

## Sustainable utilization of fishery resources in the Andaman coastal areas, southern Thailand

Yoshimi Fujioka, Chumpol Srithong<sup>1</sup>, Ryuichi Tabuchi<sup>2</sup>, Makoto Sano<sup>2</sup>, and Pipat Patanaponpaiboon<sup>3</sup>

National Research Institute of Aquaculture, Fisheries Research Agency, Mie 516-0193, Japan, <sup>1</sup>Faculty of Fisheries, Kasetsart University, Bangkok 10900, Thailand, <sup>2</sup>Forestry and Forest Products Research Institute, Ibaraki 305-8687, Japan, <sup>3</sup>Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand

**Abstract:** Mangrove swamps provide rich diversity and high productivity of fishery resources and other fundamental ecological services for local inhabitants living in the coastal regions. We demonstrated in this study, fishing activities observed in front of mangrove swamps of the Andaman coastal areas, Ranong province, southern Thailand, to reveal the relationships between wetlands and the livelihood of local inhabitants, and discussed appropriate strategies to use sustainably the fishery resources. During the last 41 years, areas of natural mangrove forests decreased drastically, whereas areas of reservoirs, aquaculture ponds and aquaculture cages were largely increased due to the development of irrigation systems and aquaculture technologies. In Kamphuan village, 11.8-25.2 % of households were involved in fishing activities at the coastal waters in front of mangrove swamps. A total of 92 commercial fish species belonging to 46 families and 13 orders and a total of 48 commercial invertebrate species belonging to the 29 families, 15 orders and 5 phyla were classified into the taxonomic lists, most of which were the marine or brackish water species. Fishermen of Kamphuan village captured crabs, shrimps, squids, cuttlefishes, jellyfish, sand borer, sardines, mackerels, and some other fishes by means of various indigenous fishing gears. Shrimp net was the most popular fishing gear in this areas, followed by crab net, fish net, cuttlefish trap and fish trap. The efficient use of the indigenous fishing gears depended on understanding of fish behaviors, habitat and seasonal environmental conditions. Fishing gears and the target fishes were considerably different among the communities. By sharing the fishing gears, the fishing grounds and the target species, local inhabitants could avoid competition for fishery resources each other, and consequently, utilize sustainably natural fishery resources in the coastal areas.

**Key words:** Fishery resources, fishing gear, coastal fishery, mangrove, Andaman sea.

### Introduction

In the tropical coastal regions, mangrove swamps are playing important roles for aquatic organisms to supply breeding sites, spawning sites, nursery grounds and potential sources of food. They provide rich natural resources and other fundamental ecological services for local inhabitants living in the coastal regions. In particular, fishery resources support their livelihood to obtain protein sources and stable cash income. Understanding their routine fishing activities as well as diversity and productivity of fishery resources are important to promote sustainable utilization of the mangrove swamps.

In coastal regions, however, mangrove forests decreased drastically due to intensive shrimp aquaculture, charcoal making, urbanization and some other reasons (Hogarth 1999, Barbier and sathirathai, 2004, Patanaponpaiboon 2010). As the result, capture fishery production decreased remarkably in coastal regions of Thailand (DOF 2008, FAO 2010, 2011). Appropriate management and conservation of the mangrove swamps and the coastal areas are utmost important for utilizing sustainably the fishery resources.

We demonstrated in this study, fishing activities observed in front of mangrove swamps of the Andaman coastal areas, southern Thailand, to reveal the relationships between fishing activities and livelihood of local inhabitants, and discussed appropriate strategies to utilize sustainably the fishery resources, following the previous studies (Fujioka *et al.* 2010b, 2012).

### Materials and Methods

We studied fishing activities in the Andaman coastal areas of the southern Thailand. Study sites were selected at the mangrove swamps and the shallow coastal areas in front of Kamphuan and Naka villages, Suksamran district,

Ranong province, the Kingdom of Thailand (Fig. 1). This areas is located near the Myanmar border, and is well known as one of the largest production centers of fishery resources in southeastern Asia. The mangrove forests and the benthic organisms have been investigated for several years in and around the Andaman coastal research station for development (Ranong coastal resources research station) (9°22'37"N, 98°23'53"E), Kasetsart University, by our survey teams (Matsumoto *et al.*, 2006, Tabuchi 2010, Fujioka *et al.*, 2010a, Sano *et al.*, 2012).

In this study, we demonstrated that (1) aquatic organisms and fishery resources, (2) fishing activities in the coastal areas, and (3) livelihood of fishermen from the biological, fisheries and social scientific standpoints, respectively. In addition to administrative information about population and fishery statistics of Kamphuan and Naka villages, we obtained knowledge about local fisheries by interviewing village mayor and every community leaders. Furthermore we carried out systematic questionnaire investigation for 22 fishermen of the Kamphuan village and 8 fishermen of the Naka village to obtain detailed knowledge about fishing grounds, fishing gears, fishery production and other routine activities. Land use in the coastal areas of Suksamran district was investigated based on the Sano's (Sano *et al.*, 2012) landscape analysis using the aerial photograph and satellite image during the last 41 years from 1966 to 2007.

This study was implemented in collaboration and coordination among several Japanese and Thailand research institutes; that is, National Research Institute of Aquaculture, Japan (NRIA), Forestry and Forest Products Research Institute, Japan (FFPRI), Kasetsart University, Thailand (KU) and the Chulalongkorn University, Thailand (CU).

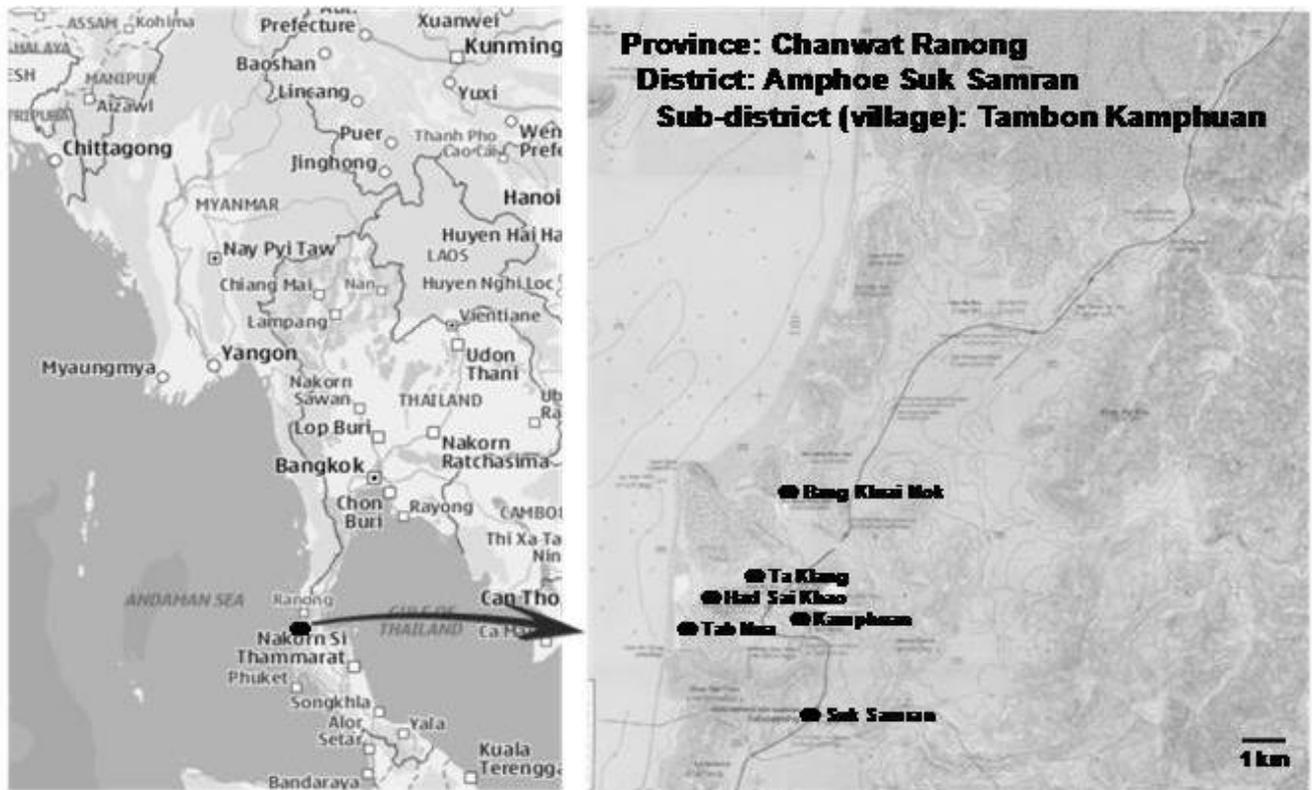


Fig. 1. Map of southern Thailand

## Results and Discussion

Sano *et al.* (2012) demonstrated land use in the coastal areas of Kamphuan village, Ranong province, based on the landscape analysis using the aerial photograph and satellite image. They classified approximately 120 km<sup>2</sup> coastal areas into 22 categories as shown in Fig. 2. Areas of natural forests (terrestrial forest, terrestrial shrub, mangrove forest, mangrove shrub and swamp forest) decreased from 52.4 % (6429.4 ha) to 37.7 % (4626.8 ha) during the 41 years from 1966 to 2007, in which the mangrove forests decreased remarkably from 797.6 ha to 53.9 ha. Whereas artificial changes were predominantly found in the areas of rubber and palm plantation, construction of villages and roads and aquaculture facilities.

Based on the landscape analysis of satellite image in 1997, spatial configuration of four categories concerning water systems; that is, river/sea, reservoir, aquaculture pond and aquaculture cage, was redrawn and separately exhibited in Fig. 2. Complicated water network of river tributaries was observed in the coastal areas since the mangrove swamps were topographically very flat and little difference in elevation. Although there was nothing areas for the latter three categories, reservoir, aquaculture pond and aquaculture cage, in 1966 (Sano *et al.* 2012), the areas increased to 22.9 ha, 295.5 ha and 54.2 ha, respectively, in 2007 (Fig. 2), due to the development of irrigation systems and aquaculture technologies in recent years. Intensive shrimp culture technologies for *Penaeus monodon* and *P. vannamei* spread throughout the southeast Asia over the last three decades and a lot of mangrove forests changed to the aquaculture ponds (Barbier *et al.*

2004). Fish aquaculture technologies by means of floating cage were also developed in recent years at the brackish waters around the mangrove estuaries.

In Kamphuan village, Ranong province, 5,695 inhabitants of 1,647 households were living in seven coastal communities; that is, Talay Nork, Tub Nua, Kamphuan, Ta Klang, Suk Samran, ToanKhoa and Hat Sai Khao (Table 1). Among them 199 households engaged in fisheries. In the four main fishermen villages, Talay Nork, Kamphuan, Ta Klang and Hat Sai Khao, 11.8-25.2 % of households were involved in fishing activities at the coastal waters in front of mangrove swamps. Most fishermen had their own fishing boats, and a total of 261 fishing boats were present in the Kamphuan village. Five of them were the medium-sized vessels of about 17-34 metric tons and the remaining 256 were small boats less than 1 metric ton.

Commercial fish species and commercial invertebrate species found in the coastal areas of Ranong province were classified into the taxonomic lists (Table 2, Table 3), which were based on the present study, comprehensive study about molluscan fauna (Fujioka *et al.*, 2007) and field survey of fish marketing system (Fujioka, unpublished). Thereby, in addition to captured fishes and cultured fishes, fishes sold in local and central markets were included in the lists. A total of 92 commercial fish species belonging to 46 families and 13 orders were hitherto identified (Table 2). A total of 48 commercial invertebrate species belonging to the 29 families, 15 orders and 5 phyla were also hitherto identified (Table 3). Most of them were marine or brackish water species, and there were a few freshwater ones.

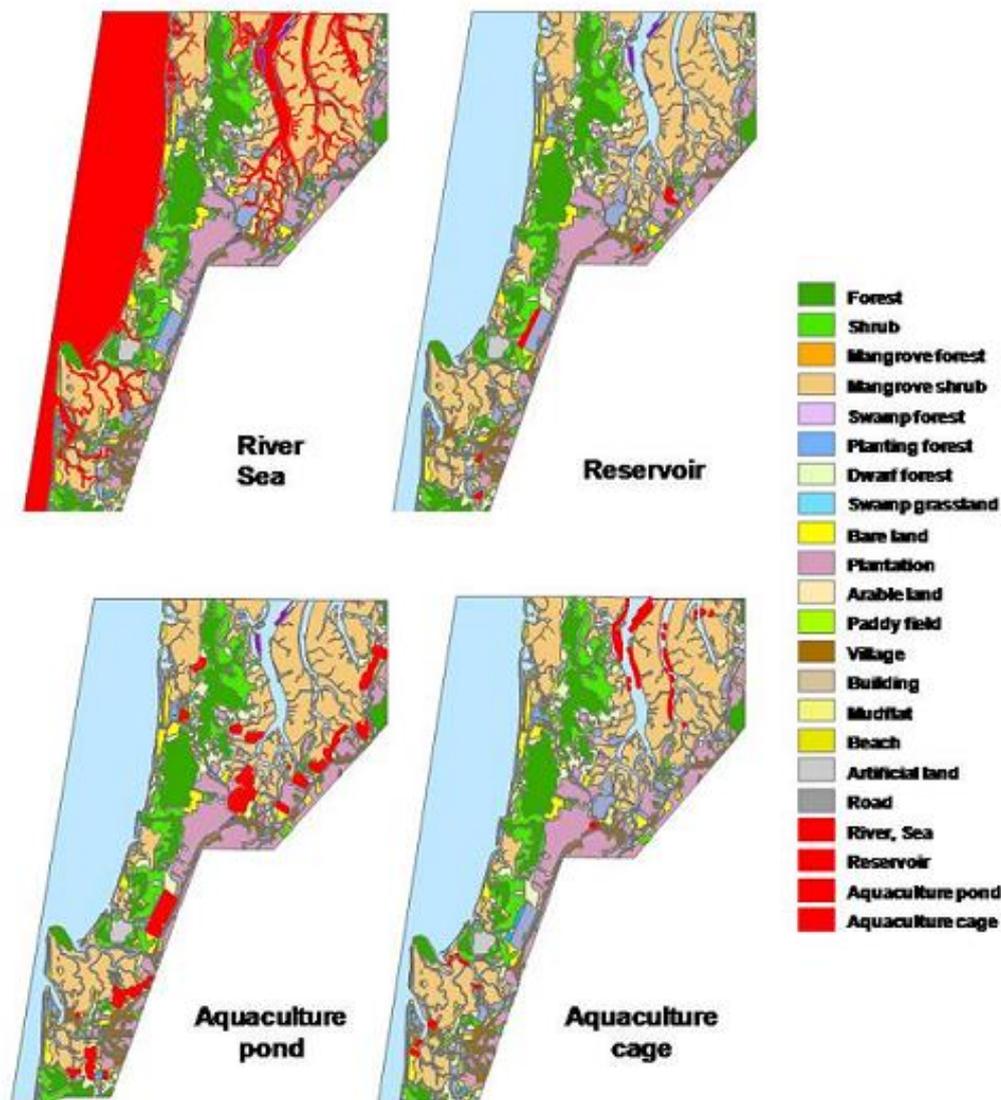


Fig. 2. Land use and water systems of Suksamran district, Ranong province, in 1997.

Fishermen of Kamphuan village captured crabs (*Portunus pelagicus*, *P. sanguinolentus*, *Charybdis feriatus* and *Thalamita crenata*), shrimps (*Penaeus merguensis* and *P. spp.*), squids (*Sepioteuthis lessoniana*, *Photololigo duvauceli* and *P. chinensis*), cuttle fishes (*Sepia pharaonis* and *S. spp.*), and borer (*Sillago sihama*), sardines (*Amblygaster clupeioides*), mackerels (*Rastrelliger kanagurta*), shads (*Anodontosto machacunda*), scads (*Selarcrumenoph thalmus*), snappers (*Lutjanus russellii* and *L. spp.*), goatfishes (*Parupeneus heptacanthus*), jellyfish (*Lobonemoides rubustus* and *L. spp.*) and Mysis (*Mysis spp.*). Besides, fishermen cultured some kinds of fishes and shells in the aquaculture cages along the river side near the mangrove estuaries; that is, giant seaperch (*Latescal carifer*), John's snapper (*Lutjanus johnii*), greasy grouper (*Epinephelus tauvina* and *E. coioides*), Nile tilapia (*Oreochromis niloticus*) and green mussel (*Perna viridis*). In the coastal aquaculture ponds, intensive shrimp culture for *Penaeus van namei* and *P. monodon* were carried out. Fishing gears observed in Kamphuan village were shown in Fig. 3. They operated various kinds of fishing gears; that is, shrimp net {Fig. 3 (1)}, crab net {Fig. 3 (2)}, sand

borer net {Fig. 3 (3)}, sardine/mackerel net (Fig. 3 (4)), squid net (Fig. 3 (5)), cuttlefish trap {Fig. 3 (6)}, fish trap {Fig. 3 (7)-(9)}, crab trap {Fig. 3 (10)}, push net (Fig. 3 (11)), scoop net (Fig. 3 (12)), handy dredge {Fig. 3 (15)} and other miscellaneous fishing gears. Aquaculture pond {Fig. 3 (13)} and aquaculture cage {Fig. 3 (14)} were also shown in Fig. 3. The efficient use of the indigenous fishing gears, especially trap fishing gears, depended on understanding of fish behaviors, habitat and seasonal environmental conditions.

Based on the administrative information about fisheries, fishing gears operated in seven communities of Kamphuan village and one neighboring community (Bang KruaiNok) of the Naka village were summarized in Fig. 4. Except for the small fishing gears (push net, scoop net and handy dredge), a total of 474 fishing gears were recognized in this areas. Shrimp net was the most popular fishing gear in this areas, followed by crab net and fish net, all of which were the kinds of gill nets and common in easy operation, simple structure and low investment cost. The length, the height and the mesh size were different according to the target species. Cuttlefish trap and fish trap included

several types of cage traps and were also popular in this areas.

**Table 1.** Population composition and fishermen in Kamphuan village, Ranong province.

No.	Village name	Population	No. of household	Fisherman household		No. of boat
				number	%	
1	Talay Nork	264	74	13	17.6	15
2	Tub Nua	1397	422	27	6.4	29
3	Kamphuan	1255	321	38	11.8	56
4	Ta Klang	1367	364	59	16.2	74
5	Suk Samran	567	167	1	0.6	2
6	Toan Khoa	284	65	2	3.1	2
7	Hai Sai Khao	561	234	59	25.2	83
Total		5695	1647	199	12.1	

**Table 2** Commercial fish species in the Andaman coastal areas of Ranong province, southern Thailand.

Phylum/Class/Order/Family	Species	Common Name	Scientist/Year
Phylum Chordata			
Class Chondrichthyes			
Order Lamniformis			
Family Sphyrnidae	<i>Sphyrna lewini</i> (Griffith & Smith, 1834)	Scalloped hammerhead shark	
Order Carcharhiniformes			
Family Carcharhinidae	<i>Rhizoprionodon acutus</i> Rüppell, 1837	Milk shark	
Order Rajiformis			
Family Rhinobatidae	<i>Rhynchobatus djiddensis</i> (Forsskal, 1775)	Giant guitarfish	
Family Dasyatidae	<i>Dasyatis zugei</i> (Muller and Henle, 1841)	Pale-edged stingray	
	<i>Himantura imbricata</i> (Bloch & Schneider, 1801)	Scaly whipray	
Class Osteichthyes			
Order Clupeiformes			
Family Clupeidae	<i>Tenuatosa toli</i> (Valenciennes, 1847)	Toli shad	
	<i>Tenuatosa macrura</i> (Bleeker, 1852)	Longtail shad	
	<i>Anodontostoma chacunda</i> (Hamilton, 1822)	Chacunda gizzard shad	
	<i>Amblygaster clupeioides</i> Bleeker, 1849	Bleeker's smoothbelly sardinella	
Family Chirocentridae	<i>Chirocentrus nudus</i> Swainson, 1839	Whitefin wolf-herring	
Family Engraulidae	<i>Stolephorus indicus</i> (van Hasselt, 1823)	Indian anchovy	
	<i>Stolephorus</i> sp.	Anchovy	
	<i>Thyssa</i> sp.	Tyssa	
Order Elopiformes			
Family Megalopidae	<i>Megalops cyprinoides</i> (Broussonet, 1782)	Indo-Pacific tarpon	
Order Anguilliformes			
Family Muraenesocidae	<i>Congresox talabon</i> (Cuvier, 1829)	Yellow pike conger	
Order Gonorynchiformes			
Family Chanidae	<i>Chanos chanos</i> (Forsskal, 1775)	Milkfish	
Order Siluriformes			
Family Ariidae	<i>Netuma thalassinus</i> (Ruppell, 1837)	Giant sea catfish	
Family Plotosidae	<i>Plotosus canius</i> Hamilton, 1822	Gray eel catfish, Eel catfish	
	<i>Plotosus lineatus</i> (Thunberg, 1787)	Striped eel catfish	
Order Myctophiformes			
Family Synodontidae	<i>Saurida undosquamis</i> (Richardson, 1848)	Brushtooth lizardfish	
Order Belontiiformes			
Family Hemiramphidae	<i>Hyporhamphus melanopterus</i> Collette & Parin, 1978	Blackfinned halfbeak	
	<i>Hyporhamphus quoyi</i> (Valenciennes, 1847)	Quoy's garfish	
Order Perciformes			
Family Mugilidae	<i>Liza vaigiensis</i> (Quoy & Gaimard, 1825)	Squaretail mullet	
	<i>Liza subviridis</i> (Valenciennes, 1836)	Greenback mullet	
	<i>Valamugil buehanani</i> (Bleeker, 1853)	Bluetail mullet	
Family Cichlidae	<i>Oreochromis niloticus</i> (Linnaeus, 1758)	Nile tilapia	
	<i>Oreochromis niloticus</i> var.	Taptim	
Family Sphyraenidae	<i>Sphyraena obtusata</i> Cuvier, 1829	Obtuse barracuda	
Family Polynemidae	<i>Polydactylus plebeius</i> (Broussonet, 1782)	Striped threadfin	
	<i>Polydactylus indicum</i> (Shaw, 1804)	Indian threadfin	
Family Centropomidae	<i>Lates calcarifer</i> (Bloch, 1790)	Giant sea perch	
Family Ambassidae	<i>Ambassis</i> sp.	Perchlet, Glassfish	
Family Serranidae	<i>Epinephelus coioides</i> (Hamilton, 1822)	Orange-spotted grouper	
	<i>Epinephelus tauvina</i> (Forsskal, 1775)	Greasy grouper	
Family Priacanthidae	<i>Priacanthus taxenus</i> Richardson, 1846	Purple-spotted bigeye	
Family Sillaginidae	<i>Sillago sihama</i> (Forsskal, 1775)	Silver sillago	
	<i>Sillago aeolus</i> (Jordan & Evermann, 1902)	Oriental trumpeter whiting	
Family Rachycentridae	<i>Rachycentron canadum</i> (Linnaeus, 1766)	Cobia	
Family Carangidae	<i>Elagatis bipinnulata</i> (Quoy & Gaimard, 1825)	Rainbow runner	
	<i>Seriolina nigrofasciata</i> (Ruppell, 1829)	Blackbanded trevally	
	<i>Scomberoides lysan</i> Forsskal, 1775	Doublespotted gueenfish	
	<i>Scomberoides commersonianus</i> Lecepede, 1801	Talang gueenfish	
	<i>Decapterus maruadii</i> Tamminck & Schlegel, 1843	Japanese scad	
	<i>Decapterus russelli</i> (Ruppell, 1830)	Indian scad, Round scad	
	<i>Selar boops</i> (Cuvier, 1833)	Oxeye scad	
	<i>Selar crumenophthalmus</i> (Bloch, 1793)	Bigeye scad	
	<i>Atule mate</i> (Cuvier, 1833)	Yellowtail scad	
	<i>Selaroides leptolepis</i> (Cuvier, 1833)	Yellowstripe scad	
	<i>Megalaspis cordyla</i> (Linnaeus, 1758)	Torpedo scad	
	<i>Caranx ignobilis</i> (Forsskal, 1775)	Giant trevally	
	<i>Caranx melampygus</i> (Cuvier, 1833)	Bluefin trevally	
	<i>Carangoides coeruleopinnatus</i> (Ruppell, 1830)	Coastal trevally	
	<i>Carangoides ferdau</i> (Forsskal, 1775)	Blue, trevally	
	<i>Carangoides hedlandensis</i> (Whitley, 1934)	Bumpnose trevally	
	<i>Alectis ciliaris</i> (Bloch, 1787)	African pompano	
Family Leiognathidae	<i>Leiognathus decorus</i> (De Vis, 1884)	Decorated ponyfish	
	<i>Leiognathus equulus</i> (Forsskal, 1775)	Common ponyfish	
	<i>Leiognathus</i> sp.	Ponyfish	
	<i>Secutor insidiator</i> (Bloch, 1787)	Pugnose ponyfish	
Family Lobotidae	<i>Lobotes surinamensis</i> (Bloch, 1790)	Tripletail	
Family Gerreidae	<i>Gerres filamentosus</i> Cuvier, 1829	Whipfin silver-biddy	
Family Sciaenidae	<i>Nibea semifasciata</i> Chu, Lo & Wu, 1963	Sharpnose croaker	
	<i>Pennahia anea</i> (Bloch, 1793)	Bigeye croaker	
Family Mullidae	<i>Parupeneus heptacanthus</i> (Lacepede, 1802)	Cinnabar goatfish	
Family Lutjanidae	<i>Lutjanus johnii</i> (Bloch, 1792)	John's snapper	
	<i>Lutjanus malabaricus</i> (Bloch & schneider, 1801)	Malabar blood snapper	
	<i>Lutjanus monostigma</i> (Cuvier, 1828)	Onespot snapper	
	<i>Lutjanus russellii</i> (Bleeker, 1849)	Russell's snapper	
	<i>Lutjanus sebae</i> (Cuvier, 1816)	Emperor red snapper	
Family Pomadasysidae	<i>Pomadasys kaakan</i> (Cuvier, 1830)	Javelin grunter	
	<i>Diagramma pictum</i> (Thunberg, 1792)	Painted sweetlips	
Family Terapontidae	<i>Terapon jarbua</i> (Forsskal, 1775)	Crescent perch	
Family Nemipteridae	<i>Nemipterus hexodon</i> (Quoy & Gaimard, 1824)	Ornate threadfin bream	
Family Lethrinidae	<i>Lethrinus lentjan</i> (Lacepede, 1802)	Pink ear emperor	
Family Ephippidae	<i>Drepane punctata</i> (Linnaeus, 1758)	Spotted sicklefish	
	<i>Ephippus orbis</i> (Bloch, 1787)	Orbfish, Spadefish	
Family Scatophagidae	<i>Scatophagus argus</i> (Linnaeus, 1766)	Spotted scat, Spadefish	
Family Caesionidae	<i>Caesio cuning</i> (Bloch, 1791)	Redbelly yellowtail fusilier	
Family Trichiuridae	<i>Trichiurus lepturus</i> Linnaeus, 1758	Largehead hairtail	
Family Scombridae	<i>Rastrelliger kanagurta</i> (Cuvier, 1817)	Indian mackerel	
	<i>Scomberomorus commerson</i> (Lacepede, 1800)	Narrow-barred Spanish	
	<i>Euthynnus affinis</i> (Cantor, 1849)	Eastern little tuna, Kawakawa	
	<i>Thunnus tonggol</i> (Bleeker, 1851)	Longtail tuna	
Family Siganidae	<i>Siganus canaliculatus</i> (Park, 1797)	Whitespotted spinefoot	
	<i>Siganus javus</i> Linnaeus, 1766	Streaked spinefoot	
Family Stromateidae	<i>Pampus argenteus</i> (Euphrasen, 1788)	Silver pomfret	
	<i>Pampus chinensis</i> (Euphrasen, 1788)	Chineses silver pomfret	
Family Gobiidae	<i>Periophthalmus argentilineatus</i> Valenciennes, 1837	Barred mudskipper	
Order Pleuronectiformes			
Family Paralichthyidae	<i>Psettodes erumei</i> (Bloch and Schneider, 1801)	Indian halibut	
Family Cynoglossidae	<i>Cynoglossus lingua</i> Hamilton, 1822	Long tonguesole	
Order Tetraodontiformes			
Family Monacanthidae	<i>Aluterus monoceros</i> (Linnaeus, 1758)	Unicorn leatherjacket	

Table 3 Commercial invertebrate species in the Andaman coastal areas of Ranong province, southern Thailand.

Phylum Mollusca		Phylum Arthropoda	
Class Gastropoda		Class Melacostraca	
Order Vetigastropoda		Order Stomatopoda	
Family Haliotidae		Family Squillidae	
<i>Haliotis asinina</i> Linnaeus, 1758	Donkey's-ear Abalone	<i>Oratosquilla nepa</i> (Latreille, 1828)	Mantis shrimp
Order Discopoda		Order Mysida	
Family Vivipariidae		Family Mysidae	
<i>Filopaludina</i> spp.	Pond snail, River snail	<i>Mysis</i> spp.	Mysis
Family Turritellidae		Order Decapoda	
<i>Turritella terebra</i> (Linnaeus, 1758)	Screw turritella, Auger terebra	Family Thalassinidae	
Family Potamididae		<i>Thalassina anomala</i> (Herbst, 1804)	Mud lobster
<i>Cerithidea obtusa</i> (Lamarck, 1822)	Blunt creeper, Horn snail	Family Penaeidae	
Family Strombidae		<i>Penaeus merguensis</i> De Man, 1888	Banana prawn
<i>Strombus canarium</i> Linnaeus, 1758	Dog conch	<i>Penaeus monodon</i> Fabricius, 1798	Giant tiger prawn
Order Neogastropoda		<i>Penaeus vannamei</i> Boone, 1931	Whiteleg shrimp
Family Buccinidae		<i>Penaeus</i> spp.	
<i>Babylonia spirata</i> (Linnaeus, 1758)	Spiral babylon	Family Palaemonidae	
<i>Babylonia areolata</i> (Link, 1807)	Spotted babylon	<i>Macrobrachium</i> sp.	Dwarf prawn
Family Volutidae		Family Palinuridae	
<i>Melo melo</i> (Lightfoot, 1786)	Indian volute, Bailer shell	<i>Panulirus versicolor</i> (Latreille, 1804)	Blue spiny lobster
Family Melongenidae		<i>Panulirus polyphagus</i> (Herbst, 1793)	Mud spiny lobster
<i>Pugilina cochlidium</i> (Linnaeus, 1758)	Spiral melongena	<i>Panulirus ornatus</i> (Fabricius, 1798)	Ornate spiny lobster
Class Bivalvia		<i>Thenus orientalis</i> (Lund, 1793)	Slipper lobster
Order Arcoida		Family Portunidae	
Family Archidae		<i>Portunus pelagicus</i> (Linnaeus, 1758)	Blue swimming crab
<i>Anadara granosa</i> (Linnaeus, 1758)	Granular ark	<i>Portunus sanguinolentus</i> (Herbst, 1783)	Three spot swimming crab
<i>Scapharca troscheli</i> (Dunker, 1832)	Ark	<i>Portunus gladiator</i> Fabricius, 1798	Swimming crab
Order Mytiloida		<i>Charybdis feriatus</i> (Linnaeus, 1758)	Crucifix crab
Family Mytilidae		<i>Thalassina crenata</i> (Latreille, 1829)	Spiny rock crab
<i>Perna viridis</i> (Linnaeus, 1758)	Asian green mussel	<i>Scylla serrata</i> Forskal, 1775	Serrated mud crab
Order Ostreoida		Family Grapsidae	
Family Pectinidae		<i>Parasesarma</i> spp.	marsh crab
<i>Anusium pleuronectes</i> (Linnaeus, 1758)	Radiated scallop		
Family Ostreidae		Phylum Echinodermata	
<i>Sacostrea forskali</i> (Gmelin, 1791)	Indian rock oyster	Class Holothuroidea	
Order Heterodonta		Order Aspidochirotrida	
Family Donacidae		Family Holothuriidae	
<i>Donax</i> spp.	Bean clam	<i>Holothuria atra</i> Jaeger, 1833	Black sea cucumber
Family Corbiculidae			
<i>Geloina erosa</i> (Lightfoot, 1786)	Common geloina	Phylum Tentaculata	
Family Veneridae		Class Brachiopoda	
<i>Tapes dorsatus</i> (Lamarck, 1818)	Turgid venus	Order Lingulida	
<i>Meretrix meretrix</i> (Linnaeus, 1758)	Oriental clam	Family Lingulidae	
Class Cephalopoda		<i>Lingula anatina</i> (Lamarck, 1801)	Lamp shell
Order Sepioida			
Family Sepiidae		Phylum Cnidaria	
<i>Sepia pharaonis</i> Ehrenberg, 1831	Rainbow cuttlefish	Class Scyphozoa	
<i>Sepia</i> spp.	Cuttlefish	Order Rhizostomae	
Family Loliginidae		Family Lobonematidae	
<i>Sepioteuthis lessoniana</i> (Lesson, 1830)	Bigfin reef squid	<i>Lobonemoides rubustus</i> Stiasney, 1920	Jelly fish
<i>Photololigo duvauceli</i> (d'Orbigny, 1848)	Indian squid	<i>Lobonemoides</i> spp.	Jelly fish
<i>Photololigo chinensis</i> Gray, 1849	Mitre squid		
Order Octopoda			
Family Octopodidae			
<i>Amphioctopus aegina</i> (Gray, 1849)	Sandbird octopus		
<i>Octopus</i> sp.	Octopus		

Fishing gears and the target fishes were considerably different among the communities (Fig. 5). Shrimp net was carried out in common throughout all the communities. Crab net was very popular in four communities, Tab Nua, Kamphuan, Ta Klang and Hat Sai Khao. Fish net was also popular in three communities, Kamphuan, Ta Klang and Hat Sai Khao. Most of the fish nets were used to catch sand borer (*Silla gosihama*) inhabiting bottom layer of the shallow waters. Mackerel net and sardine net were uncommon because they required big fishing boat with mechanized equipments. Cuttlefish trap was popular only

in two communities, Kamphuan and Hat Sai Khao. Fish trap was dominant in Talay Nork community but not popular in other communities.

Differences in the kinds of fishing gears among every communities might be related to the diffusion process of the indigenous fishing technologies because relatives and neighbors who live in the same communities tended to select similar fishing gears. It seemed to have an advantage on the marketing system to be able to sell fishery products for buyers and wholesalers within the same communities. Consequently, to share the fishing

gears and the target species was a voluntary wisdom for local communities.



Fig. 3. Fishing gears in the coast of Kamphuan village, Ranong province, Southern Thailand.

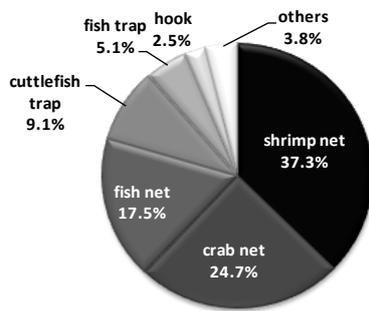


Fig. 4 Fishing gears in Kamphuan village, Ranong province.

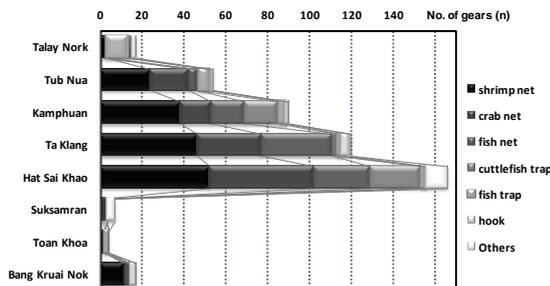


Fig. 5 Fishing gears in every communities of Kamphuan village, Ranong province.

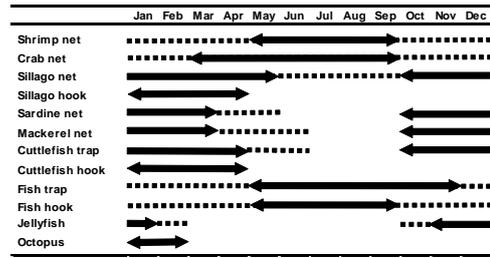


Fig. 6 Seasonality of fishing activities in the coast of Kamphuan village, Ranong province.  
Solid lines: high fishing season, dotted line: low fishing season

Seasonality of every fishing activities in the coast of Kamphuan village was summarized in Fig. 6. Fishing by means of shrimp net and crab net were carried out throughout the year, but they were predominantly operated during the rainy season from March to September. The fishing season is closely related the breeding season of these species because they migrate to the shallow waters during the breeding season. Likewise, sillago (sand borer: *Silla gosihama*) net was carried out throughout the year, but it was predominantly operated during the dry season from October to May. Sardine net and mackerel net were operated predominantly in the dry season from October to March. Cuttlefish trap and cuttlefish hook were also restricted in the dry season from October to April. Fish trap and fish hook were carried out throughout the year and predominantly operated in the rainy season from May to November. Jellyfish fishing by means of scoop net was restricted only a few months from November to January because a huge number of jellyfish were transported by monsoon toward the eastern side of Andaman coast. Thus, seasonality of every fishing activities was closely related to the life cycle and the behaviors of target species.

It is well known that rich biodiversity and high productivity were found in the coastal areas around mangrove swamps because a lot of fishes, crustaceans, molluscs and other aquatic organisms use mangrove swamps as breeding sites, spawning sites, nursery grounds and shelter as well as feeding site during a certain stage of their life cycle (Robertson *et al.*, 1992). After growing up, they were distributed in every habitats in the coastal areas, and therefore, the fishing grounds in the coastal areas of Kamphuan village were different each other depending on the habitat of the fishery resources (Fig. 7). Most fishing activities were carried out within 3 km from the coastline, where fishermen of coastal communities had an exclusive right to catch fishery resources. In Kamphuan and Naka villages, every fishing boats was located in four major fishing ports; Tab Nua, Ta Klang, Hat Sai Khao and Bang KruaiNok (Fig. 7). Fishing boats set off from these four fishing ports to their own fishing grounds through the mangrove estuaries. By sharing the fishing gears and the target fishes, fishermen could avoid competition on the fishing grounds within the coastal areas.

Mangrove swamps provided fundamental ecological services of abundant fishery resources for local inhabitants living along the coastal areas. The efficient use of various indigenous fishing gears depended on understanding of fish behaviors, habitat and seasonal environmental conditions. By sharing the fishing strategies, local

inhabitants could avoid competition for fishery resources each other, and consequently, utilize sustainably natural fishery resources in the coastal areas.

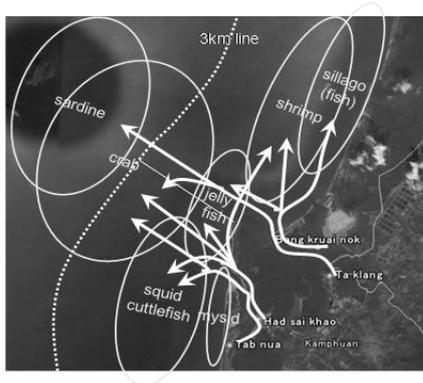


Fig. 7 Fishing grounds and fishing activities in the coast of Kamphuan village, Ranong province.

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