In northern Palawan, spawning and settlement grounds are likely further inshore, particularly within the numerous embayments and indentations along the coast (Campos 2000). The major pelagic groups in the area include the carangids, clupeids, scombrids, and engraulids, whereas the most common epibenthic groups are the gobiids, mugilids, and the reef-associated haemulids, monacanthids, and lutjanids. Collectively, these groups comprised about 65% of the larval assemblage in the area (Floro, 2003).

From the foregoing discussion and based on available data from plankton surveys, three major spawning areas are identifiable: (a) the western portion of Lingayen Gulf; (b) Mindoro Strait; and (c) Northern Palawan including the Calamianes Islands. While it is believed that Scarborough Shoal and the Kalayaan Island Group (KIG) are major sources of propagules for the country's archipelagic waters (and fishing grounds), comparable information (*e.g.,* plankton) useful for more definitive examination are lacking.

4.1.2 Known nursery areas and feeding grounds

There is a paucity of available information regarding the potential productivity of waters along the western Philippines. Investigations in 1998 show that the area south of Subic Bay extending to waters west of northern Palawan has higher phytoplankton biomass, as indexed by chlorophyll α concentrations, than waters further north (Bajarias 2000; Furio and Borja, 2000). Relatively high concentrations of chlorophyll α have also been reported for the shelf, shoal, and oceanic areas west of northern Palawan (San Diego-McGlone *et al.,* 1999). An overall distribution of chlorophyll α, zooplankton, and small pelagic fish abundance indicators is shown in **Figure 19**. High zooplankton biomass is also closely associated with areas of high chlorophyll α concentrations (Relox *et al.,* 2000). Purse seine fishing experiments conducted in the vicinity in 1998 showed that catch rates for small pelagic fish, primarily *Decapterus* spp., were at least tenfold higher just off the Bataan Peninsula than in other coastal areas further north or south (Pastoral *et al.,* 2000), thus showing a good spatial correspondence with the concentrations of phytoplankton and zooplankton.

High fish biomass is normally supported by high primary and secondary plankton production. From the information presented above, it can also be inferred that, within the SCS sub-region, high fish abundance is in close spatial correspondence with both high zoo- and phytoplankton biomass. Hence, it follows that higher concentrations of nutrients are required to sustain the primary and secondary production, which in turn supports the fisheries production capacities, in coastal embayments. A comparison of net primary production and zooplankton concentrations in the SCS area (**Table 15**) highlights the large difference. This implies that if early developmental stages (*e.g.,* larvae) of coastal stocks were to benefit from areas that provide natural protection from open water predation, and from those where productivity adequately supports high consumption and rapid growth rates, Lingayen Gulf and Manila Bay would likely serve as important nursery grounds.

The prevalence of juveniles in trawl catches in Lingayen Gulf (MERF, 2002) and Manila Bay (Armada, 1995) is a clear indication that both areas serve as nursing and feeding grounds for many coastal stocks, including those of transboundary significance. Definitely, for some species, these areas would be important spawning grounds as well, although for migratory species such as tuna and other large pelagics, their dependence on such areas for spawning is uncertain.

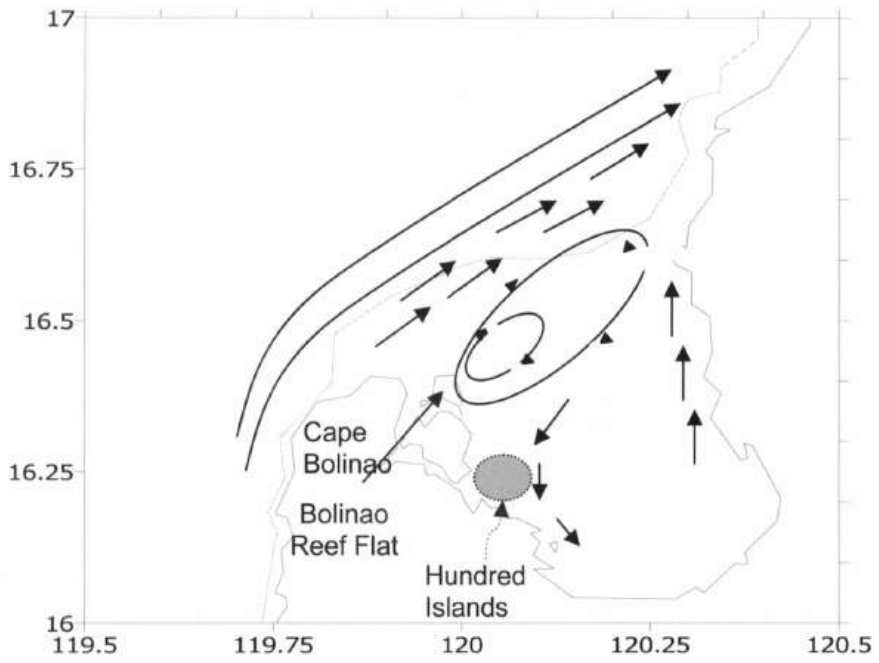

Figure 18 Water circulation in Lingayen Gulf showing eddy formation at the mouth and entrainment within the western portion of the Gulf (Altemerano and Villanoy 2002).

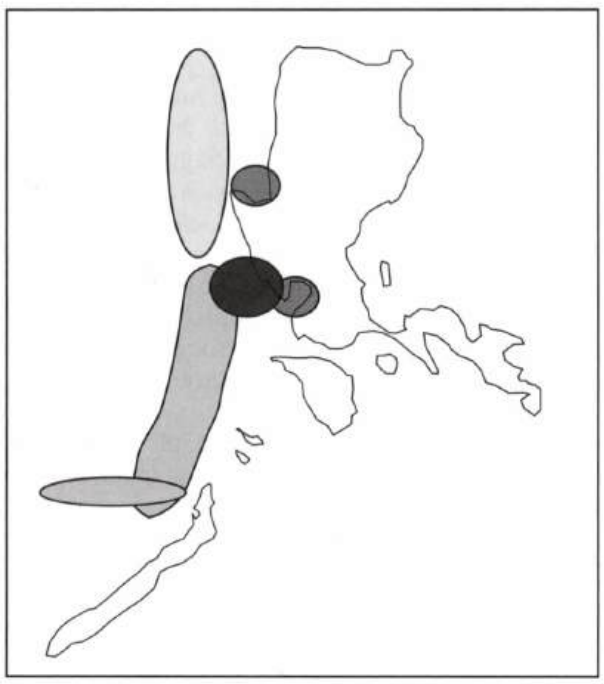

Figure 19 General distribution of chlorophyll α (green: concentration increases with darkness), high zooplankton concentrations (blue), and highest catch rates for small pelagics (red) in western Philippines during April-May 1998.

4.1.3 Known fishing grounds

Figure 20 shows the major areas where soft-bottom demersal fishing (*e.g.*, trawling) has traditionally been conducted, along with areas where primarily hard-bottom (reef) demersal fisheries normally operate (Simpson, 1979). Trawl fishing is concentrated around the two major embayments, with activities in northern and northwestern Palawan restricted to the trawlable portions. Reef fishing only covers a limited area along the Luzon coast.

In contrast, traditional fishing grounds for pelagic species, particularly small pelagics, cover almost the entire coastline from Ilocos to Batangas, including Verde Island Pass, Lingayen Gulf, and Manila Bay, and further south into Palawan (Simpson 1979). The major fishing grounds for round scads based on landing statistics are located mostly in interisland waters (**Figure 21**), with the exception of waters around northern Palawan, the coast of Batangas, and in Manila Bay. For small pelagics as a whole, the major fishing grounds along the western Philippines include western Palawan and the waters around Manila Bay. In contrast, the most productive tuna fishing grounds are located in the southern portion of the country (**Figure 22**), except the coast of Batangas.

In the open waters of the SCS, there is meager information on the spatial distribution of fish catch rates. From historical accounts, however, there have been numerous reports of foreign vessels fishing in the area of Scarborough Shoal, a disputed area about 150nm west of Zambales (Thomas, 1999). The structure of shoals, including reef habitats that provide shelter and prey for a variety of fish species and shallow areas that permit benthic primary production to enhance the carrying capacity of the immediate environment, makes them attractive fishing grounds. Also, the topography in and around shoal areas increases the potential for physical entrainment features, which tend to concentrate plankton. Thus, it is theoretically valid to claim that Scarborough Shoal may serve as a source of eggs and larvae of fish and invertebrate stocks along the coast, although there have been no systematic investigations on this matter.

4.2 Unknown issues such as stocks with undefined spawning grounds

There is scarce information about the spawning grounds for elasmobranchs (sharks and rays) and invertebrate groups. In general, elasmobranchs either deposit benthic egg cases or carry their eggs. They have very low fecundity so that protection of their spawning and nursing grounds is necessary to prevent further depletion of their stocks. Little is known about elasmobranchs in the country, even along the SCS coast, maybe due to the absence of a directed fishery for them. Elasmobranchs are still considered as bycatch in fisheries, and the practice of discarding much of the bycatch at sea, except for shark fins, hampers taxonomic identification and measurement of catch.

In the case of invertebrates, there is more information on crustaceans (shrimp and crabs), although most are from the interisland waters. Similar to fish, many invertebrates are broadcast spawners with planktonic early life stages. Thus, their propagules are also subject to dispersal by currents. However, for the less motile invertebrates, such as sea urchins, sea cucumbers, gastropods, and bivalves, it is likely that their stocks are dependent on recruitment from local spawners. This is one of the reasons why developing culture, larval rearing, and reseeding techniques remain a viable option for managing such stocks. Larval rearing techniques have been developed for species of giant clams, some bivalves, and the sea urchin *Tripneustes gratila*, while the procedures for sea cucumber are still being refined.

Cephalopods, except for *Sepioteuthis lessoniana*, are lesser studied due to an excessive interest in fish. Even in scientific surveys, most cephalopod species are often unidentified and simply lumped together as squid, octopus, or cuttlefish. There is some data for oceanic squids *Tysanoteuthis rhombus* and *Sthenoteuthis oualaniensis* from exploratory fishing cruises in the SCS (Dickson *et al.*, 2000; Siriraksophon *et al.*, 2000).

4.3 Current and potential threats

Threats to the habitats of fishing grounds are summarised in **Tables 16 to 19**. Lingayen Gulf and Manila Bay are bordered by high population centres, although there are fewer industrial operations around Lingayen Gulf. Since both have extensive shallow areas (reef flats and mudbanks in Lingayen Gulf, but mostly mudbanks in Manila Bay), they are vulnerable to global increases in temperature and the consequent rise in the sea level. This is especially true for the coral reef habitats of Lingayen Gulf.

Both Lingayen Gulf and Manila Bay are considered overexploited (Armada 1994; MERF, 2002) to a point where drastic shifts in the species composition of faunal assemblages have occurred (Armada 1999). Similarly, fisheries in Malampaya Sound have also shown signs of overfishing (Ingles, 2002). The latter, together with Calamianes Islands (also located in Palawan) is known to be some of the remaining pristine natural marine habitat in the Philippines. Aside from its high biodiversity and endemicity, the Sound is also a refuge for endangered species, including the *dugong* and the Irrawady dolphin (Ingles, 2002). Unfortunately, even these supposedly pristine areas have exhibited declines in

fish catches, an indication of overfishing (Werner and Allen, 2000). Hence, the greatest immediate threat in northern Palawan is the lack of proper fisheries/habitat management. In the densely populated waters of Lingayen Gulf and Manila Bay, the immediate threats are numerous and the persistent problem has been inadequate management of marine resources. The coast of Mindoro facing the Mindoro Strait is economically underdeveloped due to its exposure to rough (sea and land) conditions. As such, many of the perceived threats associated with human activities in this area would be of much lesser magnitude, although the downstream effects of logging and mining are likely considerable.

4.4 Ranking of habitats

4.4.1 Association with species of importance to food security

In terms of total fisheries production and fishing effort, both Lingayen Gulf and Manila Bay would rank high, since proper resource management is most needed in both areas. More people are, and will remain, dependent on fisheries production in both areas. Hence, there is a greater need for sustainable use in light of an ever-increasing human population. Northern Palawan and Mindoro Strait are not as heavily populated, although the former is already heavily fished. The areas with greatest need and priority remain to be both Lingayen Gulf and Manila Bay.

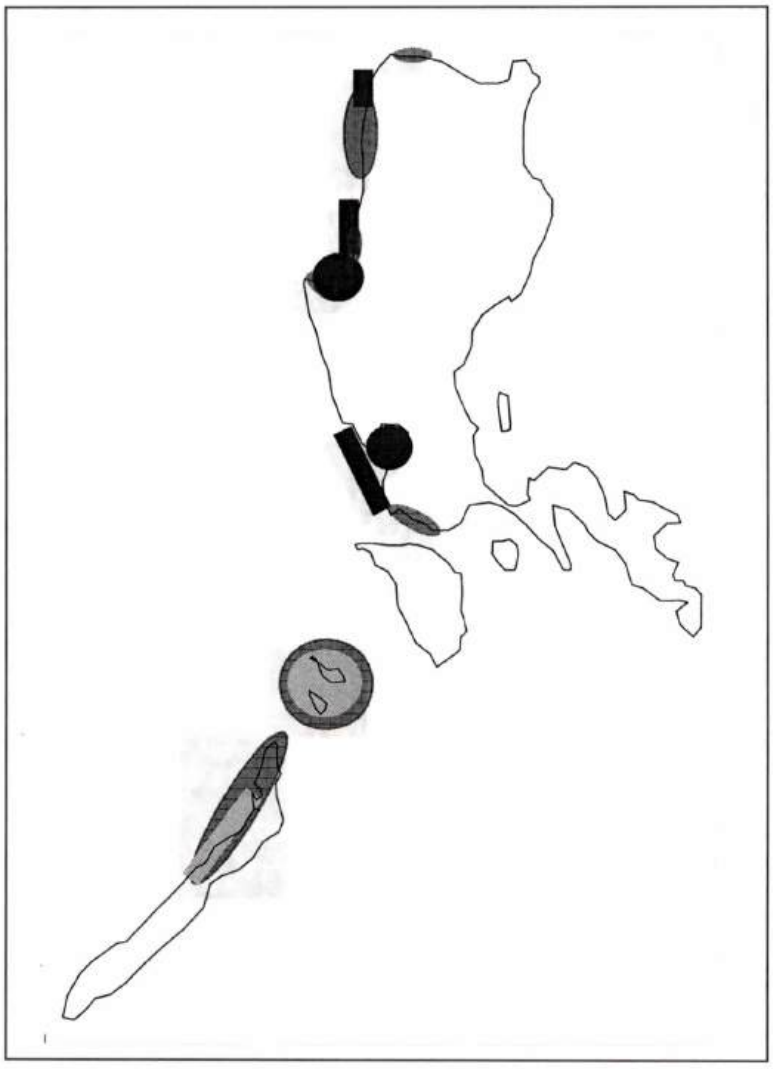

Figure 20 Distribution of soft-bottom (trawlable: blue) and hard-bottom (reef: red) fishing grounds along the country's South China Sea coast (Simpson, 1979).

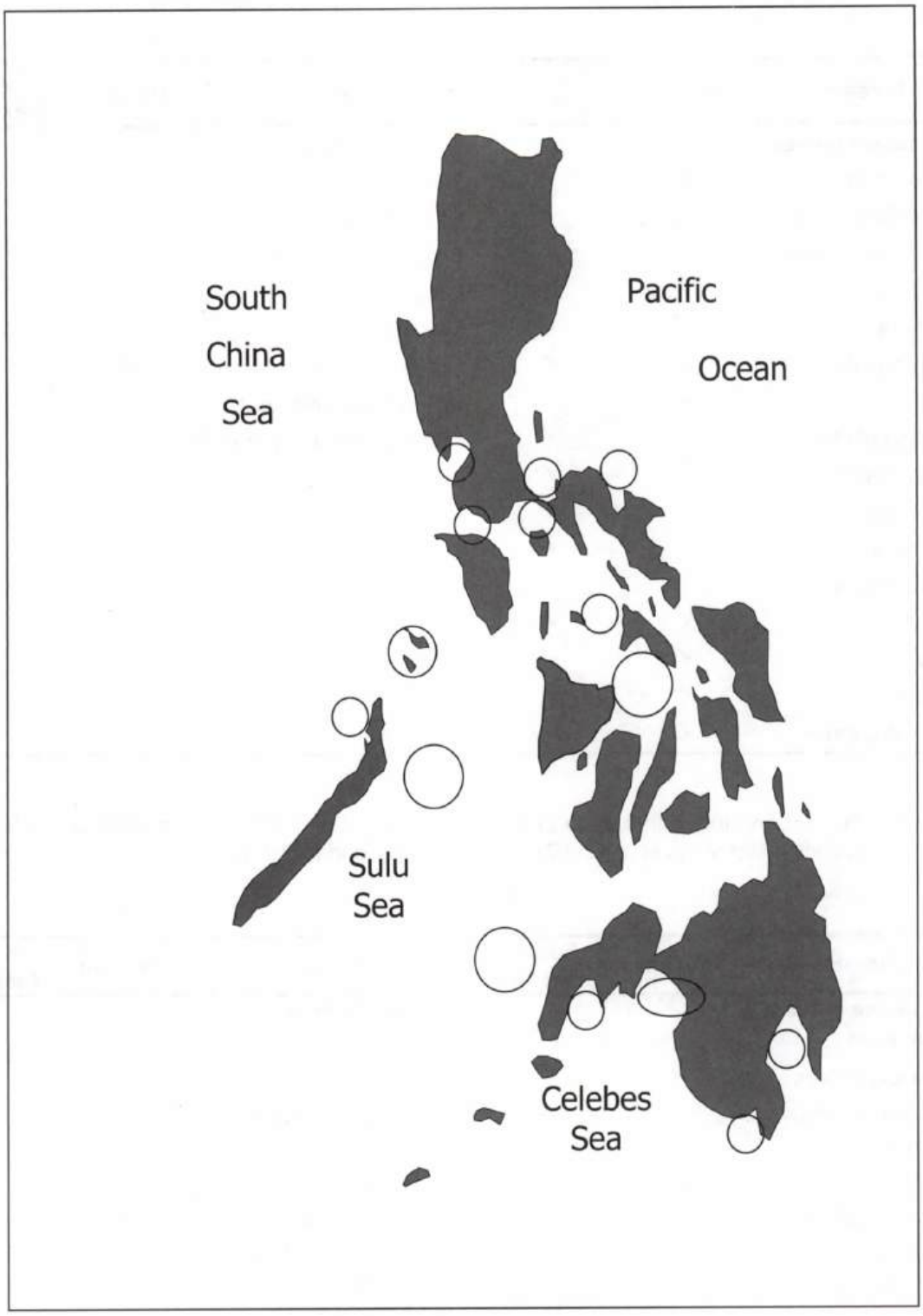

Figure 21 Most important fishing grounds for round scads from 1956 to 1970 based on Ronquillo (1975) and PCAMRD (1993).

Table 16 Present and future threats to Manila Bay based on information from MADECOR (1995) and Armada (1999).

Threats	Present	Future (next 10 y)	Threats	Present	Future (next 10 y)
Destructive harvest			**Global changes**		
Bottom trawl	✓	✓	Thermal		✓
Use of Explosives	✓	✓	Sea level rise		✓
Plant/animal removal	✓	✓	**Coastal development**		
Pollution			Land fill	✓	✓
Sediment	✓	✓	Dredging	✓	✓
Heavy metals	✓	✓	Coastal erosion	✓	✓
Oil	✓	✓	**Upland development**		
Organic pollutants	✓	✓	Changing discharge/runoff	✓	✓
Eutrophication	✓	✓			
Salinity change	✓	✓			
Pesticides	✓	✓			
Natural disasters					
Storms	✓	✓			
Flood	✓	✓			
Drought	✓	✓			
Land subsidence	✓	✓			

Table 17 Present and future threats to Lingayen Gulf based on information from various references including McManus *et al.* (1992), UPMSI (1999), and MERF (2002).

Threats	Present	Future (next 10 y)	Threats	Present	Future (next 10 y)
Destructive harvest			**Global changes**		
Bottom trawl	✓	✓	Thermal		✓
Use of Explosives	✓	✓	Sea level rise		✓
Plant/animal removal	✓	✓	**Coastal development**		
Pollution			Land fill		✓
Sediment	✓	✓	Dredging	✓	✓
Organic pollutants	✓	✓	Coastal erosion	✓	✓
Eutrophication	✓	✓	**Upland development**		
Salinity change	✓	✓	Changing discharge/runoff	✓	✓
Natural disasters					
Storms	✓	✓			
Flood	✓	✓			
Drought	✓	✓			
Land subsidence	✓	✓			

Table 18 Present and future threats to Northern Palawan (including Calamianes Islands) based on Estudillo *et al.* (1980), Werner and Allen (2000), and Ingles (2002).

Threats	Present	Future (next 10 y)	Threats	Present	Future (next 10 y)
Destructive harvest			Global changes		
Bottom trawl	✓	✓	Thermal		✓
Use of Explosives	✓	✓	Sea level rise		✓
Plant/animal removal	✓	✓	**Coastal development**		
Pollution			Tourism		✓
Sediment	✓	✓	Coastal erosion		✓
Natural disasters			**Upland development**		
Storms	✓	✓	Changing discharge/runoff		✓

Table 19 Present and future threats to Mindoro Strait.

Threats	Present	Future (next 10 y)	Threats	Present	Future (next 10 y)
Destructive harvest			**Global changes**		
Use of Explosives	✓	✓	Thermal		✓
Plant/animal removal	✓	✓	Sea level rise		✓
Pollution			**Coastal development**		
Sediment	✓	✓	Coastal erosion		✓
Oil (from collisions)	✓	✓	**Upland development**		
Natural disasters			Changing discharge/runoff		✓
Storms	✓	✓			

4.4.2 Association with high-value species

Both Lingayen Gulf and Manila Bay show clear signs of ecosystem overfishing (Pauly *et al.*, 1989), as shown by the prevalence of fast growing, small, omnivorous, and low-valued fish such as herring and anchovies, and invertebrates such as shrimps and squids (Armada, 1999). This is attributed to the loss of large predatory (high-valued) fish (*e.g.*, lutjanids, haemulids, serranids, flatfish, *etc.*) from the fish community, thus allowing the fast-growing omnivorous prey species to dominate in abundance.

In contrast, such high-valued fish are still common in northern Palawan (Werner and Allen 2000), although the live fish trade (for juvenile groupers especially) will likely take its toll if allowed to continue unabated. Overall, because of less human activities, habitat conditions are healthier and more pristine in northern Palawan than in most other areas in the country. It is likely that the production capacity of the area, including high-valued species, is still high and may be sustained if managed properly.

Mindoro Strait is relatively deep with very narrow shelves on either side of the Strait. Its natural productivity is likely to be influenced more by hydrographic processes (*e.g.*, convergence of water masses) than by the shallow water features (reefs, coastal indentions, seagrass beds, mangroves, *etc.*) and processes (interconnections between habitats), which are rather more important in northern Palawan. Thus, the Strait has a more physically driven environment where the limits to productivity are natural and generally beyond the scope of management interventions.

4.4.3 Association with endangered, rare, or threatened species

Due to less disturbed conditions, northern Palawan is among the very few areas in the country where rare and uncommon species can still be found. The high scleractinian coral diversity in the Calamianes Islands (Capili *et al.*, 2002) reflects such conditions. The area is also considered as one of the eight important marine corridors, which serve to maintain the marine biodiversity in the Philippines (Ong and Ibuna, 2000). Together with Mindoro Strait, the Mindoro-Calamianes Corridor allows the free movement of stocks, propagules, and ultimately genetic materials between the SCS and the Sulu Sea and nearby internal waters (**Figure 23**) (Endriga 2003). Faunal affinities (Juinio-Meñez *et al.*, 2003) and similarities in fish species composition (Dantis *et al.*, 1999) have been found between the two areas. In addition, the corridor also serves as a connection between the Kalayaan Island Group and the Tubbataha Reef System, both of which are believed to be major sources of fish and invertebrate larvae for the country's internal waters (McManus 1994; Dantis *et al.*, 1999). It has been suggested that Palawan likewise serves as an important source of propagules for the SCS (DENR, 1997). Thus, whether as corridor or source, the northern Palawan area is of special interest from both conservation and management standpoints.

5. CURRENT MANAGEMENT REGIME

This part discusses the basic instruments and support mechanisms for managing marine habitats and populations. It deals with legal instruments, *e.g.*, national laws that also serve as the basis for local ordinances and for the country's commitment to international agreements, and institutional arrangements in support of fisheries or coastal resources management initiatives, including the roles of various government agencies, research and academic institutions, and the local government units in monitoring, control, and enforcement. This section also examines patterns of resource ownership, the capacity of human resources and institutions to perform research, monitoring, control, and surveillance, as well as the role of management bodies and stakeholders in managing fisheries and coastal resources.

5.1 Legal instruments

A number of legal instruments form the basis for managing the country's fish stocks and marine habitats. National laws define the limits and management responsibilities for the use of fishery resources. These laws are mirrored through fishery ordinances at the local level.

Various aspects of fish stock, marine habitat, and coastal resources management are articulated in the 1987 Constitution of the Philippines, the Local Government Code of 1991 (Republic Act 7160), the Agriculture and Fisheries Modernization Act of 1997 (RA, 8435), and the Fisheries Code of 1998 (RA, 8550).

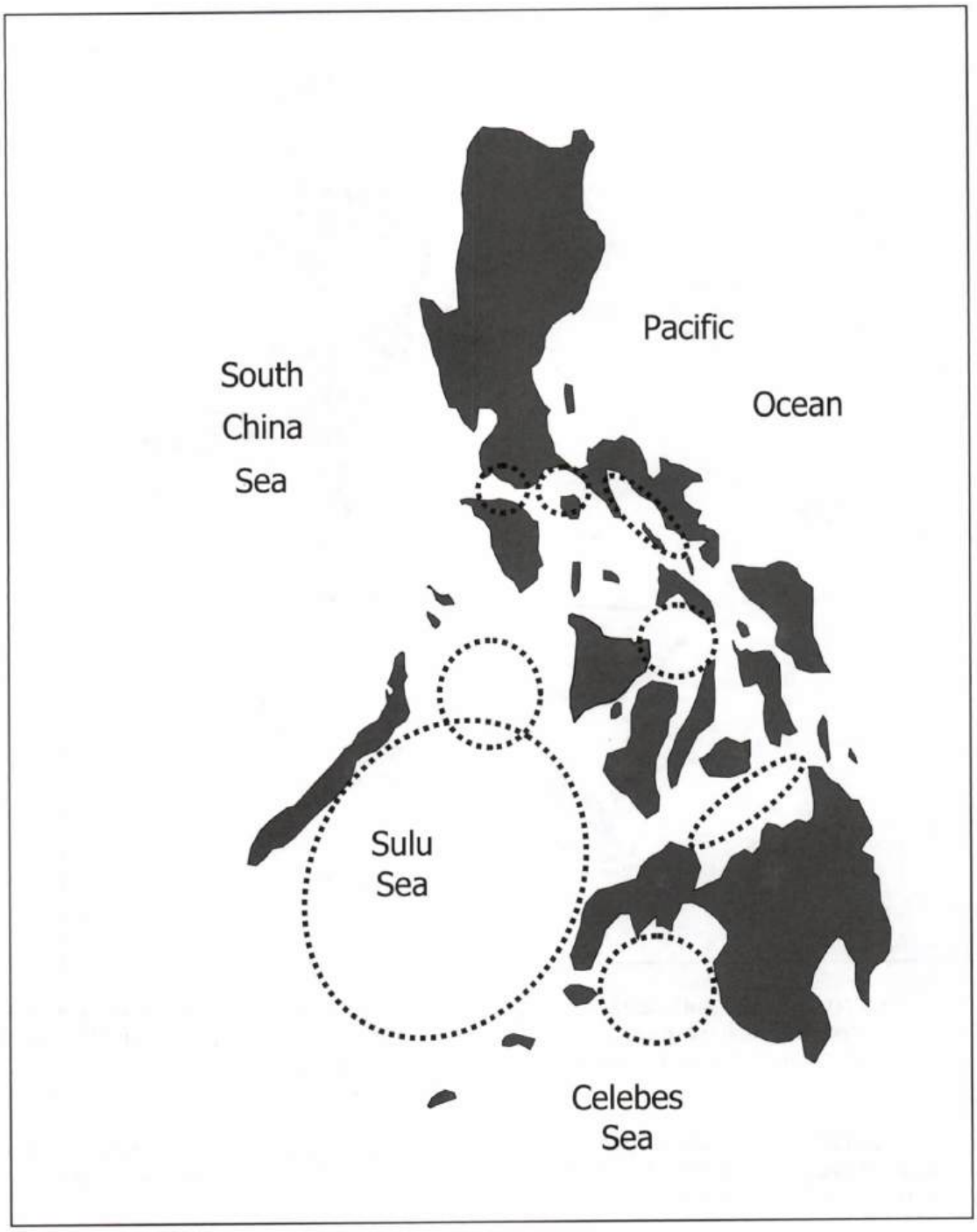

Figure 22 Top 10 tuna fishing grounds in the country with mean annual landings >30,000 MT from 1983 to 1987 (PCAMRD, 1993).

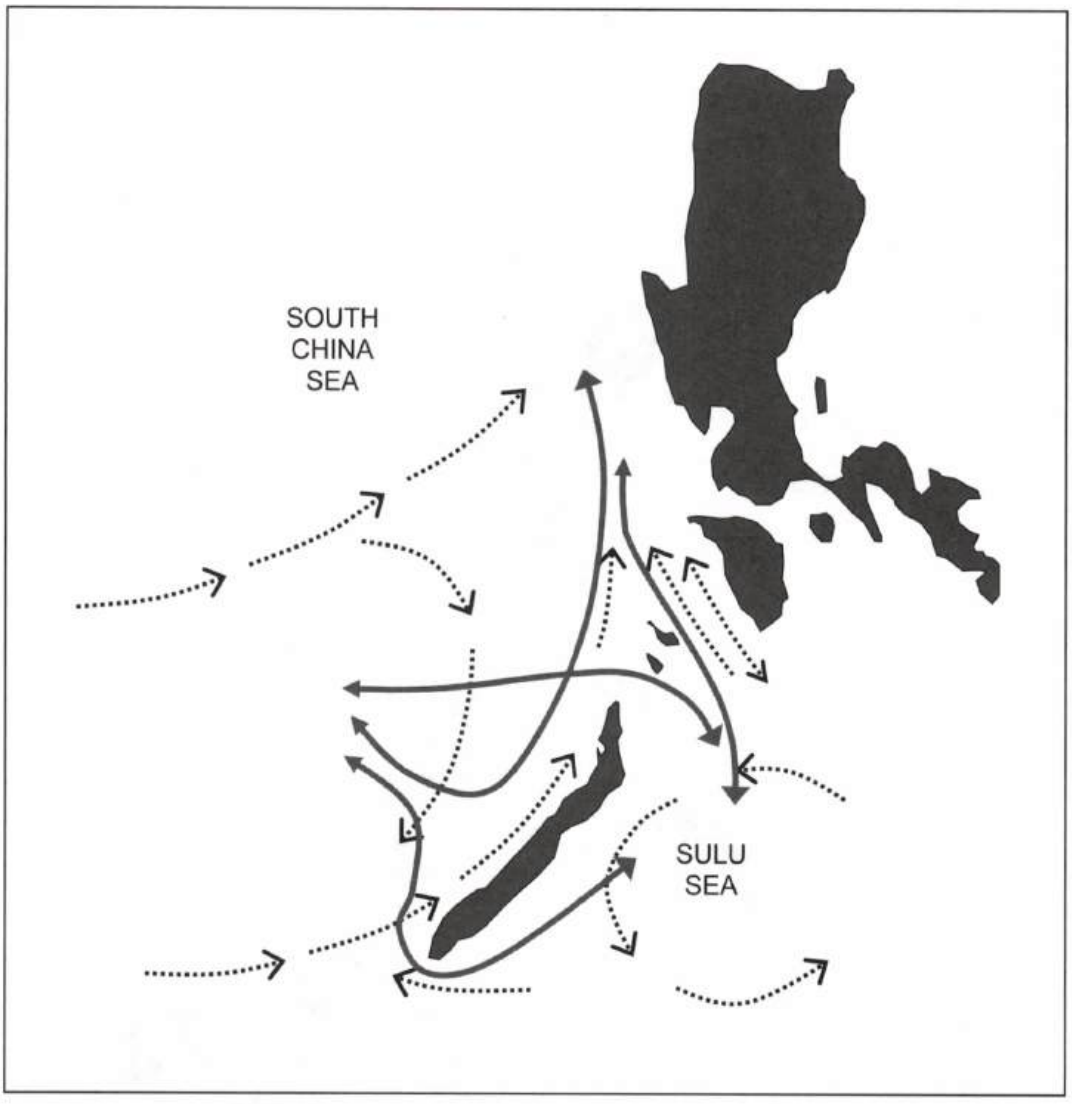

Figure 23 Predominant sea surface currents (broken arrows; from Juinio-Menez *et al.*, 2003) and inferred direction of mixing (red arrows) of stocks of fish and invertebrates in the southeastern SCS area of western Philippines (Endriga, 2003).

The Philippine Constitution articulates general principles for the management and use of all natural resources in the Philippines. In the case of fish stocks, aquatic habitats, and coastal resources, the following are the pertinent provisions:

- The State shall protect and promote the right to health of the people; the State shall protect and advance the right of the people to a balanced and healthful ecology in accord with the rhythm and harmony of nature.
- The exploration, development, and utilization of natural resources shall be under the full control and supervision of the State. The State shall protect the nation's marine wealth, and exclusive economic zone, and reserve its use and enjoyment exclusively to Filipino citizens.
- The state shall protect the rights of subsistence fishers, especially of local communities, to the preferential use of the communal marine and fishing resources, both inland and offshore. It shall provide support to such fishers through appropriate technology and research and other services.
- The right of the people and their organisations to effective and reasonable participation at all levels or social, political, and economic decision-making shall not be abridged.

The Local Government Code forms the basis for transferring (devolving) national level responsibilities to local government units (LGUs). It places the responsibility for the development and delivery of basic services with LGUs. In managing fish stocks and coastal habitats, it incorporates the following:

- Management of fishery resources within the 15-km limit of the coastal waters.
- Enhancement of the right of the people to a balanced ecology.
- Provision of extension and on-site research services and facilities related to agriculture and fishery activities.
- Provision of solid waste disposal system or environmental management system and services and facilities related to general hygiene and sanitation.
- Enforcement of forestry laws limited to community-based projects, pollution control law, small mining law, and other laws on the protection of the environment.
- Enactment and enforcement of necessary fishery ordinances and other regulatory measures in coordination with non-governmental organisations and people's organisations in the community.
- Forging of joint ventures to facilitate the delivery of certain basic services, capability-building, and livelihood development.
- Cooperative undertakings among LGUs for purposes commonly beneficial to them.
- Share in the Internal Revenue Allotment (IRA) to enable them to provide the basic services and perform fundamental functions (including fisheries management) at their level.

The Fisheries Code provides the basis for the development, management, and conservation of the country's fisheries and aquatic resources. It is essentially a consolidation of previous fishery laws and an update of existing laws related to fisheries at the time of its enactment. Pertinent provisions cover various aspects of fisheries, exploitation of fish resources, and their management, namely:

- Enactment of appropriate fishery ordinances in accordance with the national fisheries policy.
- Enforcement of all fishery laws, rules and regulations as well as valid fishery ordinances enacted by the municipal council.
- Integration of the management of contiguous fishery resources/areas, which must be treated as a single resource system.
- Granting of fishing permits and privileges to duly registered fisherfolk organizations/ cooperatives.
- Ensuring that the municipal waters are utilised by municipal fisherfolk or organisation/cooperatives except when an appropriate fishery ordinance is enacted to allow commercial fishing within the municipal waters.
- Maintenance of a registry of municipal fisherfolk for monitoring fishing activities and for other related purposes.
- Issuance of permits to municipal fisherfolk and organisations/cooperatives that will be engaged in fish farming, seaweed farming, *etc.*
- Granting of demarcated fishery rights to fishery organisations/cooperatives for mariculture operation.
- Provision of support to municipal fisherfolk through appropriate technology research, credit, production, and marketing assistance and other services.
- Provision of support for the creation of the Fisheries and Aquatic Resources Management Councils (FARMCs) at national, regional and local levels.

The major concern of the Agriculture and Fisheries Modernization Act is not just to modernise agriculture and fisheries. It also aims to serve as a framework for a sustained increase in the production of goods and services and for a more equitable distribution of opportunities, income, and wealth. Its provisions intend to attain the following:

- Modernise the agriculture and fisheries sectors by transforming them from a resource-based to a technology-based industry.
- Enhance profits and incomes in the agriculture and fisheries sectors, particularly the small farmers and fisherfolk, by ensuring equitable access to assets, resources, and services, and promoting higher-value crops, value-added processing, agribusiness activities, and agro-industrialisation.
- Ensure the accessibility, availability, and stable supply of food to all at all times.
- Encourage horizontal and vertical integration, consolidation, and expansion of agriculture and fisheries activities, groups, functions, and other services through the organisation of cooperatives, farmers' and fisherfolks' associations, corporations, nucleus estates, and consolidated farms, and to enable these entities to benefit from economies of scale, afford them a stronger negotiating position, pursue more focused, efficient, and appropriate research and development efforts, and enable them to hire professional managers.
- Promote people empowerment by strengthening people's organisations, cooperatives, and NGOs, and by establishing and improving mechanisms and processes for their participation in government decision-making and implementation.
- Pursue a market-driven approach to enhance the comparative advantage of our agriculture and fisheries sectors in the world market.
- Induce the agriculture and fisheries sectors to ascend continuously the value-added ladder by subjecting their traditional or new products to further processing in order to minimise the marketing of raw, unfinished, or unprocessed products.
- Adopt policies that will promote industry dispersal and rural industrialisation by providing incentives to local and foreign investors to establish industries that have backyard linkages to the country's agriculture and fisheries resource base.
- Provide social and economic adjustment measures that increase productivity and improve market efficiency while ensuring the protection and preservation of the environment and equity for small farmers and fisherfolk.
- Improve the quality of life of all sectors.

The Philippines, together with Brunei Darussalam, Indonesia, Japan, Malaysia, Singapore, Thailand, and Viet Nam, forms the working group that is drafting guidelines so that the provisions of the Code of Conduct for Responsible Fisheries (CCRF) will be implemented at the regional level. This is realised through coordination with the Southeast Asian Fisheries Development Center (SEAFDEC). As an active participant in the regionalisation of the CCRF, the Philippines also acts to ensure that provisions of the Code of Conduct are incorporated into policies that guide fish stock utilisation and management in the Philippines.

5.2 Institutional arrangements (research, monitoring, control, and enforcement)

Various national government agencies are concerned, directly or indirectly, with fisheries utilisation and management. These include the following:

1. The Department of Agriculture (DA) is responsible for the promotion of agricultural development and growth through increased productivity. Among the primary objectives of the DA is to increase the real incomes of farmers and fisherfolk. The following agencies under the DA are concerned with fisheries, fish utilisation, management, and other support services:
   - *Bureau of Fisheries and Aquatic Resources (BFAR)*. It recommends plans, programs, policies, rules, and regulations on matters related to fisheries and marine resources, and provides technical assistance in the implementation of these policies;
   - *National Agricultural and Fishery Council (NAFC)*. It acts as an advisory body to the DA and serves as a forum for continuing consultative discussions within the agricultural and fishery sectors. NAFC is the DA's main agency in charge of coordinating private sector participation in the development of agricultural and fisheries sectors. It builds partnerships between the government and the private sector, as well as between the DA and LGUs.

- *Philippine Fisheries Development Authority (PFDA)*. It promotes growth of the fishing industry and improves efficiency in the handling, preserving, marketing, and distribution of fish and fishery products through the establishment of fish ports, fish markets, and other infrastructures necessary for the progressive advancement of the fishing industry. It has joint management agreement with coastal LGUs for the management of municipal fish ports.

2. The Department of Environment and Natural Resources (DENR) promotes the well-being of Filipinos through the sustainable development of forest and marine resources, optimal utilization of land and minerals, and effective environmental management. The DENR also has several agencies under it that are directly or indirectly concerned with the management of marine habitats.

3. Agencies involved in research and scientific coordination work include the Department of Science and Technology – Philippine Council for Aquatic and Marine Resources Development (DOST–PCAMRD), a policy-formulating and coordinating body for aquatic and marine science and technology development; the DA – Bureau of Agricultural Research (BAR), the main coordinating body for all research conducted by the DA; and the DENR – Ecosystem Research and Development Bureau (ERDB), which is DENR's research coordinating unit. There are likewise academic institutions that focus their scientific work on fish and aquatic organisms, including the various institutes under the College of Fisheries and Ocean Sciences (CFOS); the Marine Science Institute (MSI) of the University of the Philippine System (UPS); the Marine Laboratory of Siliman University; the Marine Biology Department of San Carlos University; and various fisheries colleges and departments of other state universities.

4. Other national government agencies concerned with the enforcement of fishery and environment laws include the Department of Interior and Local Government (DILG); the Maritime Group of the Philippine National Police (PNP); the Department of Tourism (DOT)' the Department of National Defense (DND); the Department of Transportation and Communication (DOTC); and the Philippine Coast Guard (PCG).

5. Other national government agencies mandated to coordinate national activities include the National Economic Development Authority (NEDA), which coordinates various social and economic plans, policies, programs, and projects on national and sectoral levels, and the Department of Foreign Affairs (DFA), which heads the Cabinet Committee on Marine Affairs and addresses the various concerns regarding the implementation of the 1982 United Nations Convention on the Law of the Sea (UNCLOS).

6. The Congress of the Philippines, particularly the Committees on Agriculture, Ecology, and Natural Resources of the House of Representatives, and the Committees on Environment, Agriculture, and Food of the Senate.

7. The Local Government Units, which by virtue of the devolution of the responsibilities of the national government under the Local Government Code of 1991, had been given the exclusive authority to grant fishery privileges in municipal waters and the responsibility to manage its fish stocks and aquatic resources.

Although it appears that there are many agencies involved, directly and indirectly, in the management of fisheries resources, the immediate burden still lies with the local government or the municipality. The municipality, however, cannot conduct research and monitoring concerning the management of fish and invertebrate resources. This activity is usually performed in collaboration with BFAR, DENR, DOST, and various research and academic institutions in the form of projects usually funded by international agencies or in the form of loan. A number of similar initiatives are also being conducted in collaboration with non-governmental organisations (NGOs). For the gathering and monitoring of baseline data by these institutions or organisations, an institutional capability-building component is usually included to ensure the continuation of activities even beyond the life of the project.

In some initiatives, support for the development of a legal basis for the management of coastal and aquatic resources is also given. The products are municipal ordinances governing the proper utilisation of resources or, in most cases, a codified set of fisheries ordinances covering all aspects of utilisation and management of fish and other aquatic resources.

The municipality also carries the burden of enforcing fishery laws. In most cases, a composite team of civilian volunteers, police, and military personnel is formed to conducts sea patrols and apprehend violators of fishery laws or, at least, deter illegal fishing activities. Many of these sea patrols, locally

called *bantay dagat,* were created with external help from NGOs and other institutions, as part of project interventions. Members of the composite team also receive training in enforcement procedures, such as proper boarding, collection, and evidence preservation.

Municipalities sharing a common resource system, like bays and gulfs, unite and form an Integrated FARMC. Initiatives among these municipalities are harmonised to achieve proper utilisation of the common resource system. The Municipal Fisheries Ordinances (MFO) of participating municipalities are also harmonised and coastal resources management plans are coordinated by a governing body or council. Although municipal authorities manage their respective sea patrols, attempts are also made to coordinate enforcement of fishery laws.

5.3 Overview of patterns of resource ownership and traditional utilisation

Traditionally, the Philippines has had open access fisheries. Fishing of all forms used to be allowed in all waters of the archipelago, ultimately leading to the overfishing of all accessible fishing grounds and major fish stocks of the country. This prompted the government to rethink its policies, resulting in a gradual shift in recent years to a limited access regime. Initial attempts to limit access to fisheries included a ban on the operation of commercial fishing boats (more than 3 GT) in waters 7 fathoms deep or shallower, or within 7 km from the coastline. This ban was later extended to within 15 km of the coastline, which is considered as municipal waters.

Limiting access to fisheries is also integrated with the establishment of marine protected areas (MPAs). MPAs take the form of fish sanctuaries, marine reserves, marine parks, or mangrove reserves as no-take zones, regulated-use zones, or both. The establishment of MPAs is embodied in the Fisheries Code, usually implemented through community-based organisations. Another innovative endeavor by NGOs to limit access to fisheries involves the use of community property rights (CPR), which is seen as a viable option for coastal resources management that will benefit the most marginalised fisherfolk. CPR makes the community a part of the decision-making process in the design and implementation of coastal resources management activities.

5.4 Human and institutional capacities

The Philippines is a recipient of various grants and loans intended for the development of the fisheries sector. A large portion of these grants and loans was allotted to human and institutional development. Major banks and donor agencies include, among others, the World Bank (WB), Asian Development Bank (ADB), Food and Agriculture Organization (FAO), United Nations Development Programme (UNDP), United States Agency for International Development (USAID), German Agency for Technical Cooperation (GTZ), Canadian International Development Agency (CIDA), and Japan International Cooperation Agency (JICA). Through these and other foreign donor institutions, the country's human resources and institutions in fisheries research and development are strengthened.

A major recipient is the BFAR and its personnel. Many research and extension personnel of BFAR are recipient of scholarships and grants both locally and abroad in connection with the performance of their duties. This includes graduate studies, training, and exchange visits in fields including capture fisheries, aquaculture, and fish processing. Loans and grants are also used to develop the research and other scientific capabilities of educational institutions, primarily colleges, institutes, and departments of state universities and private universities that are mandated to promote fisheries and marine science through instruction, research, and extension. Institutions were also developed and strengthened through financial support for infrastructures and equipment.

The implementation of a number of projects, funded through either grants or loans, has gradually developed the capacity of human resources and institutions to manage fish stocks, aquatic habitats, and coastal resources. Although these projects were site-specific, experiences from them served a basis for replication in other areas of the country and even as model for other developing countries. Normally these projects were implemented by various government agencies in partnership with local and international NGOs, people's organisations (POs), the academe, LGUs, and the community. Projects conducted in coastal areas of the Philippines' side of the SCS include:

- *Fisheries Sector Program (FSP): 1990 to 1995.* The program was implemented by DA through BFAR and had several components: fishery resource and ecological assessment (REA), coastal resources management, income diversification, research and extension, law enforcement, credit,

and infrastructure. Manila Bay was the only SCS site included in the project. At various levels of success, the program was able to encouraged LGUs to adopt Coastal Resources Management (CRM) planning as a basic tool for resource management. Results of REA conducted on selected priority bays provided the scientific basis for the formulation of baywide management plans. FSP also claimed to have developed a high level of awareness and knowledge about the resources among stakeholders and enabled them to actively participate in resource management activities.

- *Coastal Environment Program (CEP): 1993 to onwards.* This environment program of DENR aims to institutionalise CRM in organisational structures based on the principles of sustainable development, biodiversity, and resource sharing. It also aims to strengthen the link between upland and coastal ecosystems under a watershed-based management approach. CEP is being implemented throughout the country through DENR's regional and provincial activities. It is relying on sharing with other stakeholders, especially communities and LGUs, the responsibility to manage natural resources. It also works through a decentralised structure at the local level.
- *Fisheries Resource Management Project (FRMP): 1998 to 2003.* This is the continuation of the FSP, with three components: fisheries resource management, income diversification, and capacity building. The management component was designed to strengthen fisheries regulation, rationalise the utilisation of fisheries resources, and rehabilitate damaged habitats. The income diversification component promotes income diversification for municipal fisherfolk by organising self-reliant community groups, promoting micro enterprises, and supporting mariculture development. The capacity building component aims to strengthen, in the long term, the capacity of agencies for fisheries resource management at the national, regional, and local levels.
- *Marine Science and Resource Development: 1985 to 1995.* This UNDP-funded project implemented by the UPMSI was designed to advance marine science in the Philippines, to link marine science research and development programs with the end-users of information and technology, to upgrade the capability of the UPMSI to conduct basic and applied research and instruction at the graduate level, and to develop and promote new technologies or the adaptation of existing ones for the effective utilisation, management, and conservation of the marine resources.

In addition, there are a number of fisheries and coastal resource management initiatives undertaken by local and international NGOs and the academe, together with POs, LGUs, and the community, that focus on common property rights, MPAs, participatory resource assessment and management, integrated habitat management, and livelihood diversification.

5.5 Review of stakeholders

Municipal and commercial fishers, defined in Section 1.2 above, represent stakeholders in the Philippines' capture fisheries. Municipal fishers are equivalent to the small-scale or sustenance fishers of other countries, whose primary motivation in fishing is subsistence. The commercial fishers, on the other hand, operate larger fishing boats mostly for profits. Fishers may be temporarily employed in the commercial sector while they are usually owners and operators in the municipal sector.

Fishing and farming are the dominant sources of livelihood in most Philippine fishing communities along the SCS coast. On small islands, fishing usually dominates, although there are cases where fishing and farming activities are not well differentiated. Farming is the major occupation during the wet season, but gradually shifts to fishing leading up and during the dry season. Manufacturing and other industries also provide employment opportunities in coastal communities, especially those located in or near urban centers. Ecotourism and outdoor recreation is also becoming another source of livelihood. Other sources of livelihood are aquaculture, fish handling and processing, fish distribution and marketing, boat construction and maintenance, gear construction and repair, salt making, as well as quarrying of corals and sand.

The Local Government Code, aside from defining the basic mandates of the LGUs, also increased the financial resources available to them through Internal Revenue Allotment (IRA) shares, which are proportionate to their contribution to the national coffers. In addition, it recognises the need for civil society involvement in local governance by allocating certain seats for direct people's participation in local policy and planning bodies, such as the local development councils and the local legislative bodies. It also emphasises the role of LGUs in sharing with the national government the responsibility of protecting the ecological balance of natural environments within their jurisdictions.

The implementation of resource management activities follows a holistic approach. Although some services and many of responsibilities were already devolved to the local government, the management of resources takes a broader perspective. It recognises the interrelationships and interdependencies of the physical, biological, sociocultural, economic, legal, and institutional factors affecting the entire ecosystem. Coastal communities, government agencies, LGUs, NGOs, POs, FARMCs, and other civic organisations play important, intertwining roles. Although management is implemented at the lowest LGU level, policies and the underlying framework cover a larger ecosystem (bay, gulf, or sea). Some of the policies relevant to fisheries management include:

- Decentralisation of the management of nearshore fisheries resources to municipalities and local fishing communities.
- Strengthening of fisheries law enforcement by organising municipal-based inter-agency law enforcement teams composed of representatives from fisherfolk association, NGOs, LGUs, Philippine Maritime Police (PMP), PCG, BFAR, DENR, the private sector, and other concerned agencies or institutions.
- Promotion of community-based initiatives to rehabilitate, conserve, and protect the coastal resources.
- Diversification of the source of income of fisherfolk toward other income opportunities.
- Expansion of extension services to form closer linkages between and among the fisherfolk, research institutes, and other beneficiaries.

Embodied in the Fisheries Code is the creation of the FARMCs at the national and local levels. This recognises the need to coordinate resource management activities at various levels and to ensure the participation of LGUs, coastal communities, government agencies, NGOs, and POs in the management of coastal resources. Three levels were established: national (NFARMC), municipality/city (MFARMC/CFARMC), and integrated (IFARMC).

Most municipalities bounding the South China Sea have established their MFARMCs because the law mandates it. Some were organised through the assistance of NGOs, but mostly through the regular program of BFAR in its respective regional units. Each BFAR regional unit has a FARMC coordinator whose main task during the past few years was to help each municipality or city establish their respective FARMCs.

Many municipalities also formed smaller units of FARMCs at the barangay level (BFARMCs). Though not mandated by the Fisheries Code, the formation of BFARMCs is being encouraged to institute fisheries resource management initiatives at the community level. This also facilitates the replication of efforts by the MFARMC at the community level. Also, since many management initiatives, such as the establishment of MPAs, take place at the community level, the creation of BFARMCs reinforces initiatives concerning the implementation of MPA management plans and enforcement of agreed rules regarding resource utilisation. BFARMC can also be an effective partner in fishery law enforcement. Although sea patrols are based in the municipality, BFARMCs can act as community lookouts for illegal fishing activities.

Many fisheries and aquatic resource management schemes in the coastal areas along the SCS coast were initiated independent of the creation of FARMCs and were started even before the institutionalisation of the various levels of FARMCs. These initiatives range in scope, from large-area coastal management interventions involving stakeholders of an entire body of water to concerted fisheries management activities of a fishers organisation.

On a larger scale, Lingayen Gulf became the subject of an integrated coastal resources management initiative through the participation of the Philippines in the ASEAN-USAID Coastal Resources Management Project (1986 to 1988). The then six member-nations of the Association of South East Asian Nations (ASEAN) each piloted a Coastal Resource Management Project (CRMP) in a selected site in each country (Scura *et al.*, 1992) and Lingayen Gulf was chosen for the Philippines. This led to the creation of the Lingayen Gulf Coastal Area Management Commission (LGCAMC), a coordinating body for the integrated management of the coastal resources of the gulf.

On a smaller scale, the municipalities of Mabini and Tingloy, Batangas formed the MaTinCADC (Mabini-Tingloy Coastal Area Development Council) (White and Meneses, 2003). Prior to this, a chronology of interventions by various government and non-government institutions had taken place. This included the establishment of marine sanctuaries, conservation projects, CRM activities, coral reef monitoring, and ecotourism.

Several coral reef areas were declared as marine parks, marine reserves, marine sanctuaries, or fish sanctuaries. These include marine sanctuaries declared through a municipal ordinance in Mabini, Batangas (White and Meneses, 2003); a biosphere reserve managed by the Philippine Tourism Authority in Puerto Galera, Oriental Mindoro (Rañola *et al.*, 2003); a marine park established with the assistance of the USAID/DENR Coastal Resource Management Project in San Vicente, Palawan (Uychiaoco *et al.*, 2003); and a fish sanctuary established with the assistance of the Haribon Foundation and US Peace Corps in San Salvador Island, Masinloc, Zambales (Arceo and Alano, 2003).

Some management actions were part of on-going government projects, like the Coastal Environment Program (CEP) site of DENR in Telbang, Alaminos, Pangasinan (Orallo *et al.*, 2003a). UPMSI maintains a research station in Bolinao, Pangasinan, which became the source of information derived from various research activities. The area also became the recipient of community-based coastal resource management (CB-CRM) initiatives (Ferrer *et al.* 1996). Even fisher associations can initiate fisheries resources management activities, as in the case of the Nagabugan Fishermen Association of Davila, Pasuquin, Ilocos Norte. This NGO-organised association has planted 25 hectares of mangroves, initiated alternative livelihood projects, and undertaken coastal and marine resources management activities (Orallo *et al.*, 2003b). The entire island of San Salvador, Masinloc, Zambales, a reservation area, is managed by a local people's organisation (*Samahang Pangkaunlaran ng San Salvador*) with considerable support from the local government (Arceo and Alano, 2003).

6. RECOMMENDATIONS

6.1 Recommendations for government follow-up action

- Activities under the monitoring, control, and surveillance (MCS) system should be strongly implemented and executed.
- Implementation of specific projects in fulfillment of commitments and in compliance with various international conventions, such as the FAO Code of Conduct for Responsible Fisheries.
- Collaborative interagency efforts and activities must address and incorporate relevant concerns, *e.g.*, environmental impact assessments, biodiversity conservation, marine protected areas, biosafety protocols, *etc.*

6.2 Recommendations for regional collaborative efforts

- Concerns for the international waters should also include:
  a. Highly migratory and transboundary aquatic species (*e.g.*, fishes, marine mammals, marine turtles, invertebrates).
  b. Monitoring and evaluation of catches, including bycatch and discards, in the high seas by commercial fishing fleets.
  c. Bilateral fisheries cooperation in several themes, including utilisation, management, research, and development.
- Stock assessment and studies delineating populations and stocks of shared fishery resources using available technologies, *e.g.*, surveys, tagging, morphometrics, and molecular studies.
- Establishment of a joint fisheries management framework between and among neighbouring countries that are sharing and utilising common resources.
- Joint management and research for shared stocks of threatened or endangered marine species, *e.g.*, marine mammals and whale shark.

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United Nations Environment Programme

UNEP/GEF South China Sea Project

Global Environment Facility

NATIONAL REPORT

on

The Fish Stocks and Habitats of Regional, Global and Transboundary Significance in the South China Sea

THAILAND

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Case Study: Gulf of Thailand

INTRODUCTION

The Gulf of Thailand (Figure 1) covers an area of approximately 350,000km^2. The Gulf is a shallow arm of the South China Sea, adjoining it over a distance of 200 nautical miles. It is approximately 450 nautical miles long, 300 nautical miles wide, with a maximum depth, in the central portion, of slightly more than 80m. The central depression extends for 60 nautical miles near Cape Liant at the southeast corner of the Bangkok Bight. The northeast coast is slightly shallower and flatter than the southwest coast.

The deeper central Gulf is separated from the South China Sea by 2 ridges. The first has a depth of less than 25m and extends southwest for more than 60 nautical miles from the Cape of Camau (Robinson, 1974). The other has a deeper ridge, less than 50m, which extends northeast of Kota Bharu for a distance of 90 nautical miles. Subsequent to the Naga Expedition, a further regional bathymetric survey was conducted by the DODO expedition of the Scripps Institution of Oceanography. In the narrow, deeper channel between the ridges, a still depth of 67m was observed. These general features play an important role in regional oceanography. In general, the Gulf of Thailand is divided into 2 parts:

1. **The Upper or Inner Gulf** starts from latitude 12°30′N and extends up to the Chao Phraya Estuary, forming a U-shape. This 100x100km^2 area, with an average water depth of 15m, can contain about 131km^3 of water (calculated at the MSL). The northern part is shallow, gradually sloping to a depth of 25m near the opening between Sattahip, Chonburi province, and Hua Hin, Prachuap Khiri Khan province.

2. **The Lower or Outer Gulf** starts from latitude 12° 30′ N and extends down to Cape Camau and the Kotabaru Estuary, with an average water depth of 45m. A large number of ridges and shallow valleys dominate the continental shelf next to the Gulf of Thailand and southern Viet Nam coast, where water depth gradually increases to about 130m (Siripong, 1985).

The Gulf of Thailand is considered one of the most productive marine areas of the world, with a high level of primary production and diverse range of flora and fauna. It is abundant in marine fishery resources, typical of Indo-Pacific fish fauna. Thailand's marine fish fauna includes some 1,337 species from 141 families. There are 618, 350, and 379 species of economically important marine fish, aquarium fish, and low-value fish known to occur in Thai waters, respectively (Sukhavisidth, 1996). The greatest species diversity exists within the demersal fish fauna. A high degree of intermixing is also common among the demersal species, such that no single species or group of species is observed to dominate catches. The pelagic species are somewhat less diverse than the demersal species, and are less likely to be so highly intermixed.

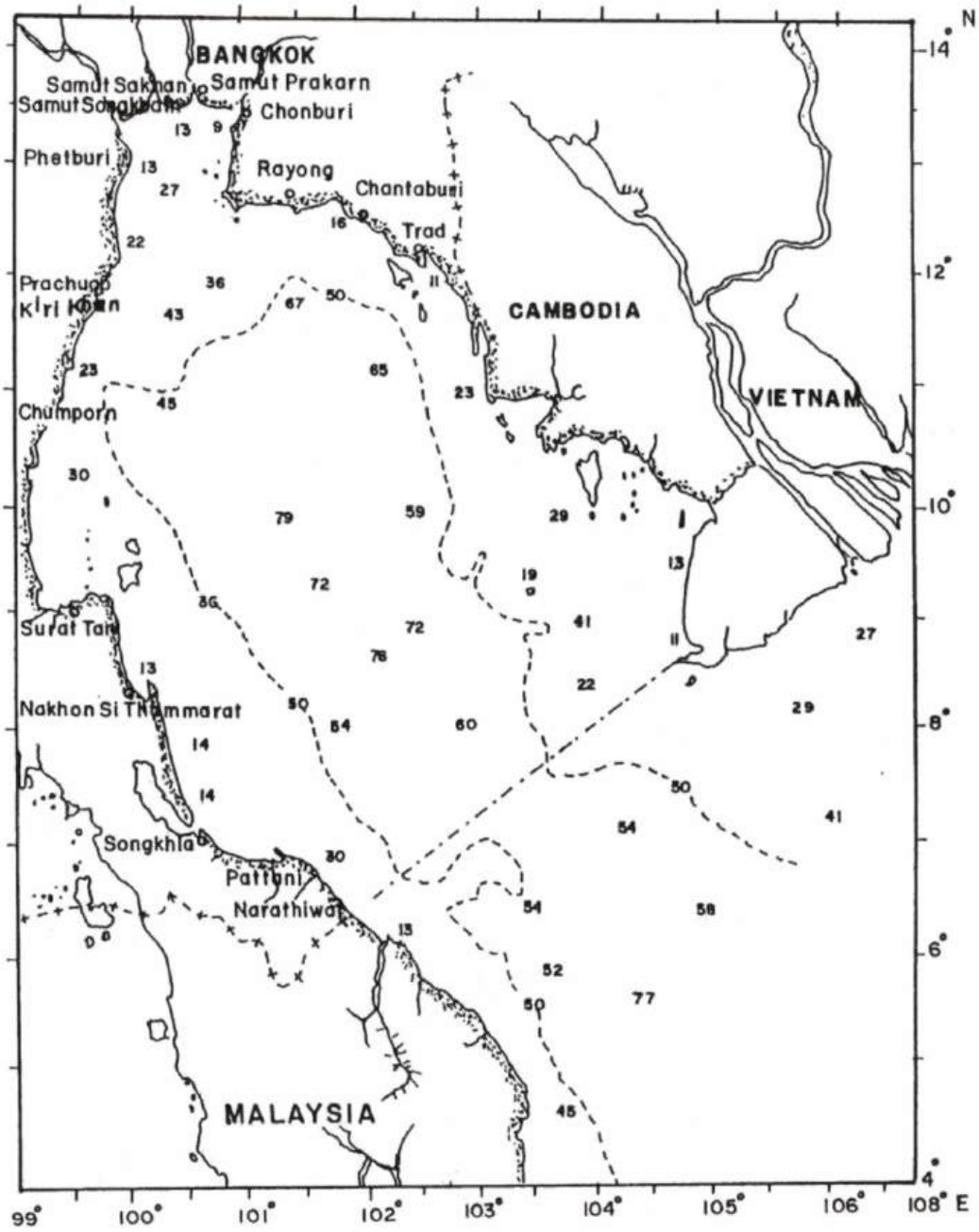

Figure 1 The Gulf of Thailand.

1. MARINE FISHERIES DEVELOPMENT

1.1 Overview of the fisheries sector [2/]

Marine fisheries are an important contributor to Thailand's economy. They are not only an important source of animal protein, but also a source of employment. Similarly, the export of fishery products is a major source of foreign exchange earnings for Thailand. Various types of fishing gear are used to exploit marine fish resources in the Gulf of Thailand, with at least 150 fishing gears being widely utilised by Thai fishers (Okawara *et al.*, 1986). It is well known that there is no particular fishing gear used to catch one single species. Thai Fisheries have developed progressively, especially with regard to the adoption of fishing gears and techniques. Historically, the development of Thailand's fisheries can be categorised into the following 3 periods:

[2/] *Data for the South China Sea coastline only.*

Pre 1960 – This was the initial development phase for Thailand's fisheries. Most fishing gear was of the artisanal type, including harpoons or spears, and stone block traps. Stationary fishing gear, including the bamboo stake trap, set bag net, and wing set bag, were introduced in 1897. Fishing gear were small-scale and operated with non-powered boats.

The use of the Chinese purse seine by 2 row boats was introduced to Thailand in 1925. This gear was rapidly accepted due to its efficiency in catching Indo-Pacific mackerel. By 1930, fishers had begun using the Chinese purse seine with boats powered by Japanese motors, and had redesigned their boats for the efficient capture of pelagic fishes.

In 1947, there were 2,615 units of fishing gear used in Thai waters. This number had increased to 11,560 by 1959 (Table 1). Set bag nets and bamboo stake traps were the main gears used. For seine nets, the total number of units increased from 177 in 1947 to 379 in 1959, and the total annual marine fish production ranged from 150,000 to 230,000 metric tonnes, or approximately 73 percent of total fisheries production (Table 2). Most of the marine fish caught were pelagic species for domestic consumption, including Indo-Pacific mackerel, Indian mackerel, sardines, and anchovies.

1960 to 1980 - This period involved the rapid expansion of Thailand's trawl fisheries, particularly during the early 1960s as a result of the introduction of German type otter board trawling. The total number of registered fishing gear units increased from 17,790 in 1960 to almost 20,000 in 1980, whilst the number of trawl gear units increased from 99 to 10,428 during the same period. Nylon was also introduced during this period as a material for fishing gear such as gill nets, push nets, and squid nets. The period involved a rapid decline in the total number of previously popular gears, including the bamboo stake trap and set bag net. This was largely due to the popularity and rapid uptake of trawl fishing gear and technology.

The development of fisheries in Thailand during this period focused on both demersal and pelagic species. The significant expansion of Thai fisheries during the period 1960-80 was mainly due to the:

1. Introduction of new technology and fishing gears, including the use of nylon nets in small scale fisheries, and otter board trawls in commercial fisheries;
2. Improved seaworthiness of both non-powered to engine powered fishing vessels;
3. Technical support from developed countries and international organisations;
4. Investment and/or financial support from industrial countries for the development of infrastructure, including fish processing, cold storage, and ice plant;
5. Exploration of new fishing areas, especially in the South China Sea; and
6. Government policy that supported the development of offshore fisheries.

All of these factors led to a significant increase in the total quantity of marine fish caught since 1960. According to fisheries statistics, total annual catch increased from about 150,000 metric tonnes in 1960 to more than 2 million metric tonnes in 1977, making Thailand one of the top 10 fishing nations since 1973. Furthermore, the contribution of marine fish production to Thailand's total fisheries production increased from 66.87% to over 90%. Total production decreased slightly to 1.8 million metric tonnes in 1980, however, due to the country's oil crisis. Pelagic fisheries also developed rapidly during this period. The uptake of luring purse seines in the 1970s, and the discovery of fishing grounds for round scads in the central part of the Gulf in 1973, were key contributing factors to this growth. The development of light luring fishing techniques to catch small pelagic fish has resulted in significant increases in landings of small pelagic fishes since 1978.

Panayotou and Songpol (1987, cited in Johnson 1997) identified 3 factors influencing the rapid rise of Thai fisheries since the early 1960s. These include the introduction of new technology, notably the trawl, the purse seine, and the motorised boat; a "laissez-faire attitude" of the Thai Government towards fisheries development, allowing private investors virtually a free-hand in resource exploitation; and the demand for fisheries products in global and domestic markets. Thailand has been one of the world's most important producers and exporters of seafood since 1972.

Table 1 Number of fishing gear units registered in Thailand from 1947 to 2000.

Year	Trawlers	Seine Nets	Gill Nets	Squid Nets	Bamboo Stake Trap	Set Bag Net	Set net	Hook & Line	Push Net	Other Nets	Grand Total
1947		177			823					1,615	**2,615**
1948		222			1,177					3,682	**5,081**
1949		151			1,160					2,999	**4,310**
1950		181			1,047					3,379	**4,607**
1951		164			1,003					2,370	**3,537**
1952		253			1,263					4,247	**5,763**
1953		259			1,334	2,238	827			4,537	**9,195**
1954		346			1,460	2,318	988			5,819	**10,931**
1955		314			1,462	2,260	843			6,082	**10,961**
1956		381			1,579	2,390	764			7,218	**12,332**
1957		324			1,287	2,813	636			7,282	**12,342**
1958		182			1,344	2,505	977			6,429	**11,437**
1959		379			1,470	2,043	618			7,050	**11,560**
1960	99	345			2,064	3,429	1,234			10,799	**17,790**
1961	201	275			1,484	2,623	365			10,654	**15,602**
1962	1,103	220			1,319	2,318	747			15,694	**21,401**
1963	2,327	242			1,528	2,674	608			13,484	**20,863**
1964	2,457	215			863	2,323	730			10,742	**17,330**
1965	2,606	218			949	2,310	625			8,085	**14,793**
1966	2,870	243			869	2,034	6,377			7,079	**13,732**
1967	1,872	324			559	1,580	591			6,935	**11,861**
1968	2,926	400			516	1,684	516			6,299	**12,341**
1969	2,602	398			451	1,522	329			5,135	**10,401**
1970	3,082	976	569		632	1,296	313		354	5,065	**12,287**
1971	3,607	718	563		398	1,420	308		610	4,364	**11,988**
1972	4,487	759	582		288	1,368	291		1,327	81	**9,183**
1973	5,837	908	1,391		281	1,262	239		1,628	49	**11,595**
1974	5,271	854	1,104		189	-	-	6	1,213	56	**8,693**
1975	4,961	812	1,050		229	-	-	16	1,075	48	**8,191**
1976	5,204	952	2,198	44	262	-	-	47	844	100	**9,651**
1977	6,288	1,020	2,611	0	222	-	-	71	1,177	240	**11,629**
1978	6,576	1,112	3,281	34	242	-	-	33	1,426	190	**12,894**
1979	8,747	1,038	4,526	12	250	-	-	210	1,923	213	**16,919**
1980	10,428	1,058	4,926	230	258	-	-	222	2,262	162	**19,546**
1981	7,525	1,091	3,893	470	264	-	-	44	1,216	79	**14,582**
1982	11,475	1,078	4,522	1,274	-	-	-	33	1,899	111	**20,392**
1983	9,390	980	5,028	1,038	-	-	-	54	1,236	165	**17,891**
1984	9,131	1,206	3,767	1,064	-	-	-	46	960	364	**16,538**
1985	8,325	1,260	4,536	663	-	-	-	63	759	362	**16,158**
1986	7,407	1,199	5,654	654	-	-	-	51	664	287	**15,916**
1987	7,343	1,397	5,492	794	-	-	-	53	624	351	**16,054**
1988	6,950	1,602	4,932	1,171	-	-	-	142	531	222	**15,550**
1989	13,119	1,551	3,107	1,055	-	-	-	50	1,904	187	**20,973**
1990	12,905	1,730	3,702	1,088	-	-	-	48	1,879	195	**21,547**
1991	10,298	1,702	3,680	1,363	-	-	-	47	1,047	33	**18,170**
1992	9,465	1,524	3,307	1,591	-	-	-	68	818	47	**16,820**
1993	9,086	1,603	4,759	1,895	-	-	-	59	808	30	**18,146**
1994	8,346	1,610	4,980	2,059	-	-	-	36	651	74	**17,657**
1995	7,995	1,479	5,228	1,894	-	-	-	53	634	80	**17,281**
1996	8,972	1,456	4,966	1,747	-	-	-	48	722	39	**17,950**
1997	8,885	1,652	4,644	1,945	-	-	-	47	901	108	**18,182**
1998	9,161	1,445	5,035	1,545	-	-	-	41	861	351	**18,439**
1999	8,324	1,670	4,214	1,232	-	-	-	53	660	768	**16,921**
2000	8,008	1,585	3,686	2,096	-	-	-	65	638	1,217	**17,295**

Source : Saikliang (1995a, cited Department of Fisheries, Fisheries Statistics Sub-Division) DOF, 1995 to 2002.

Note: 1947 to 1969 = Number of fishing gears registered.

1970 to 2000 = Number of fishing boats registered by type of fishing gears.

Table 2 The quantity and value of Thailand's fisheries production from 1947 to 2000.

Year	Production (mt)		Total (mt)	% of total	Value (million baht)		
	Marine	Freshwater		Marine	Marine	Freshwater	Total
1947	120,173	40,851	161,024	74.63	-	-	-
1948	151,380	44,460	195,840	77.30	-	-	-
1949	108,800	44,900	153,700	70.79	-	-	-
1950	115,600	42,200	157,800	73.26	-	-	-
1951	141,000	46,000	187,000	75.40	-	-	-
1952	138,500	53,000	191,500	72.32	428	324	752
1953	148,200	56,300	204,500	72.47	507	313	820
1954	166,400	63,400	229,800	72.41	581	347	928
1955	151,400	61,570	212,970	71.09	604	372	976
1956	152,240	65,720	217,960	69.84	684	462	1,146
1957	170,900	63,670	234,570	72.86	735	455	1,190
1958	145,000	51,300	196,300	73.87	725	428	1,153
1959	147,770	57,124	204,894	72.12	754	479	1,233
1960	146,471	72,574	219,045	66.87	832	580	1,412
1961	233,275	72,475	305,750	76.30	1,029	542	1,571
1962	269,709	70,079	339,788	79.38	1,106	537	1,643
1963	323,374	70,481	393,855	82.10	1,167	768	1,935
1964	494,196	82,790	576,986	85.65	1,835	655	2,490
1965	529,483	85,637	615,120	86.08	1,798	672	2,470
1966	635,165	85,117	720,282	88.18	1,903	675	2,578
1967	762,188	85,256	847,444	89.94	2,309	738	3,047
1968	1,004,058	85,245	1,089,303	92.17	3,251	786	4,037
1969	1,179,595	90,439	1,270,034	92.88	4,011	787	4,798
1970	1,335,690	112,714	1,448,404	92.22	4,097	906	5,003
1971	1,470,289	116,788	1,587,077	92.64	4,554	974	5,528
1972	1,548,157	131,383	1,679,540	92.18	4,936	1,371	6,307
1973	1,538,016	140,885	1,678,901	91.61	6,562	1,647	8,209
1974	1,351,590	158,876	1,510,466	89.48	4,094	1,890	5,984
1975	1,394,608	160,692	1,555,300	89.67	5,102	2,092	7,194
1976	1,551,792	147,294	1,699,086	91.33	5,969	2,152	8,121
1977	2,067,533	122,374	2,189,907	94.41	8,622	2,038	10,660
1978	1,195,785	141,496	2,099,281	93.26	11,459	2,369	13,828
1979	1,813,158	133,176	1,946,334	93.16	11,318	2,686	14,004
1980	1,647,953	144,995	1,792,948	91.91	10,508	3,560	14,068
1981	1,824,444	164,581	1,989,025	91.73	13,213	3,921	17,134
1982	1,986,571	133,562	2,120,133	93.70	14,246	4,685	18,931
1983	2,099,986	155,447	2,255,433	93.11	15,236	4,002	19,238
1984	1,947,019	161,819	2,108,838	92.33	14,541	3,796	18,337
1985	2,057,751	167,453	2,225,204	92.47	15,651	4,135	19,786
1986	2,352,204	187,763	2,539,967	92.61	18,883	4,005	22,888
1987	2,601,929	177,142	2,779,071	93.63	23,083	4,558	27,641
1988	2,446,100	183,600	2,629,700	93.02	28,039	4,383	32,422
1989	2,539,200	200,800	2,740,000	92.67	31,429	4,441	35,870
1990	2,555,400	231,000	2,786,400	91.71	35,492	5,904	41,396
1991	2,709,000	258,700	2,967,700	91.28	46,766	6,260	53,026
1992	2,965,700	274,100	3,239,800	91.54	59,068	6,477	65,545
1993	3,048,100	337,000	3,385,100	90.04	69,828	8,579	78,407
1994	3,150,200	373,000	3,523,200	89.41	77,299	9,702	87,001
1995	3,184,900	387,700	3,572,600	89.15	86,222	9,890	96,112
1996	3,112,100	437,100	3,549,200	87.68	88,845	11,781	100,626
1997	2,979,200	405,200	3,384,400	88.03	97,533	11,109	108,642
1998	3,076,700	429,200	3,505,900	87.76	109,907	14,640	124,547
1999	3,166,600	459,500	3,625,900	87.33	118,947	15,175	134,122
2000	3,240,700	472,500	3,713,200	87.28	132,004	15,457	157,462

Sources: DOF 1996; 2000a; Saikliang 1995a.
Coastal aquaculture were included.

1980 to present: during this period, the use of the otter board trawl has remained very popular among Thai fishers. Total production has increased dramatically, however, this has unfortunately taken place without efficient control strategies. As a result, it is believed that Thailand's fisheries resources have been subjected to biological overfishing for more than 3 decades. During this time, the abundance of fish, as indicated by catch per unit effort (CPUE), has continuously declined, leading Thai fishing fleets to seek new fishing areas in the South China Sea, the Indian Ocean, and other high sea areas. With the establishment of the 1982 United Nations Convention on the Law of the Sea, many of Thailand's neighbouring countries declared an "Exclusive Economic Zone" (EEZ), including India (15 January 1977), Myanmar (9 April 1977), Cambodia (15 January 1978), Philippines (11 June 1978), Indonesia (21 March 1980), Malaysia (25 April 1980), and Singapore (15 September 1980). Thailand declared its EEZ on 23 February 1981. The EEZ regime has had far-reaching impacts on Thailand's fishing fleet, initially restricting the area of the fleets operations to Thai waters. However, some Thai fishing boats continued to operate in the EEZs of other coastal States under joint venture arrangements. This led to conflicts between commercial and small-scale fishers in neighbouring countries, including Malaysia, Indonesia, Cambodia, Viet Nam, India, and Myanmar. This development caused a decrease in total fishing area of approximately 300,000 square nautical miles (Vetchakaran 1987), resulting in a 10% decrease in production after 1977 (Phasuk, 1987).

Fisheries resources in the Gulf of Thailand have been overused in relation to their natural rate of regeneration. The number of fishing boats far exceeds existing resource capacity. The critical state of these resources is illustrated by the ongoing reduction in CPUE observed during surveys conducted by the research vessel of the Department of Fisheries. CPUE has declined from 294.92kg per hour in 1963 to 25kg per hour at present. Furthermore, approximately 40% of marine catch consists of low-value and juvenile fish. When demersal fish production declined, Thai fishers began targeting pelagic fish using light luring purse seine techniques. Since 1982, coastal tuna and anchovy fisheries have expanded dramatically due to improvements in fishing gear and methods. Similarly, new large fishing boats installed with freezers have been built in order to enable boats to stay at sea for extended periods. In other words, there has been a transition from coastal fisheries to offshore fisheries in Thailand during this period. The increasing production from offshore fisheries is derived mainly from areas of the Gulf of Thailand.

Table 2 shows Thailand's marine fisheries production in terms of quantity and value from 1952 to 2000. Both quantity and value of production has increased markedly since 1980, despite some minor fluctuations in 1983 to 1984 due to increased fuel prices. Since 1986, marine fishery production has been maintained at above 2.5 million metric tonnes per annum. Thailand has also been the largest manufacturer and exporter of tuna since 1982 and prawns since 1993. Fishery products are one of Thailand's top 10 export products, representing 10% of Thailand's export income. In 2000, production was 3,713,200 metrics tonnes, made up of 3,240,700 metric tonnes (87.28%) of marine fish and 472,500 metric tonnes (12.72%) of freshwater fish. In 2000, approximately 2,020,876 metric tonnes (72.86%) of the total production was derived from the Gulf of Thailand.

Of Thailand's 76 provinces, 17 are located along the coast of the Gulf, providing good maritime access to Thai fishers. The Gulf of Thailand is divided into the Inner Gulf and the Outer Gulf as mentioned earlier. The Outer Gulf extends into the South China Sea, and the Gulf as a whole is divided into 7 areas for statistical data collection (Figure 2).

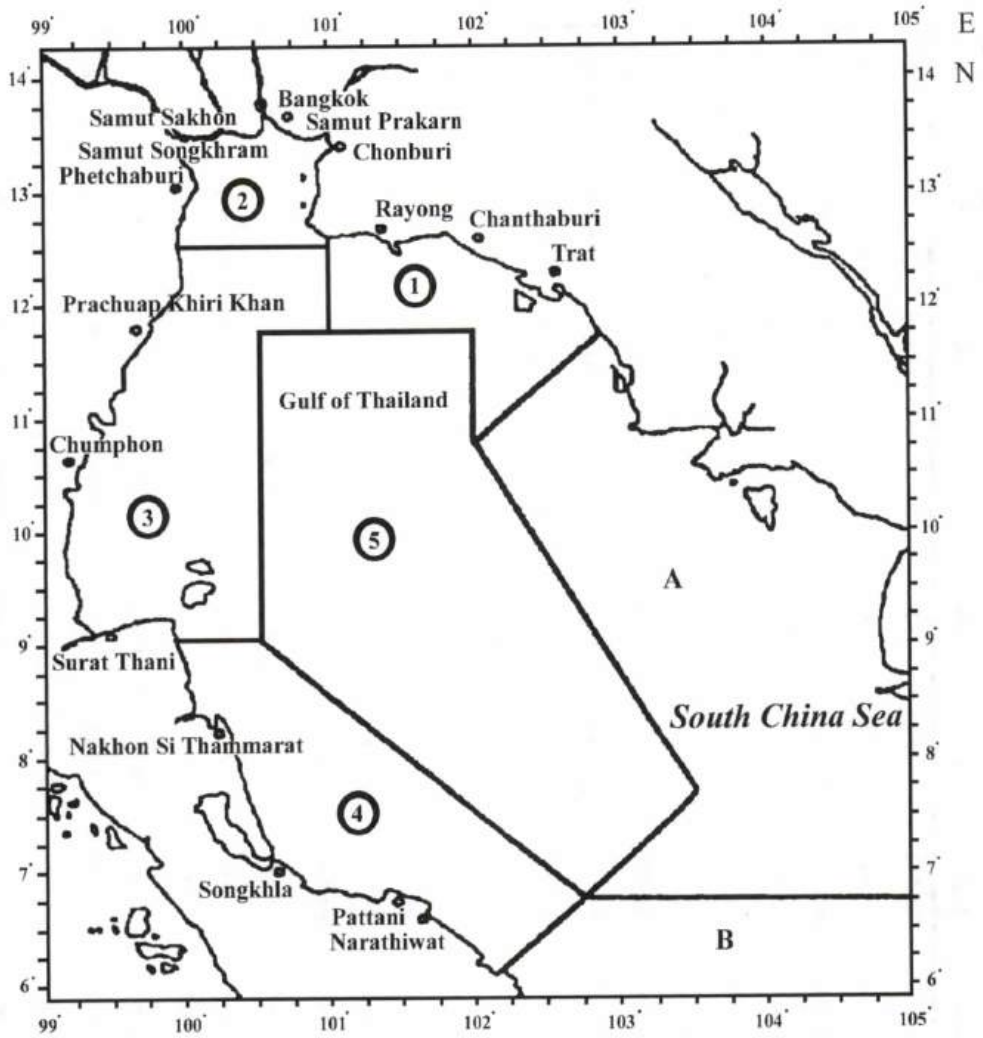

Figure 2 The statistical fishing areas in the Gulf of Thailand.

1.1.1 **Total catch by fishing area, port of landing or province** (by species/species group)

Marine fisheries production, as reported by the Department of Fisheries, has yet to be classified by species/species group and landing port. Marine fishing in the Gulf of Thailand is conducted from 37 major fishing ports and several hundred fishing villages scattered along the Gulf of Thailand coast. The catch of important species/species groups in the Gulf of Thailand from 1990 to 2000 is shown in Table 3. Catch of important pelagic and demersal fish, as well as invertebrates, in each fishing area by fishing gear type, is highlighted in Appendix 1 (Tables 1 to 3).

1.1.2 **Fishing effort by gear** (no. of fishing days, or no. of boats)

The rapid expansion of the Thai fishing fleet relates to the increase in the number of fishing boats, as well as their size and catching capacity. Most large registered fishing boats, especially those larger than 18 m in length, are equipped with advanced fishing and navigation technology, including sonar systems, echo sounders, radios, radar, and satellite navigation. There are at least 150 fishing gears that are widely utilised by Thai fishers in the Gulf of Thailand (Okawara *et al.* 1986). The fishing gears are classified into 2 main types, namely small-scale fishing gears and commercial fishing gears. Commercial fishing gears can be classified by type and by size of fishing boat. However, small-scale fishing gears, normally used by small boats in inshore waters, have not been classified by fishing boat size.

Data regarding fishing effort in terms of number of different sized fishing boats and type of fishing gear, including otter board trawl, pair trawl, luring purse seine, Thai purse seine, anchovy purse seine, gill net, push net, and other small fishing gears are presented in Tables 4 to 9.

Table 3 Catch of important marine fishes in the Gulf of Thailand from 1990 to 2000.

Unit: Metric tonnes

Species group\Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Grand total	1,923,163	1,820,687	2,081,528	1,929,672	1,996,542	2,012,013	1,903,555	1,831,129	1,802,422	1,919,564	2,020,876
Sub-total fishes	1,552,050	1,430,115	1,643,683	1,605,030	1,612,501	1,695,892	1,589,603	1,515,889	1,435,786	1,560,720	1,581,754
Sub-total pelagic fishes	582,192	559,502	700,149	612,301	643,855	690,744	629,355	590,619	606,651	639,828	642,472
Indo-Pacific mackerel	78,279	64,156	96,598	76,997	82,021	112,280	92,765	91,622	107,083	125,175	120,882
Indian mackerel	22,176	17,849	31,577	35,986	50,898	45,338	21,328	19,276	19,393	26,912	21,902
King mackerel	9,995	7,549	8,414	11,085	9,904	10,660	9,360	8,875	9,480	9,826	8,566
Longtail tuna	101,397	79,227	72,277	39,396	32,006	38,824	32,347	29,127	34,805	45,818	53,407
Eastern little tuna+Frigate tuna	54,915	58,763	84,887	67,402	67,827	48,121	47,125	42,557	44,027	56,888	46,054
Round scads	10,676	22,747	42,525	46,186	38,394	54,641	52,648	47,498	57,893	56,461	67,902
Hardtail scad	13,884	12,335	18,067	18,581	20,809	9,723	5,217	4,027	7,981	7,374	7,433
Trevallies	38,841	35,928	42,531	42,224	55,616	47,456	44,365	41,356	35,599	35,668	30,831
Big-eye scad	19,972	15,451	21,851	19,581	37,080	36,449	24,533	22,188	24,931	25,966	29,075
Sardinellas	92,281	115,641	142,634	113,860	125,179	141,180	161,771	151,708	129,045	128,492	121,738
Anchovies	123,176	115,082	123,288	123,751	102,729	123,095	122,423	117,229	121,443	103,445	117,025
Other pelagics fishes	16,600	14,774	15,500	17,252	21,392	22,977	15,473	15,156	14,971	17,803	17,657
Sub-total demersal fishes	105,740	113,769	155,886	202,875	191,348	245,483	235,700	239,833	209,806	277,645	272,521
Treadfin breams	26,282	34,125	51,655	57,903	55,850	71,637	64,749	62,944	59,683	69,949	74,544
Lizard fishes	13,169	19,750	31,840	42,486	35,593	58,482	51,004	62,397	35,289	60,534	52,601
Snappers	3,447	2,878	5,300	10,815	8,105	8,796	9,180	8,469	11,559	8,961	5,242
Big-eyes	21,219	25,269	36,221	49,710	44,680	57,723	67,411	62,675	64,873	71,127	65,168
Grouper	1,781	1,928	3,142	2,948	5,679	5,431	5,847	5,649	5,020	5,465	5,035

Table 3 *cont.* Catch of important marine fishes in the Gulf of Thailand from 1990 to 2000.

Species group\Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Other demersal fishes	39,842	29,819	27,728	39,013	41,441	43,414	37,509	37,699	33,382	61,609	69,931
Other food fishes	89,244	96,481	127,439	123,128	116,218	109,437	122,017	123,923	104,078	159,838	148,433
Trash fishes	774,874	660,363	660,209	666,726	661,080	650,228	602,531	561,514	515,251	483,409	518,328
Sub-total shrimp & prawn	93,848	103,598	96,270	97,709	103,244	103,096	102,600	96,323	73,474	62,248	69,673
Banana shrimp	8,649	7,733	7,486	8,130	9,928	9,226	7,132	7,169	7,648	8,206	10,385
Jumbo tiger prawn	121	223	274	277	488	373	631	572	341	1,043	1,580
Tiger shrimp	312	315	325	323	642	711	1,042	1,068	839	609	714
King prawn	1,364	1,271	1,624	1,399	1,304	1,486	1,600	1,838	1,775	2,546	3,400
Other shrimp	82,210	92,866	85,630	86,344	89,622	89,386	89,298	82,715	59,409	47,334	50,844
Flathead Lobster	903	807	766	1,067	861	1,730	2,716	2,785	3,005	1,760	2,289
Mantis shrimp	289	383	165	169	399	184	181	176	457	750	866
Sub-total crabs	34,306	35,149	34,831	38,066	39,881	39,820	38,856	37,515	40,852	39,137	39,137
Swimming crabs	30,402	31,190	31,784	33,059	35,157	35,414	36,219	34,916	37,281	33,864	37,219
Mud crabs	2,358	3,159	2,463	3,555	2,530	2,313	1,716	1,610	1,848	3,763	3,426
Other crabs	1,546	800	584	1,452	2,194	2,093	921	989	1,723	1,510	788
Sub-total squid & cuttlefish	119,091	120,281	113,893	114,004	109,031	115,810	115,966	116,277	130,554	119,742	120,485
Squid	57,608	56,551	51,209	55,867	55,762	59,624	56,006	55,740	68,788	62,613	64,671
Cuttlefish	45,655	50,077	48,036	44,456	41,987	45,358	47,239	48,344	44,847	45,009	44,927
Octopus	15,828	13,653	14,648	13,681	11,282	10,828	12,721	12,193	16,919	12,120	10,885
Sub-total molluscs	109,873	76,137	90,672	65,006	53,577	40,727	38,574	42,700	62,591	53,163	70,974
Others	13,995	55,407	102,179	9,857	78,308	16,668	17,956	22,425	59,165	84,554	138,855

Source: DOF 1988 to 2002; 2003a.

1.1.2.1 Trawl

As mentioned above, there are 3 types of trawl used in Thai waters. These include the otter board trawl, pair trawl, and beam trawl. Beam trawls are mostly used to catch shrimp and the total number of units of this gear type is low. Table 4 shows the number of otter board trawls and pair trawls registered in key provinces along the coast of the Gulf of Thailand from 1980 to 2000. The number of pair trawlers varied little during this period. However, the number of otter board trawls decreased from 1980 to 1988 as some trawl boats began using squid light luring cast nets to catch squid. The development of this technique gained popularity due to the high price of, and the relative fuel efficiency of the methods. From 1989 to 1990, the number of trawlers increased due to consent being given to the registration of trawlers and push netters in 1989.

Table 4 Number of trawls registered along the coast of the Gulf of Thailand from 1980 to 2000.

Year	Otter board trawl					Pair trawl					Grand Total
	< 14 m	14-18 m	18-25 m	> 25 m	Total	< 14 m	14-18 m	18-25 m	> 25 m	Total	
1980	4,038	1,768	1,189	187	7,182	54	476	567	5	1,102	8,284
1981	2,762	1,479	866	171	5,278	53	358	489	10	910	6,188
1982	4,719	1,897	1,227	185	8,028	44	528	727	7	1,306	9,334
1983	3,636	1,773	1,274	165	6,848	38	498	636	8	1,180	8,028
1984	3,608	1,681	1,286	170	6,745	40	428	598	6	1,072	7,817
1985	3,099	1,603	1,235	171	6,108	35	469	615	3	1,122	7,230
1986	2,629	1,518	1,132	137	5,416	29	440	585	6	1,060	6,476
1987	2,514	1,542	1,155	132	5,343	30	427	617	4	1,078	6,421
1988	2,339	1,491	1,057	110	4,997	31	387	628	0	1,046	6,043
1989	3,571	2,691	2,455	117	8,834	70	563	1,312	0	1,945	10,779
1990	3,302	2,804	2,457	119	8,682	84	571	1,269	5	1,929	10,611
1991	2,613	2,134	2,063	129	6,939	77	534	1,199	12	1,822	8,761
1992	2,370	2,051	1,852	101	6,374	54	475	1,117	15	1,661	8,035
1993	2,231	2,184	1,745	82	6,242	37	439	1,054	9	1,539	7,781
1994	1,870	1,965	1,624	72	5,531	34	404	1,063	7	1,508	7,039
1995	1,890	1,972	1,529	72	5,463	31	372	983	6	1,392	6,855
1996	2,098	1,976	1,746	92	5,912	25	381	1,189	15	1,610	7,522
1997	1,970	2,165	1,761	140	6,036	29	466	1,051	15	1,561	7,597
1998	2,048	2,064	1,853	144	6,109	13	345	1,221	17	1,596	7,705
1999	1,761	1,918	1,751	138	5,568	17	320	1,159	18	1,514	7,082
2000	1,742	1,829	1,634	139	5,344	16	290	1,144	14	1,4640	6,796

Source: DOF 1982 to 2002.

1.1.2.2 Purse seine/ring net

Purse seines are the major fishing gear used to exploit pelagic fish resources. Table 5 highlights increased use of purse seines. Registered purse seines are classified as Chinese purse seines (CPS), anchovy purse seines (APS), Thai purse seines (TPS), and luring purse seines (LPS). Nowadays, CPS are not used in the Gulf of Thailand, however, APS are commonly used to catch anchovy. The purse seines used to catch mixed pelagic fish species in the Gulf of Thailand are the TPS and LPS. These 2 types of purse seine were combined after 1992. In the Gulf of Thailand, the registered number of purse seines (TPS and LPS) increased from 602 units in 1980 to 1,013 units in 1988, again peaking at 1026 units in 1991. During the 1990s, the total number of purse seine units gradually decreased. However, it is apparent that purse seine use is increasing, especially by larger boats (Table 5).

Purse seines are used to catch pelagic fishes such as the Indo-Pacific mackerel, sardines, trevallies, and scads. The Thai purse seine is used to catch free-swimming fishes that are usually small and form species-specific schools. The luring purse seine, operated in conjunction with coconut leaf fish aggregating devices (FADs) or artificial lights to attract fish, was also developed to catch small pelagic fish, and has become extremely popular amongst Thai fishers. The number of purse seines registered by the type and size of fishing boats in the Gulf of Thailand from 1980 to 2000 is shown in Table 5.

Table 5 Number of purse seines registered by type and size of fishing boat in the Gulf of Thailand from 1980 to 2000.

Year	Luring purse seine					Thai purse seine					Grand
	<14 m	14-18 m	18-25 m	>25 m	Total	<14 m	14-18 m	18-25 m	>25 m	Total	Total
1980	59	150	294	3	506	40	51	5	0	96	602
1981	75	189	330	8	602	9	28	3	0	40	642
1982	59	154	362	7	582	21	19	2	0	42	624
1983	42	124	377	13	556	20	17	3	0	40	596
1984	25	34	197	6	262	26	116	218	3	363	625
1985	19	33	159	5	216	27	144	270	7	448	664
1986	27	42	183	2	254	18	108	286	13	425	679
1987	16	61	274	2	353	19	108	333	8	468	821
1988	79	45	303	0	427	28	156	392	10	586	1013
1989	45	32	369	7	453	58	88	206	5	357	810
1990	29	30	271	3	333	69	112	459	17	657	990
1991	6	18	252	6	282	88	130	512	14	744	1026
1992	6	16	228	3	253	29	91	516	21	657	910
1993*	76	118	705	26	925	0	0	0	0	0	925
1994*	45	132	704	33	914	0	0	0	0	0	914
1995*	35	87	636	27	785	0	0	0	0	0	785
1996*	29	76	579	23	707	0	0	0	0	0	707
1997*	49	106	557	26	738	0	0	0	0	0	738
1998*	68	92	590	24	774	0	0	0	0	0	774
1999*	79	74	624	24	801	0	0	0	0	0	801
2000*	62	68	569	34	733	0	0	0	0	0	733

Source : DOF 1982 to 2002. 1993*-2000* = Luring purse seine and Thai purse seine were combined.

Previously, anchovy purse seine was operated only during the daytime. However, this gear type is now also operated during the night with artificial light to attract schools of fish. Fishing effort for this gear type increased markedly following the introduction of the light fishing technique in 1985. The number of anchovy purse seines in operation has increased steadily. However, the use of this gear type at night has been illegal since 1990, when the Ministry of Agriculture and Cooperatives issued a regulation prohibiting the use of small mesh (less than 2.5cm) purse seines during the night. The number of anchovy purse seines registered by fishing boat size in the Gulf of Thailand from 1980 to 2000 is shown in Table 6.

Table 6 Number of Anchovy purse seines registered by fishing boat size in the Gulf of Thailand from 1980 to 2000.

Year	Anchovy purse seine	< 14 m	14-18 m	18-25 m	> 25 m
1980	28	14	14	5	0
1981	13	6	4	3	0
1982	24	12	6	6	0
1983	37	21	11	5	0
1984	53	24	15	14	0
1985	118	51	22	40	0
1986	91	28	25	38	0
1987	47	21	13	13	0
1988	68	31	18	19	0
1989	76	35	25	16	0
1990	105	43	36	25	1
1991	237	93	90	51	0
1992	228	92	83	50	0
1993	255	90	84	81	0
1994	285	112	89	84	0
1995	323	193	74	54	4
1996	370	245	67	57	2
1997	419	285	91	43	0
1998	290	170	71	49	0
1999	333	177	91	64	0
2000	403	222	104	77	1

Source : DOF 1982 to 2002.

1.1.2.3 Gill net

Table 7 shows the number of gill nets registered by size of fishing boat in the Gulf of Thailand from 1980 to 2000. Thai fishers commonly use 2 types of gill net, namely the Spanish mackerel drift gill net and the mackerel encircling gill net. The Spanish mackerel drift gill net, which is usually 5 to 10km long, is used to catch Spanish mackerel and small tuna. The number of fishing boats using this gear has been relatively constant. The mackerel encircling gill net is popular for catching Indo-Pacific mackerel, and is operated in a fashion similar to the purse seine, although without purse line. The use of this gear has declined since 1987.

1.1.2.4 Other gears

Most other fishing gears are small scale and operated in shallow coastal waters. These gears include push nets, trolled lures, hand lines, longlines, traps, and small gill nets. The number of push net units decreased from 1,644 in 1980 to 490 in 1988, although after consent was given to the registration of trawlers and push netters in 1989, total push net use increased significantly (Table 8). Table 9 contains information regarding the number of other small scale fishing gears, including crab gill nets, shrimp trammel nets, others gill nets, squid falling nets, anchovy falling nets, and longline. Interestingly, the use of shrimp trammel nets decreased, whilst that of squid and anchovy falling nets increased. Trap fisheries for squid and crab play an important role in the Gulf of Thailand's small-scale fisheries, however, the registration of traps is not required under Thai fisheries law.

Table 7 Number of gill nets registered by size of fishing boat in the Gulf of Thailand from 1980 to 2000.

Year	Spanish mackerel drift gill net					Mackerel encircling gill net					Grand
	<14 m	14-18 m	18-25 m	>25 m	Total	<14 m	14-18 m	18-25 m	>25 m	Total	Total
1980	86	142	44	0	272	174	73	58	0	305	577
1981	53	166	82	0	301	125	76	56	0	257	558
1982	47	148	55	0	250	103	70	54	0	227	477
1983	40	134	60	0	234	36	57	48	0	141	375
1984	50	116	76	1	243	87	40	40	0	167	410
1985	45	135	75	1	256	113	48	49	0	210	466
1986	37	148	106	6	297	106	41	45	0	192	489
1987	36	152	138	1	327	97	36	86	0	219	546
1988	45	172	175	9	401	54	28	46	0	128	529
1989	29	116	71	0	216	52	33	25	0	110	326
1990	36	112	85	6	239	44	21	35	0	100	339
1991	45	119	105	10	279	41	21	26	0	88	367
1992	45	120	124	11	300	40	19	12	0	71	371
1993	32	86	77	3	198	43	25	24	0	92	290
1994	21	96	96	7	220	36	34	28	1	99	319
1995	26	88	155	18	287	29	21	27	0	77	364
1996	24	82	111	15	232	84	21	19	0	124	356
1997	51	91	81	11	234	86	28	30	0	144	378
1998	21	72	106	10	209	75	25	28	2	130	339
1999	23	62	90	6	181	41	35	37	1	114	295
2000	21	44	65	2	132	19	23	36	1	79	211

Source : DOF 1982 to 2002.

Table 8 Number of push nets registered by size of fishing boat in the Gulf of Thailand from 1980 to 2000.

Year	< 14 m	14-18 m	18-25 m	> 25 m	Total
1980	1,579	64	1	0	1,644
1981	853	30	0	0	883
1982	1,209	35	0	0	1,244
1983	890	51	0	0	941
1984	750	27	0	0	777
1985	635	28	0	0	663
1986	536	32	11	0	579
1987	524	27	3	0	554
1988	458	30	2	0	490
1989	859	190	61	0	1,110
1990	868	193	58	0	1,119
1991	594	123	51	0	768
1992	436	96	30	0	562
1993	524	98	41	0	663
1994	451	68	24	0	543
1995	413	85	36	0	534
1996	488	93	39	0	620
1997	637	95	39	0	771
1998	590	125	61	0	776
1999	504	76	44	0	624
2000	493	81	39	0	613

Source: DOF 1982 to 2002.

Table 9 Number of other small scale fishing gears registered in the Gulf of Thailand from 1980 to 2000.

Year	Crab Gill Nets	Shrimp Trammel Nets	Other Gill Nets	Squid Falling Nets	Anchovy Falling Nets	Long line	Total
1980	868	2,175	770	115	0	222	4,150
1981	489	2,229	610	235	0	44	3,607
1982	734	2,364	423	637	0	33	4,191
1983	1,063	2,396	622	514	0	39	4,634
1984	879	1,658	445	521	0	44	3,555
1985	629	2,240	396	662	0	52	3,979
1986	1,266	2,044	823	652	0	48	4,833
1987	907	2,641	623	775	0	47	4,993
1988	995	1,903	684	1,102	0	115	4,799
1989	460	1,084	463	915	0	31	2,953
1990	911	1,141	549	1,027	0	30	3,658
1991	1,185	973	463	1,242	0	33	3,893
1992	731	937	467	1,435	0	57	3,627
1993	1,051	1,411	724	1,723	0	50	4,959
1994	1,261	1,099	688	1,881	0	27	4,956
1995	1,396	750	565	1,756	0	38	4,505
1996	1,318	755	577	1,584	0	37	4,271
1997	1,147	530	608	1,662	0	38	3,984
1998	975	624	605	1,356	358	34	3,952
1999	762	416	810	1,095	507	35	3,635
2000	816	528	1,231	1,880	778	32	5,265

Source: DOF 1982 to 2002.

1.1.3 Economic value of catch

The value of catch from commercial and small-scale fisheries has followed an increasing trend. This was especially the case during the 1990s, when total catch value increased by 105%. Commercial fishing contributes to about 90% of marine catch, with the balance flowing from small-scale/artisanal fisheries. In 2000, the percentage contribution to total catch value by key groups of marine fish was pelagic fish (28.69%), demersal fish (13.63%), other food fish (7.75%), trash fish (4.45%), shrimps (18.97%), crabs (6.63%), cephalopods (18.75%), and molluscs (0.22%) (Table 10). The species of main economic importance are Indo-Pacific mackerel and longtail tuna.

1.1.4 Importance of the fisheries sector in terms of employment & dependence

1.1.4.1 Contribution of the fisheries sector to GDP

Thailand's gross domestic product (GDP) was estimated at 4,598 billion baht in 1996, of which the fishery sector contributed 87.8 billion baht or 1.9%, representing a decline from the 2% average observed from 1994 to 1996. The key factor driving the diminished contribution of the fisheries sector to GDP was rapid growth in the manufacturing and service sectors. These factors were partially offset by increases in real fish prices. Although the fisheries sector makes a relatively small contribution to Thailand's GDP, it makes an important contribution to export earnings and employment. Fish is also a central part of the diet of most Thai people (Table 11).

Table 10 Value of production of important marine fishes from the Gulf of Thailand from 1990 to 2000.

Value: 1,000 baht

Species group\Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Grand total	16,978,200	19,667,600	25,323,400	25,450,674	25,377,702	31,019,319	29,819,652	30,304,144	30,807,616	32,615,351	34,732,645
Sub-total fishes	9,373,500	10,176,000	15,624,500	16,039,783	13,984,172	17,058,748	16,537,016	16,061,191	16,880,065	19,412,177	18,936,415
Sub-total pelagic fishes	5,631,400	6,244,200	8,038,700	7,226,628	8,203,193	9,110,821	8,354,057	8,734,353	9,901,435	10,465,862	9,964,142
Indo-Pacific mackerel	1,032,900	759,000	1,425,700	1,124,009	1,638,035	2,341,053	2,178,558	2,528,946	3,392,963	3,327,371	3,032,544
Indian mackerel	228,400	141,900	338,700	369,353	897,246	716,346	418,439	330,464	347,620	491,934	467,949
King mackerel	353,100	299,600	372,200	545,590	438,122	509,769	522,453	641,813	601,352	698,370	608,466
Longtail tuna	1,618,100	1,877,800	1,589,600	1,194,876	415,882	582,360	646,380	757,746	973,679	1,170,055	1,204,216
Eastern little tuna+Frigate tuna	685,300	940,200	1,358,200	1,011,030	952,295	580,340	733,024	638,355	792,648	911,549	784,776
Round scads	64,500	255,900	415,000	461,865	392,754	597,776	611,245	618,255	824,978	832,235	804,643
Hardtail scad	111,400	104,600	178,900	191,954	225,923	135,353	97,616	69,283	136,080	126,322	154,469
Trevallies	283,000	574,900	566,600	517,132	727,948	676,728	694,325	639,483	578,409	572,608	463,714
Big-eye scad	136,900	100,700	160,100	130,664	363,445	337,880	245,330	199,904	174,503	253,549	290,690
Sardinellas	356,600	346,900	498,400	401,610	597,445	681,897	823,417	829,242	771,474	638,854	675,249
Anchovies	363,000	402,800	478,400	481,987	487,825	718,879	541,109	441,234	543,033	546,384	606,145
Other pelagics fishes	398,200	439,900	656,900	796,558	1,066,273	1,232,440	842,161	1,039,628	764,696	896,631	871,281
Sub-total demersal fishes	1,043,400	1,495,800	2,072,500	2,918,868	3,249,117	4,318,443	4,266,125	4,094,028	4,161,258	4,987,303	4,732,770
Treadfin breams	213,600	426,500	657,100	741,749	772,307	1,230,729	1,205,649	856,062	943,757	1,075,892	1,122,468
Lizard fishes	73,100	152,100	224,500	317,848	248,534	518,740	482,506	684,501	351,921	586,302	392,126
Snappers	100,000	122,800	225,900	473,263	389,988	472,251	526,294	462,981	677,911	515,427	286,138
Big-eyes	112,200	173,100	250,700	368,889	396,249	516,626	703,093	668,733	791,212	726,711	507,446
Grouper	67,700	98,600	200,500	202,689	490,088	458,000	409,290	441,374	446,547	502,858	449,440

Table 10 *cont* Value of production of important marine fishes from the Gulf of Thailand from 1990 to 2000. .

Value: 1,000 baht

Species group\Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Other demersal fishes	476,800	522,700	513,800	814,430	951,951	1,122,097	939,293	980,377	949,910	1,580,113	1,975,152
Other food fishes	632,000	771,800	4,033,500	4,094,427	1,051,659	2,003,807	2,169,473	1,800,653	1,324,253	2,499,315	2,692,976
Trash fishes	2,066,700	1,664,200	1,479,800	1,799,860	1,480,203	1,625,677	1,747,361	1,432,157	1,493,119	1,459,697	1,546,527
Sub-total shrimp & prawn	2,906,400	2,849,300	3,080,200	3,175,616	4,591,440	5,460,029	4,809,660	5,661,549	4,890,473	4,659,472	6,589,409
Banana shrimp	1,274,300	903,100	1,125,000	1,029,841	1,758,716	1,769,205	1,245,736	1,405,857	1,677,719	1,829,478	2,389,591
Jumbo tiger prawn	19,100	40,200	50,900	52,789	92,086	88,899	149,360	147,950	87,119	290,324	549,430
Tiger shrimp	57,100	47,500	50,000	49,009	141,609	155,606	232,689	267,281	232,403	181,543	254,453
King prawn	109,500	121,500	156,900	119,569	195,670	242,366	210,050	196,690	148,813	167,252	274,643
Other shrimp	1,382,300	1,637,600	1,622,400	1,817,504	2,319,616	3,035,584	2,692,477	3,371,045	2,443,166	1,969,421	2,816,882
Flathead Lobster	58,400	89,100	70,000	101,449	71,931	161,929	272,108	265,686	281,772	183,954	265,429
Mantis shrimp	5,700	10,300	5,000	5,455	11,812	6,440	7,240	7,040	19,481	37,500	38,981
Sub-total crabs	900,000	1,307,000	1,330,000	1,296,410	1,549,157	1,935,011	1,837,952	1,685,555	1,694,761	1,950,597	2,304,265
Swimming crabs	784,800	1,086,600	1,136,600	1,028,739	1,308,186	1,615,230	1,539,411	1,549,096	1,537,582	1,646,697	2,046,076
Mud crabs	94,300	208,400	184,900	240,147	202,458	277,560	275,000	107,485	100,809	253,018	237,295
Other crabs	20,900	12,000	8,500	27,524	38,513	42,221	23,541	28,974	56,370	50,882	20,894
Sub-total squid & cuttlefish	3,207,100	4,769,300	4,599,700	4,679,596	4,910,351	6,315,248	6,359,422	6,539,379	6,891,823	6,147,804	6,511,065
Squid	1,578,000	2,302,600	2,132,100	2,375,625	2,484,167	3,352,074	3,153,216	3,365,433	3,975,005	3,573,316	3,682,020
Cuttlefish	1,473,800	2,182,000	2,244,800	2,094,437	2,319,147	2,763,305	2,935,618	2,851,561	2,247,935	2,212,092	2,533,609
Octopus	155,300	284,700	222,800	209,534	107,037	199,869	270,588	322,385	668,883	362,396	295,436
Sub-total molluscs	584,700	538,900	637,500	251,134	283,193	225,908	249,123	304,805	343,252	287,909	287,909
Others	6,500	27,100	51,500	8,135	59,389	24,375	26,479	51,665	107,242	157,392	77,762

Source : Source: DOF 1988 to 2002; 2003a. (rate of exchange; See Annex 1)

Table 11 Contribution of fisheries and other sectors to the GDP of Thailand from 1989 to 1996.

Industrail Origin	1989 M.bahts	%	1990 M.bahts	%	1991 M.bahts	%	1992 M.bahts	%	1993 M.bahts	%	1994 M.bahts	%	1995 M.bahts	%	1996 M.bahts	%
Gross Domestic Production (GDP)	1,620,882	100.0	1,895,034	100.0	2,506,635	100.0	2,830,914	100.0	3,170,258	100.0	3,630,805	100.0	4,188,929	100.0	4,598,288	100.0
Agriculture	279,094	17.2	273,973	14.5	317,085	12.6	348,127	12.3	329,878	10.4	390,233	10.7	464,171	11.1	507,339	11.0
Crops	174,809	10.8	159,992	8.4	181,918	7.3	197,058	7.0	166,564	5.3	206,264	5.7	258,432	6.2	289,570	6.3
Livestock	29,797	1.8	32,770	1.7	37,430	1.5	35,001	1.2	32,275	1.0	35,802	1.0	42,599	1.0	44,457	1.0
Fisheries	27,449	1.7	32,214	1.7	43,139	1.7	55,764	2.0	67,410	2.1	76,138	2.1	83,097	2.0	87,800	1.9
Forestry	8,181	0.5	6,665	0.4	7,110	0.3	6,705	0.2	6,443	0.2	6,145	0.2	6,098	0.1	6,291	0.1
Agricultural services	10,678	0.7	10,795	0.6	10,958	0.4	11,525	0.4	11,149	0.4	12,477	0.3	12,779	0.3	13,519	0.3
Simple agricultural and processing products	28,180	1.7	31,537	1.7	36,530	1.5	42,074	1.5	46,037	1.5	53,407	1.5	61,166	1.5	65,702	1.4

Source : NESDB.

1.1.4.2 Contribution of the fishing industry to income and employment

Thailand's labour force was estimated at 35.6 million in 1998, of which some 15.4 million (43%) were employed in the agricultural sector (including fisheries). Results from the 1995 Marine Fishery Census indicated that the total number of fishers and employees involved in Thailand's marine capture fisheries was 111,479. There were 45,898 persons engaged in coastal aquaculture (Table 12).

Table 12 Thailand's fisheries sector employment in 1995.

Type of employment	No. of Fishers, Fish farmers and Employees
Marine capture [1/]	111,479
Coastal aquaculture [2/]	45,898
Inland aquaculture [3/]	404,334
Related fisheries industry [4/]	220,370
Total	**782,091**

Sources: 1/, 2/ The 1995 Marine Fishery census 3/ No. of farmer = (no. of fishfarm x 2 persons)
4/ Ministry of Labour and Social Welfare

On the other hand, no fishery census has been conducted for Thailand's inland fishery, thus no data has been compiled for reference. It is difficult to estimate employment in Thailand's inland fisheries. However, most rice-growing farmers catch fish, and could potentially be categorised as part-time inland fishers. Millions of farmers catch freshwater fish for household consumption.

A survey regarding freshwater fish farm production has been conducted since 1974. However, the number of aquaculturists and employees were not included in the survey, and information was not collected for many farms. The survey did indicate that the number of freshwater fish farms increased continuously from 61,980 farms in 1990 to 202,167 farms in 1995. On the basis that each farm provides employment for 2 people, approximately 404,334 persons were involved in freshwater aquaculture in 1995.

Additionally, the fisheries sector supports substantial levels of employment in related industries, including fish processing, cold storage, fishmeal, ice making, and boat construction. Total employment in these industries was estimated at 211,682 in 1995.

1.1.4.3 Contribution of the fisheries sector to foreign exchange earning

The contribution of Thailand's fishing and fish-processing industries to export earnings has increased steadily in recent years (Table 13). The positive trade balance in fish and fish products increased from 6,874 million baht in 1980 to 151,755 million baht in 2000. Although the industry relies on imported inputs such as diesel fuel and netting material, earnings remain substantial, particularly in relation to the level of employment in the industry. Fishery product exports in 2000 totalled 185,750 million baht, equivalent to 69% of total agriculture exports (200,795 million including fish), and 7.3% of total exports (1,898,276 million baht).

Table 13 The trade balance of Thailand's fisheries sectors from 1980 to 2000.

	Import		Export		Trade balance	
Year	Q (tonnes)	(million baht)	Q (tonnes)	(million baht)	Q (tonnes)	(million baht)
1980	43,777	551.7	274,753	7,425.7	230,976	6,874
1981	47,174	550.0	320,325	9,102.3	273,151	8,552
1982	46,215	725.5	316,679	11,230.7	270,464	10,505
1983	58,942	1,093.2	344,899	12,677.2	285,957	11,584
1984	119,064	2,119.3	411,722	15,080.9	292,658	12,962
1985	152,707	3,857.5	466,219	18,527.7	313,512	14,670
1986	268,089	7,590.0	602,486	26,829.4	334,397	19,239
1987	227,327	7,016.9	663,650	32,654.3	436,323	25,637
1988	347,666	14,713.1	798,572	44,437.3	450,906	29,724
1989	455,755	19,066.7	875,293	53,704.9	419,538	34,638
1990	507,737	20,652.7	904,973	61,070.5	397,236	40,418
1991	724,668	27,352.9	1,087,395	78,463.2	362,727	51,110
1992	714,012	24,568.7	1,106,141	82,469.3	392,129	57,901
1993	760,919	21,629.4	1,115,078	910,18.3	354,159	69,389
1994	893,588	21,328.9	1,214,946	110,285.2	321,358	88,956
1995	872,818	21,924.7	1,192,560	116,577.8	319,742	94,654
1996	797,389	22,425.0	1,146,949	110,781.3	349,560	88,356
1997	710,115	27,438.9	1,181,255	138,624.0	471,140	111,185
1998	728,960	36,497.2	1,312,250	176,311.0	583,290	139,814
1999	930,885	33,289.3	1,394,104	165,718.1	463,219	132,429
2000	842,676	33,995.4	1,356,734	185,750.4	514,058	151,755

Sources: DOF, 1996; 2003a.

1.1.4.4 Contribution of the fishery sector to domestic nutrition

The contribution of fish and other foods to the Thai diet in 1995 is shown in Table 14a. Fish is the primary source of animal protein for most Thai people, particularly in coastal provinces. From 1980 to 1997, the apparent annual per capita consumption of fish in Thailand averaged 24 kg, fluctuating between highs of 32.8 to 33.8kg in 1994 and 1995, and lows of 18.8 to18.9kg in 1987 and1988 (Table 14b).

Table 14a Thailand's per capita food intake in1995.

Items	Whole country		Urban area		Rural area	
	grams/day	%	grams/day	%	grams/day	%
Cereals, roots and tubers	305.7	41.4	281.4	37.4	312.3	42.4
Sugar and honey	13.7	1.9	14.6	1.9	13.4	1.8
Pulses, nuts and oil seeds	17.1	2.3	19.7	2.6	16.3	2.2
Vegetables	113.2	15.3	101.4	13.5	116.7	15.9
Fruits	76.8	10.4	93.9	12.5	72.0	9.8
Oils and fats	14.0	1.9	12.3	1.6	14.4	2.0
Meats	71.4	9.7	83.4	11.1	68.1	9.3
Fish	46.6	6.3	47.3	6.3	46.5	6.3
Eggs	21.4	2.9	17.2	2.3	22.5	3.1
Milk	29.3	4.0	44.6	5.9	25.1	3.4
Others	29.9	4.0	35.8	4.8	28.4	3.9
Total	**739.1**	**100.0**	**751.6**	**100.0**	**735.7**	**100.0**

Source: Department of Health, 1997.

Table 14b Apparent consumption of fish in Thailand from 1980 to 1997.

Year	Total production (1,000 tonnes) (1)	Fish used for fishmeal (1,000 tonnes) (2)	Trade		Apparent consumption		
			Import (1,000 tonnes) (3)	Export (1,000 tonnes) (4)	Total consumption (1,000 tonnes) (5)=(1)-(2)+(3)-(4)	*Population* (million) (6)	Consumption per capita (kg) (7)=(5)/(6)
1980	1,792	773	140	227	932.3	47.0	19.8
1981	1,989	797	152	269	1,076.1	47.6	22.6
1982	2,121	813	128	338	1,098.4	48.4	22.7
1983	2,255	803	116	405	1,162.4	49.5	23.5
1984	2,135	758	166	547	996.4	50.5	19.7
1985	2,225	776	207	639	1,015.8	51.5	19.7
1986	2,536	976	362	847	1,074.2	52.5	20.4
1987	2,779	1,106	220	881	1,012.7	53.5	18.9
1988	2,630	956	343	993	1,023.8	54.6	18.8
1989	2,740	980	436	1,095	1,100.7	55.2	19.9
1990	2,786	978	475	1,174	1,108.7	56.1	19.8
1991	2,958	982	664	1,359	1,281.0	56.9	22.5
1992	3,240	1,001	637	1,393	1,482.6	57.6	25.7
1993	3,385	1,027	788	1,438	1,708.5	58.5	29.2
1994	3,523	930	883	1,535	1,940.5	59.1	32.8
1995	3,573	916	864	1,510	2,010.7	59.5	33.7
1996	3,500	900	737	1,438	1,899.5	60.1	31.6
1997*	3,460	900	728	1,645	1,642.7	60.8	27.0
Avg.	**2,684**	**903**	**426**	**911**	**1,295.4**	**53.5**	**24.0**

Source: Department of Fisheries, 1982 to 1999.
*Note: * Preliminary data.*

2. SPECIES OF REGIONAL, GLOBAL AND/OR TRANSBOUNDARY SIGNIFICANCE

According to the National Fisheries Statistics collected by the Fisheries Economics Division of the Department of Fisheries, catches are sorted by species and species group. The quantities and values of 11 pelagic fish groups, 5 groups of demersal fish, 7 groups of shrimps and lobsters, 3 groups of crabs, and 3 groups of cephalopods are shown in Tables 3 and 10. The important landing ports of the Fish Market Organization (FMO) are shown in Figure 3. However, there are many private landing ports scattered along the Gulf of Thailand coast.

In terms of transboundary significance, a joint Thai-Malaysian-German trawl survey was conducted off the eastern coast of the Malaysian Peninsular in 1967. The survey area extended from the Thai-Malaysian border to the southernmost tip of the Malaysian Peninsular. The results of the survey indicated that catches declined as the survey moved northward to the Thai border. Throughout the survey, a total of 380 species were collected, of which 42 species (including *Chiloscyllium griseum*, *Carcharinus spallanzani*, and *Rhinobatus ligonifer*) were caught only in Thai waters, whilst another 42 species (including *Dasyatis brocki*, *Sardinella melanura*, *Batrachphalus mino*, and *Lutianus rangus*) were caught only in Malaysian waters. The rest of the species were caught in both regions (Wongratana 1968). However, in both Thai and Malaysian waters the most prevalent group of fish included species of Leiognathidae, inhabiting depths from 10 to 50m. Next to this, in terms of abundance, were fish of Trygonidae, which were found mainly in Malaysian waters in depths ranging from 10 to 40m. In Thai waters, *Nemipterus* spp. was the next most prevalent group. During the survey, tagging of some important demersal fish was also conducted. 23 *Nemipterus hexodon*, 2 *N. furcosus*, 85 *Priacanthus* spp., 342 *Scolopsis cancellatus*, and *Lutianus malabaricus* were tagged and released in Malaysian waters (Marine Fisheries Laboratory and Fisheries Research Institute 1967). However, there are no reports of these fish being recaptured. The results of acoustic surveys conducted by the Exploratory Fishing Division of Thailand's Department of Fisheries in the southern part of the Gulf in 1979, very clearly showed that the pelagic traces consisted of a mixture of *Rastrelliger kanagurta*, *Caranx crumenophthalmus*, *Decapterus resselli*, and *Sardinella* sp. (SEAFDEC 1981a). *Rastrelliger* spp., *Scomberomorus* spp., *Decapterus* spp., *Sardinella* spp., *Stolephorus* spp., *Megalaspis cordyla*, *Selar* spp. and *Selaroides* spp. are economically important in both Thailand and Malaysia. It is also well known that mackerels (*Rastrelliger* spp.) and round scads (*Decapterus* spp.) are widely distributed in areas of the South China Sea.

In 1993, a joint survey was carried out in the Joint Development Area (JDA) between Thailand and Malaysia by research trawlers of both countries at depths from 40 to 70m. More than 8 species of *Nemipterus* were found, including *Nemipterus mesoprion*, *N. hexodon*, *N. marginatus*, *N. nematophorus*, *N. nemuerus*, *N. peronii*, *N. tolu* and *Nemipterus* spp. The most common species was *N. mesoprion*, followed by *N. nematophorus* and *N. marginatus* (Uraiwan and Boonvanich 1993).

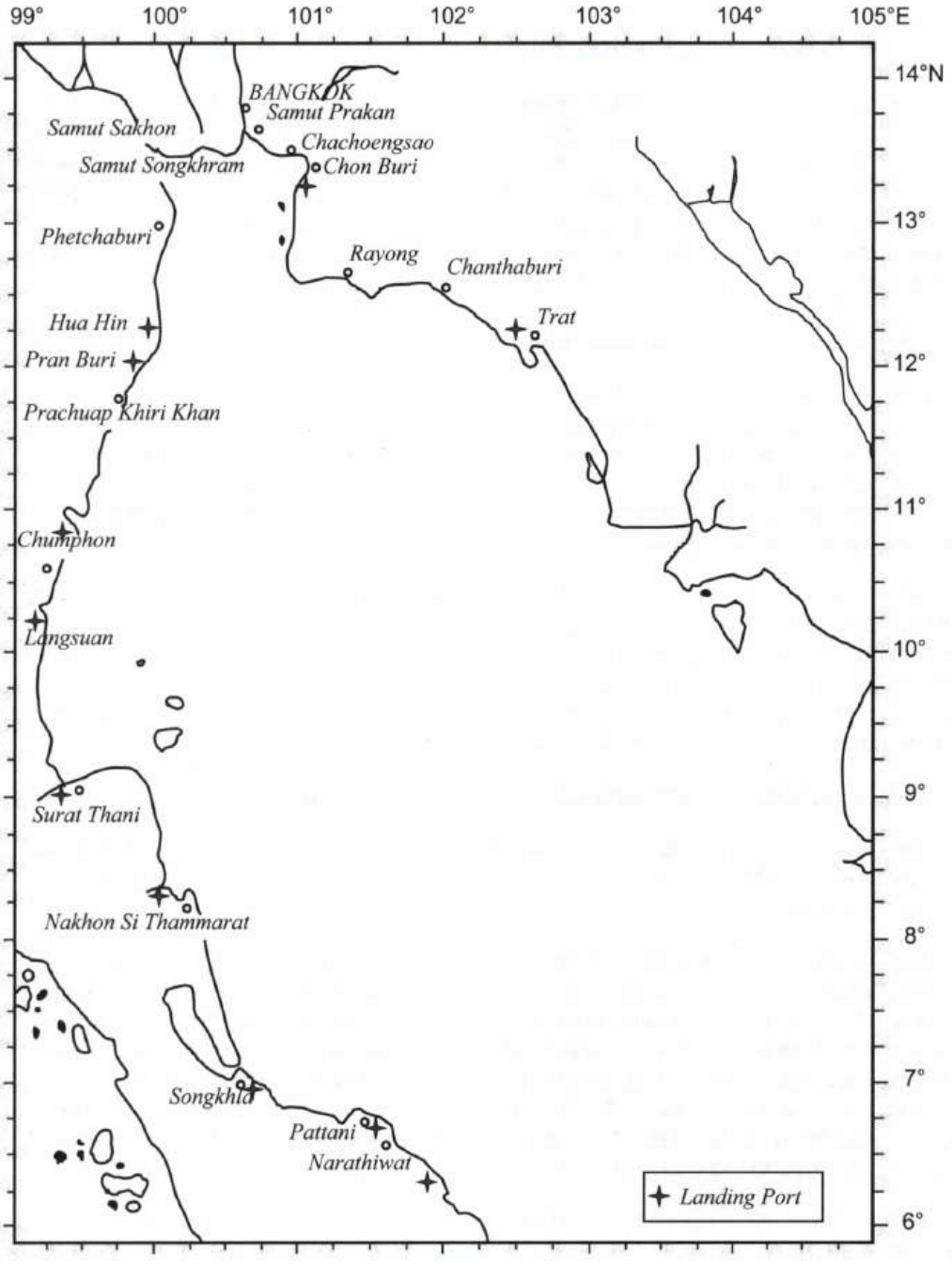

Figure 3 The important fish landing ports (FMO) along the coast of the Gulf of Thailand.

A joint fishery resources survey in the former overlapping jurisdictional area between Thailand and Viet Nam was conducted in 1997 and 1998 using bottom trawl and bottom vertical longline. The survey showed clear evidence of transboundary significance for many dominant species/species group that are distributed throughout Thai and Vietnamese waters. The dominant economically important species in waters of both countries included *Selar ctuminophthalmus*, *Rastrelliger kanagurta*, *Saurida elongata*, *S. undosquamis*, *Priancanthus macracanthus*, *P. tayenus*, *Nemipterus nematophorus*, *Upeneus sulphurus*, *Siganus oramin*, *Seriolina nigrofasciata*, *Lutjanus sanguineus*, *Pristipomoides multidens*, *Ophisurus crocodilinus*, *Loligo chinensis*, *L. duvauceli*, and *Sepia* spp.

2.1 Ranking of importance in terms of landings, value, and status

2.1.1 Landings (by site or province) (mt)

Data regarding economically important species/groups of species landed by site or province, as well as by major fishing port for the year 2000 are provided in Table 15. The ranking of importance is based on the magnitude of catch. In terms of quantity, threadfin bream, Indo-Pacific mackerel, coastal tuna, bigeye snapper, squids, sardines, round scad, and anchovies are important. In terms of both quantity and value of landings, Songkhla, Pattani, Samutprakan, Nakorn Si Thammarat, Trat, and Samut Sakhon are the most important landing ports. It is usually clear that Thai fishing boats landing their catch in these ports have been fishing in transboundary areas.

2.1.2 Local market value (Local currency, note year)

The identification of species or species groups of economic importance involves consideration of wholesale value and export potential. Some resources have not yet been exploited commercially, however, may have potential for future development; they are also included in the list of commercially important species or species groups in Thailand. According to the 2000 National Fisheries Statistics, squid, cuttlefish, Indo-Pacific mackerel, shrimps, coastal tunas, and threadfin bream were important in terms of local market value (Table 16).

In 2000, marine capture fishery production accounted for 85.6% of the total marine fishery production, which amounted to 3.24 million metric tonnes with a value of 142,004 million baht. The utilisation of marine fishery products included fresh consumption (18.8%), fresh, chilled and frozen (23.8%), canned (19.7%), steamed or smoked (0.4%), fish sauce (3.2%), shrimp paste (0.1%), salted (5.7%), dried (2.0%), fish meal (25.8%), and other (0.5%). The important marine fish species with relatively high prices at major landing ports in 2000 are shown in Table 17.

2.1.3 Status (endangered, threatened, rare etc. IUCN criteria)

Several species of marine resources in the Gulf of Thailand are becoming rare, endangered, and perhaps threatened with extinction, due to increased human use, the resultant changes in the environment, and ineffective conservation and/or enforcement measures.

Assessment of the potential yields of fish stocks in the Gulf of Thailand has clearly shown that demersal fishery resources, particularly those in coastal areas, have been overexploited since 1973. Populations of dominant demersal species in the area, namely *Nemipterus hexodon*, *Priacanthus tayenus*, *Saurida undosquamis* and *S. elongate*, all show signs of overexploitation. Among the pelagic fish species, Indo-Pacific mackerel, sardines, anchovies, round scad, and coastal tuna stocks have been fully exploited since the early 1980s. However, from a survey conducted in 1995, it is unclear whether the reduction in catches of a number of species collected during the survey indicates that those species are becoming endangered or vulnerable.

Regarding threatened species of marine fauna, even though only higher groups of animals such as reptiles and mammals have been listed as rare or threatened species, it is believed that several species of marine fish and invertebrates are becoming rare, particularly those inhabiting coral reefs that are being destroyed by intense or destructive fishing practices.

The marine fauna officially listed as being threatened is highlighted in Appendix 2. This list is based on IUCN criteria. There is a paucity of information regarding the life history and population dynamics of threatened species, which hinders the formation, and implementation of effective conservation programmes.

Marine mammals: including whale, dolphin, and dugong. 3 species are critically endangered. 18 species are endangered.

Dugong: due to their gentle nature and slow movement, they may be accidentally caught by fishing nets. This species is considered very rare. One of these is a critically endangered species.

Reptiles: among them, marine turtle are considered important. The 5 species of reptile are critically endangered species.

In the Gulf of Thailand, the abundance of many fish species has declined. 3 species are endangered, 36 species are vulnerable, and 3 species are threatened.

Table 15 Landings in metric tonnes for main species/group of species in each province in 2000.

Unit: Metric tonnes

Province-port Species	Total (mt)	Indo-Pacific mackerel	Indian mackerel	King mackerel	Coastal tuna	Round scads	Hardtail scads	Trevallies	Sardinellas	Anchovies	Threadfin bream	Lizard fish	Snapper	Big-eye	Banana shrimp	School prawn	Other shrimps	Crabs	Squid	Cuttlefish	Octopus	Others
Trat	95,228	603	225	174	126	8	224	309	41	45,636	4,552	58	0	2,033	80	332	1,651	503	1,095	1,408	1,076	35,094
	(5)	(9)	(8)	(9)	(9)	(9)	(10)	(8)	(10)	(1)	(5)	(9)		(7)	(8)	(7)	(6)	(6)	(8)	(7)	(4)	(6)
Chanthaburi	2,931	45	19	11	0	0	0	27	0	6	684	60	12	400	53	84	75	19	113	105	39	1,107
	(14)	(13)	(9)	(11)				(11)		(5)	(9)	(8)	(8)	(9)	(10)	(11)	(16)	(13)	(12)	(13)	(12)	(15)
Rayong	78,501	4,603	6,880	456	11,981	2,701	716	13	2,309	6,051	3,487	1,770	267	2,659	16	11	81	102	2,701	375	215	31,107
	(7)	(7)	(2)	(7)	(2)	(2)	(5)	(12)	(6)	(2)	(6)	(5)	(6)	(6)	(12)	(15)	(15)	(11)	(6)	(10)	(10)	(7)
Chonburi	25,657	159	0	0	481	0	256	3,730	733	1,496	60	0	0	100	307	525	5,798	492	1,886	1,608	585	7,441
	(10)	(10)			(7)		(9)	(3)	(7)	(3)	(14)			(10)	(4)	(4)	(1)	(7)	(7)	(6)	(7)	(11)
Chachoengsao	2,247	0	0	0	0	0	0	0	0	0	0	0	0	0	97	199	327	0	19	17	0	1,588
	(15)														(7)	(8)	(12)		(15)	(16)		(14)
Samut prakan	213,944	1,323	1,076	2,215	2,554	1,382	987	3,236	0	0	17,032	11,924	2,807	13,626	12	662	611	1,084	10,657	8,881	1,104	132,771
	(3)	(8)	(7)	(1)	(4)	(3)	(4)	(4)			(2)	(2)	(1)	(2)	(13)	(3)	(9)	(2)	(3)	(3)	(5)	(2)
Samut sakhon	87,489	8,214	1,163	911	0	17	1,519	2,664	605		1,215	1,327	759	4,465	12	65	1,038	544	11,969	9,746	5,126	36,130
	(6)	(3)	(5)	(5)		(8)	(2)	(5)	(8)		(7)	(6)	(5)	(4)	(13)	(12)	(7)	(5)	(2)	(2)	(1)	(5)
Samut songkram	5,357	121	0	1	0	0	0	96	246	4	73	0	6	27	58	106	403	118	429	179	132	3,358
	(12)	(12)		(12)				(10)	(9)	(6)	(12)		(9)	(12)	(9)	(10)	(11)	(10)	(10)	(11)	(11)	(12)
Phetchaburi	1,543	0	0	0	0	0	0	0	0	0	59	0	0	0	0	39	205	19	14	125	14	1,068
	(16)										(13)					(14)	(13)	(13)	(16)	(12)	(14)	(16)
Prachuap Khiri Khan	43,936	9,859	1,102	387	944	148	385	2,544	8,129	0	174	0	0	97	0	0	2,315	11	59	44	0	17,738
	(9)	(2)	(6)	(8)	(6)	(7)	(7)	(6)	(4)		(11)			(11)			(4)	(15)	(14)	(14)		(9)
Chumphon	61,328	7,917	1,480	623	274	816	363	2,017	10,949	0	1,001	347	31	1,619	433	449	2,290	278	851	569	295	28,726
	(8)	(4)	(4)	(6)	(8)	(5)	(8)	(7)	(2)		(8)	(7)	(7)	(8)	(3)	(5)	(5)	(9)	(9)	(9)	(9)	(8)
Surat Thani	18,616	0	0	0	0	0	0	0	0	0	218	0	0	0	31	971	4,827	661	348	658	410	10,492
	(11)										(10)				(11)	(2)	(2)	(4)	(11)	(8)	(8)	(10)
Nakhon Si Thammarat	170,695	6,306	0	1,841	2,464	0	448	0	21,487	0	5,767	9,358	1,156	8,568	1,398	1,441	3,784	1,590	6,326	5,036	4,186	89,539
	(4)	(5)		(4)	(5)		(6)		(1)		(3)	(3)	(3)	(3)	(1)	(1)	(3)	(1)	(4)	(4)	(2)	(4)
Songkhla	296,733	5,225	2,585	1,873	10,667	955	3,090	9,783	8,254	102	36,226	18,324	767	26,918	870	50	962	1,081	18,691	10,159	3,784	136,367
	(1)	(6)	(3)	(3)	(3)	(4)	(1)	(1)	(3)	(4)	(1)	(1)	(4)	(1)	(2)	(13)	(8)	(3)	(1)	(1)	(3)	(1)
Pattani	280,108	22,765	10,720	2,212	35,733	47,427	1,411	5,153	4,567	0	5,289	1,897	1,912	2,678	274	360	610	458	4,099	3,734	872	127,937
	(2)	(1)	(1)	(2)	(1)	(1)	(3)	(2)	(5)		(4)	(4)	(2)	(5)	(5)	(6)	(10)	(8)	(5)	(5)	(6)	(3)
Narathiwat	3,764	144	0	110	61	185	114	101	1	0	33	2	0	0	112	109	135	44	70	26	17	2,500
	(13)	(11)		(10)	(10)	(6)	(11)	(9)	(11)		(15)	(10)			(6)	(9)	(14)	(12)	(13)	(15)	(13)	(13)
TOTAL	**1,388,077**	**67,284**	**25,250**	**10,814**	**65,285**	**53,639**	**9,513**	**29,673**	**57,321**	**53,295**	**75,870**	**45,067**	**7,717**	**63,190**	**3,753**	**5,403**	**25,112**	**7,004**	**59,327**	**42,670**	**17,855**	**663,035**

Source: DOF 2003b.

Table 16 Ranking of local species market value by species/group of species for each province in 2000.

Unit: 1,000 baht

Province-port Species	Total (mt)	Indo-Pacific mackerel	Indian mackerel	King mackerel	Coastal tuna	Round scads	Hardtail scads	Trevallies	Sardinellas	Anchovies	Threadfin bream	Lizard fish	Snapper	Big-eye	Banana shrimp	School prawn	Other shrimps	Crabs	Squid	Cuttlefish	Octopus	Others
Trat	863,870	6,415	2,369	6,823	1,911	71	2,335	3,230	205	232,155	56,597	290	0	20,701	19,124	57,380	36,360	9,688	46,736	53,132	24,607	285,652
	(8)	(11)	(8)	(10)	(9)	(9)	(10)	(9)	(10)	(1)	(5)	(9)		(8)	(8)	(5)	(7)	(9)	(8)	(6)	(6)	(6)
Chanthaburi	64,062	680	450	500	0	0	0	480	0	36	11,143	878	777	5,504	11,955	13,111	3,484	364	3,621	3,219	821	5,200
	(15)	(13)	(9)	(11)				(11)		(5)	(9)	(8)	(8)	(9)	(10)	(11)	(14)	(15)	(12)	(13)	(13)	(16)
Rayong	1,000,791	81,207	102,325	22,886	198,514	27,529	4,870	203	9,985	36,293	38,734	13,233	11,548	23,893	3,421	1,086	1,839	4,288	120,858	13,125	5,172	279,782
	(6)	(6)	(2)	(6)	(3)	(2)	(7)	(12)	(6)	(2)	(6)	(5)	(6)	(6)	(12)	(15)	(16)	(11)	(6)	(10)	(10)	(7)
Chonburi	569,390	6,452	0	0	8,658	0	2,830	42,148	4,347	6,735	624	0	0	384	78,214	89,815	157,562	16,826	75,744	45,630	11,017	12,404
	(10)	(9)			(7)		(8)	(4)	(7)	(3)	(13)			(11)	(5)	(3)	(2)	(6)	(7)	(7)	(7)	(12)
Chachoengsao	65,994	0	0	0	0	0	0	0	0	0	0	0	0	0	21,950	20,598	13,740	0	380	510	0	8,816
	(14)														(7)	(8)	(11)		(16)	(16)		(15)
Samut prakan	4,978,271	34,927	21,305	67,454	50,569	16,377	11,611	52,457	0	0	199,276	185,708	126,315	109,008	2,605	219,044	182,430	65,944	597,317	499,450	43,135	2,393,339
	(3)	(8)	(5)	(2)	(4)	(3)	(3)	(3)			(2)	(1)	(1)	(2)	(14)	(1)	(1)	(1)	(2)	(1)	(4)	(3)
Samut sakhon	2,252,016	167,732	18,307	59,215	0	238	10,633	39,960	4,143		16,258	11,282	44,022	44,650	3,060	9,550	58,858	21,508	533,065	419,505	179,979	610,051
	(5)	(3)	(7)	(4)		(8)	(4)	(5)	(7)		(7)	(6)	(5)	(4)	(13)	(12)	(6)	(5)	(3)	(2)	(1)	(5)
Samut songkram	99,869	4,414	0	21	0	0	0	920	1,500	21	891	0	540	355	14,875	14,303	8,727	4,663	20,635	8,531	3,790	15,683
	(13)	(12)		(12)				(10)	(9)	(6)	(13)		(9)	(12)	(9)	(10)	(12)	(10)	(10)	(11)	(11)	(14)
Phetchaburi	34,208	0	0	0	0	0	0	0	0	0	590	0	0	0	0	3,967	2,761	1,024	472	4,977	380	20,037
	(16)										(14)					(14)	(15)	(13)	(15)	(12)	(14)	(13)
Prachuap Khiri Khan	632,200	288,998	19,779	15,394	22,528	2,582	4,904	30,644	56,595	0	2,088	0	0	970	0	0	32,467	495	2,456	1,254	0	151,046
	(9)	(2)	(6)	(8)	(6)	(7)	(6)	(6)	(4)		(11)			(10)			(8)	(14)	(14)	(14)		(9)
Chumphon	916,385	164,492	23,653	22,361	5,484	12,188	5,151	30,634	59,915	0	13,462	4,659	1,854	22,397	90,831	39,802	151,727	12,303	35,155	23,226	8,909	188,182
	(7)	(4)	(4)	(7)	(8)	(4)	(5)	(7)	(2)		(8)	(7)	(7)	(7)	(3)	(7)	(3)	(7)	(9)	(8)	(9)	(8)
Surat Thani	265,217	0	0	0	0	0	0	0	0	0	4,880	0	0	0	6,402	99,751	81,496	11,867	7,586	13,797	9,347	30,091
	(11)										(10)				(11)	(2)	(4)	(8)	(11)	(9)	(8)	(11)
Nakhon Si Thammarat	2,421,618	51,981	0	66,208	23,050	0	1,792	0	82,663	0	62,950	80,233	76,677	75,988	304,285	86,460	77,787	30,521	333,325	238,636	104,921	724,141
	(4)	(7)		(3)	(5)		(11)		(1)		(4)	(3)	(3)	(3)	(1)	(4)	(5)	(3)	(4)	(4)	(3)	(4)
Songkhla	5,811,274	111,828	57,890	39,333	396,879	5,700	67,735	219,376	57,778	513	315,767	145,745	46,908	235,180	198,096	5,800	24,018	57,597	809,064	387,317	108,657	2,517,093
	(2)	(5)	(3)	(5)	(2)	(5)	(1)	(1)	(3)	(4)	(1)	(2)	(4)	(1)	(2)	(13)	(9)	(2)	(1)	(3)	(2)	(2)
Pattani	6,126,522	641,687	263,864	200,773	802,662	408,948	29,966	110,845	45,256	0	150,213	14,253	148,144	44,145	90,675	50,396	22,011	27,407	226,014	187,084	28,830	2,633,349
	(1)	(1)	(1)	(1)	(1)	(1)	(2)	(2)	(5)		(3)	(4)	(1)	(5)	(4)	(6)	(10)	(4)	(5)	(5)	(5)	(1)
Narathiwat	140,308	6,425	0	11,692	1,620	3,178	2,587	3,617	7	0	1,348	20	0	0	34,087	19,158	7,676	1,497	3,334	1,085	1,053	41,924
	(12)	(10)		(9)	(10)	(6)	(9)	(8)	(11)		(12)	(10)			(6)	(9)	(13)	(12)	(13)	(15)	(12)	(10)
TOTAL	**26,241,995**	**1,567,238**	**509,942**	**612,660**	**1,511,875**	**479,811**	**144,414**	**534,442**	**322,394**	**275,753**	**874,821**	**456,301**	**456,785**	**583,175**	**879,580**	**730,221**	**862,943**	**265,992**	**2,815,762**	**1,900,478**	**530,618**	**9,926,790**

Source: DOF 200b.

Table 17 Average price of important marine fishes landed at major landing ports along the coast of the Gulf of Thailand by species/species group in 2000.

Unit: baht/kg

Province-port/ Species	Indo-Pacific mackerel	Indian mackerel	King mackerel	Coastal tuna	Round scad	Hardtail scads	Trevallies	Sardinellas	Anchovies	Threadfin bream	Lizard fish	Snapper	Big-eye	Banana shrimp	School prawn	Other shrimps	Crabs	Squid	Cuttlefish	Octopus	Others
Trat	10.64	10.53	39.21	15.17	8.88	10.42	10.45	5.00	5.09	12.43	5.00	...	10.18	239.05	172.83	22.02	19.26	42.68	37.74	22.87	8.14
Chanthaburi	15.11	23.68	45.45	...	...	...	15.11	...	6.00	16.29	14.63	64.75	13.76	225.57	156.08	46.45	19.16	32.04	30.66	21.05	4.41
Rayong	17.64	14.87	50.19	16.57	10.19	6.80	15.62	4.32	6.00	11.11	7.48	43.25	8.99	213.81	98.73	22.70	42.04	44.75	35.00	24.06	8.99
Chonburi	40.58	...	...	18.00	...	11.05	11.30	5.93	4.50	10.40	...	...	3.84	254.77	171.08	27.18	34.20	40.16	28.38	18.83	3.01
Chachoengsao	...	...	...	...	...	...	...	...	...	...	...	...	...	226.29	103.51	42.02	...	20.00	30.00	0.00	5.55
Samut prakan	26.40	19.80	75.60	19.80	11.85	11.76	16.21	...	...	11.70	15.57	45.00	8.00	217.08	330.88	298.58	60.83	56.05	56.24	39.07	18.03
Samut sakhon	20.42	15.74	65.00	...	14.00	7.00	15.00	6.85	...	13.38	8.50	58.00	10.00	255.00	146.92	56.70	39.54	44.54	43.04	35.11	16.88
Samut songkram	36.48	...	21.00	...	...	...	9.58	6.10	5.25	12.21	...	90.00	13.15	256.47	134.93	21.66	39.52	48.10	47.66	28.71	4.67
Phetchaburi	...	...	...	...	...	...	...	...	...	10.00	...	...	...	...	101.72	13.47	53.89	33.71	39.82	27.14	18.76
Prachuap Khiri Khan	29.31	17.95	39.78	23.86	17.45	12.74	12.05	6.96	...	12.00	...	...	10.00	...	...	14.02	45.00	41.63	28.50	...	8.52
Chumphon	20.78	15.98	35.89	20.01	14.94	14.19	15.19	5.47	...	13.45	13.43	59.81	13.83	209.77	88.65	66.26	44.26	41.31	40.82	30.20	6.55
Surat Thani	...	...	...	...	...	...	...	...	...	22.39	...	...	...	206.52	102.73	16.88	17.95	21.80	20.97	22.80	2.87
Nakhon Si Thammarat	8.24	...	35.96	9.35	...	4.00	...	3.85	...	10.92	8.57	66.33	8.87	217.66	60.00	20.56	19.20	52.69	47.39	25.06	8.09
Songkhla	21.40	22.39	21.00	37.21	9.11	21.92	22.42	7.00	5.03	8.72	7.95	61.16	8.74	227.70	116.00	24.97	53.28	43.29	38.13	28.71	18.46
Pattani	28.19	24.61	90.77	22.46	8.62	21.24	21.51	9.91	...	28.40	7.51	77.48	16.48	330.93	139.99	36.08	59.84	55.14	50.10	33.06	20.58
Narathiwat	44.62	...	106.29	26.56	17.18	22.69	35.81	7.00	...	40.85	10.00	...	...	304.35	175.76	56.86	34.02	47.63	41.73	61.94	16.77
Average	19.99	10.35	39.13	13.06	7.01	8.99	12.52	4.27	1.99	14.64	6.17	35.36	7.87	211.56	131.24	49.15	36.37	41.59	38.51	26.16	10.64

Source: DOF 2003b.

2.1.4 Food security (locally)

The fisheries sector provides an important supply of animal protein to Thai people. From 1980 to 2000, the average yearly increase in per capita fish consumption was about 2 percent. In 2000, per capita fish consumption was 32.7kg, which is relatively high compared to consumption of other main animal protein commodities, including pork, beef, and chicken. Price is a decisive factor influencing Thai consumer choice, and prices of fish are generally lower than other sources of animal protein. However, the level of per capita fish consumption varies among Thai people. This could be due to variations in household income, species preference, and geographic location, not failing to mention that fish is not a homogenous commodity (Day, 2000; Smith *et al.*, 1998; Westlund, 1995).

Piumsombun (2003) reported that demand for fish amongst Thailand's highest income earners has almost no variation relative to their incomes. However, the lowest income group has high income elasticity, especially for shrimp and high value fish. Therefore, increased purchasing power of low-income groups may lead to increased demand for fish. In order to increase fish consumption amongst higher income groups, it is necessary to improve fish quality, develop more innovative products (such as those that are easy to prepare, serve, and consume), and to promote the health benefits of seafood.

2.2 Biology & ecology of the priority species (from available information)

Marine fisheries resources in the Gulf of Thailand can be divided into 2 categories, i.e., pelagic and demersal resources. Pelagic fish are those that dwell and feed at the surface or in the water column. They are usually fast swimming with a fusiform body and fork or lunate tail. The species typically form species-specific schools in the upper part of the water column, which usually has, a temperature range from 26 to 30°C. It is well known that coastal pelagic species frequently inhabit nutrient-rich inshore and shelf waters, whilst oceanic species are usually observed in deep, clear, offshore waters.

Small pelagic fish are exploited frequently with shallow-water purse seines (i.e., Thai, Chinese, and luring purse seines), surface and mid-water gillnets, lift nets, and other surrounding nets. Shallow-water fishing grounds are generally highly productive and account for much of the Gulf's total pelagic catch.

The commercially important pelagic fish species classified by the Department of Fisheries' taxonomist include 48 species of the Carangidae family, 30 species of Engraulidae, 28 species of Clupeidae, 19 species of Scombridae, and 14 species of Mugilidae (Sukhavisidth 1996). There are 17 economically important species/groups of species of pelagic fish in Thai fisheries statistics. However, the most common groups of small pelagic fish species with substantial catch volume and value are Indo-Pacific mackerel, Indian mackerel, sardines, anchovies, round scads, bigeye scad, and trevallies.

Information regarding the geographical distribution, fishing grounds, abundance, spawning grounds, egg/larvae surveys, and migratory patterns of known small pelagic fish are shown in Figures 4 to 13. Migratory pattern information is only available for *Rastrelliger brachysoma/neglectus* in the Gulf of Thailand. Figure 4 indicates that the 2 main spawning grounds for this species are offshore from Surat Thani province and Prachuap Khiri Khan province. Young fishes migrate from these spawning grounds to the inner Gulf of Thailand for feeding, moving back inshore early in the year. The results of intensive tagging experiments carried out by the Department of Fisheries from 1960 to 1965 (26,864 fish released vs. 4,191 recaptured), highlighted that there were 3 types of movement, i.e., feeding, spawning and seasonal migration (Somjaiwong and Chullasorn 1974). The results are presented in Figure 5.

2.2.1 Large pelagic fish (FAO)

Mackerels

There are 5 main species of mackerels in the Gulf of Thailand (Sukhavisidth 1996). These include the Indo-Pacific mackerel (*Rastrelliger neglectus*), Indian mackerel (*R. kanagurta*), Faughn's mackerel (*R. faughni*), shortbody mackerel (*R. brachysoma*), and slender mackerel (*Rastrelliger sp.1*). The first and fourth species are abundant in coastal waters, whilst the second, third, and fifth species are ubiquitous in the Gulf's offshore waters. They are mainly caught by purse seine, encircling gillnet, and occasionally pair trawl. These 5 species are combined in Thai fisheries statistics as coastal mackerel (*R. neglectus/brachysoma*) and offshore mackerel (*R. kanagurta/faughni/sp.1*). Fishing grounds extend from inshore waters to the central part of the Gulf (Figures 4, 5a, b, and 6a, b).

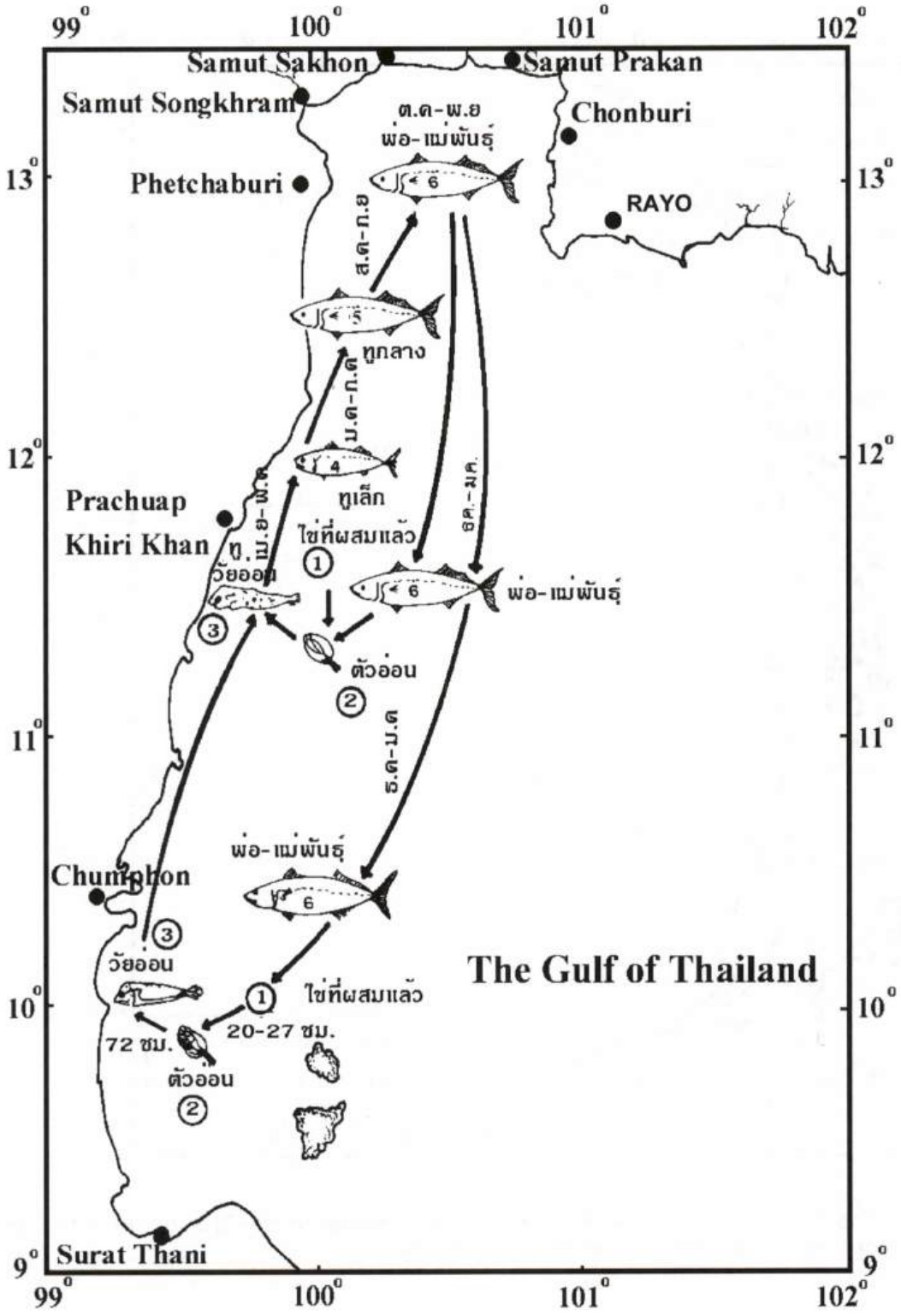

Figure 4 Life cycle of Indo-Pacific mackerel (*Rastrelliger neglectus*) in the Gulf of Thailand (courtesy of the Marine Fisheries Division).

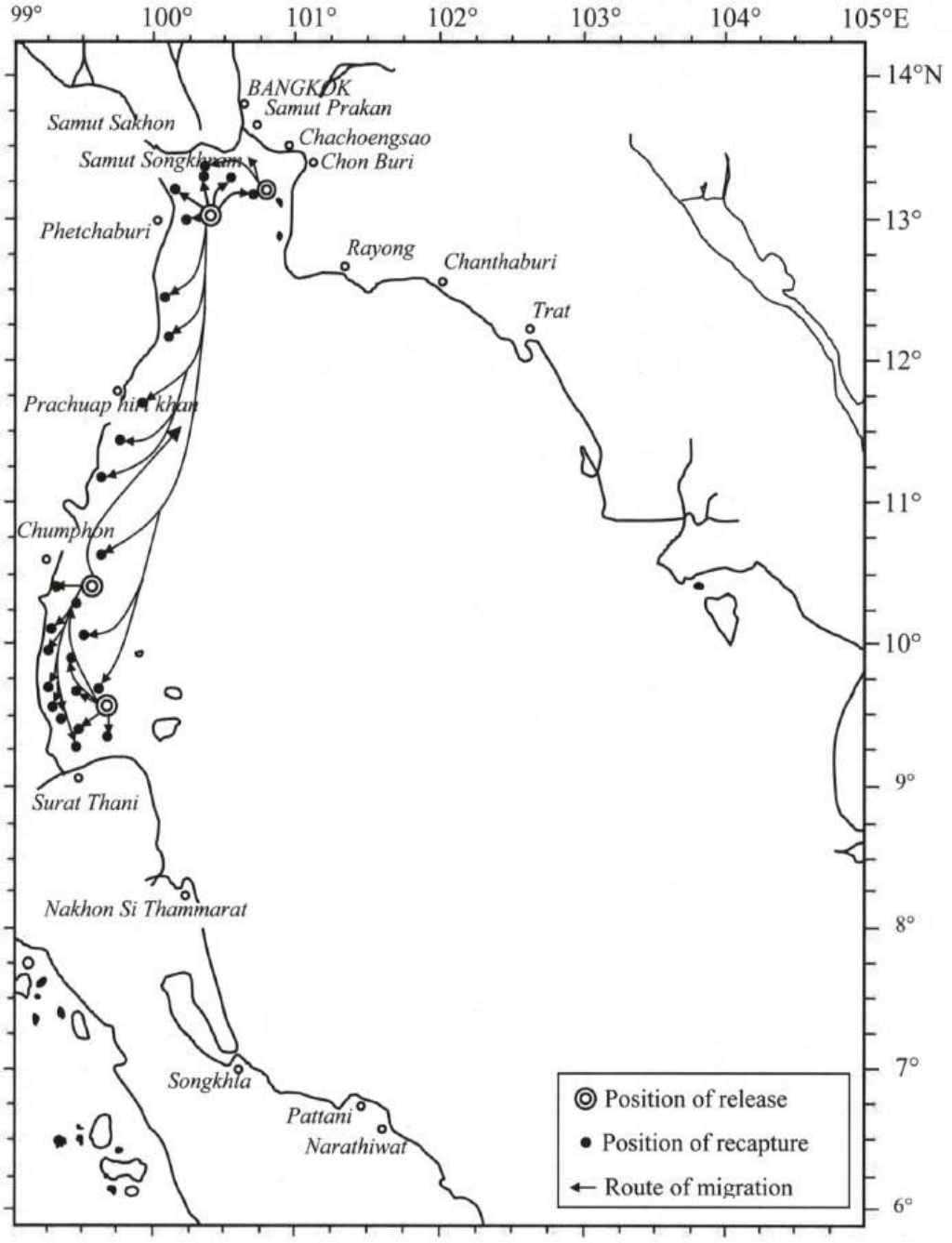

Figure 5a The migratory route of tagged Indo-Pacific mackerel (*Rastrelliger neglectus*) in the Gulf of Thailand (Somjaiwong and Chullasorn 1974).

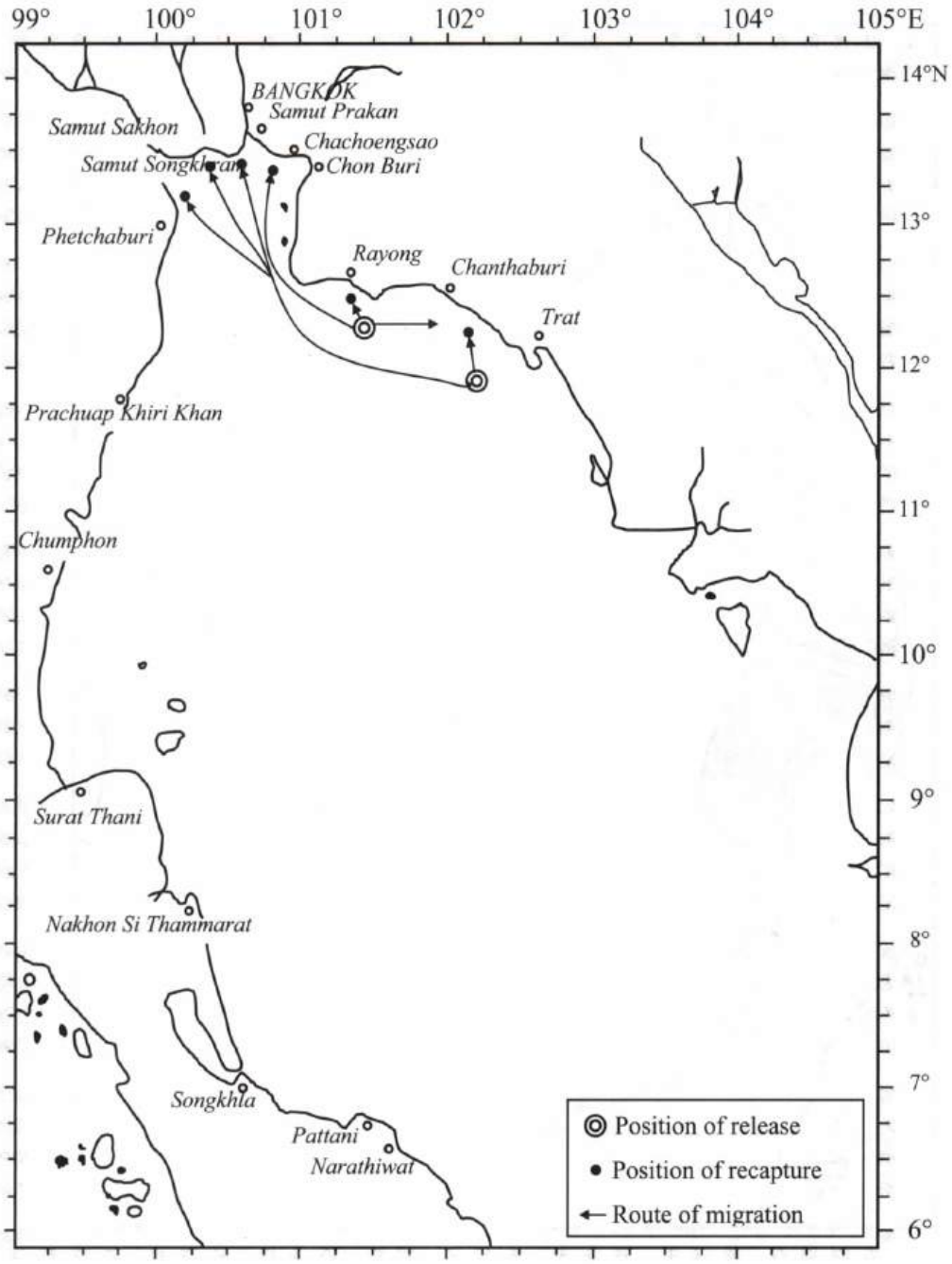

Figure 5b The migratory route of tagged Indo-Pacific mackerel (*Rastrelliger neglectus*) in the Gulf of Thailand (Somjaiwong and Chullasorn 1974).

Neritic tunas

Neritic tunas in the Gulf Thailand include longtail tuna (*Thunnus tonggol*), kawakawa (*Euthynnus affinis*), and frigate tuna (*Auxis thazard*). They are widely distributed throughout the Gulf. When demersal fish production declined, Thai fishers turned to pelagic fish species with the use of seine nets and artificial light to attract schools of fish. Stimulated by strong demand for canned tuna, fishing for neritic tunas has become an important commercial activity in Thailand (Figure 6c).

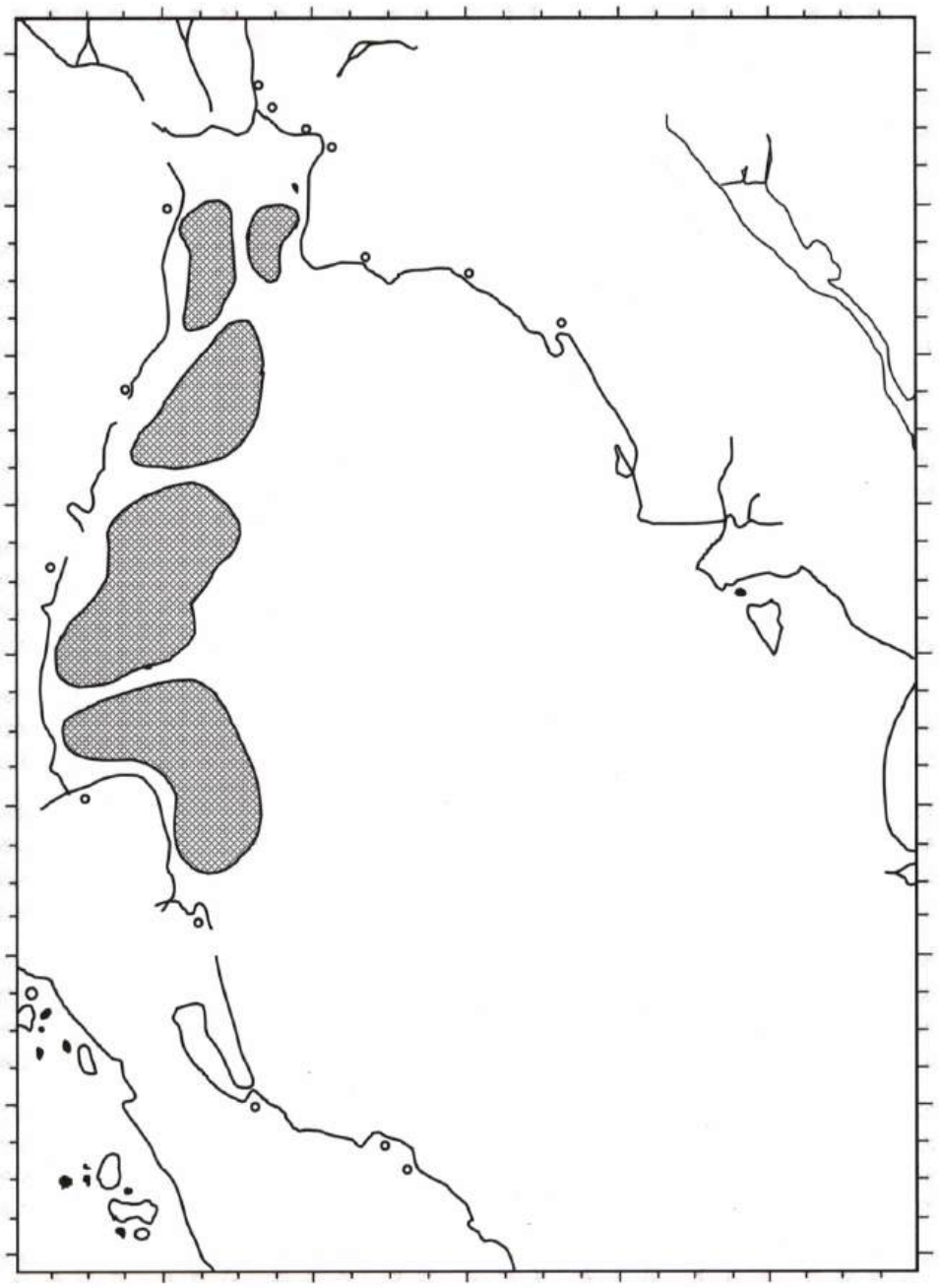

Figure 6a Fishing grounds for Indo-Pacific mackerel (*Rastrelliger neglectus*) in the Gulf of Thailand (Tantisawetrat *et al.*, 1994).

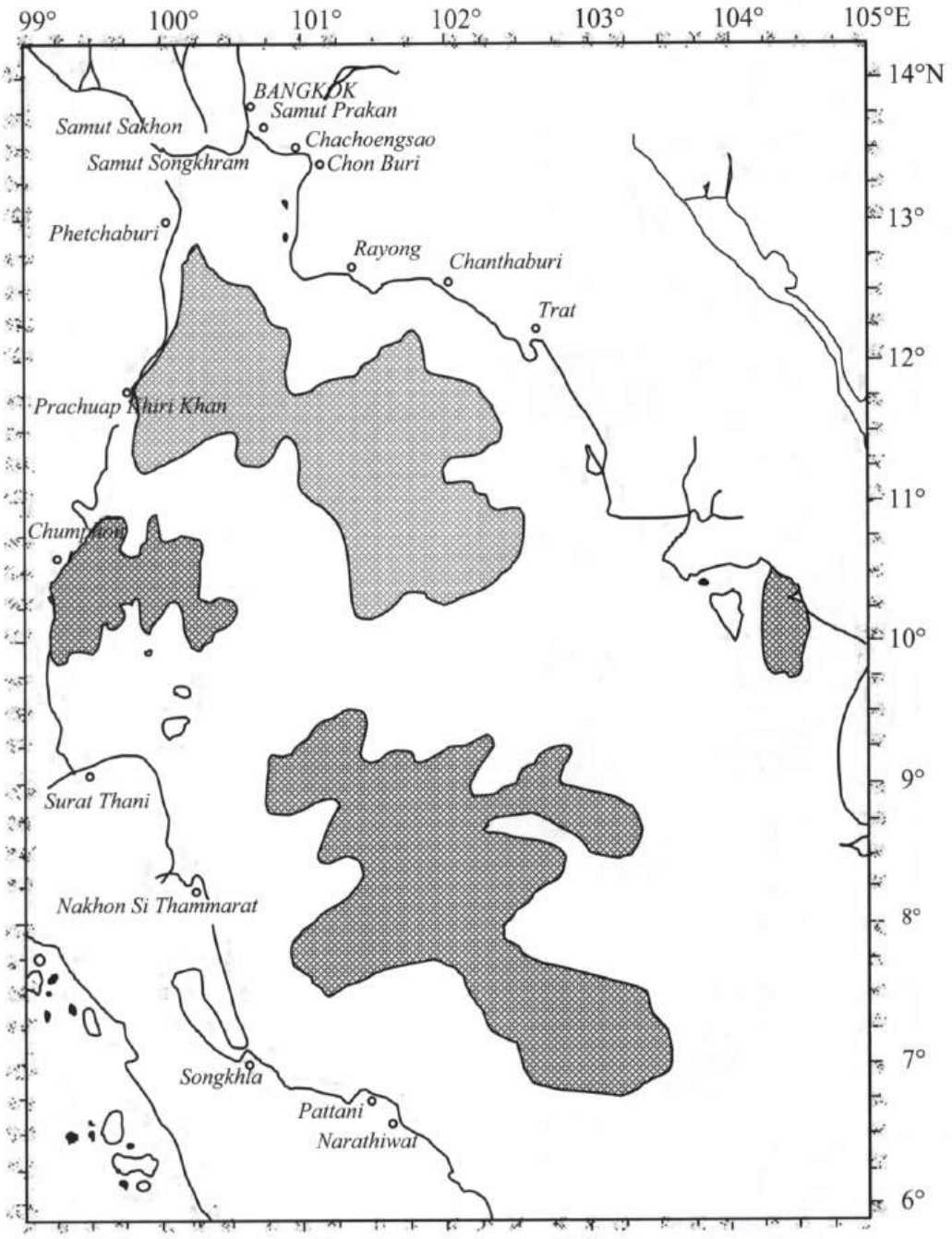

Figure 6b Fishing grounds for Indian mackerel (*R. kanagurta*) in the Gulf of Thailand (SEAFDEC 1981b).

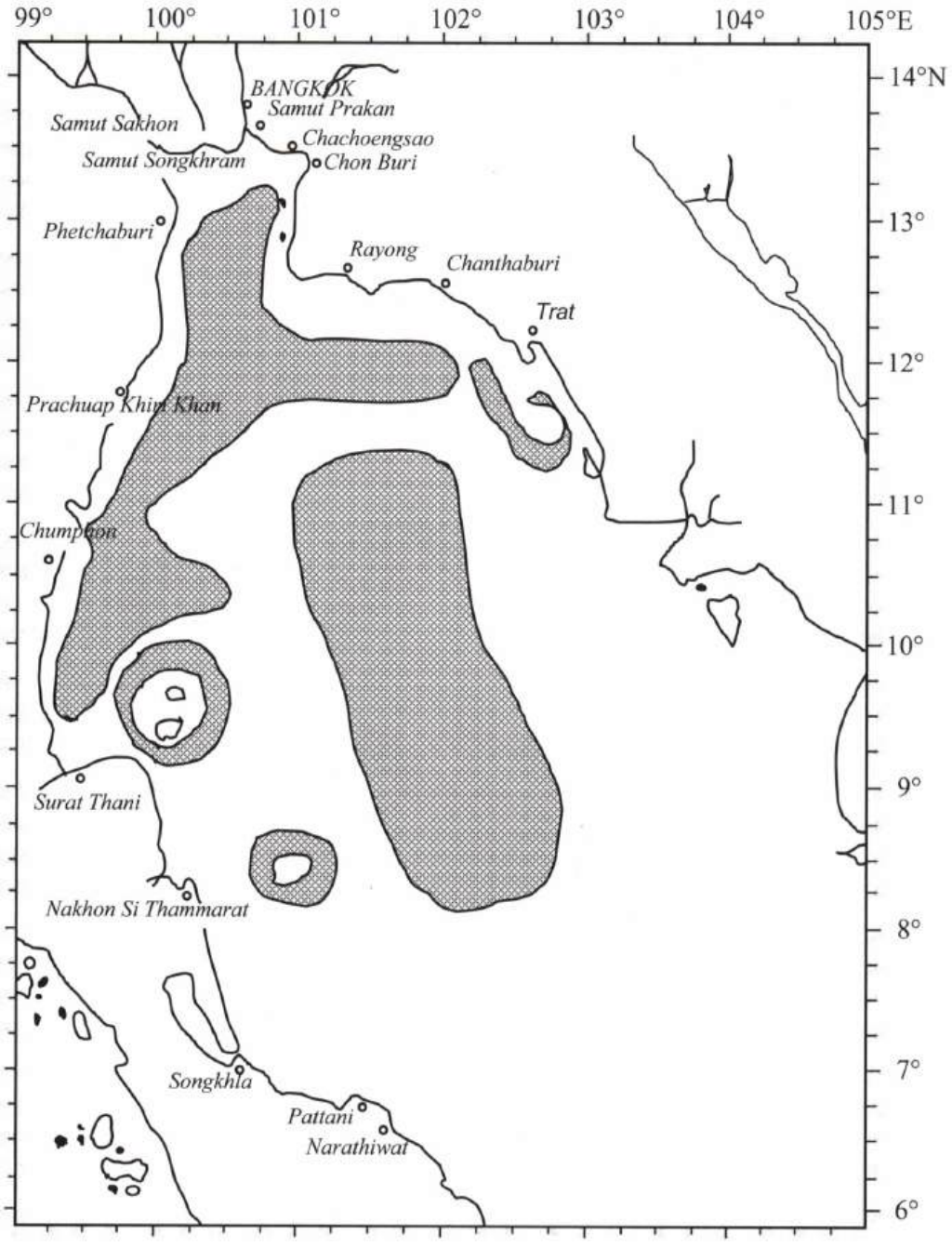

Figure 6c Fishing grounds for neritic tuna in the Gulf of Thailand (Klinmuang, 1981).

Bigeye scad

Bigeye scad (*Selar crumenophthalmus*) is a species of the family Carangidae. It is abundant and widely distributed in offshore waters (Figure 7a). It is often caught with round scads in purse seines, and substantial quantities have been caught by trawl nets. Due to the rapid increase in the catch of bigeye scad associated with the development of luring purse seine fisheries, collection of information on this species has been carried out by the Department of Fisheries species since 1980.

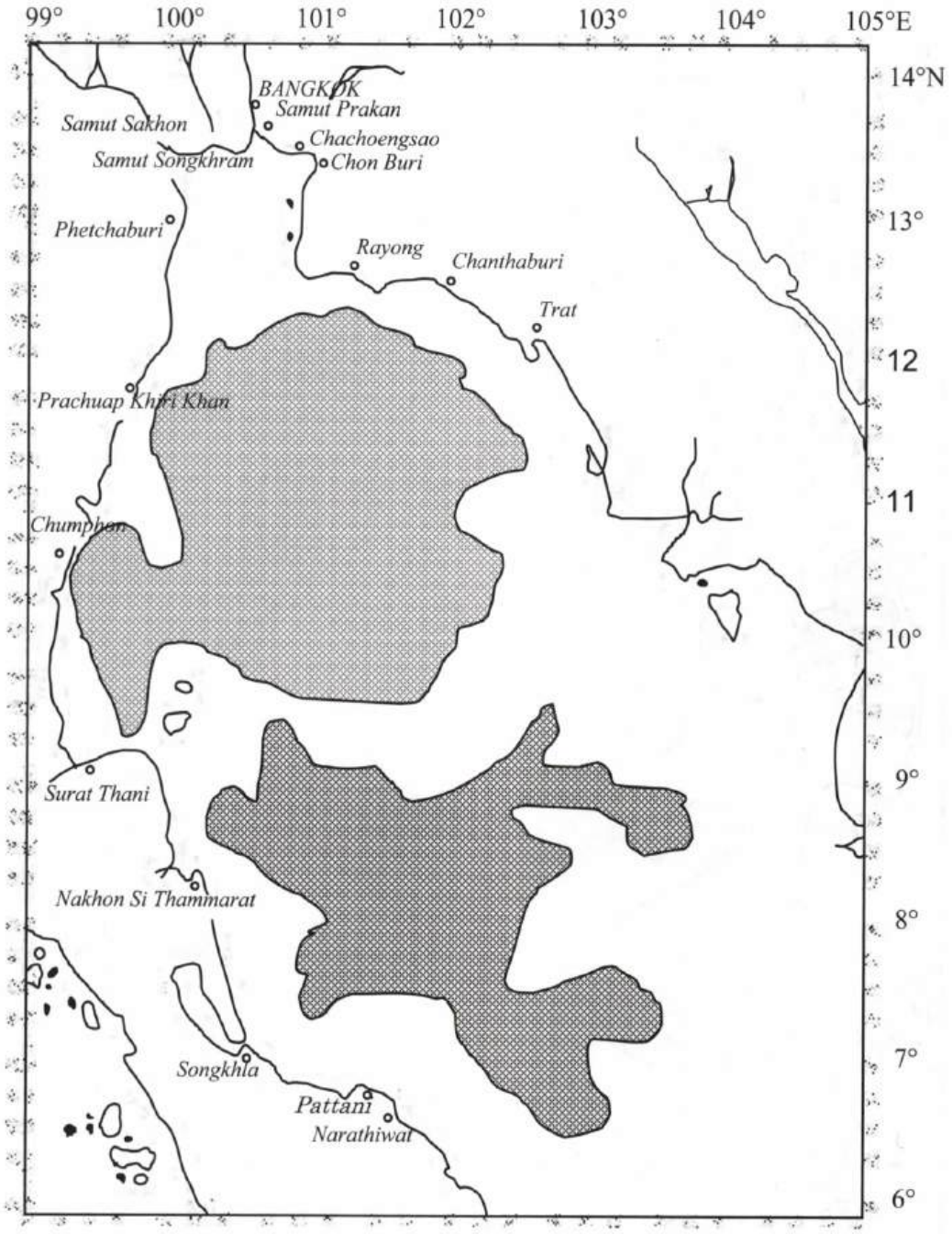

Figure 7a. Fishing grounds for bigeye scad (*Selar crumenopthalmus*) in the Gulf of Thailand (SEAFDEC 1981b).

Carangids

The carangids are fish of the family Carangidae, excluding *Decapterus* spp., *Megalaspis cordyla* and *Selar crumenophthalmus*, which have already been dealt with separately. The 39 species in Thai waters represent a number of genera such as *Atule, Carangoides, Scomberoides, Selar,* and *Selaroides*. This group of fish is considered important in terms of volume of landings, and information regarding this species is usually collected on a combined-species basis due to the difficulties associated with identifying individual species in the field. Therefore, research conducted thus far has been limited by this situation. However, some biological research activities regarding important species such as *Atule mate* (yellowtail scad), *Selaroides leptolepis* (yellow stripe scad), and *Megalaspis cordyla* (hardtail scad) have been carried out to some extent. The fishing grounds for *Atule mate* are shown in Figure 7b.

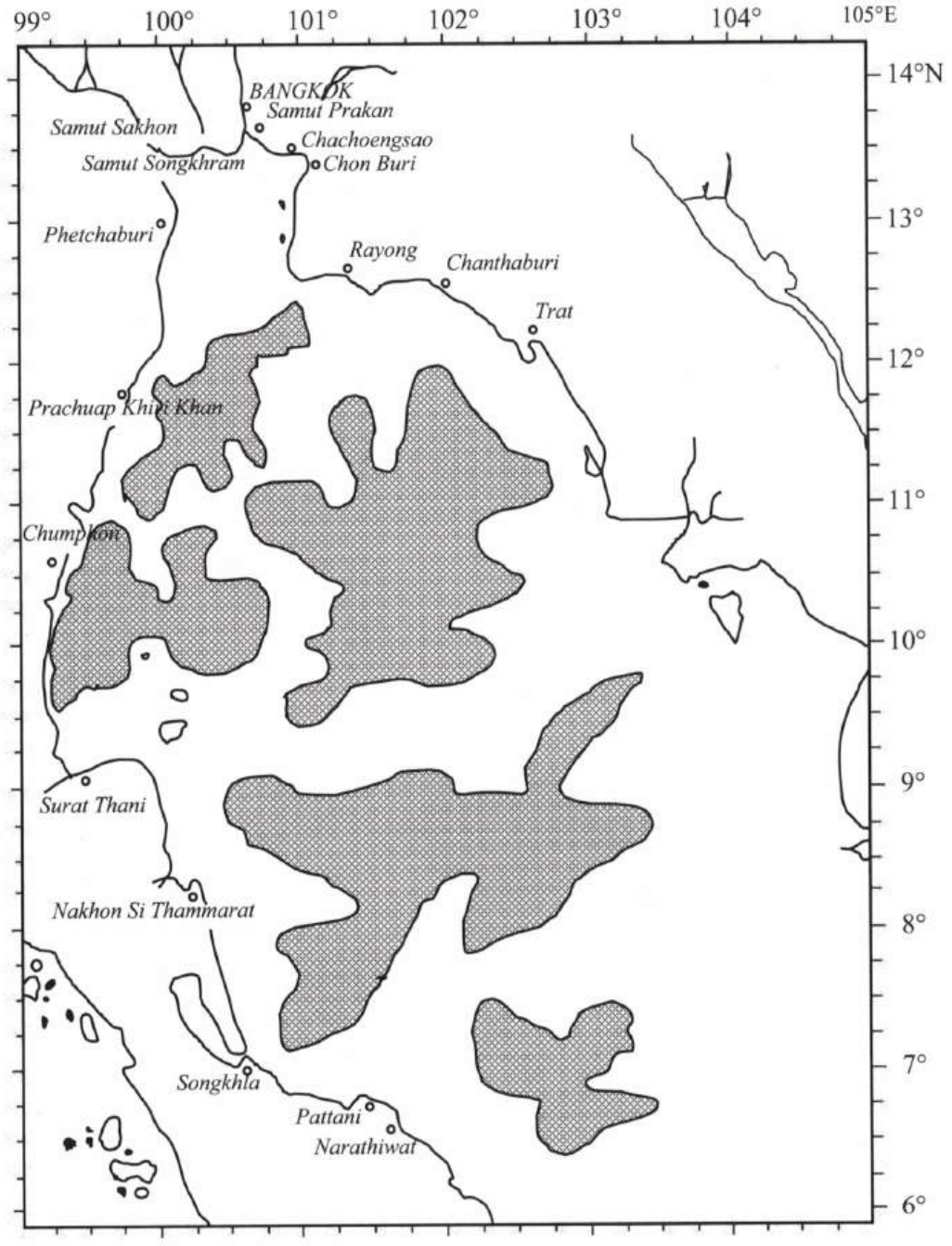

Figure 7b Fishing grounds for yellowtail scad (*Atule mate*) in the Gulf of Thailand (SEAFDEC 1981b).

Round scads

Round scads found in the Gulf of Thailand are represented by 8 species of the genus *Decapterus*. The most common species was formerly identified as *Decapterus maruadsi* (white tip round scad), however, Thai taxonomists confirm that *D. maruadsi* is found only in Japanese waters. The most common round scads found in the Gulf of Thailand are *Decapterus dayi* and *D. killiche*. Another species of round scad commonly caught in the Gulf is the shortfin or slender round scad (*D. macrosoma*).

Round scads are widely distributed in offshore waters and they are very abundant in the central part of the Gulf (Figure 7c). They are mainly caught by purse seine, especially the luring purse seine type. Catch statistics for round scad are complied on a species-combined basis as *Decapterus* spp.

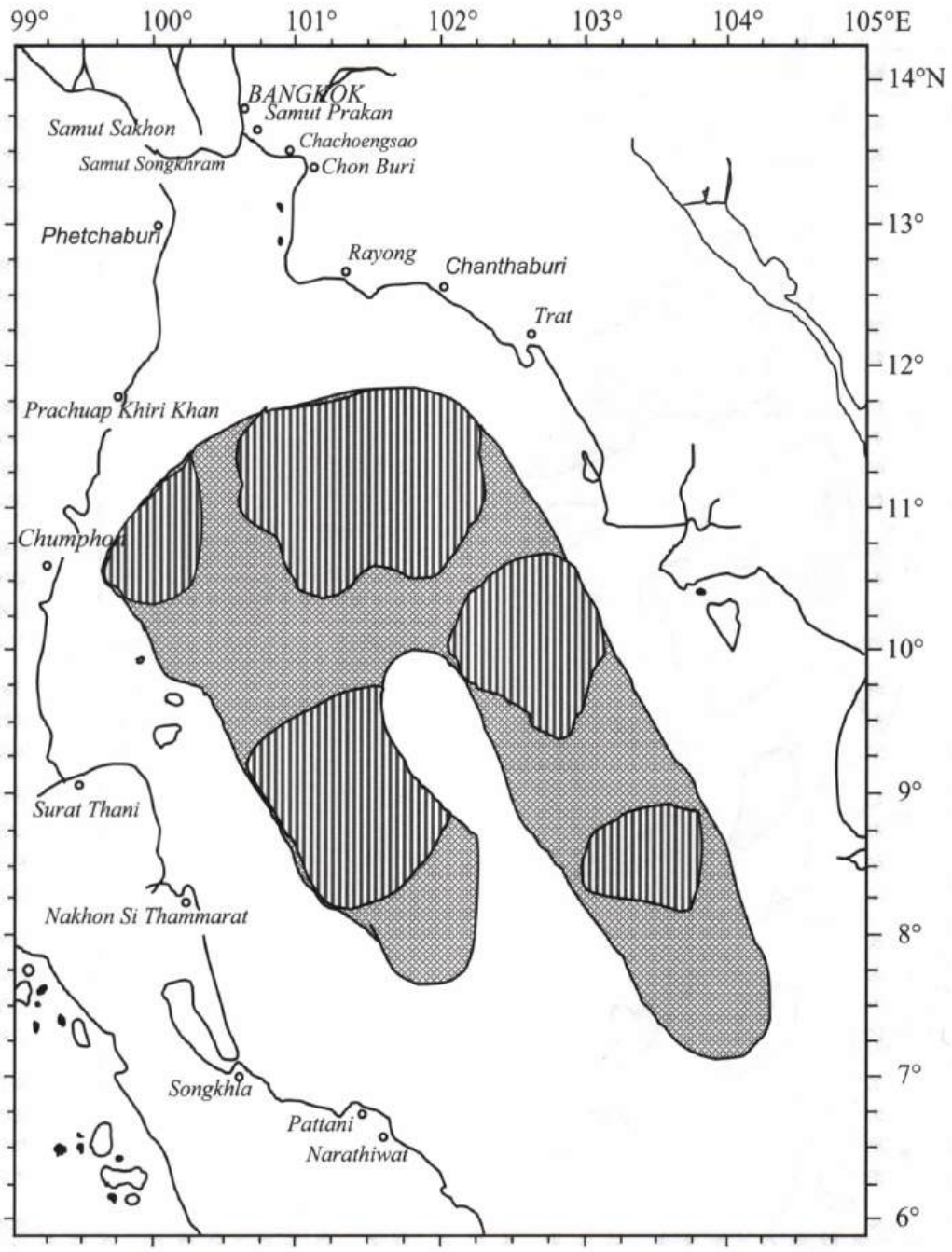

Figure 7c Fishing grounds for round scads (*Decapterus* spp.) in the Gulf of Thailand (Chullasorn and Yusuksawad 1978) (Lined areas are the main fishing grounds).

2.2.2 Small pelagic fish species

Sardines

Sardines are composed of various genera of clupeoids. There are 4 main sardine genera found in the Gulf of Thailand, including *Sardinella* spp., *Amblygaster* spp., *Dussumieria* spp., and *Herklotsichthys* spp. Among these, goldstriped sardine (*Sardinella gibbosa*), fringescale sardine (*S. fimbriata*), and spotted sardinella (*Amblygaster sirm*) are most common. However, they are grouped together in Thai fisheries statistics as sardines (*Sardinella* spp.). Sardines are widely distributed throughout the Gulf, with high concentrations in coastal areas (Figure 8). They are mainly caught by purse seines and encircling and drift gillnets.