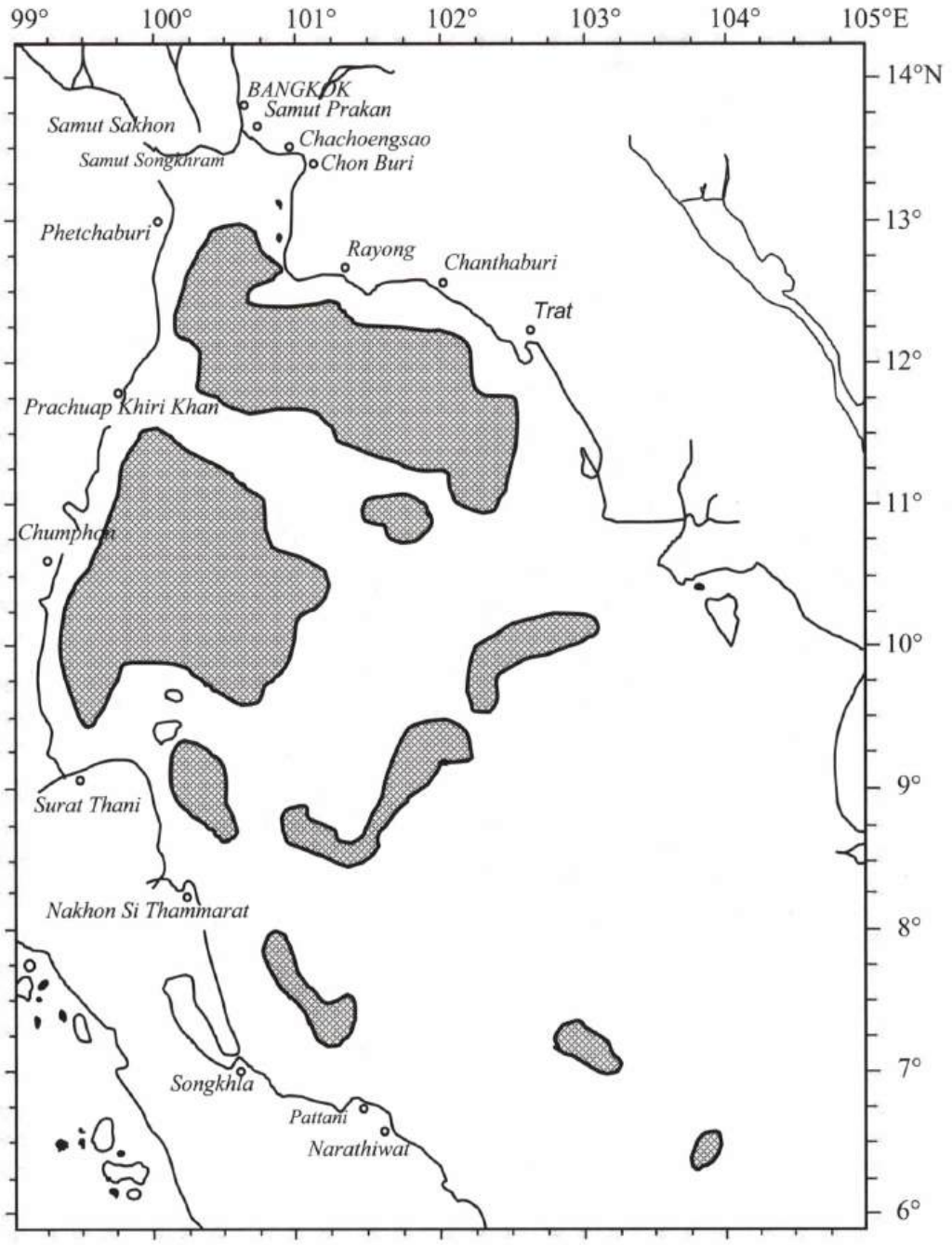

Figure 8 Fishing grounds for sardines (*Sardinella* spp.) in the Gulf of Thailand (SEAFDEC 1981b).

Anchovies

The fish of family Engraulidae are represented by several genera, including *Coilea, Setipinna, Thryssa, Thrissina* and *Stolephorus*. Among them, 12 species of *Stolephorus* spp. are most abundant. In the Gulf of Thailand, the shorthead anchovy (*Stolephorus heterolobus*) and Indian anchovy (*S. indicus*) are considered important and are very abundant in inshore waters (Figure 9). Recently, *Stolephorus heterolobus* has been reidentified and named *Encrasicholina heteroloba* (Whitehead *et al.*, 1988). Therefore, *Encrasicholina heteroloba* is a synonym of *Stolephorus heterolobus*.

As anchovies are very small-sized pelagic fish and commonly distributed in inshore waters, small-meshed purse seines (so-called anchovy purse seine), lift nets, falling nets, set bag nets, push nets, trawl nets, and bamboo stake traps are commonly used to catch them.

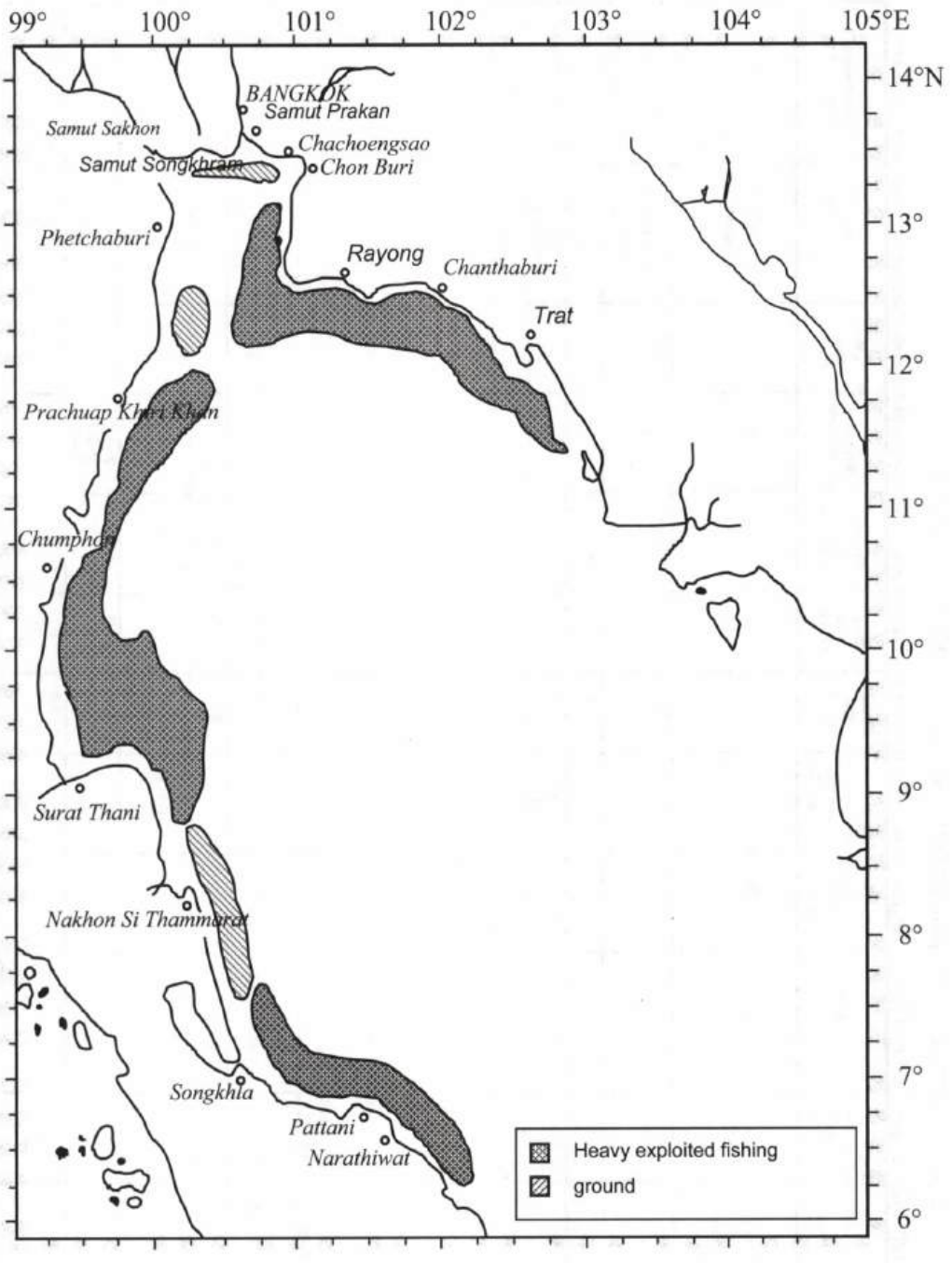

Figure 9 Fishing grounds for anchovy in the Gulf of Thailand (Saikliang 1995b; Supongpan *et al.*, 2000).

Biological features and parameters of important pelagic fishes collected from previous and ongoing studies is summarised in Table 18.

Table 18 Key biological features and parameters for small pelagic fish species in the Gulf of Thailand.

(Body size refers to total length unless specified as FL: fork length or SL: standard length; sexes are combined unless specified as M: male or F: female)

Species	Area (country) surveyed	Vertical distribution range (m)	Body size captured		Spawning		Fecundity	Recruitment		Size at first maturity (cm)	Sex ratio (M:F)	Growth (rate or coefficient)	Mortality (coefficient)	Life span (year)	Food organisms	Length-weight relationship
			Mean (cm)	Maximum (cm)	Area	Season (month)		Size (cm)	Season (month)							
FAMILY SCOMBRIDAE *Rastrelliger brachysoma*	Gulf of Thailand	20-40	15.0	20.95 21.5	10-40 mi off Prachuap Surattani	2-4, 6-8	egg = $9x10^{-8}$ $L^{4.8356}$ 20,000-30,000/ batch	10.25	1-3, 7-9	17.5	1:1	0.33	z=1.06	2-3	Phyto-planktons, zoo-planktons	W =$0.006138L^{3.215}$ M : W = $0.000005732L^{3.1235}$ F : W = $0.000006578L^{3.1235}$
R. kanagurta	Gulf of Thailand	30-60	16.0	22.9	-	2-4 7-8	200,000	7.5	5-6	18.6	1:1	k=2.76	M=3.75 F=4.973 Z=8.733	2-3	Phyto-, zoo-planktons, diatoms, copepods	M : W = $0.0000001958L^{3.7653}$ F : W = $0.000009454L^{3.0375}$
Auxis thazard	Gulf of Thailand	20	35.0	-	-	4-6 8-9	-	19.0 27.0	8-11 2, 4-5	34.1	1:1	-	-	3-4	Fish crustacean	W = $0.00002L^{2.99}$
Euthynnus affinis	Gulf of Thailand	20	37.0	-	-	1-3, 6-7	1,730,000	21.0 26.0	2-4, 6.12	37.5	1:1	-	-	-	Fish crustacean	W = $0.000015L^{2.979}$
Thunnus tonggol	Gulf of Thailand	20	38.5	-	-	3-5 7-12	1,400,000	22.0- 26.0	1-2, 4-6	39.6	1:1	1.5 cm/ month	-	4	Fish crustacean	W = $0.000021L^{2.979}$
Scomberomorus commerson	Gulf of Thailand	20-60	50.0	92.0	-	2-3, 6-9	500,000-3,800,000	11.0-21.0	3-5, 7-10	58.6	1:1.6	0.12 3.4 cm/month	-	4-5	Fish, molluses, crustaceans	W=$0.01302L^{2.8843}$
FAMILY ENGRAULIDAE *Stolephorus heterolobus*	Gulf of Thailand	5-50	4.5	8.89	30 mi off Prachuab	3-4, 7-9	2,000-4,000	2.8-4.0	All around 4-12	5.5 - 6.0	1:1	k=0.198 k=1.8/ year	Z=13.50 M=3.54	1-1.5	Phyto-planktons	M:W = $2.064x10^{-6}L^{3.2494}$ F:W =$7.089x10^{-6}L^{2.932}$
FAMILY CLUPEIDAE *Sardinella gibbosa*	Gulf of Thailand	15-40	10.0	18.4	entire coastal zone	All around 3-4, 7-8	-	12.9	-	-	-	0.33	-	1-2	Phyto-plankton	W=$9.28*10^{-6} * L3^{.0047}$
FAMILY CARANGIDAE *Decapterus maruadsi*	Gulf of Thailand	30-40	13.2	23.1	Central Gulf.	2-3, 7-8	38,000-515,000	5.5-6.5	1-2, 6-8	16.1	1:1.2	0.11 1-2 cm/month	-	2-3	crustaceans, copepods	W=$0.00005L^{2.811}$
D. macrosoma	Gulf of Thailand	30-60	-	-	-	12-5	-	-	-	16.5	1:0.9	-	-	-	-	-
Atule mate	Gulf of Thailand	15-45	16.0	25.8	30 mi off Chumporn Nakorn Si Thammarat	3-4	-	5.5-6.5	1-3, 6-9	-	-	0.8 cm/ k=0.107	-	2-3	-	-
Selar crumenophthalmus	Gulf of Thailand	30-60	20-25	28.4	-	-	-	10.0	-	19.4	1:1.3	k=2.4	Z=9.7 M=3.3 F=6.5	-	-	-
Selaroides leptolepis	Gulf of Thailand	20-50	12	19.2- 21.0	-	All around 3, 7-8	-	4.0-5.5	6, 11	F:15.4	1: 1.02	k=0.128	-	-	Zooplanktons, phytoplanktons, molluscs	M: Log W = 3.257Log $L^{-5.567}$ F: Log W = 3.629Log $L^{-6.369}$
Megalaspis cordyla	Gulf of Thailand	20-50	22.0	28.8	-	12-5, 8-11	-	10.5-11.5	5, 9	-	1:0.8	1.2cm/month 0.2	-	-	Fish, crustacean	W=$0.144L^{2.9785}$

Source: Chullasorn and Martosubroto, 1986.

2.2.3 Demersal fish species

Demersal fish species live at or near the bottom of the sea, although some groups may also inhabit the middle or upper layers of the water column. They may by divided into 2 groups: (1) demersal fish; and (2) invertebrates, including crustaceans and molluscs. They are caught by bottom trawl nets, bottom gill nets, push nets, longlines, and traps.

Fishing grounds for demersal fish are generally located in coastal waters of the Gulf of Thailand. Otter board trawls are highly effective in catching demersal fish. Otter board trawls, pair and beam trawls, and push nets are most commonly used to catch demersal fish. However, otter board trawls are the most important gear type in demersal fisheries. The areas fished using otter board and pair trawls by various sizes of fishing boats are depicted in Figures 10a to d and 11.

There are a large number of demersal fish species in Thai waters. More than 500 species have been caught and commercially utilised, however, demersal fish catches usually contain more than 50% low-value fish. These low-value fish include 3 groups: (1) non-edible species; (2) edible species of low commercial value or low quality; and (3) juveniles of commercially important species.

Based on trawl surveys conducted in the Gulf of Thailand, there are 7 species of lizardfish. The two most commonly found species are brushtooth lizardfish (*Saurida undosquamis*) and *S. elongata*. Sirapakavanich (1990) reported that brushtooth lizardfish was found along the coast of the Gulf, and that the length frequency distribution of catches vary according to depth. Generally, small fish are caught in shallow water, whereas the capture of larger fish occurs further offshore. *S. elongata* has been shown to be very abundant at depths from 10 to 20m.

Threadfin bream are demersal fish distributed throughout coastal waters to depths of 60m. The most common species are *Nemipterus hexodon*, *N. mesoprion*, *N. japonicus*, *N. nematophorus*, and *N. peronii*. *N. hexodon* is most common at depths from 10 to 40m, *N. mesoprion* and *N. japonicus* are abundant from 15 to 50m, and *N. mesoprion* and *N. peronii* are commonly found in deeper areas from 30 to 60m.

Bigeye (*Priancanthus tayenus*) is a ubiquitous demersal species in the Gulf of Thailand (Prachuab Khiri Khan and Chumphon provinces) at depths greater than 40m. It is carnivorous, feeding mostly on fish, shrimps, and squids (Jiraphanpiphat 1987).

Information regarding important demersal fishes collected from previous and ongoing studies is summarised in Table 19.

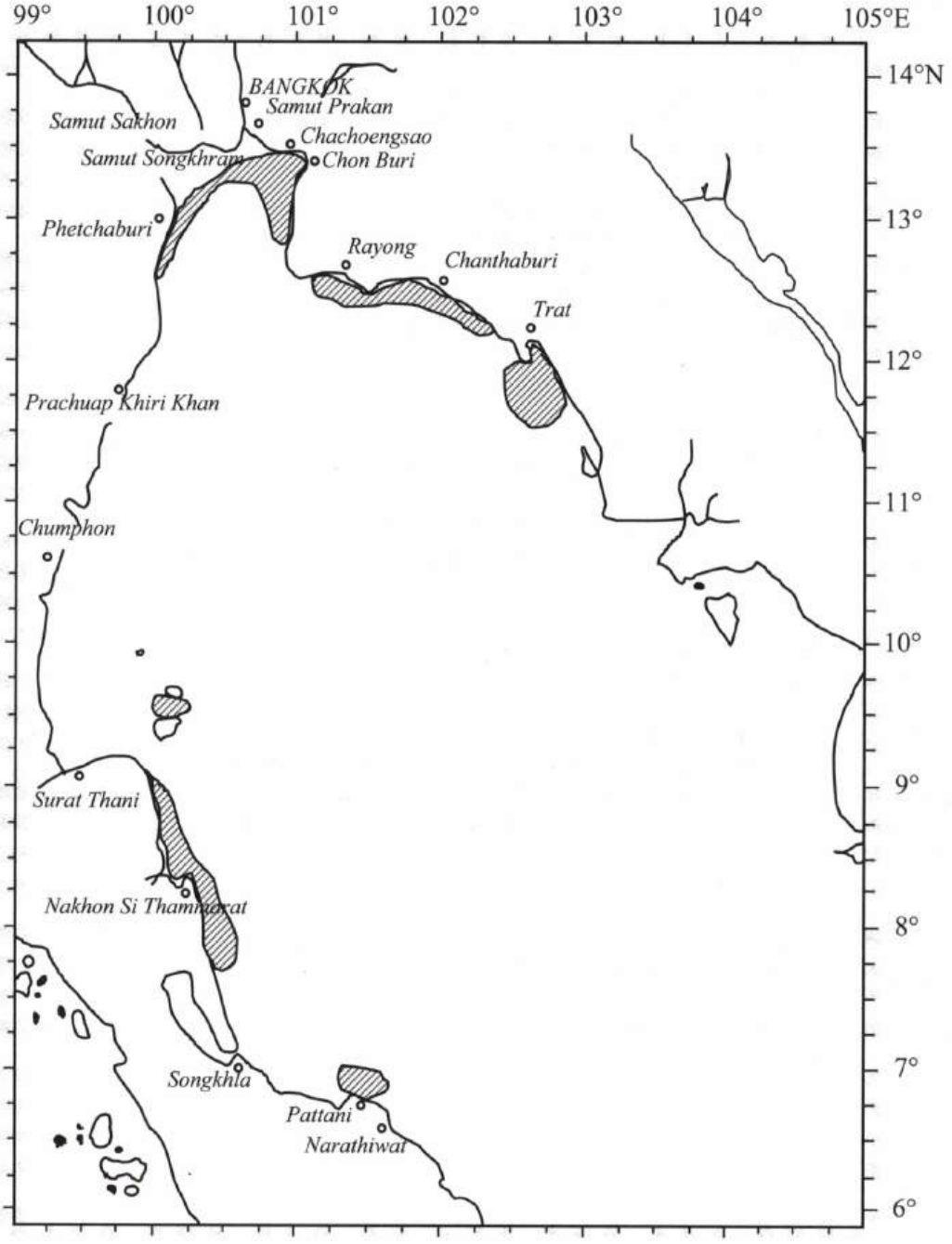

Figure 10a The fishing grounds of otter board trawl (boat length <14 m) (FAO 1996).

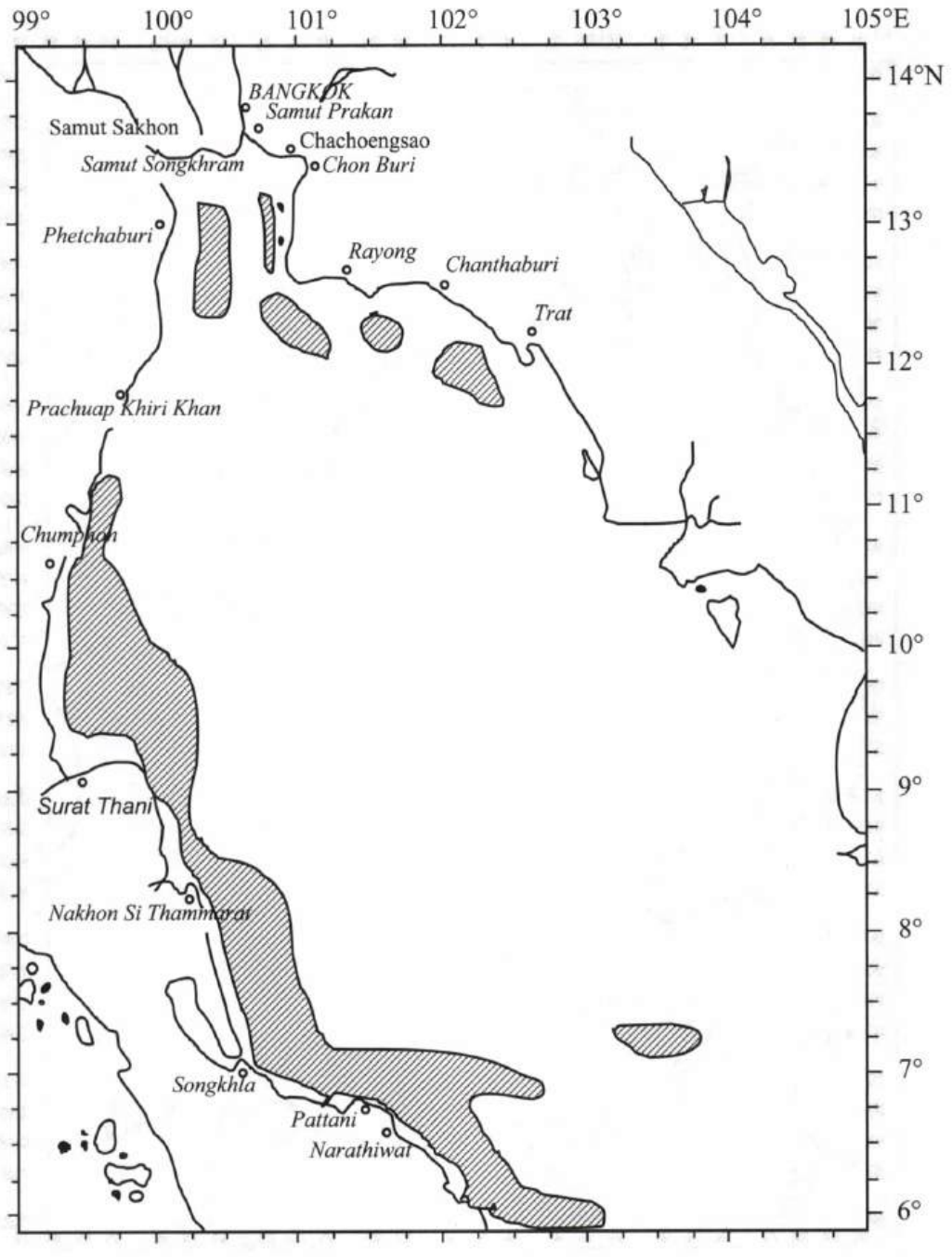

Figure 10b The fishing grounds of otter board trawl (boat length 14 to 18 m) (FAO 1996).

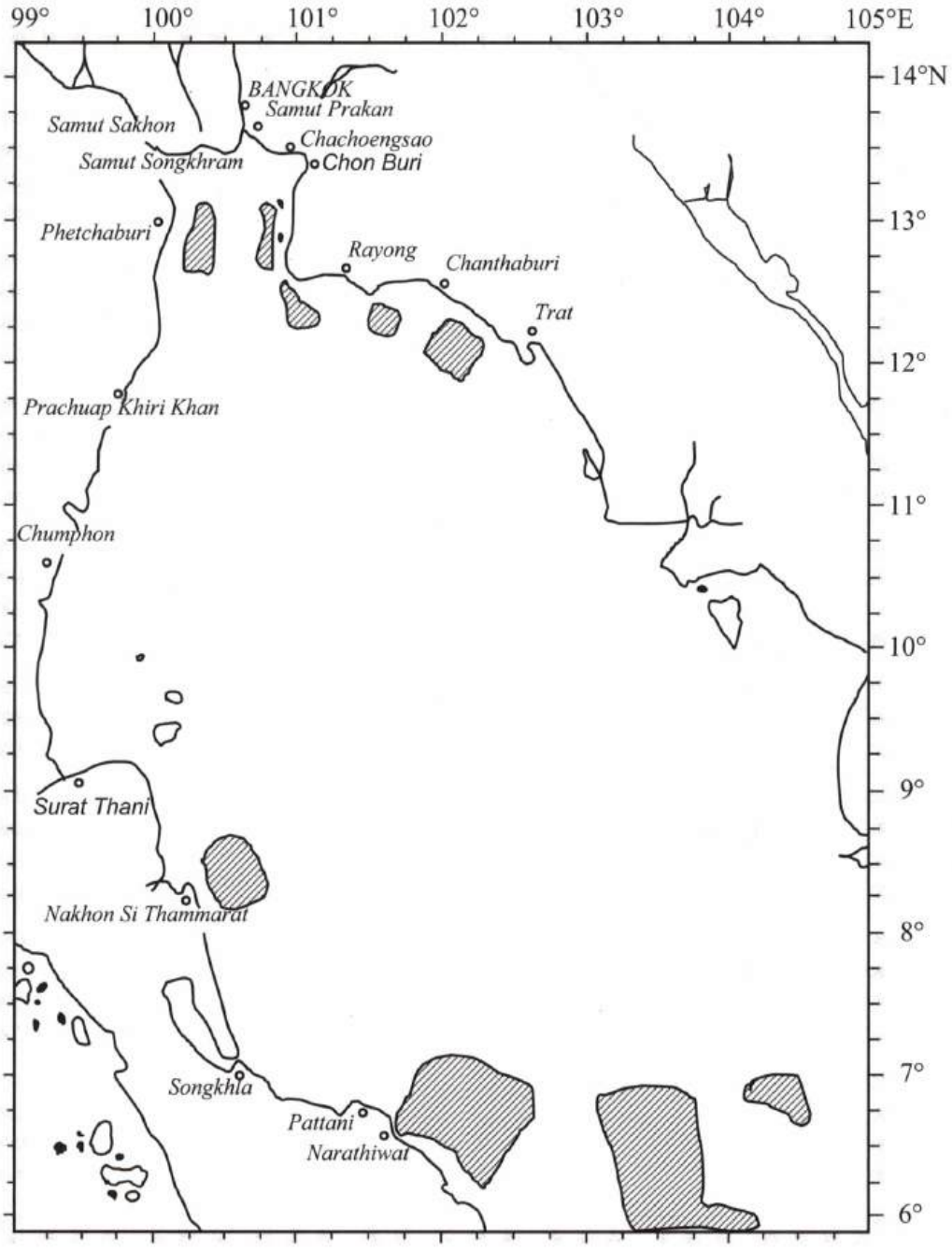

Figure 10c The fishing grounds of otter board trawl (boat length >18 m) (FAO 1996).

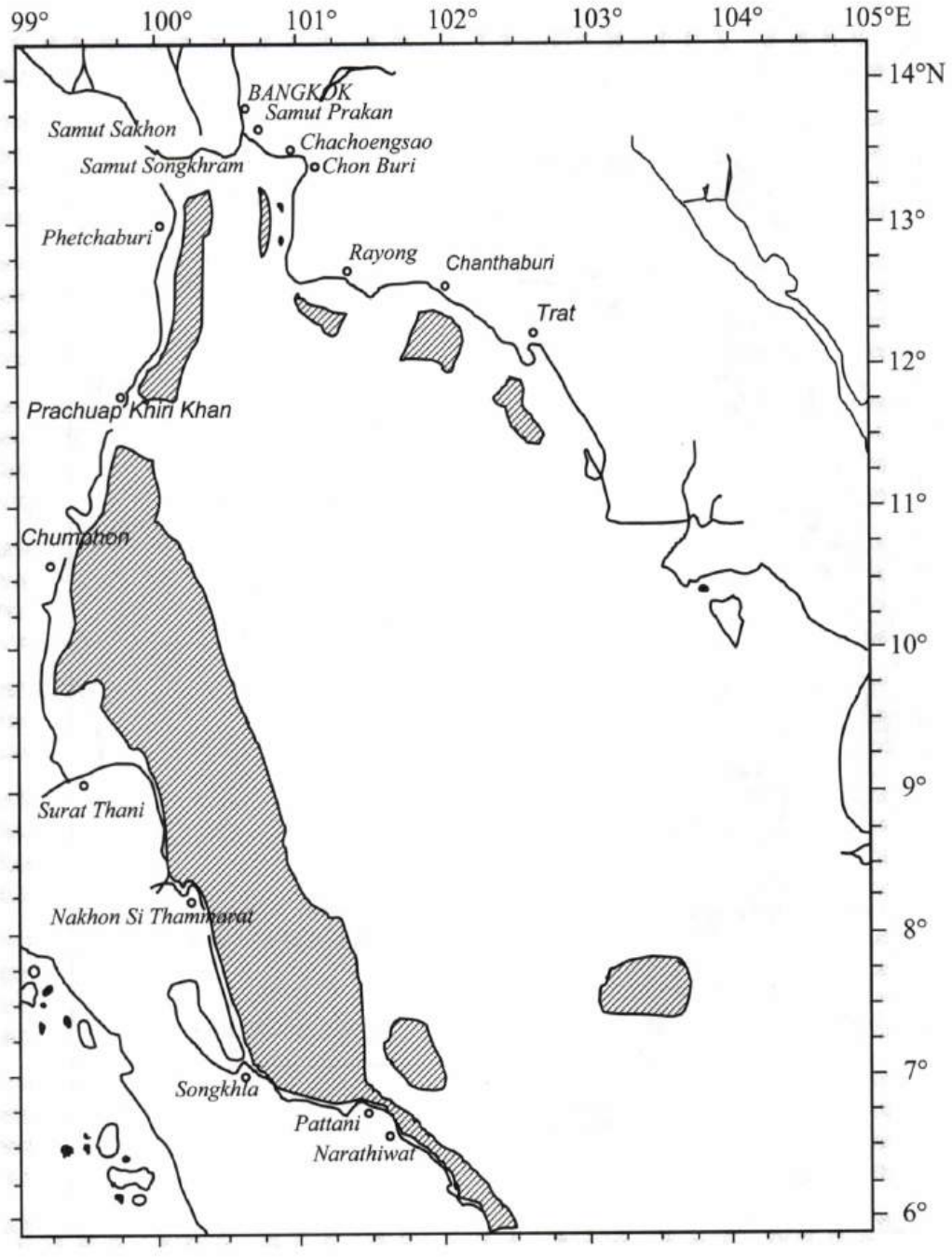

Figure 10d The fishing grounds of pair trawls (boat length >18 m) (FAO 1996).

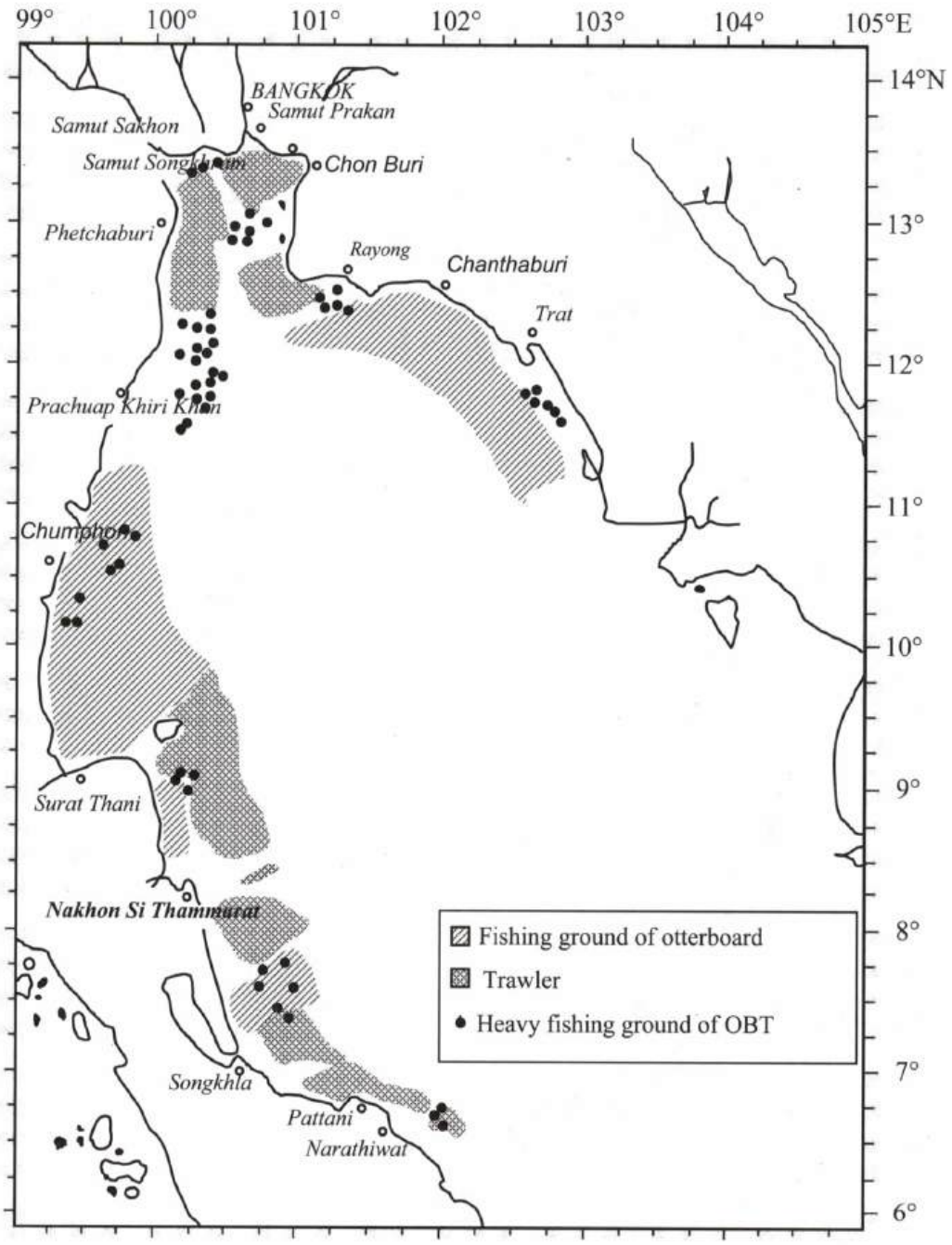

Figure 11 The fishing grounds of commercial trawls (otter board and pair trawl) in the Gulf of Thailand (FAO, 1996).

Table 19 Key biological features and parameters of demersal fish in the Gulf of Thailand.

(Body size refers to total length unless specified as FL: fork length or SL: standard length; sexes are combined unless specified as M: male or F: female)

Species	Area (country) surveyed	Vertical distribution range (m)	Body size captured		Spawning		Fecundity	Recruitment		Size at first maturity (cm)	Sex ratio (M:F)	Growth (rate or coefficient)	Mortality (coefficient)	Life span (year)	Food organisms	Length-weight relationship
			Mean (cm)	Maximum (cm)	Area	Season (month)		Size (cm)	Season (month)							
FAMILY LUTJANIDAE *Lutjanus lineolatus*	Gulf of Thailand	20-50	13.9	M:18.0 F:19.0	-	10-6	-	8.0	1-4	-	1:1	1-2 cm /month	-	-	Fish,Shrimps, squids	M:W=0.0263L$^{2.754}$ F:W=0.0668L$^{2.412}$
FAMILY NEMIPTERIDAE *Nemipterus hexodon*	Gulf of Thailand	10-40	M:16.46 F:15.12	M:27.3 F:24.4	-	All around 1-4, 6-8	-	11.0, 12.0	5, 9, 11	-	1:0.97	(1-2)	-	-	Fish Crustaceans	M:W=0.1161L$^{3.04}$ F:W=0.0176L$^{2.924}$
Nemipterus japonicus	Gulf of Thailand	25-50	-	M:25.6 F:23.3	-	-	-	10.0	-	-	-	M:k=0.1599 F:k=0.1207	M:Z=5.482 F:Z=4.814	-	-	-
Nemipterus nematophorus	Gulf of Thailand	15-50 >40	-	M:13.34 F:17.8	-	1-4, 8, 11	-	-	-	11.7	1:0.85	M:k=0.1436 F:k=0.2275	-	-	-	-
Nemipterus mesoprion	Gulf of Thailand	30-60	M:13.0 F:11.1	M:19.51 F:15.52	-	2-4	-	6.5-7.0	3, 5, 6	-	1:1.1	M:k=0.179 (1.08) F:k=0.224 (0.85)	-	-	Fish, molluscs, crustaceans	M:W=0.18*10^{-5}L$^{2.93}$ F:W=7.8*10^{-5}L$^{3.10}$
Nemipterus peronii	Gulf of Thailand	30-40	M:22.9 F:21.6	M:27.5 F:27.0	-	2-4	-	15.2, 15.5, 15.7	3, 7, 9, 12	-	1:0.84	-	-	-	Worms, fish, squid crustaceans	M:W=0.0122L$^{2.988}$ F:W=0.0199L$^{3.004}$
Scolopsis taeniopterus	Gulf of Thailand	10-40	M:21.7 F:14.6	M:27.0 F:25.0	-	All around 12-1, 4-8	-	-	6-7, 11-12	-	1:0.8	-	-	-	Crustaceans, fish	M:W=1.08*10^{-4}L$^{2.6201}$ F:W=6.17*10^{-5}L$^{2.718}$
FAMILY PRIACANTHIDAE *Priacanthus tayenus*	Gulf of Thailand	40-50	M:27.0 F:25.0	-	-	All around 1-3	56,000-152,000	11.0, 12.0, 10.5	3, 5, 10, 12	14.0	1:1	2.0 cm/month	-	-	Crustaceans Fish, squid	M:W=3.16*10^{-6}L$^{2.919}$ F:W=2.606*10^{-6}L$^{2.891}$
FAMILY SERRANIDAE *Epinephelus sexfasciatus*	Gulf of Thailand	20-70	-	-	-	-	-	-	-	-	-	-	-	-	Fish, Crustaceans Molluscs, polychaetae	-
FAMILY SYNODONTODAE *Saurida elongata*	Gulf of Thailand	10-20	M:26.3 F:30.6	M:37.7 F:41.6	-< 30 mi	1-3, 8-9	-	-	5-7, 11	-	-	M: k=0.103 1.4 cm/ month F:k=0.099 1.5 cm/ month	M:Z=5.622 F:Z=5.278	-	-	M:W=5.644*10^{-6}L$^{3.054}$ F:W=6.565*10^{-6}L$^{3.024}$
Saurida tumbil	Gulf of Thailand	-	M:26.31 F:30.56	M:34.0 F:40.0	-	1-3	-	-	5-7, 12	-	1:1	-	-	-	-	-
Saurida undosquamis	Gulf of Thailand	41-50	M:17.8 F:18.31	M:36.5 F:26.5	-	12-1, 5-9	-	12.0-14.0	6, 12, 2	-	1:0.57	2.0cm/ month	-	-	-	W=0.00000292L$^{3.183}$

Source: Chullasorn and Martosubroto, 1986.

2.2.4 Commercially exploited invertebrates

Thailand's marine invertebrate resources are highly valuable. They include shrimps (economically important penaeid shrimps and miscellaneous penaeid shrimps), cephalopods (squid, cuttlefish, and octopus), swimming crab, sergestid shrimp, jellyfish, and others.

Shrimps

More than 50 species of shrimp are found in the Gulf of Thailand and Andaman Sea (Chaitiamvong and Supongpan 1993). The economically important species are those of the penaeid group, with 9 important species (*Penaeus merguiensis*, *P. monodon*, *P. semisulcatus*, *P. japonicus*, *P. latisulcatus*, *P. longistylus*, *Metapenaeus affinis*, *M. intermedius*, and *M. ensis*) and more than 10 miscellaneous species (*including Metapenaeopsis* spp., *Trachypenaeus* spp., *Parapenaeopsis* spp., *M. lysianassa*, and *M. brevicornis*).

Vibhasiri (1984) reported that Ban Don Bay off Surat Thani province is considered one of the most productive shrimp fishing areas. *M. affinis* is the most abundant species of large-sized shrimp in this area. Thubthimsang (1981) noted that this species is found in this area all year round.

The economically important penaeid shrimps are sold in a wide variety of forms in domestic and export markets. Wild caught penaeid shrimp are mostly consumed domestically in the fresh or dried form, although some are frozen, or processed and canned as cocktail shrimp, for important export markets.

Shrimps are mainly caught by trawl nets of various types. Subsistence fishers use gill nets and push nets in inshore waters. Small trawls and beam trawls are used to catch shrimp in coastal waters of the Gulf of Thailand. The main species caught are white shrimp (*Penaeus merguiensis*), green tiger shrimp (*P. semisulcatus*), and *Metapenaeus* spp. Penaeid shrimp catch from the Gulf of Thailand fluctuated between 16,000 to 19,000 metric tonnes from 1985 to 1991. The major fishing gears are otter board trawls and shrimp gill nets, which are used to catch about 78% and 10% of the total shrimp production, respectively (Vibhasiri, 1993).

Cephalopods

The 3 major groups of cephalopod caught for commercial utilisation are squid (*Loligo chinensis*, *L. duvauceli*, *L. sumatrensis,* and *Sepioteuthis lessoniana*), cuttlefish (*Sepia pharaonis*, *S. aculeata*, *S. recurvirostra*, *S. lycidas*, *S. brevimand, and Sepiella inermis*) and octopus (*Octopus membranaceous*, *O. doffusi,* and *Octopus* spp.). These species are distributed in coastal waters of both the Gulf of Thailand and Andaman Sea, except for *S. lycidas,* which is only distributed in the Andaman Sea and the lower part of the Gulf of Thailand.

Cuttlefish are economically important in the Gulf of Thailand. There are 7 species of the Family Sepiidae found in the Gulf of Thailand, including *Sepia aculata*, *S. kopiensis*, *S. recurvirostra*, *S. pharaonis*, *S. brevimana*, *S. lycidas*, and *Sepiella inermis* (Chotiyaputta *et al.*, 1992). Cuttlefish are generally distributed in inshore areas, spending much of their lives on or near the seabed (Voss 1973, cited in Bakhayokho 1983). Therefore, cuttlefish are mostly caught by traps, push nets, and trawls operated in inshore areas. All species are widely distributed in the Gulf of Thailand, except for *S. lycidas*, which is only found in the southern part of the Gulf up to Chumphon province (Supongpan 1988). Results of a resource survey conducted in the Upper Gulf of Thailand with an otter board trawl from 1999 to 2000 indicate that the distributions of *S. lycidas* and *S. kopiensis* may not extend to these waters (Anugul, 2002).

Supongpan (1988) reported that the distribution and abundance of cuttlefish varies by water depth. *Sepiella inermis* and *S. lycidas* were abundant in depths ranging from 10 to 20m. *S. aculata* was most abundant at a depth of 10 to 30 meters, whereas *S. pharaonis* and *S. recurvirostra* were most abundant from 20 to 30m. Nabthitabhata (1997) reported that *Sepiella inermis* is abundant in shallow estuarine areas at a depth of approximately 20m.

Jindalikit and Sereeruk (2004) report that the habitats of cuttlefish species are related to distance from shore and bottom depth. High abundances of *S. aculata* were observed between 3 and 7 nautical miles offshore at a depth from 20 to 25m. *S. recurvirostra* was highly abundant more than 7 nautical miles offshore at a depth between 21 and 40m, whilst *Sepiella inermis* was found 3 to 5 nautical miles offshore at a depth of 10 to 15m. *S. aculata* was abundant at 3 nautical miles from shore at a depth of 10 to 20m, *S. recurvirostra* at more than 7 nautical miles offshore and a bottom depth from 31 to 40m, and *Sepiella inermis* at 3 nautical offshore and a bottom depth of 10 to 15m.

The total production of cephalopods during 1991 was 154,402 metric tonnes, comprised of squid, cuttlefish, and octopus at 69,367, 65,029, and 20,006 metric tonnes, respectively. Squids are mainly caught by trawls, light luring cast nets, and squid traps. The fishing grounds where these gears are used are presented in Figures 12a and b.

Shortnecked clam

The fisheries for shortnecked clam differ from other fisheries, especially in relation to species and gear selection. Fishers group together to harvest this resource on an intensive basis until either catch rates decline or the resource is depleted. The fishers then move onto other areas. Previously harvested fishing grounds usually require 4 to 5 years to recover. Shortnecked clam fishing grounds are distributed throughout the Gulf of Thailand and the Andaman Sea. The productive areas are concentrated on the eastern, upper, and western coasts of the Gulf. A problem that usually occurs is the inundation of shortnecked clam fishers to new inshore areas, often leading to conflicts with local fishers due to the use of small meshed dredges in the inshore waters assigned for the use of small-scale fishers only. Production of shortnecked clam from the Gulf ranged from 18,300 to 130,000 metric tonnes between 1985 and 2000. Peak production was observed in 1987, after which catches followed a decreasing trend until reaching the lowest recorded production in 1996. Harvests have since recovered, and a total production of 25,964 metric tonnes was recorded in 2000. The clams are mostly exported in a range of forms, including fresh and frozen whole clams, fresh and frozen meat, and boiled and canned product.

Sergestid shrimp

Sergestid shrimp include 5 species of Acetes (*A. erythreus, A. japonicus, A. indicus, A. vulgaris, A. sibogae*) and 2 species of shrimp-like (*Mesopodophsis orientalis, Rhopalopthalmus phyllodus*), and *Lucifer hanseni. Acetes sibogae* is found only in the Andaman Sea. Total production in 1991 was 21,753 metric tonnes, with a value of 108.7 million baht. Sergestid shrimp and shrimp-liked are mostly utilised for domestic consumption in the form of shrimp paste and small dried shrimp. Production derived from the Gulf of Thailand represents approximately 87% of Thailand's total production of this group. From 1985 to 2000, Gulf of Thailand production ranged between 6,400 and 21,400 metric tonnes.

Jellyfish

There are 2 economically important species of jellyfish in Thai waters, *Rhopilema hishidum* and *Lobonema smithi. Rhopilema* is treated with local wood and dried for export, whereas *Lobonema* is treated with salt and dried for local consumption. Production from both the Gulf and Andaman Sea fluctuated between 6,500 and 138,600 metric tonnes between 1985 and 2000.

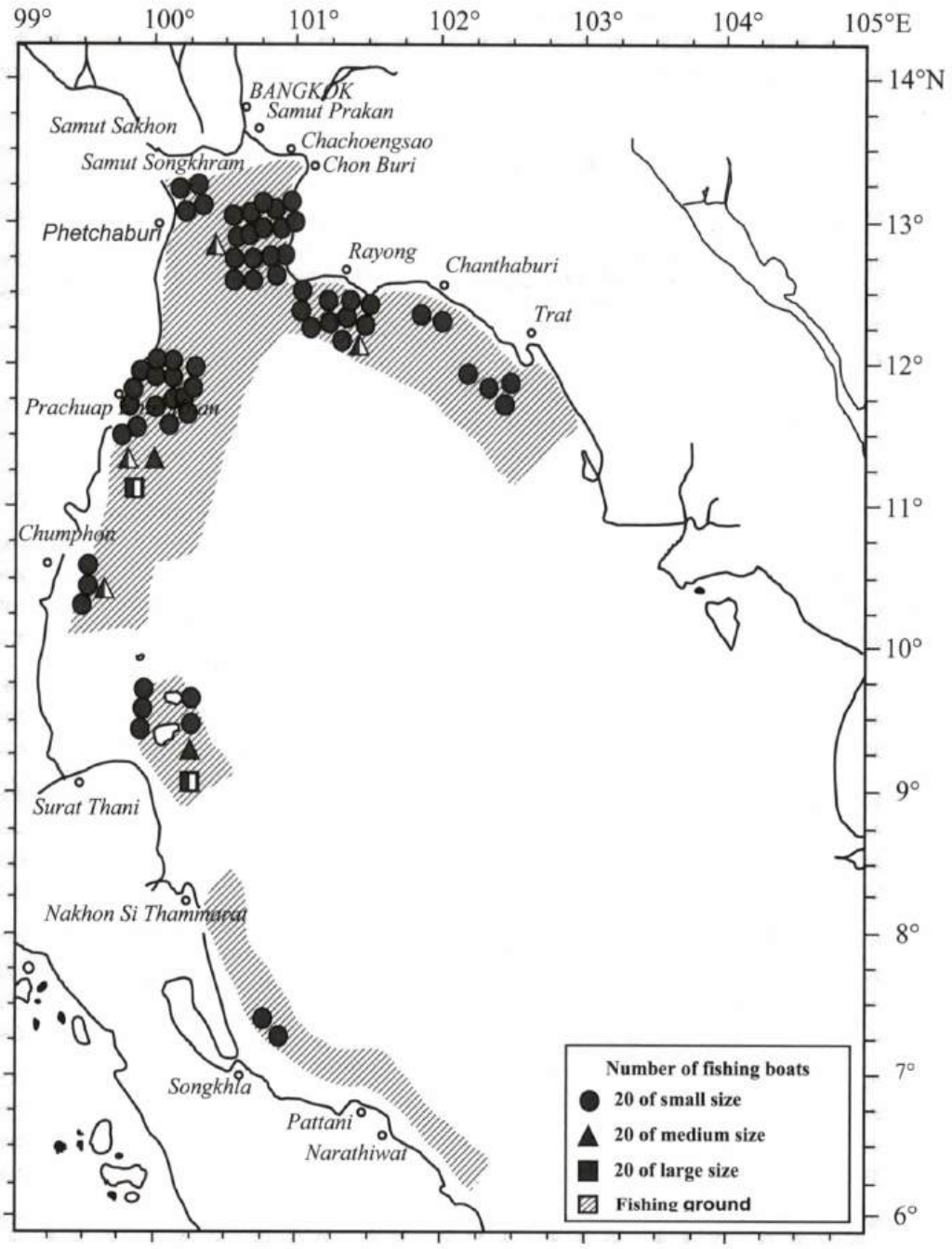

Figure 12a Area of light luring fishing for squid in the Gulf of Thailand (Supongpan, 1996).

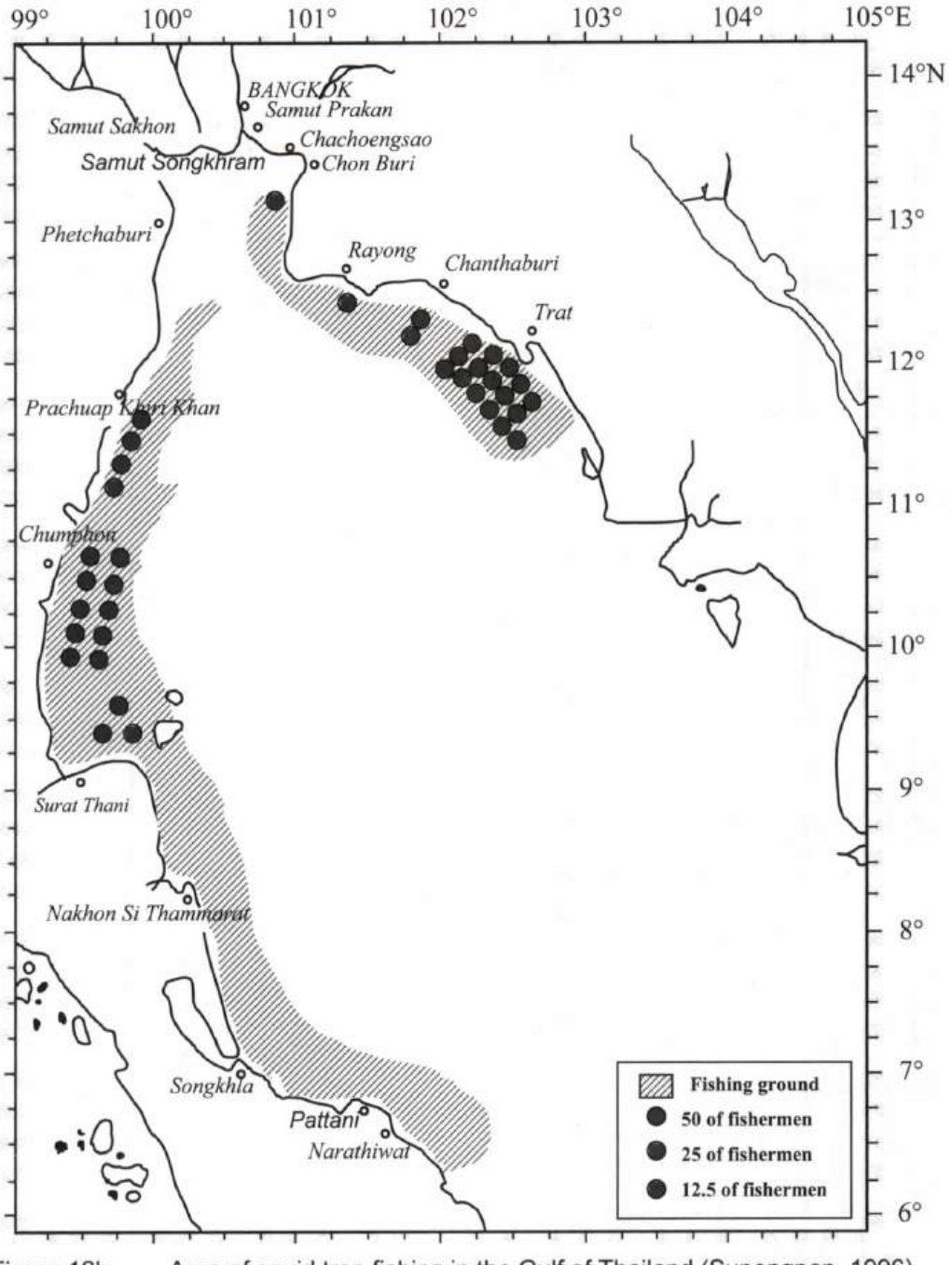

Figure 12b Area of squid trap fishing in the Gulf of Thailand (Supongpan, 1996).

Swimming crab

The swimming crab (*Portunus pelagicus*) is distributed throughout the Gulf and Andaman Sea. The areas in which this species is abundant include the eastern, upper, and western coasts of the Gulf. From 1985 to 2000, total production of this species from the Gulf ranged between 19,000 and 37,300 metric tonnes. The species is thought to have been overexploited. It is mostly consumed locally, in the fresh and boiled form. The major fishing gears used to catch swimming crabs are trawls, push nets, and gill nets. Conflicts usually arise between gill net and trawl fishers targeting this species in the same areas. Another problem involves the catch of immature crabs by push nets and small mesh trawl fishing gear operated in inshore waters.

The key biological features and parameters of important invertebrates collected during previous and existing studies are summarised in Table 20.

Table 20 Key biological features and parameters of small invertebrates in the Gulf of Thailand.

(Body size refers to total length unless specified as FL: fork length or SL: standard length; sexes are combined unless specified as M: male or F: female)

Species	Area (country) surveyed	Vertical distribution range (m)	Body size captured		Spawning		Fecundity	Recruitment		Size at first maturity (cm)	Sex ratio (M:F)	Growth (rate or coefficient)	Mortality (coefficient)	Life span (year)	Food organisms	Length-weight relationship
			Mean (cm)	Maximum (cm)	Area	Season (month)		Size (cm)	Season (month)							
FAMILY PENAEIDAE *Penaeus merguiensis*	Gulf of Thailand[1]	15-30	-	-	-	1-3, 9-12	129 650-960 950	-	-	13.0-14.2	-	-	-	-	Polychaetae Fish larvae, Copepods euphausis	M:W= $0.000010L^{2.963}$ F:W= $0.0000049L^{3.113}$
Penaeus japonicus	Gulf of Thailand[1]	10-19	12.9	20.9	-	All around 1-3, 7-8	257 889- 1 009 459	7.0	-	14.0	1:1	-	-	-	Shrimps larvae, crabs larvae, cephalopods larvae, molluscs larvae	M:W= $0.0000712L^{2.5703}$ F:W= $0.0000149L^{2.9018}$
Loligo duvauceli	Gulf of Thailand[2] :East coast	Shallow to depth over 50 m	6-30	30	Prachuap Khiri Khan-Chumphon	All around 1, 3-4, 6-7, 12	1,500-10,000	0.5-5.0	1,3-6,9	6.5-7.0	F>M	M:0.0083 day^{-1} or 2.52 year F:0.0069 day^{-1}		1	Fish, molluse and shrimp	M:W= $0.9594L^{1.73509}$ F:W= $0.1829L^{2.16290}$
L. chinensis	Gulf of Thailand[2] :East coast	>30	6-42	42	South of Ko Chang, off shore of Chumphon and Pracuap Khiri Khan	All around 3-4, 6-7, 11-12	3,000-11,000	0.5-6.5	1, 3-6, 10	8.5	-	M:0.0072 day^{-1} Or 2.62 yr^{-1} F:2.704 day^{-1} or 2.70 yr^{-1}		1	Fish, mollusce and shrimo	M:W= $0.2134L^{2.11948}$ F:W= $0.051L^{2.42078}$
Sepia aculata	Gulf of Thailand Upper[3]	1-7 nmi or 20-25 m	5-16.9	-	-	3-4,7-8	4,547	-	-	8.1	-				Crustacean, fish	M:W= $0.00099L^{2.5032}$ F:W= $0.000722L^{2.5919}$
S. recurvirostra	Gulf of Thailand Upper[4]	>7 nmi or 21-40 m	-	-	-	-	-	-	-	-	-	-	-	-	Crustacean, fish	M:W= $0.00191L^{2.3579}$ F:W= $0.001984L^{2.3579}$
S. pharaonis	Gulf of Thailand Upper[5]		10-24.5	-	-	1-2,7-8	1,400 (900-2,700)	-	-	M:13.7 F:14.2	-	-	-	-	Crustacean, fish	W= $0.4118ML^{2.4233}$

[1] *Chullasorn and Martosubroto, 1986.*
[2] *Chotiyaputta. 1995b.*
[3] *Chotiyapunta, 1977; 1978.*
[4] *Chotiyapunta, 1977.*
[5] *Chotiyapunta, 1980; 1982; Nabthitabhata, 1997.*

3. THREATS & CURRENT STATUS

3.1 Status of fishery in terms of CPUEs

A commonly used indicator of changes in abundance of fisheries resources is catch rate, or the quantity of catch per unit of fishing effort (CPUE). From 1966 to 1996, the Marine Fisheries Division, using Research Vessels *Pramong 2* and *9*, conducted monthly surveys of demersal fisheries resources in the Gulf of Thailand. Prior to 1966, a catch rate of 297.80kg/hr was reported in 1961. In 1966, the sampling protocol survey of demersal resources was initiated. The fixed stations in the Gulf of Thailand were designed by separating the area into grids, leading to the establishment of more than 700 grid stations. From survey data collected in 1966, catch rate was 177.42kg/hr. Primarily, a codend mesh size of 4cm was used for the surveys, although in 1971 the codend was covered with an additional net of 2.5cm mesh, which is a mesh size commonly used by fishers. This modified method has been followed to the present day, however, the number of stations have been reduced due to budget limitations. The surveys were conducted on a bi-monthly basis. The results show that catch rate declined from 177.42 kg/hr in 1966 to 77.51kg/hr in 1976. It is noteworthy that the oil crises of 1973 and 1975 resulted in some trawl fishers suspending their fishing activities. During this period, catch rates fluctuated from 60 to 80kg/hr (Figure 13).

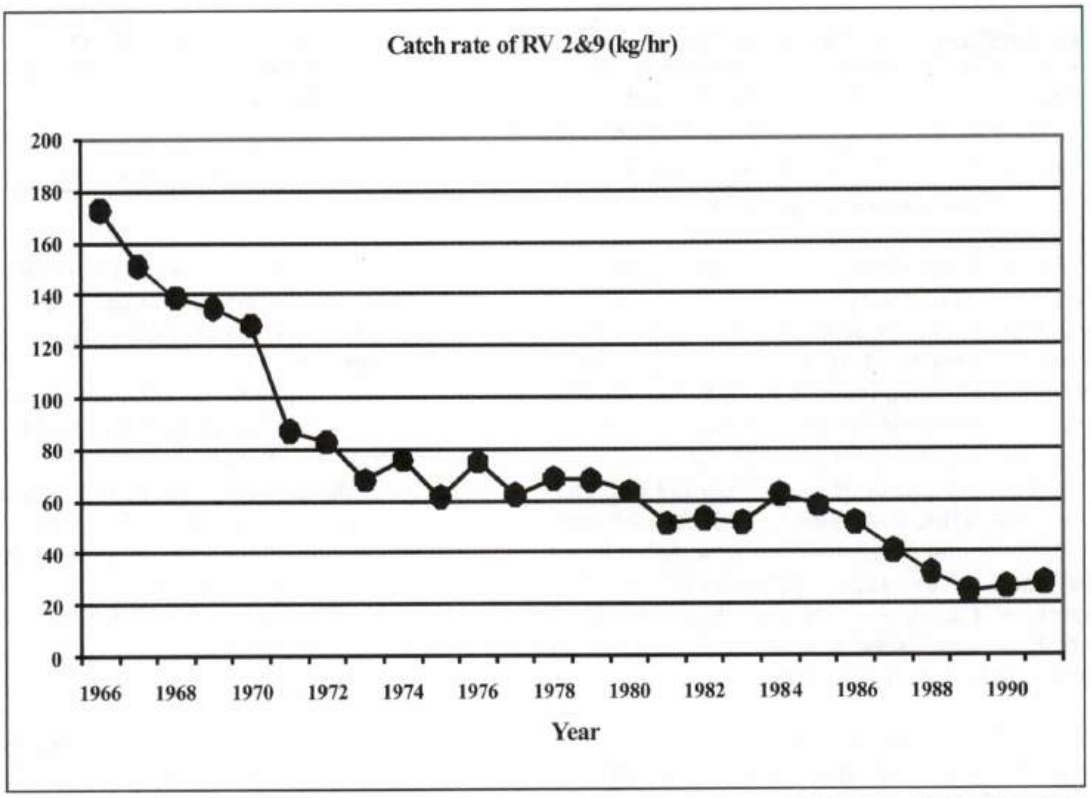

Figure 13 The catch rate (CPUE) for demersal resources caught in the Gulf of Thailand from 1966 to 1991 during surveys conducted from Research Vessels *Pramong 2* and *9* (National Seminar, 1999).

As mentioned above, catch rates have continuously declined since the introduction of trawl fishing in Thai waters. The catch rate of 177.42kg/hr observed in 1966 fell to 17.9kg/hr in 1998 (National Seminar 1999). It is likely that catch rate may fall to near zero if there is no proper management. In recognition of this situation, DOF has introduced many management measures aimed at regulating and controlling the exploitation of fish resources. However, significant difficulties have been experienced in taking action to enforce regulations due to concerns regarding potential socioeconomic impacts and political intervention.

3.2 Status of fish stocks based on historical review of landings and CPUEs

Marine catches in recent years have been dominated by pelagic species, including mackerel, round scads, anchovies, sardines, and neritic tunas, as well as some demersal fish species such as threadfin bream, lizard fish, and big-eye, and invertebrates, including shrimp, squid, and swimming crabs (DOF 1996).

The present level of exploitation of demersal fisheries resources in the shallow (less than 50m) coastal waters of the Gulf of Thailand is higher than the estimated Maximum Sustainable Yield (MSY) for this area. It is clear that this overfishing is a result of intensive trawl fishing in the area. The current situation is clearly reflected in the index of abundance or CPUE, which has declined significantly during the past 3 decades. At the same time, the amount of low value fish in demersal catches has increased significantly. On the other hand, catches of a number of other species, particularly demersal resources, have declined. Catches of both pelagic and demersal stocks have long surpassed their estimated MSYs. In 2000, catches were nearly twice the estimated MSY levels (Table 21). Actual catch may be, for many reasons, higher than that reported.

Table 21 Maximum Sustainable Yields and actual catches in Thai waters during 2000.

Fish Category	Maximum Sustainable Yields[1/]	Actual Catches (2000)[2/]
Pelagic fishes	624,318 metric tonnes	642,472 metric tonnes
Demersal fishes	970,905 metric tonnes	939,282 metric tonnes
Total Gulf.	1,595,223 metric tonnes	1,581,754 metric tonnes

Source: [1/]Kongprom et al in press and [2/]DOF 2003a.

A review of the status of small pelagic fisheries resources in the Gulf of Thailand highlights that the development of pelagic fisheries has occurred since 1973. It shows a marked (almost 4 fold) increase in pelagic fish production from 141,608 metric tonnes in 1973 to 614,814 metric tonnes in 1994. However, almost all species of pelagic fish are fully exploited, whilst some species, including the round scads, have been depleted. This situation has mainly arisen due to the efficacy of new fishing methods, involving the use of artificial light and FADs to attract fish during both the night and day. Large scale purse seine operations have been modernised and most boats are equipped with colour echo-sounder or sonar for fish school detection; power saving devices (e.g. purse line winch, power block) that enable vessels to reduce man power; radar; wireless communication equipment; satellite navigation; and refrigeration. Purse seine boats may now travel further and stay at sea longer. These may lead to the rapid depletion of resources. Nevertheless, the Gulf of Thailand's pelagic fish resource is comprised of a multitude of species. This enables fishers to redirect fishing effort from heavily to less fished species. Therefore, the problem of resource depletion for pelagic resources is not as serious as it should be.

Of the 17 species/groups of species of pelagic fish that appear in national fisheries statistics, 6 species/groups of species of small pelagic fish are considered important, and various aspects of their populations have been studied. The results of these studies will now be briefly summarised.

Indo-Pacific mackerel (*Rastrelliger brachysoma/neglectus*)

The Indo-Pacific mackerel is one of the most economically important pelagic fish in the Gulf of Thailand. The main fishing grounds for this species are located in coastal waters, especially between Chonburi to Surattani provinces. This area provides approximately 80% of the total catch taken from the Gulf.

The annual catch of Indo-Pacific mackerel in the Gulf of Thailand ranged from 26,129 metric tonnes in 1971 to 99,638 metric tonnes in 1994. A stock assessment conducted for this species indicated that its MSY in the Gulf is about 104,000 metric tonnes, equivalent to approximately 146,600 days of Thai purse seine fishing effort (Tantisawetrat, 1994). It indicated that Indo-Pacific mackerel has been fully exploited in the Gulf of Thailand since 1984. An increase in fishing effort beyond the maximum level of 146,600 fishing days is inadvisable, especially in light of the potential for effort creep.

Indian mackerel (*Rastrelliger kanagurta*)
The fisheries for Indian mackerel have been significant since 1973, mostly due to the development and expansion of luring purse seine fisheries in offshore areas. Since then, substantial quantities of Indian mackerel have been caught, with catches increasing from 12,690 metric tonnes in 1973 to a peak of 50,574 metric tonnes in 1983. After that, catch has followed a fluctuating and slightly decreasing trend. Tantisawetrat (1996) estimated MSY for the Indian mackerel using data relating to catches made from 1984 to 1993 in waters adjacent to the western coast of the Gulf of Thailand (areas II, III and VI). MSYs estimated from the use of virtual population analysis and the surplus production model, were 32,866 and 32,533 metric tonnes, respectively. The analysis indicated an optimum fishing effort level of 112,500 days of luring purse seine fishing. No definite sign of overfishing has been observed for this species yet. However, it is suggested that an increase in luring purse seine mesh size from 2.5 cm to 3 cm would increase yield per recruit by approximately 20%.

Sardines (*Sardinella* spp.)
Sardines are mainly caught by purse seines, particularly luring purse seine in both coastal and offshore areas. The development of large-scale fishing for sardines has followed a trend similar to that for Indian mackerel. Fishing effort levels increased significantly after 1973, resulting in a peak landing of 203,364 metric tonnes in 1977. After that, catches declined gradually to 68,447 metric tonnes in 1985, which then slowly recovered to a range from 110,000 to 140,000 metric tonnes per annum. From 1983, the number of purse seines increased, although the production of sardines did not increase accordingly. The estimated MSY for sardines in the Gulf of Thailand is 104,000 metric tonnes, with an optimum fishing effort level of approximately 190,000 days of luring purse seine fishing. It is clear that fishing effort levels for sardine have exceeded the optimum since 1988. Hence, sardine stocks have shown signs of overfishing. It is recommended that fishing effort levels be reduced by 14% in order to prevent further stock depletion.

Round scads (*Decapterus* spp.)
It is well known that the development of purse seine fisheries in Thailand depended significantly on the discovery of new fishing grounds for round scads in the middle of the Gulf of Thailand in 1973. This resulted in the abrupt increase in the catch of these species from 660 metric tonnes in 1972 to 12,690 metric tonnes in 1973, which then increased steadily to reach a maximum catch of 129,800 metric tonnes in 1977. Catches then declined gradually and have fluctuated between 20,000 and 40,000 metric tonnes for the past 15 years. Although the number of luring purse seines increased from 505 units in 1977 to 730 units in 1981 and 1982, catches were extremely low during this latter period when compared to the high catches observed in 1977 and 1978.

Anchovies (*Stolephorus* spp.)
Anchovies are very small pelagic fish that are widely distributed in inshore waters. In the Gulf of Thailand, 12 species are observed in catches, although the most dominant is *Stolephorus heterolobus* (or *Encrasicholina heteroloba*). This species constitutes about 87% of the total anchovy catch. The main fishing gears used in anchovy fisheries include the small-meshed purse seine (or anchovy purse seine), push net, bamboo stake trap, and luring lift net or luring falling net. However, the most important fishing gear is the anchovy purse seine, which is utilised both during the day and night time.

The catch of anchovies increased markedly after 1981, mostly in response to the use of artificial light to attract schools of fish at night and a redirection of fishing effort to offshore waters. These factors contributed to increases in catch levels from approximately 15,000 metric tonnes to 103,101 metric tonnes in 1985. Catches of anchovies have been maintained at a level from 110,000 to 120,000 metric tonnes for the past 5 years. The estimated MSY for anchovies in the Gulf is 104,000 metric tonnes. This means that anchovy resources have been heavily exploited since 1985 and that any increases in fishing effort should be carefully considered.

Bigeye scad (*Selar crumenophthalmus*)
Bigeye scad is a member of the Carangidae family. Previously, fishery statistics for bigeye scad were compiled at the species combined level due to mixed catches and the difficulties associated with species identification at-sea. After the development of luring purse seine fisheries and the redirection of fishing effort to offshore waters, bigeye scad have been caught in large quantities. Since 1980, statistics for bigeye scad have been compiled at the species level and some research into the species has been conducted. The catch of bigeye scad from 1980 to 1993 ranged between 15,000 and 26,000 metric tonnes. However, catches increased significantly in 1994, peaking at 37,080 metric tonnes. Assessment of the status of this species indicates that it is fully exploited in the Gulf, with an

estimated MSY of 18,500 metric tonnes and optimal fishing effort level of 125,000 days of luring purse seine fishing (Isara, 1993).

Neritic tunas (*Thunnus tonggol*, *Euthynnus affinis* and *Auxis thazard*)
Prior to the 1980's, neritic tuna catches in the Gulf of Thailand were relatively low, ranging from 3,298 to 19,929 metric tonnes. However, fisheries for these species developed rapidly after 1982, mostly in response to strong demand for tuna for canning. Expansion has also been driven by improvement in fishing gear and methods, including purse seine technology, new larger fishing boats, and use of refrigeration. Accordingly, catches increased from 39,368 metric tonnes in 1982 to 157,163 metric tonnes in 1992, which also depended on promoting fisheries outside Thai waters through joint ventures or fisheries agreements with neighbouring countries, and the exploration of new fishing grounds. The MSY for neritic tuna has been estimated at 86,000 metric tonnes (Chuenpun, 1996).

Demersal fish
Attempts have been made to assess the state of demersal fish and trawl fisheries in the Gulf of Thailand. Gulland (1972) estimated the total potential of the waters along the coast of Thailand as 500,000 metric tonnes. Boonyubol and Pramokchutima (1982) estimated the potential yield at 750,000 metric tonnes per year at 8.6 million hours of fishing effort. Boonwanich (1993) estimated a maximum sustainable yield of demersal resources at 893,000 metric tonnes, with optimal fishing effort levels of 22 million hours. However, total catch and effort in 1989 was 843,300 metric tonnes and 34 million hours, respectively. The results of these studies indicate that demersal fisheries resources have been overexploited.

Shrimps
The potential yields and optimal fishing effort levels (otter board trawl boat <18 m) for economically important and miscellaneous penaeid shrimp from 1971 to 1990 were estimated to be 22,000 metric tonnes at 25 X 10^6 hrs and 110,000 metric tonnes at 44 X 10^6 hrs, respectively. The overexploitation of shrimps has taken place since 1981 (Vibhasiri, 1993).

Cephalopods
In the Gulf of Thailand, squid production increased from 21,000 metric tonnes in 1971 to 72,000 metric tonnes in 1983. This increased production relied on the use of artificial light to attract squid for capture, as well as a highly developed fishing practice known as "light luring squid fishing". At present, 4 types of net are used to catch squid, including cast nets, stick-held dip nets, stick-held cast nets, and stick-held box nets, among which the stick-held cast net is the most popular (Supongpan *et al.*, 1992). From 1984 to 1991, production ranged between 57,000 and 68,000 metric tonnes (Supongpan, 1993). It was estimated that *Loligo duvauceli* has been fully exploited since 1984 (Supongpan, 1988; FAO, 1993) and *Loligo chinensis* was overexploited around 20% of the present catch of the year 1984 (Supongpan, 1988).

The production of cuttlefish from the Gulf of Thailand from 1971 to 1991, ranged from 12,000 to 50,000 metric tonnes. The highest recorded production was 50,077 metric tonnes in 1991. Cuttlefish are thought to be overexploited (Supongpan 1995). According to statistics, cuttlefish production increased annually from 1985 to 1991. This was mainly a result of the development and expansion of squid traps, which catch bigfin reef squid and cuttlefish. The statistical records for cuttlefish include bigfin reef squid due to the similarity in appearance between it and cuttlefish.

Octopus production from the Gulf of Thailand ranged between 500 and 16,000 metric tonnes from 1971 to 1991. The highest recorded production was 15,828 metric tonnes in 1991. Octopus is thought to be overexploited (Supongpan, 1993). The statistical records show increases in production from 1985 to 1990. This was mostly due to improved utilisation and processing of octopus, which resulted in fishers sorting octopus from catches of trash fish.

3.3 Threats

3.3.1 **Current** (e.g., destructive fishing practices, overfishing)

The rapid development of both pelagic and demersal fisheries has resulted in reduced abundances of fisheries resources. Many of the coastal and inshore fisheries resources are fully utilised, and some groups, especially demersal species, have been depleted due to intense exploitation and the use of destructive fishing gears and methods, including trawls, push nets, shortnecked clam dredges,

dynamite blasting, and chemical poisoning. These fishing methods have direct and indirect implications for living resources and their habitats.

The use of destructive fishing gears and illegal fishing methods are problems that require law enforcement. As the use of various types of fishing gear has increased, conflicts have arisen between commercial and small-scale fishers, and even among small-scale fishers themselves. These conflicts have revolved around competition for scarce resources in inshore and coastal waters. Trawls and mechanised push nets often damage small-scale fishing gears, such as gill nets and traps. Such occurrences exacerbate conflict situations.

Thailand's marine capture fisheries face many problems associated with law enforcement in the EEZs of neighboring countries. Many of these areas were fishing grounds for Thai fishers prior to the adoption of the EEZ regime, which has resulted in a reorientation/realignment of their traditional fishing grounds and decreases in available fishing areas and resources.

The impacts of human and economic activities on the coastal zone are visible in the form of resource degradation or depletion either by direct exploitation or indirectly through pollution. Mangroves, which serve as nurseries for marine juveniles and protect shorelines, have been reduced to less than half of their area in 1961. This has mainly been due to their use for charcoal making, and destruction for road and port construction, human settlements, agriculture, fishing gear, and aquaculture. Coral reefs and seagrass beds have also been extensively damaged in many areas by fishing activities, however, inadequate data makes estimation of exact losses difficult. Beaches have also been degraded by development activities, notably tourism. The expansion of industrial, urban, tourism, agriculture, and aquaculture activities in coastal areas have all contributed to intensified resource use and pollution.

The agents of coastal resource degradation are not confined to coastal areas themselves. The rapid industrial, urban, and agricultural growth experienced during the economic boom of the last decade, has resulted in increased pollution loads entering the sea via river runoff. Deforestation in upper watersheds has increased sediment loads in river discharge, causing sedimentation and the clogging of harbours and estuaries, requiring frequent dredging. Some 70% of pollution in the Gulf of Thailand is attributed to land-based activities (OEPP 1995). Pollution was implicated as one of the main factors responsible for the shrimp production crash in the upper Gulf of Thailand area during 1989 and 1990 (Briggs 1994). Nutrient-rich agricultural and domestic waste may also play a major role in the frequent algal blooms (red tide) and fish mortalities observed along the eastern and southern Gulf coasts.

As most shrimp farms are located on mangrove sites, the highest rates of mangrove destruction occurred from 1979 to 1986. During this period, many mangrove areas were converted to shrimp farms, with mangrove losses averaging almost 13,000ha/year (Tongchai and Jirawan 1997 cited Aksornkoae 1998), or 4.5% annually (Isvilanondas and Tokrisna 1994). As much as 93% of the mangrove destruction observed during this period has been attributed to conversion to shrimp farms (Aksornkoae, 1989).

Time series trends for a number of industry indicators have raised increasing concerns about the sustainability of the sector. These include:

- Rapidly declining catch rates (CPUE), which are now only 7% of the levels in the early 1960s;
- Fish catches from the Gulf of Thailand are well above the estimated MSYs, and catch rates (CPUE, kg/hr) have declined significantly;
- Nearly 40% of the catch from Thai waters consists of low value fish; the demand from a heavily protected local fishmeal industry is at least partly responsible for the continued exploitation of an otherwise uneconomical fishery. A significant portion of the trash fish catch consists of juveniles of important species, indicating non-compliance with mesh size regulations;
- The actual numbers of boats fishing is much higher than that registered, since many boat owners tend to avoid registration and fish illegally. Annual fluctuations in the number of registered boats are due to many factors, including termination of licences for old boats, new licences issued to ageing vessels, licences being revoked for violators, and reluctance of some boat owners to renew licences;
- An unknown quantity of fish caught illegally by commercial operators in coastal waters reserved for small-scale fisheries, generating conflict within coastal fishing communities; and

- The degradation of coastal and marine environments associated with the development of infrastructure, urbanisation, industry, land-based agriculture, and aquaculture.

Declines in marine fisheries resources can be attributed to a number of factors. These include: excessively high fishing effort levels; use of destructive fishing gear (e.g., trawl, push nets) and methods (e.g., large scale trawling in near shore areas, use of push nets near coral reefs); violation of regulations (e.g., fishing in fish spawning grounds during periods of temporary fishing bans); destruction of fish habitats, such as mangroves, seagrass meadows, and coral reefs; and inappropriate or uncoordinated policies (e.g., the protection of the fishmeal industry has a direct impact on fisheries, since it has encouraged capture of small trash fish, often leading to high catches of juveniles of other important species).

3.3.2 Potential (project market demand, increased coastal population)

Fish and fish products are particularly important to Thai people as a primary source of animal protein. With a wide range of species and products available to choose from, and rising purchasing power of consumers, demand for fish products has grown in recent years.

The domestic demand for fish is predicted to increase at an average of 1 to 2% per annum. International demand for fish products is expected to increase with a wide range of products available. However, growth in international demand substantially relies on product quality and safety.

Recently, market demand for live marine resources has increased significantly, especially in coastal areas frequented by tourists. Consumer preferences are also shifting to smaller sizes of specially prepared fish, shrimps, crabs, and squids. Accordingly, fishers have begun to supply these smaller fish to markets as much as possible, with little attention paid to the potential impacts of such actions on fish populations and their environments.

4. HABITATS & AREAS OF IMPORTANCE IN THE MAINTENANCE OF EXPLOITED FISH STOCKS

4.1 The physical, chemical, and biological characteristics of the Gulf of Thailand

The Gulf of Thailand may be characterised as a classical two-layered, shallow water estuary. Low salinity water, diluted by heavy precipitation and fresh water runoff, flows out of the Gulf at the surface. There is inflow of high salinity, relatively cool water from the South China Sea into the Gulf. This high salinity water fills the deep, central depression below a depth of approximately 50m. Superimposed on this 2-layered system is a complex circulation system, which is established by wind-driven currents related to monsoon winds and tidal currents. Neither the northeast nor the southwest monsoon winds are observed to have a constant direction or velocity over the Gulf as a whole. The interplay of variable winds, tidal currents, fresh water runoff, and excessive precipitation gives rise to localised areas of divergence where low temperature, high salinity water, usually of low oxygen content, is upwelled. These forces also establish areas of convergence where high temperature, low salinity, and highly oxygenated water sinks. All of these characteristics make the Gulf of Thailand one of the most productive areas in Southeast Asia.

Takahashi *et al.* (1985) observed that regions of relatively steep horizontal gradients in surface water properties, such as salinity, nutrient salts, and phytoplankton, were located in the vicinity of Samui Island, where oceanic fronts form due to the convergence of water masses from coastal areas and the central Gulf that originate from the South China Sea. This indicates that water areas adjacent to Samui Island are potentially good for fishing.

The combined effects of topographical features, tidal regimes, monsoonal water circulation, freshwater runoff, coastal upwelling, and offshore water intrusions govern the oceanography of the Gulf of Thailand. The annual surface water temperature varies very little. Gulf waters are well mixed before the NE monsoon, after which a thermocline becomes more distinct.

From fish egg and larval surveys, it is apparent that pelagic and demersal fish spawn during both the NE and SW monsoon, with a peak in spawning after the NE monsoon. More species probably spawn in the area during the SW monsoon season (SEAFDEC, 1999).

There are 12 species or groups of species with known spawning and fishing grounds. Marine environmental conditions are also known. These include: bathymetry and coastal geomorphology; water circulation and tide; meteorological parameters, i.e., wind, monsoon season, air temperature, humidity, and air pressure; seawater parameters, i.e., salinity, temperature, pH, dissolved oxygen (DO), nutrients, total suspended solids, and turbidity; phytoplankton and zooplankton; primary production, benthos, and bottom sediment characteristics.

4.1.1 Known spawning grounds

Describing the spawning and fishing grounds of 12 species/species groups is complicated. Here, the characteristics reviewed are similar to the environmental characteristics of the spawning grounds. The spawning grounds of some marine fauna in the Gulf of Thailand have been surveyed intensively. The results of the surveys, conducted since 1963, indicate that the larvae of *Rastrelliger* spp. concentrate in an area 10 to 40 nautical miles off the western coast of the Gulf of Thailand (Figure 14) (Boonprakob 1965; Matsui, 1970). Phytoplankton and zoophankton were abundant in this area during the spawning season (Suvapepun and suwanrampha, 1970).

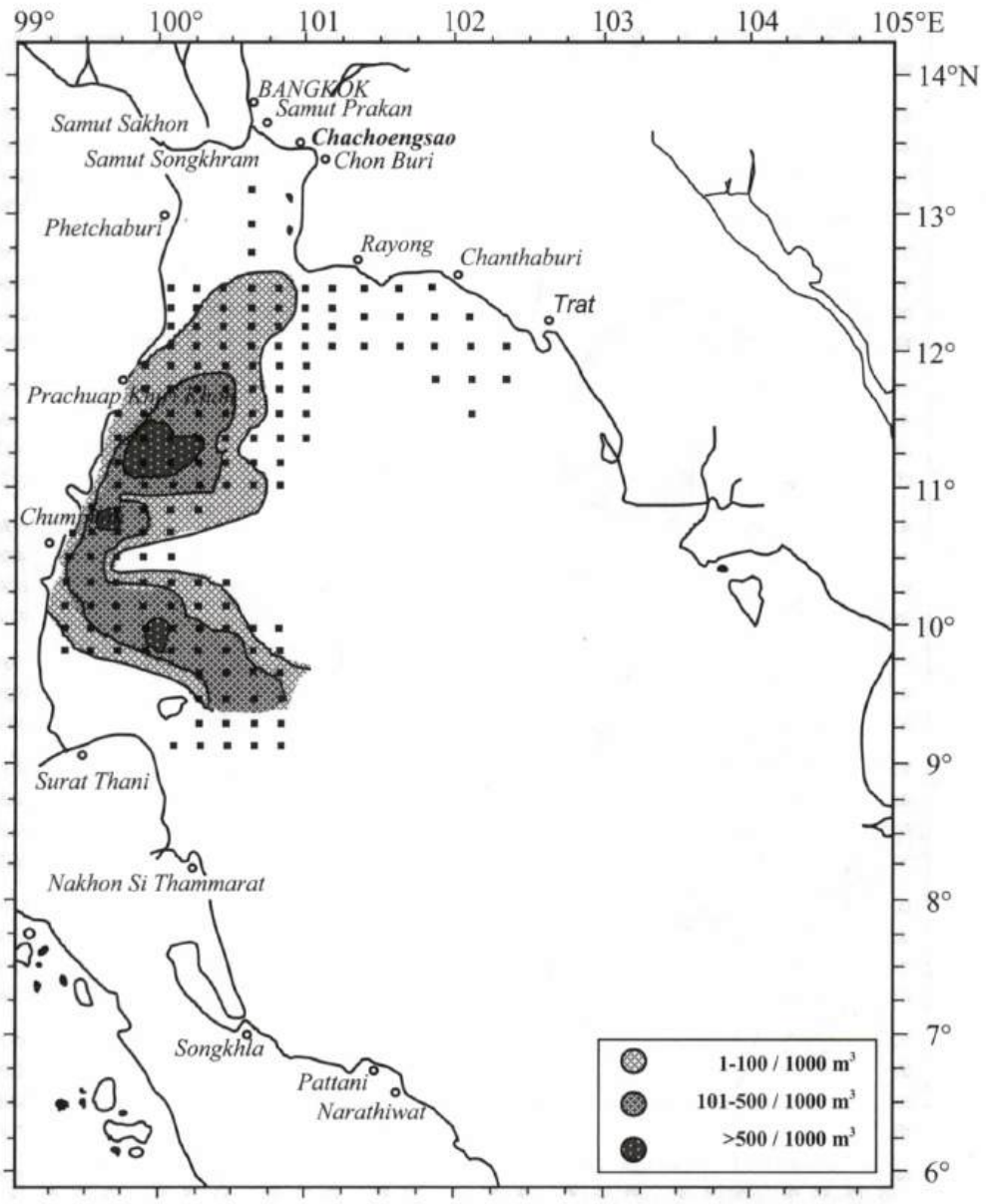

Figure 14 The abundances of Indo-Pacific mackerel larvae (*R. neglectus*) observed at various surveys stations in the Gulf of Thailand (Boonprakob, 1965).

The spawning grounds and season for *Decapterus maruadsi* and *D. macrosoma* in the Gulf of Thailand was determined from observations of seasonal changes in the stage of gonad development. Spawning was believed to occur from February to August, with peaks from February to March and from July to August in the deeper area of the Gulf (Figure 15) (Chullasorn and Yusukswad 1978). Spawning grounds of neritic tuna are located along the Gulf's western coast, with concentrations in the middle of the Gulf (Figure 16). The spawning grounds for anchovy are depicted in Figure 17.

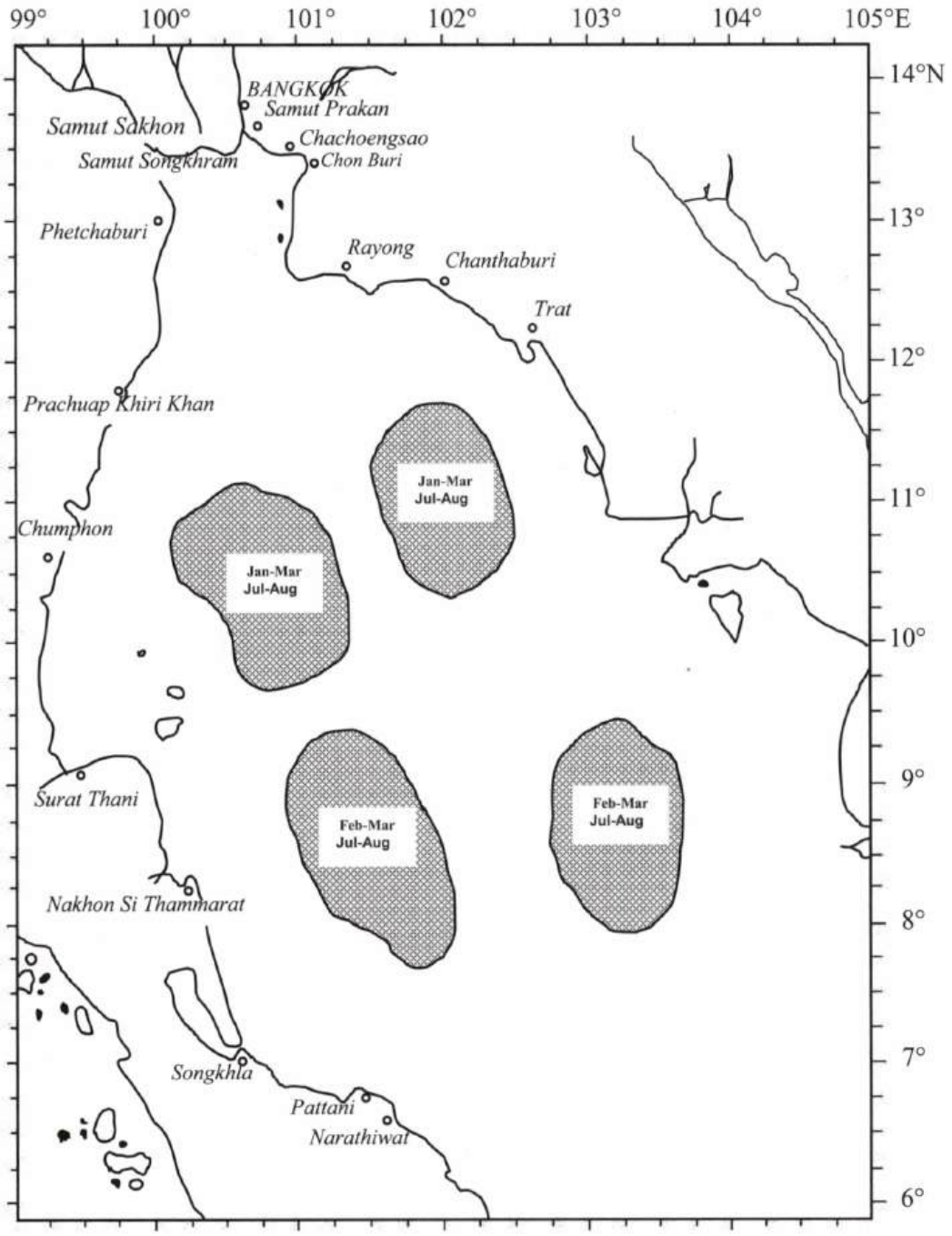

Figure 15 The spawning grounds of round scads (*Decapterus* spp.) in the Gulf of Thailand (Chullasorn and Yusuksawad, 1978).

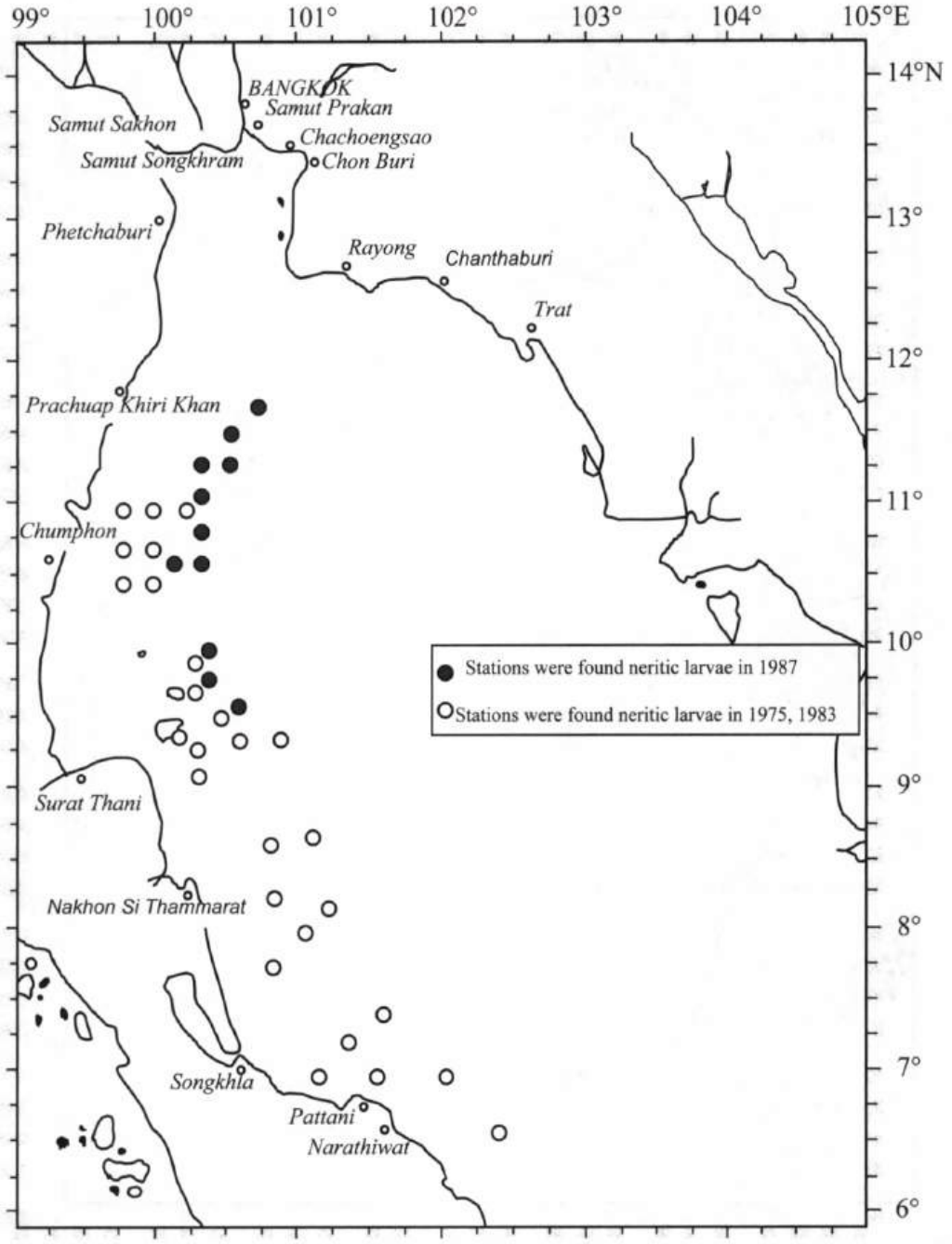

Figure 16 The stations where the eggs and larvae of neritic tunas have been observed to be abundant during surveys conducted in the Gulf of Thailand (Chamchang and Chayakul, 1990).

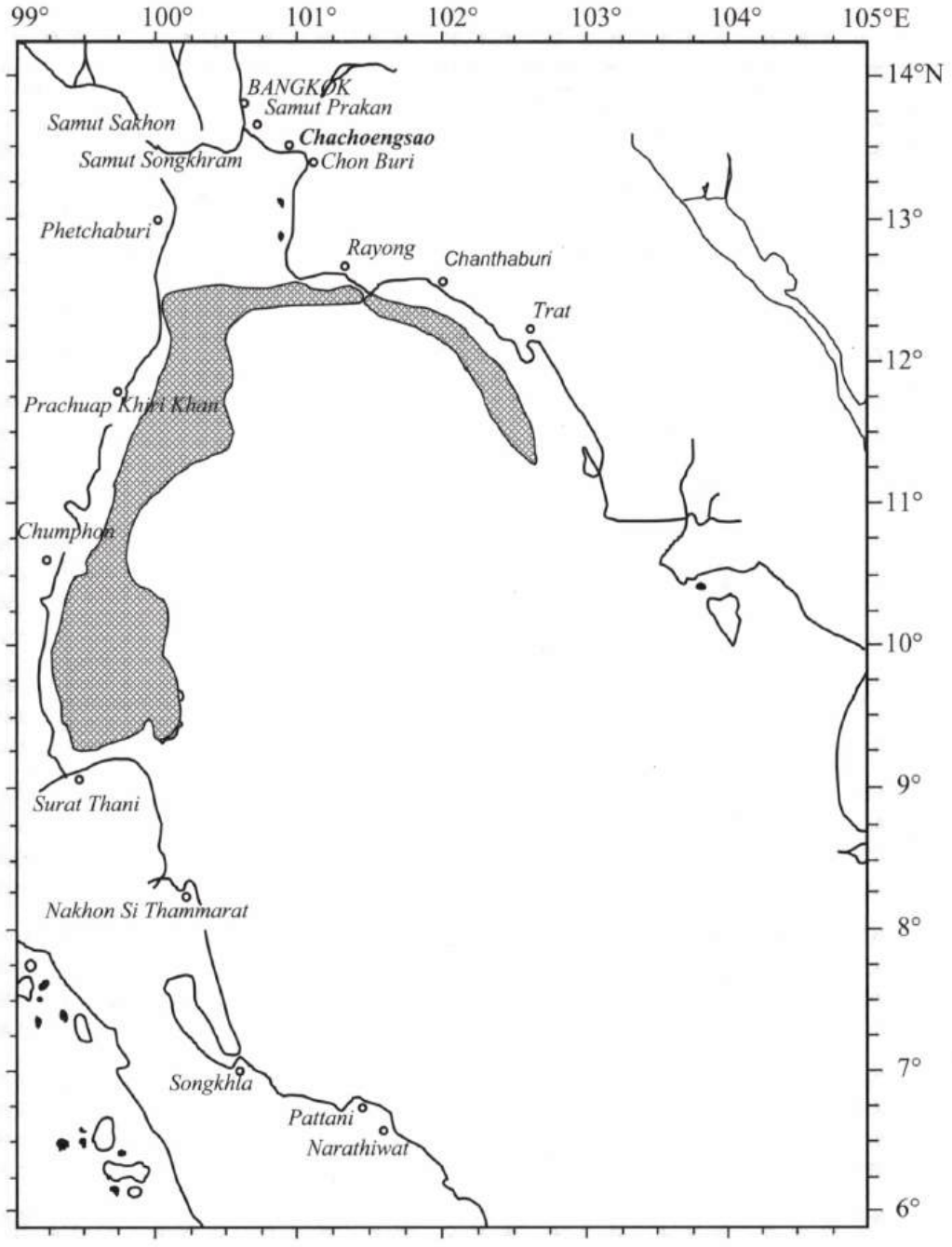

Figure 17 The spawning grounds for anchovy in the Gulf of Thailand (Vatanachai, 1978; Chansakul, 1988; Chayakul, 1990 cited in Saikliang, 1995b).

4.1.2 Known nursery areas

Many studies have shown that the distribution and abundance of pelagic and demersal fish larval are related to plankton densities. Plankton production rates are higher in near shore areas and decrease vertically with depth.

The nursery areas of important marine fauna in the Gulf of Thailand are mostly located in inshore areas, including mangrove areas, seagrass meadows, and coral reefs. The feeding grounds of most fished species are generally the same as the areas in which they are fished.

4.1.3 Known fishing grounds

The fishing grounds for important marine fish species in the Gulf of Thailand were depicted in Figures 6 to 12 of this report.

4.1.4 Seawater quality and pollutants

Seawater Quality

Seawater quality has been studied since 1956. The data vary widely in response to spatial and seasonal fluctuations. Low DO, high biological oxygen demand (BOD), and elevated nutrient concentrations characterise coastal water areas adjacent to river mouths and human settlements (Sitthichokpan 1977; Tharnbubpa 1977; Tharnbubpa and Jusiripongkul 1984; Sanguansin *et al.*, 1999). These characteristics may be influenced by waste disposal from human, agricultural, and industrial activities into the Chao Phraya, Tha Chin, Mae Klong, and Bang Pakong Rivers. These rivers also receive organic wastes from human activities and carry them toward the sea, often resulting in poor estuarine water quality (Table 22). The Pollution Control Department (PCD) (1999) studied water quality at 218 sampling stations located 100 m and 500 m offshore during dry and rainy seasons in 1998. The study identified DO lower than 4 mg/l in some inner Gulf stations adjacent to the estuaries of the Chao Phraya, Tha Chin, and Bang Pakong Rivers, as well as the Taboon canal at Petchaburi. The nutrient enrichment of coastal waters has also caused low water quality, eutrophication, and phytoplankton blooms (Suvapepun 1984).

Table 22 Water quality parameters recorded in lower parts of the Chao Phraya, Tha Chin, Mae Klong, and Bang Pakong Rivers.

Area	DO (mg/l)	BOD (mg/l)	$NH_3 - N$ (mg/l)	Coliform bacteria (MPN/100 ml)	Reference
- Lower Chao Phraya	0.5	3.0	1.3	46,000	PCD (1998)
- Lower Tha Chin	1.0	2.1	0.7	24,000	PCD (1998)
- Lower Mae Klong	6.0	1.3	-	3,200	PCD (1998)
- Lower Bang Pakong	4.3	0.9	-	500	PCD (1998)
- Chao Phraya and Tha Chin River mouth	1.1-3.5	-	0.005-0.099	32-54,000	PCD (1999)
- Mae Klong and Bang Pakong River mouth	2.4-8.3	-	0.006-0.25	8-2,300	PCD (1999)

Source: PCD, 1998; 1999.

4.1.5 Biological parameters

Phytoplankton

Piromnim (1985) studied phytoplankton in the central Gulf of Thailand from Chumphon to Songkhla Province during the southwest monsoon in 1984. The area surveyed covered a wide range of depths (13 to 77m), grouped into the depth ranges of 17 to 48, 50 to 61, and 65 to 77m. The results indicated that the average density of phytoplankton was 96,674, 17,689, and 8,729 cells/m^3 at each of the 3 depth ranges, respectively. Of the 36 genera identified, there were 28 genera of diatoms, 7 genera of dinoflagellates, and 1 genus of green algae. *Trichodesmium thiebauti* dominated all stations and depths. The species confined to the deepest waters were *Planktonella sol, Gosslerriella tropica*, and *Biddulphia sinensis*. The density of some species varied significantly by water depth. These include *Thalassiothrix frauenfeldii, Cossinodiscus* spp., *Rhizosolenia calcaravis, Ceratium dens, C. trichoceros*, and *Thalassiosira subtilis*. Moreover, *Cerataulina compacta, C. bergonii,* and *Guinardia flaccida* were mostly coastal species. *Asterolampra marylandica, Asteromphalus* sp., *Dactyliosolen antarcticus,* and *Planktonella sol* were observed offshore.

Boonyapiwat (1999) studied phytoplankton in the Gulf of Thailand from the upper part of the Gulf to the eastern coast of Malaysian Peninsular. Seawater samples were collected from 81 stations during the pre-northeast monsoon season (4 September – 4 October 1995) and the post-northeast monsoon season (23 April – 23 May 1996). The study observed 260 taxa, composed of 2 species of blue green algae, 133 species of diatoms, and 107 species of dinoflagellates. A blue green algal species and 17 species of diatoms were dominant. The species most frequently observed were *Ocillatoria erythraea, Thalassionema flauenfeldii, Chaetoceros lorenzianus,* and *C. compressus.* Cell densities in the study area ranged from 178 to 113,336 cells/l, and were generally higher in coastal waters than those offshore.

Phytoplankton observations were carried out during joint surveys of fisheries resources and oceanography by Thai and Vietmanese researchers in the area from latitude 07°40′ to 09°30′N and longitude 101°50′ to 103°10′E in the middle of the Gulf of Thailand. 2 sampling cruises were conducted from 16 November – 18 December 1997 and 11 August – 2 September 1998. 320 taxa, composed of 2 species of blue green algae, 154 species of diatom, and 144 species of dinoflagellates were identified. 8 species of phytoplankton were dominant during the southwest monsoon. *Chaetoceros diversus* and *C. lorenzianus* dominated the surface flora, whilst *C. messanensis* and *Proboscia alata* dominated mid depths. *Coscinodiscus jonisianus* was the dominant species at the bottom. The species with highest cell densities at all sampling depths were *Oscillatoria erythraea, Thalassionema frauenfeldii,* and *T. nitzschioides.* The relative abundance of these species during the southwest monsoon was low. During the northeast monsoon, *O. erythraea* and *T. frauenfeldii* dominated. The first species occurred with highest relative abundance from surface to mid-depths, whilst the second dominated the bottom layer of all stations. The densities observed during this period were relatively high (Department of Fisheries, 1999).

Musikasung *et al.* (1998) studied primary production in the Gulf of Thailand and the eastern coast of the Malaysian Peninsular. The rates of primary production observed, ranged from 0.20 to 0.61 and 0.29 to 0.47gC/m^2/day for the Gulf of Thailand and the eastern Malaysian Peninsular waters, respectively. In nearshore areas, highest rates of primary production were observed near the surface, which declined gradually with depth. However, in offshore areas, the production rate increased in the layers where subpycnocline chlorophyll was found. Moreover, variability in daily primary production was observed to be closely related to changes in phytoplankton biomass.

Zooplankton

Jivaluk (1999) studied the distribution, abundance, and composition of zooplankton in the Gulf of Thailand from the upper Gulf to the eastern coast of the Malaysian Peninsular. Samples were collected at 81 stations from 4 September – 4 October 1995 for the pre-northeast monsoon and from 23 April – 23 May 1996 for the post-northeast monsoon. This study observed 34 groups of zooplankton. Copepods were most abundant during both periods, followed by Chaetognatha in during the pre-monsoon period and Ostracod in the post-monsoon period. Biomass and density varied from 0.069 to 20.172ml/m^3 and 36 to 3,413no/m^3 during the pre-monsoon period, and 0.18 to 2,589ml/m^3 and 91 to 1,514no/m^3 during the post-monsoon period, respectively. There was significant difference in abundance between pre and post monsoon periods, although there was no significant difference between biomass for both periods. Generally, abundance was higher at nearshore stations, especially near Pattani Bay, Samui Island, and Sattahip, than offshore stations. Moreover, fish larvae and eggs occurred near Samui Island, Pattani Bay, and nearshore stations adjacent to the lower part of the Malaysian Peninsular during pre-monsoon periods. During the post-monsoon period, fish larvae were abundant near Samui Island, whilst fish eggs were observed near Prachuab Khiri Khan Bay.

The Department of Fisheries (1999) studied zooplankton in the central Gulf of Thailand between latitude 07°40' to 09°30'N and longitude 101°50' to 103°10'E from 16 November – 18 December 1997 and 11 August – 2 September 1998. 8 phyla of zooplankton, composed of Coelenterata, Chaetognatha, Annelida, Branchiopoda, Arthropoda, Mollusca, Echinodermata, and Chordata, were collected. The most abundant phylum was Arthropoda. The average biomass and density were 0.79ml/m^3 and 4,300.39no/m^3 during the first cruise, and 0.45ml/m^3 and 751no/m^3 during the second cruise, respectively.

Fish larvae

Termvichakorn (1999) reported that 73 families and 97 species of fish larvae were found from the upper part of the Gulf to the eastern coast of the Malaysian Peninsular during the pre-northeast (4 September – 4 October 1995) and post-northeast (23 April – 23 May 1996) monsoon seasons. The most abundant fish larvae retained in horizontal surface hauls were *Stolephorus* spp., *Sardinella* spp., Gobiidae, and *Upeneus* spp. Those from the oblique hauls included Gobiidae, *Stolephorus* spp., *Bregmaceros rasisguamosus*, and *Nemipterus* spp. Moreover, larvae were more abundant in coastal waters and adjacent to islands, than deeper or offshore waters. The observed abundances of *Sardinella* spp. and *Stolephorus* spp. larvae indicate that spawning peaks in the post monsoon.

Fish larvae in the central Gulf of Thailand were surveyed by the Department of Fisheries (1999) from 16 November – 18 December 1997 and 11 August – 2 September 1998. 50 families of fish larvae were found during this study. The Gobiidae were most abundant, followed by Monacanthidae, Carangidae, Scombridae, Bothidae, and Bregmacerotidae, respectively.

Surveys conducted in the western Gulf of Thailand from Surat Thani to Narathiwat during February to August 1984 yielded 47 families of pelagic fish larvae (Chamchang 1986). Family Gobiidae was observed to dominate in terms of distribution and abundance. Family Engraulidae was the most dominant group of economically important pelagic fish larvae. Total density of fish larvae was highest during the inter-monsoon period (April). Densities declined in the month of June and August during the southwest monsoon period. Lowest densities were recorded in February during the northwest monsoon period. Most fish larvae were widely distributed throughout the study area, although were concentrated in the area from Samui Island to Songkhla province. Larvae were most concentrated along the coast of Pattani province in April. Similarly, the highest and lowest densities of fish eggs were recorded in February and June, respectively.

Pornpatimakorn and Chayakul (1986) found 24 families of fish larvae in the central Gulf of Thailand. Englaulidae were dominant and represented by several *Stolephorus* species, followed by Hemirhamphidae, Theraponidae, Clupeidae, Eisterlaridae, Mullidae, Bothidae, and Carangidae.

Benthos

Sanguansin (1986) studied the benthic macrofauna of the central Gulf of Thailand from 16 May – 9 June 1984. 102 species were found with an average biomass of 9.67g/m^2 and average density of 68no/m^2. *Callianassa* sp. was the dominant crustacean species, whilst the polychaete fauna was dominated by *Terebellides* sp. Both were very abundant. Echinoderm biomass was the highest. Fishes, molluscs, nemerteans, echiurans, sipunculids, oligochaetes, nematodes, and anthozoans were also recorded. The benthic macrofauna was concentrated in shallow areas, especially near Samui and Pha-ngan Island.

The ecology of macrobenthic fauna in the Gulf of Thailand, from the upper part of the Gulf to the eastern coast of the Malaysian Peninsular, was studied during pre-northeast monsoon (4 September – 4 October 1995) and post-northeast monsoon (23 April – 23 May 1996) periods. This study identified 6 groups of macrobenthic fauna in the study area, including polychaetes, crustaceans, molluscs, echinoderms, fishes, anthozoans, nemerteans, sipunculids, and amphioxus. The polychaetes dominated the benthic fauna. The average density of the benthic macrofauna was 88no/m^2 in the pre-northeast monsoon period, and 97no/m^2 in the post NE monsoon period. Moreover, species abundance and diversity was higher in inshore rather than offshore areas. Polychaetes, crustaceans, and echinoderms displayed marked changes in abundance by monsoon period, and the diversity index varied during the pre and post-northeast monsoon periods (Piamthipmanus 1999).

Benthic macrofauna in the central Gulf of Thailand from latitude 07°40′ to 09°30′ N and longitude 101° 50′ to 103° 10′ E was surveyed by the Department of Fisheries (1999). The survey identified 7 groups of benthic animals from 16 November – 18 December 1997 and 11 August – 2 September 1998. Polychaetes and crustaceans dominated the first and second cruises, respectively. Echinoderms, oligochaetes, nemerteans, fishes, and sipunculids were also observed. Average density and biomass was 22.5no/m^2 and 3.79g wet weight/m^2 for the first cruise, and 37.86no/m^2 and 3.47g wet weight/m^2 for the second cruise, respectively.

4.1.6 Bottom sediment

Reports of bottom sediment studies conducted by Charoenruay (1984) in the Gulf of Thailand indicate that Gulf sediments are mostly mud or silt. There are only two locations characterised by sand, namely the Sattahip coast and the Pattani Province coast. The thickness of sediments range from 5 to 75cm, with mud sediments being thicker than sandy sediments. Hard clay is usually found beneath the soft substrates.

The mud sediments of the central Gulf of Thailand can be subdivided into 3 types, according to mud content. The finest particle sediments (mud content >90%) are located adjacent to Samui Island. Medium sized particle sediments (mud content 70 to 90%) characterise the inner central Gulf, whereas the coarsest sediments (mud content <70%) are distributed on Gulf's outer sides (Takahashi *et al.*, 1985).

4.2 Unknown issues such as stocks with undefined spawning grounds

There are many unknown issues regarding fishery resources in Thai waters. Geographical distributions and spawning grounds of many economically important species/species groups are not clearly known. Similarly, it is a known fact that marine resources in tropical areas are multi-species in nature and may be composed of several different stocks for each species. Information regarding the migratory routes of pelagic and semi-pelagic resources is also lacking, except for Indo-Pacific mackerel that has formed part of an extensive tagging program for many years. Therefore, basic information relating to significant transboundary stocks is usually not available. Strengthened cooperation amongst scientists and research institutes should be pursued.

The 1985 FAO/SEAFDEC Workshop on Shared Stocks in Southeast Asia (FAO/SEAFDEC 1985) aimed to provide some guidance for improved regional utilisation and management of stocks. There are now at least 40 stocks being shared by 2 or more regional countries. A key action in identifying shared stocks is to determine the location and timing of spawning. Genetic studies are now an effective method to identify stocks, with the implementation of such activities requiring the close cooperation of the coastal States concerned.

4.3 Threats, current and potential (coastal development, pollution, oil spills)

4.3.1 Coastal development

A number of changes have occurred in Thailand's coastal areas during the past 40 years. These include the establishment of human settlements and urban expansion, infrastructure development, tourism and industry development, agriculture and tree plantations, and coastal aquaculture. Perhaps the most widely recognised impacts of these changes in land usage include the large (approximately 50%) loss of mangrove forest cover since the early 1960s, and the dereliction of land following shrimp pond failures in a number of coastal provinces.

Land rights are one of the most complicated and politically sensitive issues in Thailand. Like their inland counterparts, coastal communities often do not have adequate land rights. However, land ownership is frequently transferred through informal and illegal deals. Increased agricultural and industrial activities, as well as urbanisation further inland, have created a number of externalities in the form of hydrological changes, and the land-based pollution of coastal waters.

4.3.2 Oil spills

Numerous oil spills have occurred in both Thai river mouths and the Gulf. Oil can be discharged into the Gulf not only from routine transportation activities, but also from accidents. Although large oil spill accidents are infrequent (Table 23), they usually release a large quantity of oil each time they occur. Consequently, oil spills contribute to 12% of the total volume of oil pollution in Thai waters (Yindepit 1993).

Along the coast of Rayong Province, oil spills have occurred frequently since 1986. In fact, there are 3 to 5 oil spills annually. Most spills involve crude oil, which pollutes beaches and inshore waters. Typically, the length of beach affected ranges from 5 to 15km, and the spills are thought to have had negative impacts on capture fisheries and aquaculture in this area.

4.3.3 Pollution

Chareonpanich and Seurungreong (1999) reported that coarse material, including sand and gravel, usually settles in the nearshore zone of Peninsular Malaysia, whilst fine-grained particles, including silt and clay, are usually deposited in areas with restricted current in the central Gulf of Thailand and near Samui Island.

The coastal and marine environment of the Gulf of Thailand has been degraded by a combination of land and marine-based pollutants. Land-based pollutants are transported via major rivers to the Gulf of Thailand. They are derived from municipal, agricultural, and industrial activities in river catchments. Several land-based activities near coastal areas, including deforestation, urban development, tourism, and the human aggravation of erosion and siltation, have a high potential to pollute the Gulf either directly or indirectly. Increased marine-based activities in the Gulf of Thailand threaten to exacerbate pollution problems. These activities include dredging, shipping, and hydrocarbon exploration and production.

Major sources of land-based pollution are domestic sewage, solid waste, agricultural waste, industrial waste, and toxic and hazardous waste. Land-based sources contribute approximately 70% of marine pollution, whilst marine-based sources account for the remaining 30%. The pollutants threatening the marine environment include organic matter, nutrients, sediments, litter and plastics, metals, radionuclides, and hydrocarbons. They are prioritised differently from country to county. Many of them are of particular concern, as they may be biomagnified in aquatic food chains (Jala and Aziz, 1986).

Table 23 Large oil spill accidents in the Gulf of Thailand during the last 25 years.

Date	Oil type	Volume (tonnes)	Location	Cause
1973	J.P. 4	Unknown	Sriracha Chonburi Province	Fire tanker
1979	Crude oil	300	Srichung Island Chonburi Province	Fire tanker
6 Mar.1994	Diesel	400	Srichang Island	Collision of tanker And container
30 Oct.1996	Crude oil	160	Oil loading station, Rayong Province	Leaking during Loading

4.3.4 Plankton blooms

The most conspicuous and widespread effect of pollution on the marine environment of the Gulf is perhaps eutrophication associated with nutrient enrichment, especially compounds of N and P, leading to accelerated growth of plankton, algae, and higher forms of plant life (Brodie 1996). Nutrient enrichment is a key contributor to large phytoplankton blooms, which can harm and even kill other marine organisms and humans.

Algal blooms have been studied in Thailand since the 1950s (Charoenpol 1957). This early work included the development of a map illustrating the distribution of phytoplankton blooms and their causes. *Noctiluca* sp. and *Trichodesmium* sp. were identified as species that often bloomed in the Gulf of Thailand. In the past, such blooms were considered a natural phenomena and harmless to the marine environment. However, the frequency of blooms has increased significantly. During the last 3 decades, algal blooms have occurred between January and August. During the rainy season, algal blooms have often occurred at the river mouth areas of the Chao Phraya, Tha Chin, Mae Klong, and Bang Pakong Rivers (Tamiyavanich 1984). The most common blooming species are the blue green algae *Trichodesmium erythraem* and *Noctiluca scintillans* (Suvapepun 1989). Furthermore, *Coscinodiscus* sp., *Rhizosolenia* sp., *Hemidiscus* sp., *Chaetoceros* sp., *Bacteriastrum* sp., *Ceratium* sp., and *Nitzschia* sp. bloom occasionally. The major cause of algal blooms may be excessive nutrient and organic pollution from major rivers.

From 1981 to 1987, there were 43 large phytoplankton blooms, mostly involving *Trichodesmium erythraeum* (21 blooms), *Noctiluca scintillens* (17 blooms), and Diatom (5 blooms). A bloom caused by *Trichodesmium erythraeum* was observed in eastern and central parts of the Gulf of Thailand from May to June 1983. It covered an area of 7,000km^2, causing anoxic conditions that subsequently led to massive mortalities of demersal fishes, shellfish, crabs, and benthos, and crippled many aquaculture activities. The estimated economic losses associated this bloom are in excess of US$1.16 million (Suvapepun 1984). From 1991 to 1998, the 2 species of phytoplankton highlighted above caused 13 blooms along the eastern coast of the Gulf (Chonburi, Rayong, and Chantaburi provinces). *Noctiluca* sp. has bloomed in coastal waters from Ang Sila to Sri Racha, Chonburi province, every year during July and August, causing mass mortalities of fish and damage to aquaculture operations. Normally, algal blooms caused by common species, i.e., *Trichodesnium* sp. and *Noctiluca* sp., have no direct effects on fish. Bloom-related fish mortalities are mostly driven by sudden reductions in dissolved oxygen and high ammonia concentrations. A bloom of *Ceratium furca* was observed at the Chao Phraya River mouth during early January 2000. Figure 18 highlights areas in which phytoplankton blooms occurred in the Gulf of Thailand from 1982 to 2000.

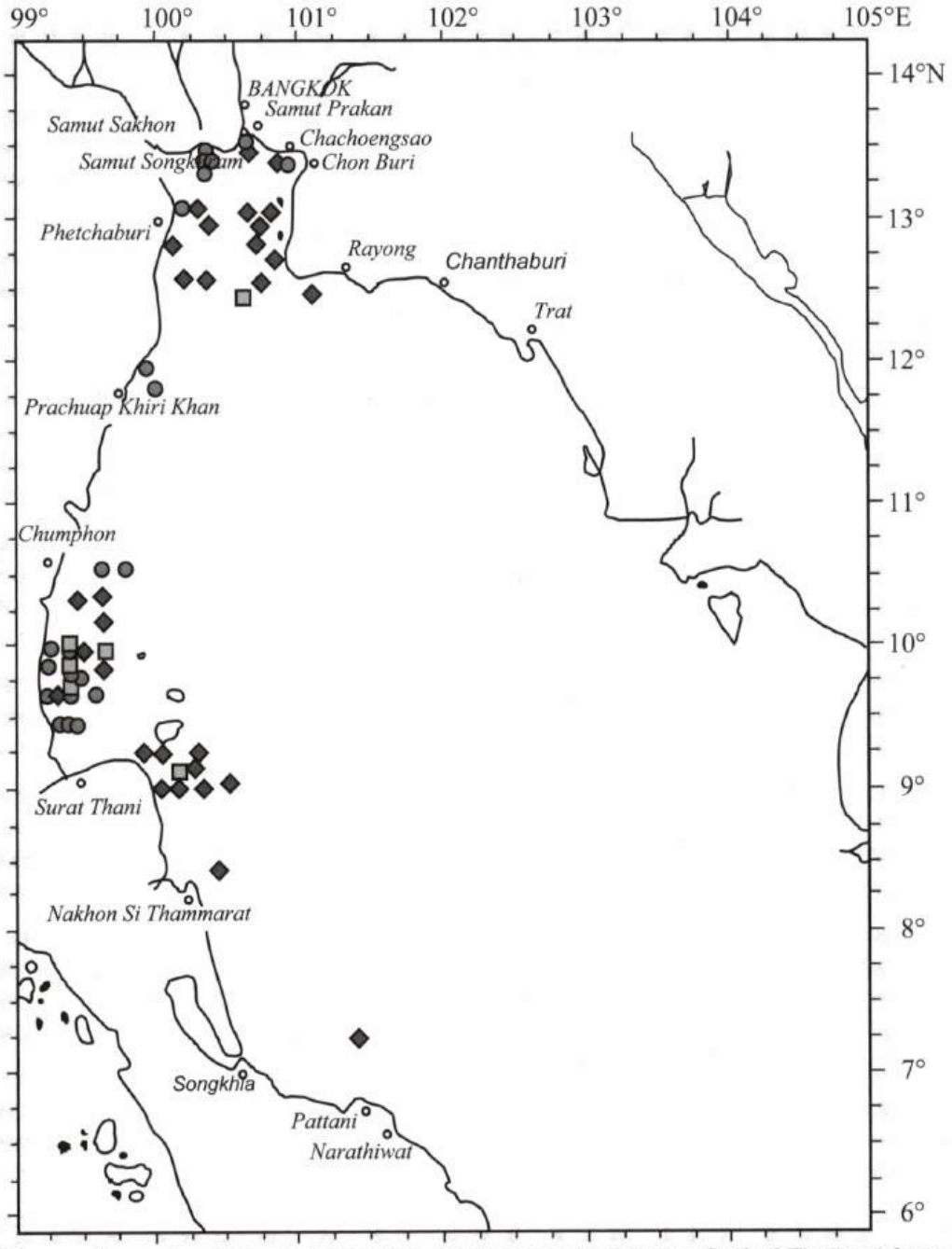

Figure 18 Areas in which phytoplankton blooms occurred in the Gulf of Thailand from 1982 to 2000 (after Suvapepun 1997).

Studies conducted since 1981 indicate that no phytoplankton bloom has involved a toxic species. In May 1983, paralytic shellfish poisoning (PSP) was recorded in green mussels at Pranburi Estuary, Prachaub Kiri Khan. Despite the problem occurring at the same time as a phytoplankton bloom, its cause was unclear. At the time, phytoplankton was dense and comprised of various species. In particular, the water was rich in blue green algae, and the diatom community was dominated by *Chaetoceros* spp., *Skeletonema costatum*, *Thalassiosira* spp., and *Cyclotella* sp. Densities of dinoflagellates were also above normal. The most abundant species was *Protoperilinium qinguecorne*, and *Prorocentrum micans*, *Peridinium* spp., and *Dinophysis* spp. were abundant. *Alexandrium* sp. was present, albeit in very low densities (Suvapepun *et al.* 1984). Following the bloom, human consumption of toxic green mussels (PSP) led to the loss of 1 human life and another 62 seriously ill patients. This event led to many studies on phytotoxicology. Subsequently, the toxic phytoplankton, *Alexandrium cohoticula,* was found in the Gulf of Thailand. These algae are rare and in very low concentrations, and have most likely never caused a bloom. In conclusion, the effects of phytoplankton blooms in the Gulf of Thailand have related to visual amenity, and the health of aquatic organisms and perhaps humans.

4.4 Ranking of habitats

Among coastal ecosystems, mangroves, seagrass beds, and coral reefs are the most important habitats. Physically, they play an important role in land protection by trapping sediments and reducing erosion from various physical forces. Ecologically, they are characterised by high primary productivity, which may enhance coastal production and fishery yields. Their environmental characteristics are suitable for extensive assemblages of a vast variety of aquatic organisms, ranging from autotrophs to heterotrophs, from tiny invertebrates to mammals, from juveniles to adults, from sedentary inhabitants to highly migratory ones, or from dependent residents to transitory ones. More specifically, these habitats have frequently been referred to as important nursery areas. In a socioeconomic sense, these habitats provide significant economic benefits to local fishers and fish product traders. However, seagrass beds are damaged directly by intense fishing with destructive fishing gears, *i.e.*, beach seines, mechanised push nets, and trawlers, and indirectly from sediment loads derived from tin mining and land development. The marine fauna that are officially listed as being found in any of these habitats are shown in Appendix 3.

Coral reefs are economically important because they provide sanctuary and feeding grounds for higher order fish, which form the basis of small-scale fisheries. Similarly, they play a vital role in supporting ecological balance. Furthermore, they are important in attracting tourists to the country. In the Gulf of Thailand, Mu Koh Chang in Trat province, Ang Thong Archipelago, and Koh Tao in Chumphon province have been declared as National Marine Parks.

4.4.1 Association with species of importance to food security

Fish is an important component of the diet of Thai people. Thailand is one of the top fish-producing nations in the world. Geographical advantage is a factor attributed to the relatively high annual fish production. Thailand has a total land area of about 540,000km^2 and a coastline of 2,614km. Marine fishing grounds that fall within Thailand's EEZ are located partly in the Gulf of Thailand and the Andaman Sea, with a total area of about 350,000km^2. The area of inland waters is approximately 3,750km^2. Furthermore, over 1 million hectares of the Kingdom's coastal areas have coastal aquaculture potential.

In 2000, the gross domestic production (GDP) of the fisheries sector was 123.2 billion baht, which accounted for about 2.5% and 27.6% of national GDP and agricultural GDP, respectively. The fishing industry has contributed to the development of other related industries, including fish processing, cold storage, ice production, and shipbuilding. The number of people engaged in this sector was estimated at approximately 826,980, of which 161,670 were engaged in marine capture fisheries, 77,870 in coastal aquaculture, 404,340 in freshwater fish culture, and 183,100 in other related activities.

The fish produced are consumed domestically and exported for foreign exchange earnings. It is one of the most important sources of protein. This is reflected in the per capita fish consumption rates of 25 to 32 kg per annum observed during the past decade. The export value of fish and fishery products has increased significantly.

More than 200 fishing villages are in or near the area of coastal habitats along the Gulf of Thailand. More than 80% of fishers engage in traditional or small-scale fisheries. The production from their fishing activities has played an important role as a source of food and income for their families and communities.

The Thai Government has recently introduced a project named the "Seafood Bank", which aims to guide the allocation of approximately 284,000 rai (1,817.60km^2) of inshore waters to small-scale fishers and their communities for the development of aquaculture and sea farming. This project will be of importance to food security and export promotion.

4.4.2 Association with high value species

Thailand's fisheries demonstrated marked growth over the last 3 decades. The total production of 2.77 million tonnes of fisheries products from Thailand's marine capture fisheries in 2000 was comprised of food fish (52.0%), shrimps (3.2%), crabs (2.1%), squids (6.4), and cuttlefish and shellfish (3.4%). These high value species/groups of species have mostly been derived from capture fisheries conducted in coastal waters.

Coastal habitats of the Gulf of Thailand play critical roles in the life cycles of many important species, especially in terms of spawning, nursery, and feeding areas. The most recent figures from 2000 show a marine catch of 2.77 million tonnes, valued at THB 49,401.7 million. Fishing grounds that fall within Thailand's EEZ are in the Gulf of Thailand and Andaman Sea. It is estimated that, of the total average marine catch, 70% is caught in Thai waters (60% from the Gulf and 10% from the Andaman Sea), whilst the remainder is derived from international waters or foreign EEZs.

4.4.3 Association with endangered, rare, threatened species

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. Dense and increasing human populations in coastal areas, use of destructive fishing practices, intensive industrial activities, and waste disposal are all exacerbating this problem.

It is believed that several species of marine fish and invertebrates are becoming rare, particularly those inhabiting coral reefs, which are being destroyed by intense fishing or other unwise practices. Furthermore, many groups of endangered species, including marine turtles, dugong, and dolphins, spend part of their life cycle in coastal habitats, especially for feeding and nursing areas.

5. CURRENT MANAGEMENT REGIME(S)

Regarding current management regimes relating to fish stocks and their habitats, the following subtopics will now be discussed.

5.1 Legal instruments

Thailand is currently implementing several key legal instruments in order to conserve, preserve, protect, and manage fish stocks and their habitats. These legal instruments include the:

(a) Constitution of the Kingdom of Thailand relating to natural resources management;

(b) Fisheries Act 1947 (B.E. 2490) and related regulations and notifications, especially concerning transboundary stocks:

- Articles 19 and 20 of the Fisheries Act 1947 relate to environmental aspects of fishing grounds, including aquatic animal habitats;

(c) National Environmental Quality Act 1992 (B.E. 2535);

(d) Act Determining Plan and Process of Decentralisation of Power to Local Government Organisation 1999 (B.E. 2542);

(e) Navigation in Thai Waters Act 1913 (B.E. 2456)

- Dumping of ballasts in a river, port area or anchoring location, Section 119: No person is allowed to dump, discard or ballast articles or any waste except for oil and chemical in a river, canal, marsh, reservoir or lake used for public traffic or common use or a sea with Thai waters which will cause shoal, sediment or filth therein unless permitted by the harbour master. Any person violating this provision must be subject to an imprisonment not exceeding six months or a fine not exceeding ten thousand bath or both and must also reimburse the costs paid for disposal thereof. And Section 119 bis: No person shall be allowed to dump, discard or otherwise act so as to allow oil and chemical or any thing in a river, canal, marsh, reservoir or lake used for public traffic or common uses or a area within Thai water which may be toxical to living organisms or environment or harmful to navigation in said river, canal, marsh, reservoir or lakes. Any person violating these provisions must be subject to an imprisonment not exceeding three years or a fine not exceeding sixty thousand bath or both and must also reimburse the costs paid for rehabilitation of such toxic or pay damages therefore;

(f) The Act Governing the Right to Fish in Thai Fisheries Waters B.E.2484 (1939);

(g) Wildlife Reservation and Protection Act 1992

- This Act empowers the Department of Fisheries to protect all animals and their products listed as for reservation and protection, which include all endangered species such as marine mammals, turtles, coral, and seashells.

The recent fisheries regulations that have been issued and implemented in Thai waters are summarised in Table 24.

Table 24 Marine fisheries management measures in Thailand.

Period of prohibition	Management measures	Type of gear
Whole year	1. The distance of 3,000m from shoreline and 400 m out off the stationary gear 2. Songkhla lake 3. Phang-nga Bay (Phang-nga to Krabi province)	Motorised fishing gears, i.e., trawls, push net, shortnecked clam dredge
Whole year	1. The distance of 3,000m in some area of Prachuab Khiri Khan and Chumphon province influenced by typhoons	Trawls, push net, purse seine, shortnecked clam dredge, fishing gear used with light
Whole year	Some areas in Trat province (within 15km from shore)	Purse seine with light luring
Whole year	All areas both in the Gulf of Thailand and Andaman Sea	Purse seine mesh less than 2.5cm (in night time operation)
Whole year	1. The distance of 3,000m from shoreline. The dredge used should be: a. The mouth width not less than 3.5m b. The sieve size not less than 1.2cm c. The boat length not more than 18m d. The number of dredge not more than 3 per one boat 2. The distance of 8,000m from shoreline in Samut Sakhon province	Shortnecked clam dredge
Whole year	All areas both in the Gulf of Thailand and Andaman Sea	Squid light luring with mesh not less than 3.2cm
Whole year	All areas both in the Gulf of Thailand and Andaman Sea	Set bag net
Whole year	All areas both in the Gulf of Thailand and Andaman Sea and in the coral and artificial reef areas	Drive in net
Whole year	All areas both in the Gulf of Thailand and Andaman Sea	Mine equipment for shell collection
Whole year	1. Sea turtle and turtle eggs 2. Sea Dugong 3. Sea Corals 4. Dolphin 5. No fishing in the preservation areas 5.1 A certain area in Phuket province 5.2 A certain area in Chumphon province 5.3 A certain area in Trat province 5.4 A certain area in Phang-nga province	All gears
Whole year	The distance of 3,000 m from shoreline in certain areas in Prachuab Khiri Khan to Chumphon province for pilot CBFM project	Trawl, push net, purse seine, clam dredge and light luring nets
6 months (1 Sep – 28 Feb)	A certain areas in Chonburi province (Historical Bay)	Motorised fishing gears
3 months (15 Feb-15 May)	Protection of fish spawners and larvae in certain areas in Prachuab Khiri Khan, Chumphon and Surat Thani provinces	Pair trawl, otter board trawl, purse seine, mackerel encircling gill net, except the otter-boom and beam trawl fishing at night time during 15 February – 31 March and fishing at both night and day time 1 April – 15 May
3 months (Oct-Dec)	No fishing of female eggs-barriers of mud crab, swimming crab and *Charybdis feriatus*	All gears
3 months (1 Dec-28 Feb)	Protection of Horse Shoe crab in Phang-nga Bay including in the rivers around Phang-nga Bay	All gears
2 months (15 Apr-15 Jun)	Protection of fish spawners and larvae in the Phang-nga Bay, from Krabi to Phuket provinces	All trawlers, Purse seine, Gill net with mesh size not less than 4.7cm

5.2 Institutional arrangements (research, monitoring, control & surveillance)

At present, the lead government organisation with direct responsibility for fisheries, marine resource, and habitat management is the Department of Fisheries, as part of the Ministry of Agriculture and Cooperatives. Other governmental organisations, including the Department of Marine and Coastal Resources and the Office of Environment Policy and Planning, as part of the Ministry of Natural Resources and Environment, also play very important roles in conserving Thailand's marine resources and environments.

The Marine Fisheries Research and Development Bureau conduct research regarding marine fisheries and resource management. The Bureau's Marine Fisheries Research and Development Centre has locations in 4 regions of the Gulf of Thailand, namely Rayong, Samut Prakan, Chumphon, and Songkhla. Marine and coastal research is also conducted by a newer organisation, the Department of Marine and Coastal Resources, through its regional research centres.

A number of other government organisations contributed to various aspects of marine resource and environmental management. They can be considered as supporting research agencies for the Department of Fisheries. They include many organisations under the Department of Pollution Control, Department of National Park Conservation and Management, Department of Marine Transportation and Commerce, Burapha University, Kasetsart University, Chulalongkorn University, Songkhla University, and Walailuk University.

Monitoring, control and surveillance (MCS), is a very important mechanism for fisheries and resource management in the Gulf of Thailand. The Fisheries Administration and Resource Management Bureau of the Department of Fisheries is the leading organisation responsible for MCS, and is supported by various Provincial Fisheries Offices and other organisations empowered by the Fisheries Act and Ministerial Notifications of the Ministry of Agriculture and Cooperatives.

When the government agencies reform program took place in October 2002, the Department of Marine and Coastal Resources (DMCR) was established under the Ministry of Natural Resources and Environment. The DMCR was given the mandate to develop relevant regulations in order to achieve effective managerial action relevant to vulnerable resources, including resource preservation and conservation for sustainable use. The MCS activities for the conservation of marine and coastal resources and habitats are under the mandate of the office of Marine and Coastal Conservation and Enforcement. The transfer of some authority for enforcement of the Fisheries Act has taken place in order to empower the DMCR to act in an enforcement capacity.

The organisational structure of the Department of Fisheries (DOF) and the Department of Marine Coastal Resources (DMCR) is highlighted in Appendices 4 and 5.

5.3 Overview of patterns of resources ownership and traditional utilisation

- Section 290 of the Constitution of the Kingdom of Thailand states that "For the purpose of promoting and maintaining the quality of the environment, a local government organisation has powers and duties as provided by law.

The law under paragraph 1 shall at least contain the following matters as its substances:

(1) The management, preservation and exploitation of the natural resources and environment in the area of the locality;
(2) The participation in preservation of natural resources and environment outside the area of the locality only in the case where the living of the inhabitants in the area may be affected; and
(3) The participation in considering the initiation of any project or activity outside the area of the locality which may affect the quality of the environment, health or sanitary conditions of the inhabitant in the area."

It is very clear that fisheries resources in the coastal areas of the Gulf of Thailand have been degraded and some groups are depleted. This has led to escalating conflict among resources users competing for the same scarce resources. Conflicts between small-scale and commercial fishers are increasing in occurrence on a daily basis. This conflict situation is perhaps not only due to overfishing, but also due to a lack of clear policies pertaining to the conduct of fisheries and their management.

It is well known that Thailand's marine capture fisheries are open access in nature. Prior to the introduction of fisheries management, Thai fishers operated when, where, and how they pleased. However, this situation resulted in unsustainable fisheries. The only areas of non-open access include permitted areas for coastal aquaculture and the prohibition of active fishing gear use within 400m of the permitted areas for bamboo stake traps.

In response to the problems of open access, the Thai Department of Fisheries has attempted to revise the Fisheries Act in order to limit access in Thailand's marine capture fisheries. A proposal has been submitted to parliament for their consideration and approval. Some Articles of the present

Fisheries Act provide a pathway for the limitation of access to fisheries resources. For example, Article 32 indicates that Provincial Governors, with the permission of the Minister, have the authority to fix the type, size, and number of fishing gears to be operated at the provincial level. Nevertheless, this does not provide for the prevention of fishers from other provinces applying for a fishing licence.

Recently, the Department of Fisheries has implemented a pilot project on community based fisheries management across a range of areas, including Bangsapan District, Prachuab Khiri Khan Province, Phang-nga Bay, Phang-nga Province, Pathew District, and Chumphon Province. These pilot projects aim at developing the concept of community level ownership and participation in management of fisheries resources. The participation of the local community in natural resources and environmental management is supported by the present constitution, and the future may see fishing communities being provided with ownership of resources in an attempt to curb the tendency for overexploitation in Thai fisheries.

5.4 Human & Institutional Capacity

The Marine Fisheries Research and Development Bureau of the Department of Fisheries is responsible for marine fisheries resource surveys/research, restoration of fisheries resources and the environment, professional development of fishers, fishing gears/methods research and development, and other duties as required. There are 4 Marine Fisheries Research and Development Centres under the Marine Fisheries Research and Technology Development Institute, and 4 MCS centers under the Marine Fisheries Administration and Conservation Bureau of the Department of Fisheries along the coast of the Gulf of Thailand. However, there are many institutions, including universities and colleges that conduct research into fisheries of the Gulf of Thailand. The locations of these institutions are highlighted in Figure 19.

In order to conduct research and development, and effectively implement management strategies, the provision of additional education and training for officers of the Department of Fisheries in areas such as resource assessment, conservation of fishery resources, and fisheries management is very necessary. This type of education and training has been made available to fishers and other fishing industry representatives in response to government policy aimed at promoting the participation of all stakeholders in the planning and implementation of various fisheries management measures. In doing so, the Fisheries Technology Development and Transfer Bureau of the Department of Fisheries have collaborated with relevant research institutes and universities involved in fisheries training.

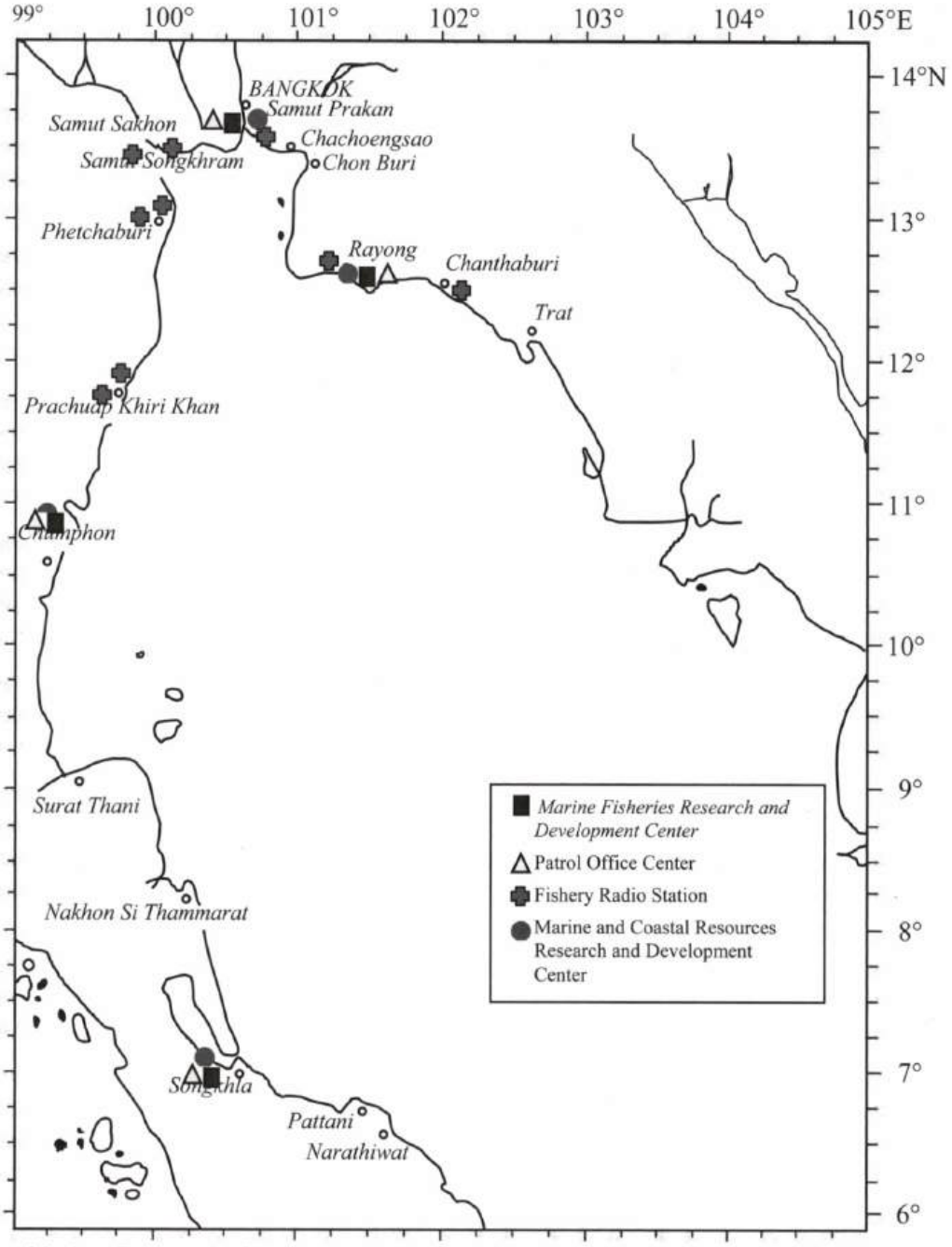

Figure 19 Marine Research Centres and Monitoring, Control, and Enforcement Sites along the coast of the Gulf of Thailand.

5.5 Review of stakeholders (e.g., Fishers, National and/or provincial/local management bodies, NGOs)

The importance of community participation in natural resource and environmental management has become increasingly recognised, particularly since the Eight National Economics and Social Development Plan (1997 to 2001). Creating opportunities and an enabling environment to support the participation of all sectors in the development process is one of the main strategies for the national plan. In providing more opportunity for local communities and people to participate actively in natural resource and environmental management, the following guidelines at the national policy level include:

- Providing opportunities for people and communities to participate in decision-making, monitoring and evaluation of public development projects likely to have an impact on natural resources and the environment. The government should facilitate continual public discussion at every stage of those projects such as initiation, preparation and implementation.

- Providing legal quarantines of the rights of local communities and small-scale fishers to participate in coastal resource management, as well as the conservation, rehabilitation and maintenance of mangrove forests, seagrass and coral reefs, to ensure sustainable use of coastal resources, especially those related to the fishing industry.

As such, in order to achieve the sustainable utilisation of coastal resources, upgrading the capacities of rural communities for economic and social development and for conservation of natural resources and environment has become the key element.

Existing Fisheries and Coastal Community-Based Management Programs

The private sector working for public interests in the area of natural resources and environmental protection and conservation can be found in the form of foundations, associations, projects, clubs, or other formal groups. In general, they can be categorised as follows:

- Non-government organisations (NGOs) registered with the Ministry of Science, Technology, and Environment (MOSTE);
- Non-government organisations not registered with the Ministry of Science, Technology, and Environment (MOSTE);
- Business firms; and
- People's organisations (PO).

At present, there are more than 60 non-governmental organizations (NGOs) working for natural resources and environmental protection and conservation registered with the MOSTE (Office of Environmental Policy and Planning 1996). Under the Enhancement and Conservation of the National Environmental Quality Act of 1992 (Section 8), registered NGOs can obtain support from government agencies, including loans from the environmental fund. In this respect, they will have to submit the proposals, by stating the objectives, plans, project duration, and proposed budget, and then apply for them from the environmental fund. The committee under the Department of Environmental Promotion, MOSTE will review the proposals accordingly.

Fisheries and coastal community-based management in Thailand are mainly carried out with the support of NGOs, particularly in southern Thailand (Table 25). Informal people's organisations may exist before they work in association with NGOs, but with encouragement of NGOs and university lecturers working as activists, the organisations become more recognised and they may establish a formal people's organisation, sometimes registered with MOSTE. The Southern Small-Scale Fishermen Association is a good example following its establishment in September 1993, which resulted from a seminar of NGOs, local fishers, and university activists who realised the problems of coastal resource degradation that adversely affects societal well-being.

Although fishery and coastal management programs in Thailand are carried out by governmental, non-governmental, and people's organisations, they normally share the following goals or objectives:

1. Create awareness of local communities in the sustainable management of coastal resources;
2. Build up and strengthen local capacities in the conservation and rehabilitation of coastal resources; and
3. Encourage the coordination among local communities, local government agencies, and NGOs.

Concerning fishery and coastal resource protection and conservation, the main NGOs working in these areas are the Volunteer for Society Fund, Lae Tai Project, Southern Small-Scale Fisheries Association, Yad Fon Association, and Wildlife Fund Thailand. Acting as the supporting and facilitating organisations in various mechanisms, financially and/or academically, there are various NGOs and POs working in association with them. The programs can be implemented as sub-projects in which the above key NGOs are the executing agencies. Examples of this case are illustrated in Table 25.

Table 25 Non-government organisations (NGOs) involved in coastal resource management in southern Thailand.

Name of the Organisation	Address	Type of Activities	Working Area/Site
Coordinating Committee for Non-government Organizations, Southern Thailand	65 Srisuda Road Amphur Muang Songkhla 90000 Tel: 074 311821	Acting as coordinating Center for NGOs in the south of Thailand	Provinces in southern Thailand
Small-scale Fisheries Community Development	57/216 Kehasathan Khrutai Village Tambol Pawong Amphur Muang Songkhla 90000 Tel: 074 333 114	Solving problems facing small-scale fisheries, pressure group, resource and environmental management	Songkhla Lake area (Amphur Hat Yai), Amphur Muang, Amphur Jana, Amphur Ranode, Songkhla
Lae Tai Project to Rehabilitate Songkhla Lake	68 Mu 4 Tambol Ku Khud, Amphur Satingpra, Songkhla 90190 or 56/9 Soi Pian Phiboon Apai Boriruk Road Tambol Kuha Sawan Amphur Muang Pattalung 93000	Management of natural resource and the environment	Songkhla Lake (Songkhla and Pattalung areas)
Wildlife Fund Thailand (Under the Royal Patronage of H.M. the Queen, Wetland and Coastal Conservation Project	57/6 Paknam Road, Tambol Sabarang, Amphur Muang, Pattani 94000 Tel: 333 227	Management of natural resource and environment concerning small-scale fisheries' problems	Pattani Bay and Nongjik area of Pattani
The Ruk Kukhud Committee	61/1 Mu 3 Tambol Jatigpra, Amphur Satingpra, Songkhla 90190	Management of local Natural resource and Environment (15 local volunteers fully participating in resource protection	Tambol Kukhud Amphur Satingpra of Songkhla and area Surrounding Songkhla Lake
Small-scale Fishery Development Group	n.a.	Nine groups supported by the Department of Fisheries and Provincial Authority in facilities and budget for improving livelihoods	Villages as they settle
Study Center and Development of Pattani Bay	Prince of Songkhla University, Pattani Campus, Amphur Muang, Pattani 94000 Tel: 334 871	Providing knowledge on legal aspects and fishery management	Pattani Bay
Small-scale Fishery Network Project under Earth Island Association	57/6 Paknam Road, Tambol Sabarang, Amphur Muang, Pattani 94000 Tel: 333 227	Working on fishery resources and environment problems in cooperation with the Wildlife Fund Thailand	Pattani
Strengthening Capacity of Non-government Organizations under the Local Community Development Institute	693 Department of Medical Science, Bamrung Muang Road, Pomparb, Bangkok 10100 Tel: 2236713, 2257293	Working on fishery resource and environment problems	Amphur Ta Chana of Surat Thani, Amphur Sichol and Pak Phanang of Nakon Sri Thammarat
Small-scale Fisheries Association of Southern Thailand	57/6 Pak Nam Road, Tambol Sabarang, Amphur Muang, Pattani 94000 Tel: 333 227	Working as coordinating center for groups of small-scale fishing communities in the southern provinces	Southern provinces

Source: Department of Fishery and Lae Tai magazine (various issues).
Note: District = Amphur, Sub-district = Tambol.

There are also various businesses and private organisations working directly with collective activities, and indirectly through provision of financial support. Private organisations dealing with coral reefs include the Siam Diving Association, the Thai Diver Company, and other local business groups. Their activities are conducted along Thailand's coasts, often in collaboration with the Tourism Authority of Thailand, National Park officers from the Royal Forestry Department, and local academic institutions (Table 26).

Table 26 Natural resources and environmental protection and conservation programs under the Wildlife Fund Thailand and corresponding activities.

Name of the Project/Program	Activities
Thailand Coastal Wetland Resources Project, program for conservation of wetland and coastal zone (Pattani and Phuket)	Short-necked clam conservation at Tambol Pana Reh, Pattani Community mangrove reforestation at Nongjik, Pattani and Thlang, Phuket Coastal zoning for seagrass conservation at Nonjik, Pattani and surrounding areas
Program for village conservation of sea turtle (Mai Khao Beach at Phuket)	Promotion of sea turtle conservation program Through media, exhibition, and youth camp, in collaboration with education institutes Study visit of youth group from Mai Khao, Phuket to observe a sea turtle conservation program at Thlang, Phuket
Program for conservation of wetland areas (Samut Songkram)	Survey of base map on land use developing, flora and fauna at the site where the site where the center is located
Program for rehabilitation of coastal resources and small-scale fisherman organization (Tamblo Pha Klog, Amphur Talang, Phuket)	Community training on seaweed conservation project, Tambol Pah Klog Community training on mangrove conservation project, Tambol Pah Klog Placement of signs for conservation zoning of coastal resources Meeting of small-scale fishing community leaders (Pattani, Songkhla, Trang, and Pattalung)
Program for strengthening capacity of local communities in wetland and coastal resource management	Data gathering on socioeconomic, ecological system, and natural resources of the community, NGOs in collaboration with local scholars and lectures at Prince of Songkhla University, Pattani Campus Formulation of local groups to further formulate network of small-scale fishermen in other provinces including Pattani, Trang, Songkhla, Surat Thani, Phang Nga, Krabi, Phuket, Pattalung, Nakorn Si Thammarat, Chumphon, and others.

Source: Wildlife Fund Thailand1996 (unpublished documents) and Lae Tai magazine (various issues).

Case Study

The following cases are reviewed from published and unpublished documents, mostly obtained from NGOs. Additional information is obtained from personal communication with NGO staff. The cases include Pattani Bay and Amphur Pana Reh of Pattani.

Case study: Pattani Bay and Amphur Pana Reh, Pattani

Pattani Bay covers a total area of 74km^2 facing the Gulf of Thailand to the west. With its estuarine area for the Yaring and Pattani Rivers, the bay is rich with natural resources, abundant mangrove forests and nursery areas for fishery resources. The community at Pattani Bay is mostly living at Tambol Lam Pho of the Bay in 4 villages, including Bang Dato, Ban Talo Samilae, Ban Kampong Budee, and Ban Pata Budee. The community is mainly Moslem and their main livelihood is small-scale fishing.

The coastal area of 15km^2, about 2,000 m from the coastline of Amphur Phanare, Pattani is abundant with short-necked clams. The Department of Fisheries (DOF) estimated that the available resources could be valued up to 500 million baht (Lae Tai 12). In March 1992, concessions for short-necked clam fisheries in Amphur Pana Reh were given by the DOF to 30 fishing boats. However, the concessionaire boats entered into the 3-km zone reserved for small-scale fisheries. As such, in April 1992 local people, religious leaders, and village leaders protested and requested the governor not to allow the concession of short-necked clam fisheries in Amphur Pana Reh. As a result, the concession was successfully stopped.

On 28 July 1992, the Pana Reh Coastal Fisheries Association was established as a people's organisation with the objective of conserving and rehabilitating coastal resources in Amphur Pana Reh. Its ultimate goal is to improve the living conditions of the small-scale fishers in Pana Reh in a sustainable manner.

Problem: Declining fishery resources in the Bay caused by large-scale fishing, including trawlers and push nets operated within the 3-km zone.

Involvement of local organisations: The Association of Small-scale Fishermen was established in March 1993 through the exchange of information and discussion among villagers in solving problems regarding the degradation of fishery resources. The sub-district leader of Tambol Lam Pho chairs the association with members from 4 villages of Lam Pho. The Pattani Bay Rehabilitation Organisation was later established in September 1993.

Programmes and activities:

- The "Pattani Bay Conservation" Day was established on 11 May 1993. The activities for this day, in collaboration with government agencies, included the placement of conservation zones for fishery resources and seaweed, and for the release of shrimp and fish juveniles into the Bay.
- A study visit of 850 member representatives was organised from 14 to 16 June 1993. The trip to Pattalung, Trang, Phang Nga, and Phuket was aimed at representatives observing, discussing, and exchanging information with local people who were actively working on coastal conservation programmess.
- Survey of coastal resources at Lam Tachi bay was conducted from 21 to 25 June 1993 by fishers and divers from the Wildlife Fund of Thailand. The data collected were prepared to support government agencies in planning for future coastal resource development and management of the bay.
- Mangrove planting was arranged by the association with close collaboration of the regional forestry office of Pattani in August 1993. The objective was to rehabilitate the existing mangrove area to become the community forest area for the villagers of Ban Dato and Ban Talo Samilae.
- A seminar on "Past, Present, and Future of Pattani Bay" was convened from 5 to 6 September 1993 in order for the concerned parties, government, non-government, and local communities to discuss future plans for sustainable coastal resource management in Pattani Bay. On 6 September, the Pattani Bay Rehabilitation Organisation was established as the result of the seminar.

Fisher Associations and Non-Government Organisations

There are 47 registered fisher associations in the Gulf of Thailand region. 44 associations are members of the National Fisheries Association of Thailand, which acts as a central organisation for stakeholders concerned with marine fisheries, including fisheries officials, private sector representatives, fisher organisations, and fishers themselves. The aims of these organisations are to guide the development of the fishing industry. Fishers associations have been categorised as follow:

- National organisations: 7
- Provincial organisations: 12
- Local organisations: 25

At present small-scale fisher groups have been established to monitor coastal resources and promote responsible fishing. The FAO Code of Conduct for Responsible Fisheries has been introduced to fishers. Hence, in 2002, the National Fisheries Association of Thailand encouraged fishers to become members of the association. This association can be used to build the capacity of fishers to become stewards of their resources.

National Fisheries Association of Thailand

Objective:

1. Promote fishing and standard of living of fishers
2. Promote unity among fisher associations in Thailand
3. Promote fishing extension and technologies
4. Train fishers
5. Promote public activities
6. Non-political activities

Activities of the National Fisheries Association of Thailand

1. Fishing extension
   - Conduct joint projects with neighboring countries for fishing group extension
   - Conduct co-operative projects with the government sector to provide discounted fuel to fishers
   - Conduct co-operative projects with the government sector to ban destructive fishing gears, including pushnet, and control the number of some fishing gears such as trawls, anchovies lift net/falling net
2. Comment on fisheries
   - Comment to the government sector regarding fishing regulations relating to fishing zones and fishing seasons
3. Focal point for fisheries association
   - Disseminate fisheries information to fisheries associations
   - Arrange committee meetings
   - Promote knowledge and fishing technology
   - On-site meetings for solving fisheries problems

National Organisations

1. Oceanic Fisheries Association of Thailand
2. Fishmeal Producer Association of Thailand
3. Nakorn Si Thammarat Trawler Association
4. Fisheries Export and Aquaculture Extension Association of Thailand
5. Central Gillnet Association
6. Southern Gillnet Association
7. Frozen Food Association of Thailand

Provincial Organisations

1. Cholburi Fisheries Association
2. Nakorn Si Thammarat Fisheries Association
3. Paknam Chumphon Fishermen Association
4. Pattani Fisheries Association
5. Petchaburi Fishermen Association
6. Rayong Fisheries Association
7. Samut Prakan Fisheries Association
8. Samut Sakorn Fisheries Association
9. Samut Songkram Fisheries Association
10. Surat Thani Fishermen Association
11. Songkhla Fishermen Association
12. Trat Fisheries Association

Local Organisations

1. Kanom District Fisheries Association	Nakorn Si Thammarat Province
2. Klongyai Fisheries Association	Trat Province
3. Klongwan Fisheries Association	PrachupKiri Khan Province
4. Chaiya District Fishermen Association	Surathani Province
5. Dansawi Fishermen Association	Chumporn Province
6. Thamai District Fishermen Association	Chantaburi Province
7. Banleam District Fishermen Association	Petchaburi Province
8. Banphe Fisheries Association	Rayong Province
9. Paktago Fishermen Association	Chumporn Province
11. Paknam Prasae Fishermen Association	Rayong Province
12. Pakpanang Fishermen Association	Nakorn Si Thammarat Province
13. Pranburi Fisheries Association	PrachupKiri Khan Province
14. Sunthornpu Fisheries Association	Rayong Province
15. Sichon District Fishermen Association	Nakorn Si Thammarat Province
16. Hua Hin Fishermen Association	Prachup Khiri Khan Province
17. Leamsing Fisheries Association	Chantaburi Province
18. Angsila Fisheries Association	Chonburi Province
19. Paknampangrad Fishermen Association	Rayong Province
20. Bangjakreng Fisheries Cooperative	Samutsongkram Province
21. Banleam Fisheries Cooperative	Petchaburi Provin ce
22. Pattani Fisheries Cooperative	Pattani Province
23. Maeklong Fisheries Cooperative	Samut songkram Province
24. Samutsakorn Fisheries Cooperative	Samut sakorn Province
25. Bangsalae Fishing Group	Chonburi Province

6. PROBLEMS, CONSTRAINTS AND RECOMMENDED ACTIONS

6.1 Problems and Constraints

The rapid development of marine fisheries in Thailand has mainly been a result of intensive exploitation of marine fisheries resources, without systematic management and rehabilitation of the resources, often leading to conflicts between resource users. Marine fisheries resources, which had once served as key contributing factors to national economic prosperity, have now become constraints for future development that must be carefully taken into consideration. In particular, demersal and many groups of pelagic resources are rapidly being degraded, resulting in decreases in their distribution and abundance. Similarly, coastal habitats, particularly mangroves, seagrasses, and coral reefs have also been damaged by natural phenomena, human activities, and economic factors, particularly fisheries and tourism.

It is clear from this review that marine fisheries resources have been overexploited for more than 3 decades. Therefore, appropriate management actions at various levels need to be taken. Fisheries management has been contained as one of the most important strategies since the Fourth (1977 to 1981) to the Ninth (2002 to 2006) National Economic and Social Development Plans. The main policy is to reduce excessive fishing effort levels to that appropriate toward achieving optimal sustainable yields from resources, and to protect and rehabilitate important habitats and environments. The Standing Committee on National Fisheries Policy, chaired by the Deputy Prime Minister, has approved these strategies. This reflects the Government's policy commitment to overcome these problems.

Although fisheries management has existed for some time, the government has not yet been able to ban destructive fishing gears and reduce excessive fishing effort, mostly due to potential economic, social, and political implications. Moreover, the MCS system has not been effective, mainly due to the lack of understanding and participation by the fishing community and fishers themselves. Many fishers have little awareness of resource conservation, concentrating mainly on immediate income needs associated with their socioeconomic situations. Coordination among the Department of Fisheries, fishing communities/associations, and the various other governmental agencies concerned is also considered poor. These problems require solving.

6.2 Recommendations

In order to conserve and manage marine fisheries resources and their habitats, it is urgent that the government express strong political will and commitment through implementing the approved action plans contained in the National Fisheries Policy. There are a number of other recommended actions at national and regional levels requiring attention, these include:

1. Development of strategic plans of studies and utilisation of living resources; studies on biology and dynamics of important fish stocks; conservation and protection of marine environment against pollution from any sources; fishery resources investigation service; fishing activities research and development; management and conservation of living resources; development of regulations of fisheries and alternative use strategies for living resources.
2. Periodical determination of the total allowable fishing effort and catch of fish in the respective fishing areas, or from respective fish stocks, based on the best scientific evidence, provisions set forth in international agreements and resolutions of international organisations where Thailand is a member State.
3. To undertake a review and expedite amendment of laws, rules, and regulations concerned with the conservation and management of fishery resources and environment and to ensure that they are compatible with relevant regional and international instruments as well as to ensure promoting more coordination for active participation of other department in fisheries management.
4. Improvement of fisheries information and catch and effort statistics in the fishing grounds both inside and outside Thai waters and to strengthen socio-economic information, which will be of value in supporting improved fisheries management measures.
5. To promote awareness building and the participation of fishers, fisher associations, and fishing industry stakeholders in the planning process and implementation of fisheries management measures; education and training for the people concerned must be provided and regular meetings for evaluation and improvement are needed.
6. In order to reduce the problem of open access in fisheries, demarcation of fishing zones for various sizes and type of fishing boats/gears, coral reef zones, seagrass meadows, and conservation zones should be established with agreement among stakeholders concerned. The introduction of right-based fisheries, community-based fishery management, as well as resource enhancement programs through installation of artificial reefs should be created and strengthened for the optimal use of inshore waters as agreed at the ASEAN-SEAFDEC Conference: Fish for People.
7. Fisheries MCS is a vital mechanism for strengthening fisheries management. It needs to be modernised and strengthened, and training for the officers concerned is necessary.
8. One of the problems in tropical multi-species fisheries is the by-catch and discards that require reduction, the development and introduction of appropriate selective fishing gear, as well as technologies for at sea fish processing should be considered in order to reduce by-catch and waste.

Considering the geographical distribution and migration of fisheries resources, it is being increasingly recognised that effective management of the resources has to be conducted at 2 levels, national and regional. National management should be concerned with the actual implementation of the various policies created for instituting sustained development, while regional management should seek to identify common issues and facilitate resolution for the benefit of the coastal States of the region as a whole.

It is evident that a number of fish stocks, both pelagic and demersal resources in the Gulf of Thailand and South China Sea, move freely from EEZs of one country to another, or straddle the boundaries of 2 or more countries. The exploitation of those resources may be shared by the neighbouring countries. Therefore, improved understanding of the biology, dynamics, and the state of stocks is required to facilitate the establishment of appropriate management plans.

For evolving regional level management measures, the following actions may be necessary: i) formation of a strong regional body to design regional policies; ii) development of a mechanism to strengthen national management measures; iii) identification of the regional changes in fisheries, especially the shared stocks and periodically advising the member countries; iv) provision of strong scientific support for fisheries development by imparting training on technological changes; v)

development of a system for communication, exchange of data and interaction on management experiences among the member countries; vi) promotion of compatibility and consensus among the countries in sharing the stock assessment studies; and vii) generation of adequate funds for implementing the management program.

REFERENCES

Aksornkoae, S. 1989. Mangrove: Ecology and Management. Compute advertising. 251pp. (*In Thai*)

Aksornkoae, S. 1998. Mangroves: Ecology and Management. Kasetsart University Press: Bangkok.

Anugul, T. 2002. Marine Resources Caught by Research Vessels (otter board trawl) in the Upper Gulf of Thailand in 1999. Technical Paper no.18, Upper Gulf Fisheries Development Center, Department of Fisheries. 37pp. (*In Thai*)

Bakhayokho, M. 1983. Biology of the cuttlefish *Sepia afficinalis* Hierredda off the Senegalese coast. Advances in assessment of world cephalopod resources. Food and Agriculture Organisation of the United Nations, Rome. 412pp.

Boonprakob, U. 1965. The identification of pelagic eggs and larvae of Chub mackerel, Rastrelliger spp., in the Gulf of Thailand with additional study on their distribution. Contrib. Mar. Fish. Lab., Bangkok, (4) : 115-151. (*In Thai*)

Boonwanich, T. 1993. Demersal resources and trash fish. A paper presented on the Seminar on the Thai Fisheries Improvement, Ao Kunggaben Study and Development, Chantaburi Province, 20-22 August 1993. 13pp. (*In Thai*)

Boonyapiwat, S. 1999. Distribution, Abundance and Species Composition of Phytoplankton in the South China Sea, Area I: Gulf of Thailand and East Coast of Peninsular Malaysia. *In* Proceedings of the First Technical Seminar on Marine Fishery Resources Survey in the South China Sea, Area I, Gulf of Thailand and East Coast of Peninsular Malaysia. 24-26 November 1997, Bangkok, Thailand. Southeast Asian Fisheries Development Center, March 1999. pp.111-134.

Boonyubol, M. and S. Pramokchutima. 1982. Trawl fisheries in the Gulf of Thailand. A paper submitted to the Second National Seminar on Marine Science, Bangsan 8-10 September 1982, 7pp.

Briggs, M.R.P. 1994. 'Status, problems and solutions for a sustainable shrimp culture industry.' *In* M.R.P. Briggs (ed). *Development of strategies for sustainable shrimp farming. Final report to the Overseas Development Administration.* Research Project R4751. Institute of Aquaculture, University of Stirling, UK.

Brodie, J. 1996. Nutrient and Sediment Pollution and its Effects. *In* Trevor J. Ward (ed.), Proceedings of the Workshop on Eutrophication in Tropical Marine Systems – the Impacts and Management of Nutrient Pollution. RCU/EAS Technical Reports Series No.8. Bangkok, Thailand : UNEP. pp.15-20.

Chaitiamvong, S. and M. Supongpan. 1993. A guide to Penaeoid shrimps found in Thai waters. Australian Institute of Marine Science Townsville, Australia. 77pp.

Chamchang, C. 1986. Distribution of Economically Important Pelagic Fish Larvae from Surat Thani to Narathiwat Province, Western Portion of the Gulf of Thailand. Technical Paper of Marine Resource Survey Team No.2/1986, Marine Fisheries Division, Department of Fisheries. 45pp.

Chamchang, C. and R. Chayakul. 1990. Distribution of longtail tuna (*Thunnus tonggol*, Bleeker), Kawakawa (*Euthynuus affinis, Canter*) and Frigate tuna (*Auxis thazard*, Lacepede) in the Eastern Coast of the Gulf of Thailand. Technical paper no.2/1990, Marine Resources Survey, Marine Fisheries Division, Department of Fisheries. 17pp.

Chansakul W. 1988. Identification and Distribution of Fish Larvae in Rayong Bay, Rayong Province. 194pp.

Chareonpanich C. and S. Seurungreong. 1999. Some physical and Chemical Characteristics of Bottom Sediments in the South China Sea, Area I : Gulf of Thailand and East Coast of Peninsular Malaysia. *In* Proceedings of the First Technical Seminar on Marine Fishery Resources Survey in the South China Sea, Area I, Gulf of Thailand and East Coast of Peninsular Malaysia. 24-26 November 1997, Bangkok, Thailand. Southeast Asian Fisheries Development Center, March 1999. pp. 12-33.

Charoenphol, S. 1957. Preliminary study of discoloration of sea water in the Gulf of Thailand. Paper presented in the IXth Pacific Science Congress, Bangkok, 18-30 November.

Chotiyaputta, C. 1977. Relationship between Length and body weight and sex ratio of the cuttlefish, *Sepia* spp. in the Gulf of Thailand. Technical Paper no.9/1977. Invertebrate section, Marine Fisheries Division, Department of Fisheries. 30pp. *(In Thai)*

Chotiyaputta, C. 1978. Biology of the cuttlefish, *Sepia recurvirostra* Steenstrup in the Gulf of Thailand. Technical Paper no.1/1978. Invertebrate section, Marine Fisheries Division, Department of Fisheries. 26pp. *(In Thai)*

Chotiyaputta, C. 1980. Biology of the cuttlefish, *Sepia aculeata* Ferussac and d'Orbigny in the Gulf of Thailand. Technical Paper no.17/1980. Invertebrate section, Marine Fisheries Division, Department of Fisheries. 28pp. *(In Thai)*

Chotiyaputta, C. 1982. Biology of the cuttlefish, *Sepia pharaonis* Ehrenberg. Technical Paper no.4/1982. Invertebrate section, Marine Fisheries Division, Department of Fisheries. 6pp. *(In Thai)*

Chotiyaputta, C. 1995a. Juvenile and adult taxonomy and fishery biological of neritic squid in Thai waters. A Ph.D.dissertation submitted to the Tokyo University of Fisheries, Tokyo, Japan. 121pp. 15 Appendix Table and 10 Plates.

Chotiyaputta, C. 1995b. Distribution, abundance, reproduction biology age and growth of *Loligo chinensis* in the western Gulf of Thailand. Technical Paper no.2/1995, Marine Resources Survey Unit, The Upper Gulf Marine Fisheries Development Center, Marine Fisheries Division, department of Fisheries. 67pp.

Chotiyaputta, C., T. Okutani and S. Chaitiamvong. 1992. Systematic study of cephalopods in Thailand. Report Presented to National Research Council of Thailand, JSPS-NRCT October 1992: 96pp. (*In Thai*)

Chuenpun, A. 1996. Coastal tuna resources in the Gulf of Thialnd. Stock Assessment Section, Bangkok Marine Fisheries Development Center, Marine Fisheries Division. (*In Thai*)

Chullasorn, S. and P. Martosubroto. 1986. Distribution and Important Biological Feature of Coastal Fish Research in Southeast Asia. FAO Fisheries Technical Paper No.278.

Chullasorn, S. and S. Yusukswad. 1978. Preliminary report on the fisheries biology of the roundscads (*Decapterus spp.*) in the Gulf of Thailand. Technical Paper no.2/1978, Pelagic Fish Unit, Marine Fisheries Division, Department of Fisheries. 33pp.

Day, M.M. 2000. Analysis of demand for fish in Bangladesh. Aquaculture Economics & Management. 4(1&2), 63-79.

Department of Fisheries, 1982-2002. Thai Fishing Vessels Statistics 1980-2000. Small-Scale Fisheries Statistics Analysis Sub-Division, Fisheries Economics Division, Department of Fisheries, Ministry of Agriculture and Cooperatives. (*In Thai*)

Department of Fisheries, 1988-2002. Fisheries Statistics of Thailand 1985-1999. Fisheries Statistics and Information Technology Sub-Division, Fisheries Economics Division, Department of Fisheries, Ministry of Agriculture and Cooperatives. (*In Thai*)

Department of Fisheries, 1995-2002. Thai Fishing Vessels Statistics 1993-2000. Small-Scale Fisheries Statistics Analysis Sub-Division, Fisheries Economics Division, Department of Fisheries, Ministry of Agriculture and Cooperatives. (*In Thai*)

Department of Fisheries, 1996. Fisheries Statistics of Thailand 1994. No.13/1996. Fisheries Statistics and Information Technology Sub-Division, Fisheries Economics Division, Department of Fisheries, Ministry of Agriculture and Cooperatives. (*In Thai*)

Department of Fisheries. 1998. Fisheries Statistics of Thailand 1995. No.5/1998. Fisheries Statistics and Information Technology Sub-Division, Fisheries Economics Division, Department of Fisheries, Ministry of Agriculture and Cooperatives. 86pp. (*In Thai*)

Department of Fisheries. 1999. Fisheries Statistics of Thailand 1996. No.5/1999. Fisheries Statistics and Information Technology Sub-Division, Fisheries Economics Division, Department of Fisheries, Ministry of Agriculture and Cooperatives. 86pp. (*In Thai*)

Department of Fisheries. 2002. The Landing Place Survey 1998. No.14/2002. Small-Scale Fisheries Statistics Analysis Sub-Division, Department of Fisheries, Ministry of Agriculture and Cooperatives. 38pp. (*In Thai*)

Department of Fisheries. 2002. Fisheries Statistics of Thailand 1999. No.10/2002. Fisheries Economics Division, Department of Fisheries, Ministry of Agriculture and Cooperatives. 87pp. (*In Thai*)

Department of Fisheries. 2003a. Fisheries Statistics of Thailand 2000. No.4/2003. Fishery Statistics Analysis and Research Group, Fishery Information Technology Center, Department of Fisheries, Ministry of Agriculture and Cooperatives. 91pp. (*In Thai*)

Department of Fisheries. 2003b. The Landing Place Survey 2000. No.9/2003. Fisheries Statistic Analysis and Research Group, Fishery Information Technology Center, Department of Fisheries, Ministry of Agriculture and Cooperatives. 38pp. (*In Thai*)

Department of Fisheries. 1995. Statistics of Marine Fisheries Production, Year 1993. Department of Fisheries. Bangkok. Thailand. (*In Thai*)

Department of Health. 1997. http://www.anami.moph.go.th

FAO. 1993. Report on the First and Second THAILAND/FAO/DANIDA Workshops on Fishery Research Planning Held at Phuket, 28 October to 8 November 1991 and Songkhla, 15 to 26 February 1993 for the Project "Training in Fish Stock Assessment and Fishery Research Planning" GCP/INT/392/Den Report on Activities Nos. 35 and 41. 109pp.

FAO. 1996. Chub mackerel fishery in the Gulf of Thailand. Third Thailand/FAO/DANIDA Workshop on Fishery Research Planning, Chiangrai, Thailand, 23 Jan 3 Feb. 1995. FAO Report on Activity No.12, Supplement 1, 33pp.

Gulland, J.A. 1972. Some notes on the demersal resources of South China Sea. Proc. Indo-Pacific Fish. Coun. 13(3) : 51-60.

Isara, P. 1993. Assessment of Big-eye scad (*Selar crumenophthalmus*) from Purse Seine in the Gulf of Thailand. Technical paper no. 5/1993. Stock Assessment Section, Bangkok Marine Fisheries Development Center, Marine Fisheries Division. (*In Thai*)

Isvilanondas, S. and R. Tokrisna. 1994. National Resources and Environment Economics. Faculty of Economics, Kasetsart University, Bangkok. (*In Thai*)

Jala, K.F. and M.A. Aziz. 1986. Pollution control from agro-based and small-scale industries of the ESCAP region. In Proceeding of the International Conference on Water and Wastewater Management in Asia. pp. 65-81. Singapore.

Jindalikit, J and K. Sereerux. (2004). Distribution and spawning grounds of cuttlefish in the Upper Gulf of Thailand. Technical Paper no. X, Upper Gulf Marine Fisheries Research and Development Center, Marine Fisheries Research and Development Bureau, Department of Fisheries. 14pp.

Jiraphanpiphat, K. 1987. Growth and mortality of bigeye (*Priancanthus tayenus*) in the Gulf of Thailand, Prachuap Khiri Khan – Surat Thani provinces. Technical Paper no. 5/1987. Population Analysis section, Marine Fisheries Division. 11pp. (*In Thai*)

Jivaluk, J. 1999. Distribution, abundance and composition of zooplankton in the South China Sea, area I: Gulf of Thailand and East Coast of Peninsular Malaysia. *In*: Proceeding of the First Technical Seminar on Marine Fishery Resources Survey in the South China Sea area I. Gulf of Thailand and east coast of Peninsular Malaysia, 24-26 November 1997, Bangkok, Thailand, Southeast Asian Fisheries Development Center. pp. 256-284.

Johnson, C. 1997. Conflict and Change in an Open-Access Resource: An Analysis of Thailand's Coastal Fisheries, Background Paper for the Thai Marine Rehabilitation Plan Project. Bangkok: Natural resources and Environment Program, Thailand Development Research Institute. December.

Klinmuang, H. 1981. Length distribution and relationship between length and weight of tuna species in the Gulf of Thailand. Technical paper No.24, Pelagic Fish Unit, Marine Fisheries Division, Department of Fisheries. 39pp. (*In Thai*)

Kongprom, A., P. Khaemakorn., M. Eiamsa-ard and M. Supongpan. (in press). The status of demersal fishery resources in the Gulf of Thailand. A paper presented to ICLARM/ADB Project, ADB-RETA 5766: Sustainable Management of Coastal Fish Stocks in Asia.

Marine Fisheries Laboratory and Fisheries Research Institute. 1967. Result of the Joint Thai-Malaysian-German Trawling Survey off the East Coast of the Malay Peninsula, 1967. The Marine Fishery Laboratory, Department of Fisheries, Ministry of Agriculture, Bangkok, Thailand and The Fishery Research Institute, Fisheries Division, Ministry of Agriculture & Cooperatives, Malaysia, December, 1967.

Matsui, T. 1970. The larvae of Rastrelliger. Ecology of the Gulf of Thailand. NAGA REPORT. S10 (Scripps Inst. Oceanogr.) Ref. (63-6) : 59-69.

Musikasung, W., S. Rattanaruangsi and N. Yama. 1998. Life History and Environmental Effects on Anchovies in the Southern Gulf of Thailand. Southern Marine Fisheries Development Center.

Nabhitabhata, J. 1999. Checklist of Diversity and Distribution of Recent Cephalopods from Thai Waters. Thai Marine Fisheries Research Bulletin, 7: 89-96.

Nabthitabhata, J. 1997. Life cycle of three cultured generations of spineless cuttlefish, Sepiella inermis (FERUSSAC&D'ORBIGNY, 1848). Phuket Marine Biological Center Special Publication 17(1): 289-298.

National Seminar. 1999. The proceeding of the 3rd National Seminar on the Thai Marine Direction in Future, Department of Fisheries of Thailand.

NESDB. http://www.nesdb.go.th

OEPP (Office of Environmental Policy and Planing). 1995. Status Report on Environment Quality, 1994. Bangkok : OEPP, Ministry of Science, Technology and Environment. December. (*In Thai*)

Okawara, M., A. Munprasit, Y. Theparaoonrat, P. Masthawee and B. Chokesanguan. 1986. Fishing Gear and Methods in Southeast Asia I, Thailand. Training Department, Southeast Asia Fisheries Development Center. TD/Res./9.

Phasuk, B. 1987. The Marine Fisheries in Thai Waters. *In* Seminar on Fisheries in the Future. Southeast Asian Fishery Development Center. pp 324-404. (*In Thai*)

Piamthipmanus, M. 1999. Temporal Change in the Abundance of Macrobenthos in the South China Sea, Area II: Sarawak, Brunei and Sabah. *In* Proceedings of the Second Technical Seminar on Marine Fishery Resources Survey in the South China Sea AREA II West Coast of Sabah, Sarawak and Brunei Darussalam, 14-15 December 1998, Kuala Lumpur, Malaysia. Southeast Asian Fisheries Development Center, March 1999. pp.323-337.

Piromnim, M. 1985. Phytoplankton in the Inner Gulf of Thailand. Report No.5, Marine Fisheries Laboratory, Marine Fisheries Division, Department of Fisheries. 35pp.

Piumsombun, S. 2003. Analysis of demand for fish consumed at home in Thailand. *In* Thai Fisheries Gazette 56(2) : 113-121.

Pollution Control Department. 1998. Development of an action plan to improve water quality in the Eastern River Basin, Thailand: Main Report, vol 3/10. Ministry of Science, Technology and Environment, Thailand.

Pollution Control Department. 1999. A survey of coastal water quality along the Andaman Sea and the Western Gulf of Thailand. PCD 02/027, Pollution Control Department, Ministry of Science, Technology and Environment.

Robinson, M.K. 1974. The physical oceanography of the Gulf of Thailand. The University of California, Scripps Institution of Oceanography, La Jolla, California, NAGA REPORT, Volume 3, Part I : 5-109.

Saikliang, P. 1995a. Implication of the International law of the Sea to Fisheries of Thailand. Paper presented to The15th Training Programme on the Entry into Force of the United Nations Convention on the Law of the Sea, Its Implementation and Agenda 21, June 5- August 11, 1995. 14pp.

Saikliang, P. 1995b. Economics of Anchovy Fishery Management in The Gulf of Thailand. A Paper Presented Kasetsart University Research Project Resources Management Committee. 138pp. (*In Thai*)

Sanguansin, J. 1986. Benthic Macrofaura in the Central Gulf of Thailand. Report of the Thai-SEAFDEC Joint Fishery Oceanographic Survey in the Central Gulf of Thailand, Vol. II, Training Department Southeast Asian Fisheries Development Center. 24pp.

Sanguansin, J., D. Tanvilae, S. Suwannagosoom and S. Jaipium. 1999. Seawater quality along the Eastern Coast of the Gulf of Thailand in 1994-1995. Technical Paper No.71/1999, Eastern Marine Fisheries Development Center, Department of Fisheries. (*In Thai*)

SEAFDEC. 1981a. Preliminary Results from Acoustic Survey in the Gulf of Thailand, 1979. *In* Report of Seminar on Stock Assessment of Pelagic Resources with Emphasis on Shared Stocks. Bangkok, Thailand 10-14 August 1981. pp.177-186.

SEAFDEC. 1981b. Country Report of Thailand. *In* Report of Seminar on Stock Assessment of Pelagic Resources with Emphasis on Shared Stocks. Bangkok, Thailand 10-14 August 1981. pp.123-143.

SEAFDEC. 1999. Proceedings of the First Technical Seminar on Marine Fishery Resources Survey in the South China Sea Area I : Gulf of Thailand and East Coast of Peninsular Malaysia, 24-26 November 1997, Bangkok, Thailand. Southeast Asian Fisheries Development Center, March 1999. 366.

Siripong, A. 1985. The hydrography of the South China Sea and the Gulf of Thailand. Vol. III, Hydrology and Climatology. 260pp.

Sitthichokpan, S. 1977. Water quality in estuary and coastal area in the Inner Gulf of Thailand 1977. Marine Fisheries Laboratory Report No.5/78, Marine Fisheries Division, Department of Fisheries.

Smith, P., G. Griffiths and N. Ruello, 1998. Price formation on the Sydney fish market. ABARE Research Report no.98.8. Australian Bureau of Agricultural and Resource Economics, Canberra.

Somjaiwong, D. and S. Chullasorn 1974. Tagging experiment on the Indo-Pacific mackerel, Rastrelliger neglectus (van Kampen) in the Gulf of Thailand (1060-1965) Proc.Indo-Pac. Fish.Counc., 15(3) : 287-296.

Sukhavisidth, P. 1996. Checklist of Marine Fishes of Thailand. Technical Paper no.2/1996. Marine Resources Surveys Section, Bangkok Marine Fishes Development Center, Marine Fishes Division, Department of Fisheries. (*In Thai*)

Supongpan, M. 1988. The cephalopod fisheries and resource in the Gulf of Thailand. Technical paper no.2/1988. Stock Assessment Section, Marine Fisheries Division. 34pp.

Supongpan, M. 1993. Cephalopod resources in the Gulf of Thailand. A paper presented on the Seminar on the Thai Fisheries Improvement, Ao Kungaben Study and Development, Chantaburi province, 20-22 August 1993. 45pp.

Supongpan, M. 1995. Cephalopod Resource in the Gulf of Thailand. Contribution no.17. Upper Gulf Marine Fisheries Development Center, Marine Fisheries Division, department of Fisheries. 30pp. (*In Thai*)

Supongpan, M. 1996. The fisheries biology of Indian squid (*Loligo duvauceli*) in west coast of the Gulf of Thailand. A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Marine Science, Graduate School of Marine Science and Engineering, Nagasaki University, Japan. 132pp.

Supongpan, M. 1998. The fisheries biology of Indian squid (*Loligo duvauceli*) in west coast the Gulf of Thailand. Thai Fisheries Gazette Vol.51(2): 157-158

Supongpan, M., C. Chamchang., S. Boongerd and A. Laowapong. 2000. Anchovy fisheries in the Gulf of Thailand. A Paper Submitted to Fishcode Management, FAO/NORWAY Programme of Assistance to Developing Countries for the Implementation of the Code of Conduct for Responsible Fisheries Sub-Programme F: Provision of Scientific Advice to Fisheries Management. January 2000. 139pp.

Supongpan, M., M. Shinodo and S. Boongerd. 1992. Catch analysis of Indian squid *Loligo duvauceli* by light luring fishing in the Gulf of Thailand. Nippon Suisan Gakkaishi, 58, 439-444.

Suvapepun, S. 1984. Red Tide and Fisheries in the Gulf of Thailand. Technical Paper No.27/7, Marine Fisheries Laboratory, Marine Fisheries Division, Department of Fisheries. 19pp.

Suvapepun, S. 1989. Occurrences of Red Tide in the Gulf of Thailand. *In* T. Okichi, D.M. Anderson and T. Nemoto (eds.), Proceedings of the First International Symposium on Red tide : Biology, environment science and toxicology (10-14 November, 1987). New York : Elsevier Science Publishing Co., Inc., pp.41-44.

Suvapepun, S. 1997. An effective investment in coastal fishery management: Thailand's experience. Proceeding of the regional workshop on coastal fishery management based on Southeast Asian Experiences, Chaingmai, Thailand, 19-22 November 1996. TD/RP/40: February 1997, Training Department, Southeast Asian Fisheries Development Center, Samut Prakan, Thailand.

Suvapepun, S. and W. Suwanrumpha. 1970. Distribution and seasonal variation in the abundance of plankton off the western coast of the Gulf of Thailand. First Symp.mar.Fish.,Mar.Fish.Lab., Bangkok, Jan. 26-27, 1970. 23pp.

Suvapepun, S., S. Chernbamrung, W. Wangcharoenporn. 1984. Effect of water discolouration on coastal fisheries. In Report of the Marine Fisheries Division, Fisheries Department, Bangkok.

Takahashi, Z., N, Ruangsivakul and S. Silpipat. 1985. Distribution and Seasonal Fluctuation of Heterotrophic and Coliform Bacteria in the Chao Phraya River and the Bangkok Bight. Southeast Asian Fisheries Development Center, Samut Prakarn.

Tamiyavanich, S. 1984. The causes and impacts of the Red tide phenomena occurring in the Upper Gulf of Thailand. *In* Proceedings of the Third Seminar on the Water Quality and Quantity of Living Resource in in Thai Waters, 26-28 March 1984, pp.841-486. National Research Council of Thailand, Bangkok.

Tantisawetrat, C. 1994. Status of Indo-Pacific mackerel (*Rastrelliger neglectus*, van Kampen) Resource in the Gulf of Thailand. Stock Assessment Section, Bangkok Marine Fisheries Development Center, Marine Fisheries Division. (*In Thai*)

Tantisawetrat, C. 1996. Status of Indian mackerel Resources and Fishery in the Gulf of Thailand. Technical paper no. 4, Stock Assessment Section, Bangkok Marine Fisheries Development Center, Marine Fisheries Division. (*In Thai*)

Tantisawetrat, C., A. Cheunpan and P. Suvatthee. 1994. Status of Chub Mackerel in the Upper Part of the Gulf of Thailand. Technical paper no.5/1994, Stock Assessment Section, Bangkok Marine Fisheries Development Center, Marine Fisheries Division, Department of Fisheries. 25pp.

Termvidchakorn, A. 1999. Kinds, Abundance and Distribution of the Fish Larvae in the South China Sea, Area I: Gulf of Thailand and East Coast of Peninsular Malaysia. *In* Proceedings of the First Technical Seminar on Marine Fishery Resources Survey in the South China Sea, Area I, Gulf of Thailand and East Coast of Peninsular Malaysia. 24-26 November 1997, Bangkok, Thailand. Southeast Asian Fisheries Development Center, March 1999. pp.241-255.

Tharnbubpa, C. 1977. Seawater quality in the Inner Gulf and Western Coast of the Gulf of Thailand 1977. Marine Fisheries Laboratory Report No.5/77, marine Fisheries Laboratory, Department of Fisheries.

Tharnbubpa, C. and A. Jusiripongkul. 1984. Seawater quality in the Eastern Coast of the Gulf of Thailand 1982. Marine Fisheries Laboratory Report No. 6/83, Marine Fisheries Division, Department of Fisheries.

Thubthimsang, W. 1981. Observation on the spawning ground and spawning season of shrimps in the territorial water of Ko Samui and Ko Phangna, Surat Thani. Deptment of Fisheries, bangkok. 27pp. (*In Thai*)

Uraiwan, S. and T. Boonvanich. 1993. Collaborative Demersal Fish stock Survey between Thailand and Malasia in the Joint Development Area (JDA). Technical paper no. 4/1993. Southern Marine Fisheries Development Center. Marine Fisheries Division, department of Fisheries. 34pp. (*In Thai*)

Vatanachai, S. 1978. Distribution and abundance of fish eggs and larvae in the inner Gulf of Thailand. Marine Fisheries Laboratory, Marine Fisheries division, Department of Fiseries. Technical Report No. S.J./20/15 : 1-22.

Vetchakaran, K. 1987. Far sea fisheries of Thailand. *In* Seminar on Fisheries in the Future. Southeast Asian Fishery Development Center. pp. 405-445.

Vibhasiri, A. 1984. The status of shrimp resources and fisheries in the Gulf of Thailand. A report submitted to the seminar on Marine Fisheries of Thailand, Bangkok. 19pp. (*In Thai*)

Vibhasiri, A. 1988. An assessment of Jinga shrimp, *Metapenaeus affinis* (Penaeiddae), in Ban Don Bay, Gulf of Thailand. *In* Venema, S.C., J.M. Christensen and D. Pauly, (eds.), Contributions to Tropical Fisheries Biology. FAO Fish.Rep., (389): 101-116.

Vibhasiri, A. 1993. Penaeid Shrimp Resources in the Upper Coast, Gulf of Thailand. Technical paper No.4/1993, Stock Assessment Section, Bangkok Marine Fisheries Development Center, Sathon Distric, Bangkok. 24pp.

Westlund, L. 1995. Apparent historical consumption and future demand for fish fishery products exploratory calculation. Paper presented for the International Conference on Sustainable Contribution of Fisheries to Food Security, Kyoto, Japan, 1995. Rome: FAO/KC/FI/95/TECH/8.

Whitehead, P.J.P., G.J. Nelson and T. Wongratana. 1988. FAO species catalogue. Vol. 7. Clupeoid fishes of the world (Suborder Clupeoidei). An annotated and illustrated catalogue of the herrings, sardines, pilchards, sprats, shads, anchovies and wolf-herrings, Part 2. Engraulididae. FAO Fish. Synop., (125) Vol.7, Pt.1:303pp.

Wongratana, T. 1968. A check list of fishes caught during the trawl surveys in the Gulf of Thailand and off the east coast of the Malay Peninsula. Contribution no.13, Marine Fisheries Laboratory, Marine Fisheries division, Department of Fisheries, Ministry of Agriculture, Bangkok, Thailand. 96pp.

Yindepit, S. 1993. Kwuamrouu kue prateep. ESSO No. 2/34.

APPENDIX 1

Rates of Exchange of Commercial Bank in Bangkok Metropolis
(Baht per currency unit)

Year	Baht per one U.S. dollar Buying	Baht per one U.S. dollar Selling	Reference rate [1/]
1982	22.9000	23.0500	23.0000
1983	22.9000	23.0500	23.0000
1984	23.5392	23.6892	23.6393
1985	27.0593	27.2093	27.1594
1986	26.1991	26.3491	26.2992
1987	25.6359	25.7859	25.7353
1988	25.1941	25.3441	25.2940
1989	25.6020	25.7520	25.7020
1990	25.4960	25.6360	25.5854
1991	25.4157	25.5657	25.5166
1992	25.3203	25.4553	25.3999
1993	25.2197	25.3697	25.3196
1994	25.0498	25.1998	25.1498
1995	24.8151	24.9651	24.9151
1996	25.2439	25.3939	25.3439
1997	31.1542	31.4817	31.3723
1998	41.0276	41.5850	41.3709
1999	37.6172	37.9618	37.8405
2000	39.9535	40.2694	40.1621

1/ Prior to July 1997, the figures were the rate of the Exchange Equalization Fund (EEF)
Source : Bank of Thailand

Table 1a Indo-Pacific mackerel caught by commercial fishing gears in specific areas of the Gulf of Thailand from 1990 to 2000.

Year	Total (mt)	Area 1	Area 2	Area 3	Area 4	Area 5	Area A	Area B
1990	69,866	5,141	12,259	29,238	11,752	3,780	3,837	3,859
1991	55,169	1,494	1,091	17,722	23,929	0	9,865	1,068
1992	88,308	4,126	24,924	38,254	4,972	214	7,510	8,308
1993	68,025	2,553	824	44,944	5,048	360	3,613	10,683
1994	73,944	3,679	19,595	33,230	6,989	14	7,441	2,996
1995	105,323	1,269	34,261	36,530	9,624	74	9,126	14,439
1996	86,617	4,825	32,677	26,525	2,760	0	15,267	4,563
1997	84,620	4,273	31,442	24,105	6,637	0	13,600	4,563
1998	91,943	2,130	25,569	38,459	13,719	0	6,699	5,367
1999	111,366	1,450	27,253	37,336	2,196	0	15,006	27,125
2000	107,667	1,524	21,509	38,699	1,445	0	11,716	32,774
Avg.	**85,713**	**2,951**	**21,037**	**33,186**	**8,097**	**404**	**9,425**	**10,522**

Table 1b Indian mackerel caught by commercial fishing gears in specific areas of the Gulf of Thailand from 1990 to 2000.

Year	Total (mt)	Area 1	Area 2	Area 3	Area 4	Area 5	Area A	Area B
1990	20,922	5,577	1,550	8,120	1,549	3,658	419	49
1991	16,269	8,011	969	6,523	757	0	1	8
1992	29,353	9,639	132	8,156	436	10,506	337	147
1993	33,882	7,633	1,303	4,887	1,094	16,018	979	1,968
1994	49,235	31,645	316	5,188	2,073	9,913	100	0
1995	43,697	7,017	42	4,287	1,643	28,511	1,055	1,142
1996	19,934	3,080	505	4,802	2,607	6,635	2,228	77
1997	18,352	2,748	482	4,519	2,525	5,972	1,994	112
1998	18,475	2,519	2,176	7,437	4,539	0	1,474	330
1999	25,984	1,856	5,446	10,707	3,805	1,011	1,775	1,384
2000	20,561	1,737	1,484	9,953	2,532	657	2,516	1,682
Avg.	**26,969**	**7,406**	**1,310**	**6,780**	**2,142**	**7,535**	**1,171**	**627**

Table 1c Spanish mackerel caught by commercial fishing gears in specific areas of the Gulf of Thailand from 1990 to 2000.

Year	Total (mt)	Area 1	Area 2	Area 3	Area 4	Area 5	Area A	Area B
1990	9,223	1,507	393	2,780	2,212	1,379	692	260
1991	6,118	670	205	1,886	1,675	0	1,235	447
1992	6,711	1,017	229	1,271	1,545	104	1,172	1,373
1993	9,568	1,275	212	1,572	1,733	150	1,642	2,984
1994	8,537	2,288	109	947	727	604	1,482	2,380
1995	9,258	1,603	231	1,121	1,174	376	2,513	2,240
1996	8,205	885	370	2,170	1,834	29	2,243	674
1997	7,654	794	358	1,962	1,661	26	1,942	911
1998	7,516	440	767	1,384	3,193	0	807	925
1999	7,922	303	702	1,024	2,430	339	1,180	1,520
2000	6,516	135	607	1,232	1,418	248	1,590	1,539
Avg.	**7,930**	**992**	**380**	**1,577**	**1,782**	**296**	**1,500**	**1,387**

Table 1d Longtail tuna caught by commercial fishing gears in specific areas of the Gulf of Thailand from 1990 to 2000.

Year	Total (mt)	Area 1	Area 2	Area 3	Area 4	Area 5	Area A	Area B
1990	101,293	2,642	1,869	5,413	15,416	67,284	4,658	4,011
1991	79,186	4,754	6,521	2,327	2,053	0	63,531	0
1992	72,276	617	2,145	569	3,466	398	3,467	61,614
1993	39,395	1,261	1,300	2,095	3,140	2,131	8,561	20,907
1994	31,767	10,457	14,428	1,900	1,655	865	1,495	967
1995	38,746	7	1,537	850	2,256	351	18,359	15,386
1996	32,235	111	1,732	764	2,795	285	17,672	8,876
1997	29,016	100	1,560	688	2,516	256	15,906	7,990
1998	34,715	1,463	1,102	2,077	4,215	0	12,135	13,723
1999	45,736	339	1,497	1,232	3,290	329	11,710	27,339
2000	52,978	44	1,490	1,280	1,442	219	6,342	42,161
Avg.	**50,668**	**1,981**	**3,198**	**1,745**	**3,840**	**6,556**	**14,894**	**18,452**

Table 1e Little tuna caught by commercial fishing gears in specific areas of the Gulf of Thailand from 1990 to 2000.

Year	Total (mt)	Area 1	Area 2	Area 3	Area 4	Area 5	Area A	Area B
1990	54,915	5,150	1,089	2,777	20,628	14,599	9,799	873
1991	58,763	6,134	270	2,087	3,876	0	46,396	0
1992	84,887	6,707	25	3,827	2,125	7,425	15,074	49,704
1993	67,402	5,691	0	2,895	2,086	9,286	13,784	33,660
1994	67,817	38,960	0	4,224	1,588	15,561	7,272	212
1995	48,117	3,568	0	382	2,781	17,819	9,458	14,109
1996	47,125	926	341	2,643	2,118	8,324	27,569	5,204
1997	42,557	833	307	2,380	2,049	7,491	24,814	4,683
1998	43,930	548	303	592	4,655	0	20,211	17,621
1999	56,681	137	35	712	3,171	1,209	12,947	38,470
2000	43,988	109	80	1,110	1,897	830	11,538	30,424
Avg.	**56,017**	**6,251**	**223**	**2,148**	**4,270**	**7,504**	**18,078**	**17,724**

Table 1f Round scad caught by commercial fishing gears in specific areas of the Gulf of Thailand from 1990 to 2000.

Year	Total (mt)	Area 1	Area 2	Area 3	Area 4	Area 5	Area A	Area B
1990	10,676	232	218	997	1,418	72	7,739	0
1991	22,747	53	4	448	898	0	21,344	0
1992	42,525	3,266	795	577	1,297	3,722	32,868	0
1993	46,186	1,380	0	2	892	5,947	37,884	81
1994	38,394	4,753	0	204	0	1,696	31,741	0
1995	54,633	502	0	948	0	7,744	35,755	9,684
1996	52,640	239	0	0	34	2,541	37,370	12,456
1997	47,379	215	0	0	31	2,287	33,634	11,212
1998	57,893	0	0	279	0	0	37,051	20,563
1999	56,461	0	102	2,207	0	2,643	51,071	438
2000	67,902	470	8,321	5,608	0	1,605	51,733	165
Avg.	**45,221**	**1,010**	**858**	**1,025**	**415**	**2,569**	**34,381**	**4,964**

Table 1g Hardtail scad caught by commercial fishing gears in specific areas of the Gulf of Thailand from 1990 to 2000.

Year	Total (mt)	Area 1	Area 2	Area 3	Area 4	Area 5	Area A	Area B
1990	13,663	1,447	707	3,451	4,074	806	3,168	10
1991	11,941	5,537	1	383	2,171	0	3,424	425
1992	17,775	530	449	917	1,299	1,915	12,665	0
1993	18,345	1,282	15	241	1,214	3,665	7,053	4,875
1994	20,532	4,707	5	61	1,737	1,843	8,716	3,463
1995	9,474	1,002	3	243	1,096	3,710	2,309	1,111
1996	4,412	858	81	0	929	817	1,421	306
1997	3,947	750	69	0	837	736	1,279	276
1998	7,499	260	471	2,906	391	0	3,172	299
1999	6,232	37	259	1,168	409	340	4,019	0
2000	6,185	35	194	932	0	139	4,885	0
Avg.	**10,910**	**1,495**	**205**	**937**	**1,287**	**1,270**	**4,737**	**979**

Table 1h Bigeye scad caught by commercial fishing gears in specific areas of the Gulf of Thailand from 1990 to 2000.

Year	Total (mt)	Area 1	Area 2	Area 3	Area 4	Area 5	Area A	Area B
1990	21,548	2,823	311	6,715	3,415	512	7,670	102
1991	15,462	692	166	1,315	2,394	0	10,895	0
1992	21,851	876	45	1,920	974	1,340	16,660	36
1993	19,581	1,295	51	540	1,190	2,960	13,544	1
1994	37,080	4,532	87	963	2,347	708	28,427	16
1995	36,449	2,376	77	1,395	2,144	4,388	20,158	5,911
1996	24,533	152	98	6,439	2,156	1,276	10,676	3,736
1997	22,188	136	96	5,799	1,946	1,149	9,495	3,567
1998	24,931	487	406	2,074	1,640	0	18,302	2,022
1999	26,029	103	4,093	9,093	2,274	548	8,206	1,712
2000	29,075	342	6,971	6,518	1,259	535	11,273	2,177
Avg.	**25,339**	**1,256**	**1,127**	**3,888**	**1,976**	**1,220**	**14,119**	**1,753**

Table 1i Trevallies caught by commercial fishing gears in specific areas of the Gulf of Thailand from 1990 to 2000.

Year	Total (mt)	Area 1	Area 2	Area 3	Area 4	Area 5	Area A	Area B
1990	36,186	3,007	15,582	9,911	5,154	1,136	887	509
1991	34,574	2,847	21,478	5,254	4,470	0	501	24
1992	41,281	3,416	26,566	2,521	3,590	2,232	2,670	286
1993	40,913	1,498	14,782	13,750	4,963	329	2,347	3,244
1994	54,546	5,711	27,375	8,564	6,734	33	4,798	1,331
1995	46,485	2,657	18,993	1,646	6,942	5,917	7,386	2,944
1996	43,643	3,586	15,729	9,093	6,221	1,142	5,577	2,295
1997	40,731	3,167	14,239	8,193	6,718	1,028	4,805	2,581
1998	33,346	3,818	7,159	6,831	5,851	0	7,495	2,192
1999	35,217	1,743	9,715	8,824	4,705	83	7,224	2,923
2000	30,744	573	12,064	6,007	2,968	62	6,245	2,825
Avg.	**39,788**	**2,911**	**16,698**	**7,327**	**5,301**	**1,087**	**4,540**	**1,923**

Table 1j Sardines caught by commercial fishing gears in specific areas of the Gulf of Thailand from 1990 to 2000.

Year	Total (mt)	Area 1	Area 2	Area 3	Area 4	Area 5	Area A	Area B
1990	90,789	14,555	9,276	26,428	20,356	11,746	8,428	0
1991	114,472	7,941	3,120	49,214	7,911	0	46,286	0
1992	141,422	8,689	12,966	66,568	5,699	1,944	45,556	0
1993	112,620	4,558	1,456	67,309	5,503	7,114	19,974	6,706
1994	123,700	5,375	4,785	98,939	7,533	2,195	4,873	0
1995	137,965	1,534	7,239	116,703	6,687	5,517	0	285
1996	159,071	928	5,686	131,712	11,769	862	6,087	2,027
1997	149,177	836	5,742	118,541	15,978	776	5,479	1,825
1998	124,907	1,997	2,447	98,376	12,248	0	8,925	914
1999	126,040	349	17,898	89,088	9,921	220	8,564	0
2000	120,571	412	38,233	78,232	2,528	276	890	0
Avg.	**127,339**	**4,289**	**9,895**	**85,555**	**9,648**	**2,786**	**14,097**	**1,069**

Table 1k Anchovies caught by commercial fishing gears in specific areas of the Gulf of Thailand from 1990 to 2000.

Year	Total (mt)	Area 1	Area 2	Area 3	Area 4	Area 5	Area A	Area B
1990	118,707	107,072	2,493	9,063	39	40	0	0
1991	110,013	52,675	2,579	54,719	1	0	0	39
1992	120,211	72,600	1,978	43,634	86	1,551	156	206
1993	116,648	61,282	5,575	49,119	56	1	80	535
1994	97,343	33,156	1,666	58,812	138	0	1,145	2,426
1995	116,180	62,137	1,214	48,654	39	2	881	3,253
1996	115,217	45,396	3,030	59,858	3,819	0	1,529	1,585
1997	111,482	42,880	2,767	59,149	3,607	0	1,430	1,649
1998	115,747	44,391	3,956	60,541	4,631	0	843	1,385
1999	96,877	37,831	1,017	50,964	5,780	0	466	839
2000	113,665	51,503	2,216	51,967	5,694	0	1,195	1,090
Avg.	**112,008**	**55,538**	**2,590**	**49,680**	**2,172**	**145**	**702**	**1,182**

Table 2a Threadfin breams caught by commercial fishing gears in specific areas of the Gulf of Thailand from 1990 to 2000.

Year	Total (mt)	Area 1	Area 2	Area 3	Area 4	Area 5	Area A	Area B
1990	23,583	5,765	829	5,237	4,583	658	4,373	2,138
1991	33,044	12,125	1,030	5,360	8,621	0	220	5,688
1992	51,259	13,187	1,481	5,089	4,451	25	9,661	17,365
1993	57,452	13,007	1,656	3,683	9,192	825	8,334	20,755
1994	55,551	17,610	2,056	3,963	12,167	303	4,785	14,667
1995	71,064	8,671	1,865	5,104	15,306	1,352	22,280	16,486
1996	64,077	7,663	1,055	1,205	5,737	0	27,515	20,902
1997	62,441	6,896	1,006	1,086	5,226	0	24,125	24,102
1998	59,225	5,928	2,833	2,423	7,947	0	17,827	22,267
1999	69,866	5,740	2,011	3,087	6,181	0	22,207	30,640
2000	73,892	6,838	1,552	4,487	6,661	0	19,392	34,962
Avg.	**56,496**	**9,403**	**1,579**	**3,702**	**7,825**	**288**	**14,611**	**19,088**

Table 2b Lizard fishes caught by commercial fishing gears in specific areas of the Gulf of Thailand from 1990 to 2000.

Year	Total (mt)	Area 1	Area 2	Area 3	Area 4	Area 5	Area A	Area B
1990	12,985	1,985	492	3,846	2,056	528	3,068	1,010
1991	19,994	3,992	504	4,101	4,842	0	217	6,338
1992	30,789	3,617	458	5,037	2,564	8	8,774	10,331
1993	42,485	4,430	1,206	4,828	4,351	463	12,063	15,144
1994	34,973	5,828	861	3,751	4,715	121	8,741	10,956
1995	58,482	2,643	1,096	5,012	5,094	1,574	9,607	33,456
1996	51,004	2,870	1,471	626	7,673	0	18,704	19,660
1997	62,397	2,610	1,404	572	6,934	0	12,295	38,582
1998	35,289	1,832	945	1,323	9,083	0	8,536	13,570
1999	60,534	2,224	541	2,374	6,998	0	8,966	39,431
2000	52,601	1,826	561	1,131	4,079	0	7,327	37,677
Avg.	**41,958**	**3,078**	**867**	**2,964**	**5,308**	**245**	**8,936**	**20,560**

Table 2c Snappers caught by commercial fishing gears in specific areas of the Gulf of Thailand from 1990 to 2000.

Year	Total (mt)	Area 1	Area 2	Area 3	Area 4	Area 5	Area A	Area B
1990	3,154	196	210	113	1,105	138	609	783
1991	2,633	397	256	195	1,014	0	0	771
1992	4,977	517	162	205	67	0	704	3,322
1993	10,676	448	194	248	573	41	619	8,553
1994	7,977	606	8	296	1,420	69	513	5,065
1995	8,658	391	165	244	2,035	54	991	4,778
1996	8,962	221	235	181	3,284	2	2,360	2,679
1997	8,383	206	226	165	2,970	2	1,720	3,094
1998	11,360	725	193	373	1,974	0	5,586	2,509
1999	8,470	155	121	600	2,409	0	1,451	3,734
2000	5,207	151	227	331	1,228	0	887	2,383
Avg.	**7,314**	**365**	**182**	**268**	**1,644**	**28**	**1,404**	**3,425**

Table 2d Big-eyes caught by commercial fishing gears in specific areas of the Gulf of Thailand from 1990 to 2000.

Year	Total (mt)	Area 1	Area 2	Area 3	Area 4	Area 5	Area A	Area B
1990	19,438	4,618	954	4,350	6,509	622	1,876	509
1991	24,899	8,213	882	4,335	6,380	0	327	4,762
1992	36,221	9,062	323	4,165	2,504	153	10,745	9,269
1993	49,710	10,994	759	2,918	11,560	971	8,600	13,908
1994	44,674	13,607	843	2,797	12,696	281	4,686	9,764
1995	57,723	7,807	672	3,895	12,048	1,396	15,809	16,096
1996	67,411	7,445	810	1,558	21,173	0	26,418	10,007
1997	62,673	6,695	770	1,426	19,249	0	23,521	11,012
1998	64,871	4,095	2,052	1,847	20,995	0	16,417	19,465
1999	71,065	4,610	1,774	3,080	16,111	0	19,223	26,267
2000	65,166	5,629	1,102	3,238	12,586	0	15,800	26,811
Avg.	**51,259**	**7,525**	**995**	**3,055**	**12,892**	**311**	**13,038**	**13,443**

Table 2e Groupers caught by commercial fishing gears in specific areas of the Gulf of Thailand from 1990 to 2000.

Year	Total (mt)	Area 1	Area 2	Area 3	Area 4	Area 5	Area A	Area B
1990	1,156	163	84	247	156	100	341	65
1991	1,537	348	107	339	452	0	11	280
1992	2,666	510	129	277	162	0	1,171	417
1993	2,742	448	152	209	613	63	479	778
1994	5,598	721	34	193	2,015	35	572	2,028
1995	5,257	352	136	310	1,677	51	798	1,933
1996	5,662	277	201	153	2,721	0	1,463	847
1997	5,515	253	194	140	2,475	0	1,130	1,323
1998	4,904	196	166	304	1,501	0	1,148	1,589
1999	5,420	228	140	586	1,028	0	1,260	2,178
2000	4,843	233	225	258	708	0	1,169	2,250
Avg.	**4,118**	**339**	**143**	**274**	**1,228**	**23**	**867**	**1,244**

Table 3a Banana prawn caught by commercial fishing gears in specific areas of the Gulf of Thailand from 1990 to 2000.

Year	Total (mt)	Area 1000	Area 2	Area 3	Area 4	Area 5	Area A	Area B
1990	1,652	271	465	162	248	0	494	12
1991	1,494	542	307	290	328	0	20	7
1992	2,089	154	441	338	372	0	181	603
1993	1,734	341	632	365	354	15	27	0
1994	2,431	1,247	328	449	365	0	36	6
1995	2,445	88	623	384	307	0	1,022	21
1996	1,429	48	558	297	302	0	204	20
1997	1,354	48	532	267	300	0	187	20
1998	2,342	47	418	154	644	0	1,023	56
1999	2,339	135	769	219	401	0	89	726
2000	3,651	91	983	936	728	0	130	783
Avg.	**2,087**	**274**	**551**	**351**	**395**	**1**	**310**	**205**

Table 3b Jumbo tiger prawns caught by commercial fishing gears in specific areas of the Gulf of Thailand from 1990 to 2000.

Year	Total (mt)	Area 1000	Area 2	Area 3	Area 4	Area 5	Area A	Area B
1990	59	10	23	25	0	0	0	1
1991	135	29	49	41	15	0	1	0
1992	154	0	37	73	44	0	0	0
1993	167	4	35	59	45	19	5	0
1994	363	61	34	140	124	0	3	1
1995	317	3	12	189	101	0	12	0
1996	527	13	50	201	153	0	92	18
1997	495	13	50	180	149	0	85	18
1998	253	7	73	73	31	0	22	47
1999	829	60	37	64	104	0	15	549
2000	1,096	32	59	371	63	0	43	528
Avg.	**400**	**21**	**42**	**129**	**75**	**2**	**25**	**106**

Table 3c Tiger prawns caught by commercial fishing gears in specific areas of the Gulf of Thailand from 1990 to 2000.

Year	Total (mt)	Area 1000	Area 2	Area 3	Area 4	Area 5	Area A	Area B
1990	245	83	7	118	6	0	31	0
1991	319	159	2	121	18	0	19	0
1992	283	168	0	79	0	0	36	0
1993	308	185	0	70	13	0	40	0
1994	543	230	0	81	85	0	78	69
1995	670	139	0	45	61	0	215	210
1996	1,041	159	3	75	68	0	579	157
1997	1,023	144	3	73	68	0	406	329
1998	839	81	2	118	60	0	176	402
1999	587	156	0	20	136	0	146	129
2000	713	124	18	35	187	0	188	161
Avg.	**597**	**148**	**3**	**76**	**64**	**0**	**174**	**132**

Table 3d King prawns caught by commercial fishing gears in specific areas of the Gulf of Thailand from 1990 to 2000.

Year	Total (mt)	Area 1000	Area 2	Area 3	Area 4	Area 5	Area A	Area B
1990	644	187	71	192	166	0	28	0
1991	1,029	212	84	371	350	0	12	0
1992	592	114	16	425	24	0	13	0
1993	400	109	15	267	6	0	3	0
1994	308	9	109	170	7	0	10	3
1995	368	61	0	167	94	0	3	43
1996	498	10	47	232	95	0	71	43
1997	500	10	47	216	89	0	59	79
1998	440	5	133	49	153	0	18	82
1999	287	20	74	134	46	0	4	9
2000	948	11	93	717	53	0	27	47
Avg.	**547**	**68**	**63**	**267**	**98**	**0**	**23**	**28**

Table 3e Other shrimps caught by commercial fishing gears in specific areas of the Gulf of Thailand from 1990 to 2000.

Year	Total (mt)	Area 1000	Area 2	Area 3	Area 4	Area 5	Area A	Area B
1990	58,110	1,772	7,589	11,115	36,418	39	1,069	108
1991	69,486	950	11,067	24,305	32,084	0	723	357
1992	61,195	647	13,032	17,536	27,782	82	1,382	734
1993	63,815	1,619	13,509	21,919	23,758	305	1,165	1,450
1994	64,314	547	12,570	19,089	29,423	0	1,195	1,490
1995	65,774	240	17,437	10,449	34,077	0	1,787	1,784
1996	68,639	371	12,528	11,496	35,844	0	7,984	416
1997	65,140	353	11,753	10,210	34,765	0	7,167	892
1998	43,078	659	9,794	7,537	21,356	0	1,601	2,131
1999	32,908	971	9,054	5,463	14,846	0	250	2,324
2000	36,891	1,022	9,399	5,969	15,548	0	2,462	2,491
Avg.	**57,214**	**832**	**11,612**	**13,190**	**27,809**	**39**	**2,435**	**1,289**

Table 3f Flathead lobsters caught by commercial fishing gears in specific areas of the Gulf of Thailand from 1990 to 2000.

Year	Total (mt)	Area 1000	Area 2	Area 3	Area 4	Area 5	Area A	Area B
1990	853	103	94	179	260	17	166	34
1991	923	20	170	56	436	0	11	230
1992	766	11	27	48	82	0	369	229
1993	1,053	119	55	262	167	5	163	282
1994	858	47	33	52	201	0	162	363
1995	1,669	10	117	20	311	0	113	1,098
1996	2,629	57	328	167	1,156	0	357	564
1997	2,687	57	311	152	1,050	0	285	832
1998	2,957	29	368	109	1,038	0	491	922
1999	1,746	3	12	66	646	0	83	936
2000	2,254	2	61	157	575	0	289	1,170
Avg.	**1,672**	**42**	**143**	**115**	**538**	**2**	**226**	**605**

Table 3g Mantis shrimps caught by commercial fishing gears in specific areas of the Gulf of Thailand from 1990 to 2000.

Year	Total (mt)	Area 1000	Area 2	Area 3	Area 4	Area 5	Area A	Area B
1990	314	66	72	107	45	0	15	9
1991	382	17	9	305	37	0	0	14
1992	165	10	2	117	6	0	16	14
1993	166	25	8	109	9	0	2	13
1994	296	77	20	180	8	0	3	8
1995	184	63	37	64	11	0	6	3
1996	181	26	65	46	37	0	7	0
1997	176	25	65	45	34	0	7	0
1998	427	2	163	1	60	0	57	144
1999	750	4	387	269	76	0	12	3
2000	866	17	223	609	4	0	13	0
Avg.	**355**	**30**	**96**	**168**	**30**	**0**	**13**	**19**

Table 3h Swimming crabs caught by commercial fishing gears in specific areas of the Gulf of Thailand from 1990 to 2000.

Year	Total (mt)	Area 1	Area 2	Area 3	Area 4	Area 5	Area A	Area B
1990	9,993	595	4,213	1,609	3,035	169	302	70
1991	6,532	683	731	2,576	2,052	0	132	358
1992	5,942	497	1,155	1,841	1,176	168	803	302
1993	6,733	559	756	2,043	2,522	61	524	268
1994	8,709	539	834	2,094	4,243	0	552	447
1995	9,321	425	889	997	4,852	4	726	1,428
1996	12,285	569	1,229	1,998	6,360	0	1,517	612
1997	11,408	515	1,166	1,804	5,875	0	1,330	718
1998	9,183	213	707	1,243	5,273	0	1,250	497
1999	7,008	163	588	998	4,311	0	605	340
2000	8,577	187	669	1,236	5,368	0	710	407
Avg.	**8,699**	**450**	**1,176**	**1,676**	**4,097**	**37**	**768**	**495**

Table 3i Common squids caught by commercial fishing gears in specific areas of the Gulf of Thailand from 1990 to 2000.

Year	Total (mt)	Area 1000	Area 2	Area 3	Area 4	Area 5	Area A	Area B
1990	35,048	6,775	2,064	8,367	12,877	1,759	2,463	743
1991	33,915	5,826	1,910	9,752	14,413	0	338	1,676
1992	29,243	4,707	2,056	6,258	7,893	706	3,207	4,416
1993	35,257	6,084	1,782	5,157	13,078	1,272	2,910	4,974
1994	33,166	5,842	1,771	4,780	12,957	241	2,520	5,055
1995	38,431	4,427	1,759	4,314	12,393	2,165	5,607	7,766
1996	37,802	4,556	2,002	3,473	10,551	0	8,883	8,337
1997	35,773	4,092	1,879	3,168	9,677	0	7,799	9,158
1998	34,442	2,839	2,205	4,207	10,342	0	5,681	9,168
1999	40,246	3,592	3,012	3,875	9,422	0	7,276	13,069
2000	48,911	3,722	5,339	9,235	8,190	0	9,532	12,893
Avg.	**36,567**	**4,769**	**2,344**	**5,690**	**11,072**	**558**	**5,111**	**7,023**

Table 3j Cuttlefish caught by commercial fishing gears in specific areas of the Gulf of Thailand from 1990 to 2000.

Year	Total (mt)	Area 1000	Area 2	Area 3	Area 4	Area 5	Area A	Area B
1990	37,352	3,924	2,036	10,039	16,085	725	3,620	923
1991	41,645	5,680	4,449	11,125	15,334	0	464	4,593
1992	39,321	7,767	2,866	7,831	7,853	282	6,780	5,942
1993	36,574	5,673	1,766	7,505	10,938	645	5,141	4,906
1994	34,342	4,963	1,433	6,317	12,229	81	4,146	5,173
1995	37,190	3,296	2,006	5,344	11,874	778	4,385	9,507
1996	37,640	2,787	2,271	2,905	9,643	0	9,232	10,802
1997	37,439	2,494	2,138	2,643	8,840	0	7,655	13,669
1998	36,928	2,310	2,039	2,992	10,699	0	5,762	13,126
1999	37,945	2,594	2,417	2,366	8,716	0	6,498	15,354
2000	35,841	2,345	2,201	2,470	7,154	0	6,413	15,258
Avg.	**37,474**	**3,985**	**2,329**	**5,594**	**10,851**	**228**	**5,463**	**9,023**

Table 3k Octopus caught by commercial fishing gears in specific areas of the Gulf of Thailand from 1990 to 2000.

Year	Total (mt)	Area 1000	Area 2	Area 3	Area 4	Area 5	Area A	Area B
1990	15,729	883	2,050	3,704	7,857	294	866	75
1991	13,960	1,192	1,952	6,045	3,949	0	249	573
1992	14,646	1,034	1,673	6,264	1,942	211	1,992	1,530
1993	13,681	1,089	1,883	4,489	2,478	120	1,870	1,752
1994	11,145	1,012	947	3,856	2,572	32	1,295	1,431
1995	10,795	690	1,600	1,933	1,841	372	1,266	3,093
1996	12,718	578	1,790	2,242	3,291	0	3,090	1,727
1997	12,112	520	1,695	2,049	3,043	0	2,621	2,184
1998	12,949	843	1,626	2,104	3,296	0	1,845	3,235
1999	11,961	1,048	1,697	1,209	3,370	0	1,646	2,991
2000	10,866	449	1,900	1,081	4,015	0	1,877	1,544
Avg.	**12,778**	**849**	**1,710**	**3,180**	**3,423**	**94**	**1,692**	**1,830**

APPENDIX 2
Extinct, Extinct in the Wild, Critically Endangered, Vulnerable, and Threatened Marine Species in Thailand

No.	Type	Scienticific name	Common name	Local name (Thai name)	Status
1	Mammal	*Orcaella brevirostris*	Irrawady dolphin	Loma erawadee	CR
2	Mammal	*Dugong dugon*	Sea cow, Dugong	Payoon	CR
3	Mammal	*Mesoplodon ginkgodens*	Ginkgotoothed beaked whale	Wal fun khaew	CR
4	Mammal	*Peponocephala electra*	Melonheaded whale	Wal hua tang mo	EN
5	Mammal	*Steno bredanensis*	Roughtoothed dolphin	Loma fun hang	EN
6	Mammal	*Delphinus capensis*	Longbeaked common dolphin	Lonma pak yoa	EN
7	Mammal	*Balaenoptera physalus*	Fin whale	Wal fin	EN
8	Mammal	*Balaenoptera edeni*	Bryde's whale	Wal sit tang	EN
9	Mammal	*Physeter macrocephalus*	Sperm whale	Wal hua tui	EN
10	Mammal	*Kogia breviceps*	Pigmy sperm whale	Wal hua tui lex	EN
11	Mammal	*Kogia simus*	Dwarf sperm whale	Wal hua tui kak	EN
12	Mammal	*Orcinus orca*	Killer whale	Wal pet cha kart	EN
13	Mammal	*Globicephalus macrorhynchus*	Pigmy killer whale	Wal num rong krep sun	EN
14	Mammal	*Stenella coeruleoalba*	Striped dolphin	Loma tab	EN
15	Mammal	*Stenella attenuata*	Spotted dolphin	Loma jud	EN
16	Mammal	*Feresa attenuata*	Pygmy killer whale	Wal petchakart lex	EN
17	Mammal	*Neophocaena phcaenoides*	Finless porpoise	Loma hua baht lan leab	EN
18	Mammal	*Sousa chinensis*	Indo-Pacific humpbacked dolphin	Loma perk	EN
19	Mammal	*Stenella longirostris*	Spinner dolphin	Loma kadod	EN
20	Mammal	*Tursiops aduncus/truncatus*	Bottlenose dolphin	Loma pakkhod	EN
21	Mammal	*Pseudorca crassidens*	False killer whale	Wal petchabart dum	EN
22	Fishes	*Macrochirichthys macrochirus*		Dab loas	EN
23	Fishes	*Tetraodon baileyi*		Pukpult khon	EN
24	Fishes	*Sphyrna blochii*	Wing hammerhead shark	Chalam hua korn yao	EN
25	Fishes	*Chiloscyllium plagiosum*	Whitespot bambooshark	Chalammalayoo chalamhin	VU
26	Fishes	*Carcharhinus brachyurus*	Copper shark	Chalamkeepdang	VU
27	Fishes	*Carcharhinus obscurus*	Dusky shark	Chalamtow	VU
28	Fishes	*Rhizoprionodon acutus*	Milk shark	Chalamhualeam	VU
29	Fishes	*Rhina ancylostoma*	Bighead quitarfish	Ronin krabentongnum	VU
30	Fishes	*Rhinobatos granulatus*	Rough-backed guitarfish	Ronun emud	VU
31	Fishes	*Rhinobatos thouini*	Bottlenosed guitarfish	Emod emud	VU
32	Fishes	*Narcine brunnea*	Brown electric ray	Krabenfirefahseenumtan	VU
33	Fishes	*Narcine maculata*	Blotched electric ray	Krabenfirefajudkem	VU
34	Fishes	*Narke dipterygia*	Electric ray	Krabenfirefa	VU
35	Fishes	*Dasyatis brevicaudatus*	Smooth stingray	Krabenhangsun	VU