (Davidson, 1978). This bird is said to use bits of regurgitated seaweed to construct nests, which are collected by hand from the nesting sites, and are sold for large sums of money. Statistics on this trade are not available.

Incidental exploitation

Although some incidental exploitation in nets must occur, it has not been studied in any detail, and no statistics are available.

Human impacts

Seabirds may be affected directly by oil, and may build up high levels of pesticides and other non-biodegradable compounds within their bodies, but little is known about these problems in the East Asian region.

The most serious impact on birds is probably from loss, disturbance or degradation of their feeding and nesting areas, and from hunting. Species such as the Megapode and the Pied imperial pigeon are particularly vulnerable and have been eliminated from a number of islands as a result of hunting and collection of eggs. Heavy human disturbance probably reduces the breeding success of species such as terns (De Korte, 1984). Rats, cats and dogs disturb and prey on birds and their eggs. This happens even in reserve areas (De Korte, 1984).

Management policy and practice

Little information on management policies has been found. It appears that many of the protected areas are not actively managed, and hunting still goes on (Wood, 1981; Soegiarto & Polunin, 1982). In some areas (e.g. Apo Reef Bird Sanctuary) access to the reserve area is totally prohibited during the breeding season.

Priority concerns and recommendations

Insufficient is known about the status of marine bird populations in the East Asian region. However, it appears that various important wetland sites are not being protected and, as pointed out by Salm and Halim (1984c), it is important to protect the staging sites of migratory birds as a contribution to the global efforts to protect these far-ranging species.

Management of existing reserves appears to be inadequate, particularly in Malaysia. For example, at Pu Sipadan, which was declared a bird sanctuary in 1933, specifically to protect the Nicobar pigeon, these birds having been exterminated as a result of hunting (Wood, 1981).

Other Resource Species

Character/occurrence/conservational status/value

An enormous number of marine species are utilised in the East Asian region. Some of the major resource species, or groups, are shown in Table 1.

Targeted exploitation

One of the characteristics of this region is the very wide range of plants and animals which are exploited in the seas. The exploitation of seagrasses and seaweeds has already been mentioned, as has the exploitation of coral. Giant clams (Tridacna gigas) have been exploited throughout their range for sale as curios or ornaments and for making tiles. They have already been eliminated from part of their range, and in Pulau Seribu even dead clams are being excavated from beneath reefs flats (Salm et al., 1982b). Other molluscs including pearl oysters, cowries, commercial trochus and turbans are exploited throughout most of the region, largely by free divers. Exploitation of trochus shells is measured in hundreds of tonnes throughout the whole region, as is that of turban shells and other shells. The Philippines in particular is a large exporter of ornamental marine shells including cowries, cones and conches. These are, again, collected by hand. In 1980 a mere 6 tonnes of pearl oyster shells (mother of pearl) were taken in the whole of the eastern Pacific Ocean (FAO, 1981).

Squids and cuttlefish appear to be distributed abundantly along the entire coast of the Philippines and to be fished by various gears. Their exploitation has not been intense and the biological information on them is poor (Chikuni, 1983). Cuttlefish catches have been increasing since the mid-1970s, but are still very small around 3,000t per annum. The squid fishery is more intensive, but has been rather stagnant in the same period at around 26,000t. Despite their limited operations, trawlers have contributed most of the squid production, which shows that other squid fishing operations could increase their catch level considerably.

Table 1

Species	Uses	Occurrence	Conservational Status
Algae, e.g. *Eutrema* spp. *Gricularia*, *Sargassum*	food (humans and animals); and industrial purposes soil fertiliser	widespread - rocky/sandy substrates coral reefs	none
Black coral *Antipatharia* spp.	curio trade	coral reefs	Listed on App. II of CITES and as commercially threatened in the IUCN Red Sea Data Book Unprotected in East Asia.
Hard corals	see earlier		
Bivalve molluscs *Tridacna* spp. *Hippopus* spp.	food, curio trade; manufacture of floor tiles	coral reefs	*Tridacna deresa* & *Tridacna gigas* listed on App. II of CITES and as vulnerable in IUCN Red Data Book Unprotected in East Asia.
Mussels, e.g. *Mytilus* & *Modiolus*	food	mangroves	none
Cockles, e.g. *Anadara*	food	mud/sand estuaries mangrove	none
Capiz *Placuna placenta*	mother-of-pearl	mud/sand estuaries, mangrove	none
Oysters *Pinctada* spp.	food and mother-of pearl	mangrove	none
Gastropods - Triton *Charonia tritonis*	food curio trade	coral reefs	Listed as rare in the IUCN Red Data Book
Commercial Trochus *Trochus nilotilus*	manufacture of buttons, etc.; food	reef flat	none

Table 1 (cont.)

Green turban *Turbo marmoratus*	food curio trade	reef flat	none
Lambis, Cypraea Strombus and many others	food curio trade	reefs, reef flat	none
Nerita, *Cerithidae* and others	food	mangrove/mud flats	none
Sea cucumbers e.g. *Holothuria Strichopus*	food	reef flat sandy lagoons	none
Saltwater crocodiles *Crocodylus* spp.	food skin for curio trade	mangroves	*C. porosus* and *C. novaeguineae* listed as vulnerable in the IUCN Red Data Book. *C. novaeguineae* protected in Indonesia.

In Malaysia, there is no major directed fishery for squid except on the east coast of Peninsular Malaysia, where 37% of the squid landings come from squid-jigging, and 50% by trawling (Latif, 1982). In contrast, 97% of the squid landings on the west coast came from trawlers. The combined squid and cuttlefish catches amounted to 16,700t in 1981 (FAO, 1983).

Cephalopods are also considered a by-catch in Indonesia. Both squid and cuttlefish landings come from coastal small-scale exploitation; octopus is fished in coral reef areas. The main production areas are the Malacca Strait, the Java Sea, south Sulawesi and west Nusatenggara (Unar & Sahabi, 1982), and the total catch for 1981 was 2,183t and 10,814t for cuttlefish and squid respectively (FAO, 1983). High abundance of oceanic squids has been reported along the Indian Ocean coastal waters; these are not as yet commercially exploited.

The most productive areas for squid fishing in Thailand are along the southern part of the west coast and the upper end of the Gulf of Thailand near Bangkok (Chotiyaputta, 1982). They are fished mostly by otter trawl and pair trawl, although fishing by light attraction is very popular. The estimated MSYs of 41,965t in the Gulf of Thailand and 5,834t in the Andaman Sea appear to have been reached in the mid-1970s. The combined squid and cuttlefish landings amounted to 60,610t in 1981 (FAO, 1983). The export of cephalopods in Thailand is second only to shrimp exports, and was valued at US$98million in 1979.

Apart from the coastal areas of the Gulf of Thailand and the Andaman Sea, cephalopod resources are lightly exploited throughout the East Asian Seas. Substantial catches from the Taiwanese trawl fleet in the Arafura Sea and the Sunda Shelf indicate the existence of largely unutilised abundant cephalopod resources (Chikuni, 1983).

Other animals taken include jellyfish and sea cucumbers. Jellyfish have a long history of commercial exploitation in Thailand, Malaysia and Indonesia, with export values of more than US$4million in Thailand and US$1.6million in Indonesia (SEAFDEC, 1979). Almost nothing is known of the biology of these species. Similarly, sea cucumbers have a long history of exploitation, and a high export value, with several hundred tonnes being landed annually in Indonesia, Malaysia and the Philippines. In the Philippines in particular, the fishery appears to be expanding dramatically at present (FAO, 1981).

Around 15,000 skins of the crocodile, Crocodylus porosus, are exported every year from the region.

Incidental exploitation

Sea snakes are taken in very large numbers, particularly those in the Java Sea, although statistics have not been collected. The species most commonly affected are Pelamis platurus and Lapemis hardwickii, although a number of other species are taken in smaller numbers.

Human impacts

Resource species may be directly affected by pollution or be secondarily affected by degradation or loss of their natural habitat, but these problems have not been investigated in any detail.

The major problem, at least with some species, is over-collection by tourists and by local and commercial fishermen. For example, giant clams (Tridacna spp., Hippopus spp.) are reported to be seriously depleted at Pu Seribu (Salm et al., 1982a), rare or extinct on the Taka Bone Rate Atoll

(UNDP/FAO, 1982c), and apparently fished out in the Strait of Bali (Usher, 1983). Pearl oysters are similarly depleted.

Saltwater crocodiles appear to have been seriously depleted in, or eliminated from, many areas. For example, they were last seen in Tarutao National Park in 1971.

Management policy and practice

At present, virtually no management of resource species is attempted, except in conservation areas, where collecting is regulated and can only be carried out in specific zones.

Considerable attention is being paid to mariculture of various species, especially algae and mother-of-pearl shells. In Indonesia attempts are being made to establish commercially viable populations of Tridacna, and other valuable species.

Recent and current conservation projects

Steps are proposed in Indonesia to re-establish breeding populations of Tridacna gigas in two protected areas in the Moluccas. The survey of marine species has been undertaken, and recommendations have been made for certain species to be given protected status (Salm, 1984d) (see Table 2).

Priority concerns

Marine plants and animals have been utilised for centuries by coastal inhabitants, but an increase in population, plus a considerable export demand for certain species, have led to overfishing and depletion of stocks. At present it is difficult for governments to propose management procedures that can be enforced and will also be effective, since so little research has been carried out on the effects of exploitation (Wells, 1982).

Degradation and loss of natural habitats of resource species is also of concern.

Priority recommendations

a) Specific protection should be given by national governments to species listed on CITES, or in the IUCN Red Data Book.

b) The status of all major resource species should be assessed by national governments. Some information on distribution, abundance and exploitation already exists but insufficient is known at present to apply any management guidelines/ legislation. Work of this nature has already begun in Indonesia (Salm, 1984d), and it is stressed that the Directorate of Nature Conservation and Directorate General of Fisheries need to collaborate to locate the critical habitats of threatened, protected, shared and commercial species, and they need to work together to manage these regional and national resource heritages.

c) All boats with divers using SCUBA should be licenced in order to control their activities and protect the interests of local fishermen using traditional techniques (Usher, 1983).

Table 2

Species	Red Data Book category	Proposed Indonesia category
Hippopus hippopus (Horse's hoof clam)	Intermediate	Vulnerable, locally eliminated
H. porcellanus (China clam)	Intermediate	Endangered
Tridacna gigas (Giant clam)	Vulnerable	Endangered, locally eliminated
T. deresa (Southern giant clam)	Vulnerable	Endangered
T. maxima (Small giant clam)	Insufficiently known	Intermediate
T. squamosa (Fluted giant clam)	Intermediate	Vulnerable, locally eliminated
T. crocea (Crocus clam)	Insufficiently known	Intermediate
Charonia tritonis (Triton's trumpet)	Rare	Endangered
Trochus niloticus (Commercial trochus)	(Commercially threatened)	Commercially threatened
Turbo marmoratus (Green snail)	(Commercially threatened)	Commercially threatened
Pinctada maxima (Gold-lipped pearl oyster)	(Commercially threatened)	Commercially threatened
P. margaritifera (Black-lipped pearl oyster)	(Commercially threatened)	Commercially threatened

CONCLUSIONS AND RECOMMENDATIONS

Priority Concerns

The population of South East Asia is increasing rapidly, and this is bringing increased pressure on coastal and marine ecosystems. Exploitation of natural resources has escalated, both in the sea and on the land, and this has caused indirect and direct damage to coastal and marine habitats and species. The concerns apply to all ASEAN countries, but with varying degrees of emphasis:

1. Enhanced sedimentation in coastal and marine ecosystems, through soil erosion. Coral reefs are particularly vulnerable, but other habitats may also be degraded.

2. Pollution from land-based sources. This has particular impact on enclosed or semi-enclosed coastal habitats (e.g. mangroves and estuaries) near large population centres or where mining is in operation (e.g. especially in Thailand and the Philippines).

3. Loss and destruction of coastal habitats as a result of reclamation and other development. This applies particularly to mangrove forest.

4. Destructive fishing methods, such as blasting with explosives, which are particularly damaging to coral reefs.

5. Over-exploitation of many resource species, including endangered and vulnerable species such as turtles, giant clams and other molluscs.

Recommendations for Action.

1. Watershed management: It is recommended that national governments give priority to developing guidelines and legislation for soil conservation. This would be in the interests of both the agricultural sector, where soil loss is a threat to the future productivity and viability of land, and to the health and productivity of coastal and marine habitats. The Philippines has already begun of research and reafforestation programme (NEPC, 1983), but a co-operative approach by the ASEAN nations is recommended.

2. Control of pollution: It is recommended that national governments seek to ensure that pollution is monitored and that pollution control legislation is enforced. If necessary, new legislation should be introduced. Proposals for methods and action to assess and control pollution are included in the WHO/PEPAS Report (1981), and a 'Manual on the Compilation and Exchange of Marine Environment Data and Information in the East Asian Seas' has been produced as part of the Regional Seas Programme (Siripong, 1983). Considerable attention to pollution studies is already being given under the UNEP Regional Seas Programme.

3. Coastal zone management: It is recommended that national governments introduce coastal zone management plans (these are already being developed in Indonesia and the Philippines) in order that strategies can be formulated for different areas, thereby reducing the present conflicts of use, overexploitation, degradation and loss of habitats, and other problems.

4. Legislation: It is recommended that national governments review existing legislation to ensure that there are adequate provisions for protection of marine species and habitats. All legislation should be rigorously enforced, include CITES regulations.

5. Environmental impact studies: It is recommended that national governments require that environmental impact studies are carried out before habitats and species are exploited. This applies especially to mining and extraction of metalliferous deposits. For example, concessions continue to be granted for tin mining in Thailand, despite environmental damage.

6. Protected areas: It is recommended that greater priority should be given to the establishment of conservation/management areas. In particular, it is recommended that efforts are made to establish areas that include a wide range of ecosystems, for example, from inland forest to mangrove forest, mudflats, seagrass beds and coral reefs. These ecosystems form an interlinked progression, and disruption of one component can affect the others. This approach would increase the chances of successful protection of offshore habitats (e.g. coral reefs) because adjacent waterways and forests would also be managed.

7. Mangroves: In view of the rapid rate at which mangroves are being degraded or lost, it is recommended that national governments (especially in the Philippines and Thailand) should take immediate steps to radically reduce the amount of mangrove being released for development.

8. It is urged that the East Asian Nations become parties to the Wetlands and World Heritage Conventions, and set aside appropriate sites under the terms of each.

National governments should seek to strengthen the administration for the protection of marine species and habitats, and for the management of marine protected areas.

PROJECT RECOMMENDATIONS

Management/Conservation Projects

1. Management of coral reefs and resource species: It is recommended that national education and publicity programmes should be launched to try and involve local communities in managing and protecting their reefs. It is difficult to police many of the remoter areas, and in any case, more effective control could be brought in with the co-operation and active participation of local people. This method has apparently worked successfully on Apo Island in the Philippines, where most of the destructive fishing methods have now ceased.

   The campaign should:-

   a) draw attention to the problems being caused by such activities as destructive fishing methods, over-exploitation of turtle eggs and molluscs;

   b) emphasise the importance and advantages of self-imposed conservation; and

   c) outline possible methods of management at a local level.

   The campaigns should be co-ordinated by the national authority responsible for nature conservation, in collaboration with the Fisheries Department and local communities.

2. Establishment of a multi-national conservation area: There is a need for multi-national co-operation and collaboration, and development of regional strategies for conservation and management. An area known to be particularly rich in coral resources, and a centre of nesting turtles, is in the southwest Sulu Sea, incorporating northeast Kalimantan (Indonesia), Sabah (Malaysia) and the Philippines (de Silva, 1981; Wood, 1981; Salm et al., 1982b). It appears that parts of this area are being degraded and would clearly benefit from a multi-national approach to management.

3. Data atlases: It is recommended that data atlases are produced for each of the ASEAN nations, on the same format as the one already produced for Indonesia (Salm & Halim, 1984c). These contain essential information on the distribution of habitats and species, and form the basis on which coastal zone management plans can be formulated.

Research Projects

1. Coral reefs: It is recommended that further efforts and funding are put into the two projects that have already been planned and initiated through the Regional Seas Programme. These are:-

   a) survey of the state of coral resources;

   b) study of the effects of pollutants and destructive factors on coral communities and related fisheries.

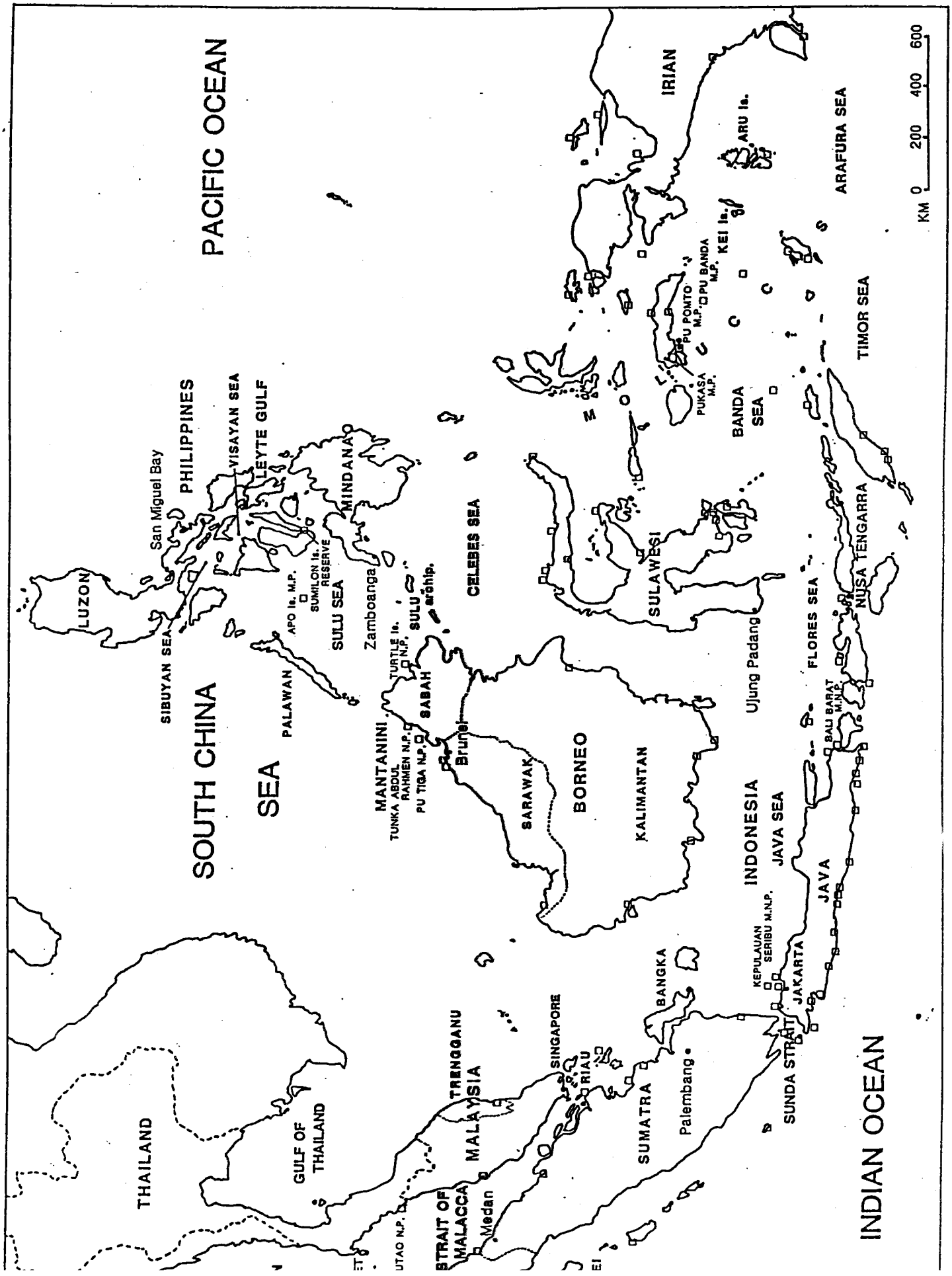
Details of these projects are given in the Report of the first meeting of the co-ordinating body on the Seas of East Asia UNEP/IG.37/10, 1982.

2. Mangroves: It is recommended that the two projects included in the Draft East Asian Seas Action Plan are funded. These studies would complement the coral reef projects, and it is recommended that the research programmes are structured in a similar way, with lead countries undertaking particular aspects (see UNEP/IG.37/10, 1982).

3. Seagrasses: A multi-national seagrass group should be set up with a view to identifying priority environmental research topics for seagrass beds. Projects could include an examination of the relationship between the condition of these beds and their corresponding value to nearby fisheries, and to resource species such as Dugongs and turtles.

4. Turtles: A working group should be established with a view to initiating a co-ordinated programme of regional research on turtle populations (to include a census of each species, and their migratory patterns), and formulating broad conservation strategies. At present there are few data on which management policies can be based.

The location of the major protected marine areas in the East Asian Seas region. (For clarity some protected areas which are smaller or of uncertain status are not shown).



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