Fisheries Resources in Trat Province, Thailand

"Strategies for Trawl Fisheries Bycatch Management" (REBYC-II CTI; GCP/RAS/269/GFF)

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ACRONYMS

APS	Anchovy Purse Seine
AFN	Anchovy Falling Net
CHARM	Coastal Habitats and Resources Management Project
cm	centimeter
CPUE	catch per unit effort
DOF	Department of Fisheries
FAO	Food and Agriculture Organization of the United Nations
kg	kilogram
LPS	Thai purse seine with light luring
m	meter
MFD	Marine Fisheries Division
MFRDB	Marine Fisheries Research and Development Bureau
MFRDD	Marine Fisheries Research and Development Division
OBT	Otter Board Trawl
TPS	Thai Purse Seine

ABSTRACT

This study of fisheries resources in the Trat Province (Thailand) was conducted during January to December 2014 by collecting the data from commercial fishing vessels landings at fishing ports in the Province. It was found that the catch per unit of effort(CPUE) of Thai Purse Seine(TPS), Light luring Purse Seine(LPS), Anchovy Purse Seine(APS) and Anchovy falling net (AFN) fisheries were 3,825, 5,859, 2,949 and 685 kg/day respectively. Short mackerel and gold stripe sardinella formed the highest composition of the catch from TPS and LPS while anchovies were the main component of APS and AFN. The CPUE of otter board trawl (OBT) was calculated as 23.7 kg/hour comprising of 15.1 kg of food fish (63.8% of the total catch) and 8.6 kg trash fish(36.2% of the total catch). Threadfin bream was the major species making up 7.95% of the total food fish weight. In the trash fish group, juveniles of economic fish accounted for 40.4% of the catch, whereas the remaining 59.6% was made up of true trash fish. Pony fishes made up the highest composition (46%) of the trash fish catch.

Size measurements of 13 economically important species suggested that the mean length of three pelagic species were larger than the size at first maturity while the other ten species were smaller than size at first maturity. There is evidence that effective management measures are urgently needed to prevent recruitment overfishing which may lead to a further decline of fisheries resources. More effective management of high-efficiency fishing in some seasons and areas should be considered to conserve fisheries resources and their sustainable use for the future.

1. Introduction

The status of fisheries in Trat Province was documented in the 'Review of the Marine Fisheries in Trat Province, Thailand'. This study pointed out that fisheries resources in the area have been declining. This study reports on the current status of fisheries resources caught by commercial fishing vessels operating in Trat Province. The information presented in this report is intended to help policymakers to make appropriate decisions on fisheries management measures, aimed at regulating the harvesting of fisheries resources in a sustainable manner.

2. Data collection and analysis

2.1 Sampling sites

Catch data were collected from commercial fishing vessels in the Trat province, including Thai purse seine (TPS), Thai light luring purse seine (LPS), Anchovy purse seine (APS), Anchovy falling net (AFN) and Otter board trawl (OBT) fisheries during January - December 2014. The study sites were fishing ports in three districts of Trat province, i.e., Muang District, Laem Ngop District and Khlong Yai District.

2.2 Sampling methods

The data were collected on a monthly basis during January to December 2014. Two types of data collection were used in this research as follows.

a) Catch sampling: Catches were sampled from landings at the sampling sites in order to identify the species caught. The sampling was based on the methods shown by Carpenter and Niem (1998, 1999a,b, 2001a,b) to measure the weight (g) (using 500-g and 7-kg balances), and length (cm)(using punching paper with 0.5-cm class intervals) of trash fish and economically important species caught. Total length of fish, mantle length of squid, and carapace length of shrimp was measured.

b) Interviews: The captains of the fishing vessels, assistant captains, and/or the vessel owners were interviewed. The information needed from them included fishing effort, fishing grounds, and weight of catch.

The catches from TPS and LPS purse seines were not sorted on board. All fish were kept in a storage room or another type of container on ice and were sorted at the fishing port. For this study, 30-40 kg samples were taken from the storage room or iced containers. For APS and AFN, 10-15 kg samples was taken. In the case of high catches, the sample weight was higher. Species were identified and hundreds of the target species and/or economically important species making up the catch were sampled and measured for length and weight. For practical purposes, if the number of sampled fish were more than 100, all fish were weighed but no measurement was taken for length. If the sampled fish were less than 100 in number then all of the fish were weighed and their length measured.

The catch of trawlers was sorted on board by species or group and by size. The catch was divided into two main clusters; economically important fish species and trash fish (Figure 2). Economically important fish were sorted by species, family or group, and these included short mackerel, threadfin breams (Nemipteridae), or lizard fishes (Synodontidae),

which are of a similar size. These fish were kept in wooden or plastic trays or in other types of containers, for convenience of selling and transferring to fish markets. Ice for keeping the fish fresh was added on top of the fish in each tray and the trays were layered in the storage room. When the storage room was full, ice was added on top before the room was closed. Trash fish, which also consisted of juveniles of economically valuable fish species, such as mackerel, threadfin bream and bigeye, were sorted out from economically important fish and put into trays but with less ice.

Fish samples from the trawlers were collected from the trays or containers. The number of samples of each economically important species depended on the fish size. If the variety of fish length was more varied, the sampling of more trays was needed. All fish sampled were measured for length and weight. For trash fish, three to five kg was taken, depending on the fish size, for identifying species and measuring length and weight. The juveniles of economically important fish were also measured for length and weight. Other species were weighed only (Figure 2). A five hundred-gram balance was used in cases where the size of the fish was small.

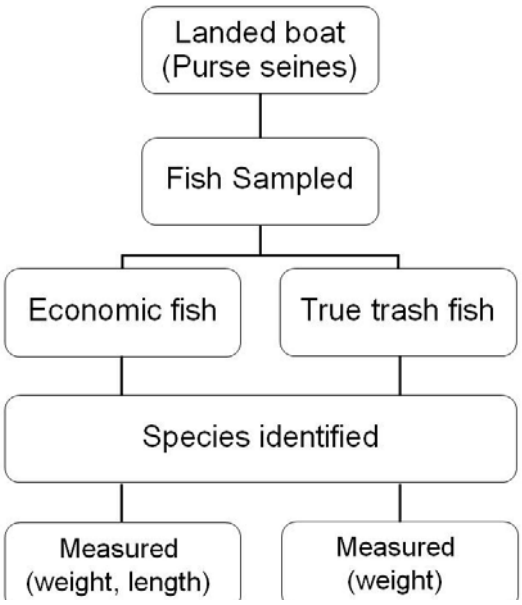


Figure 1. Sampling process of TPS, LPS, APS and AFN

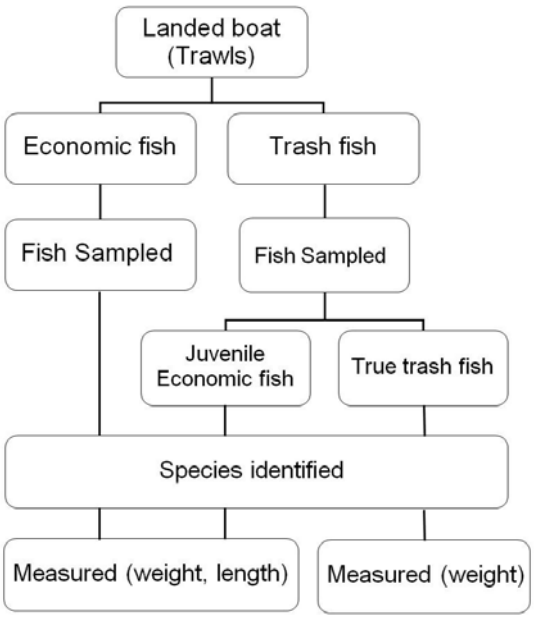


Figure 2. Sampling process of OBT

2.3 Data analysis

Data from fishing vessels operating in Trat province were used to analyze fisheries status. Catch data from fishing vessels that may have included catches from fishing grounds outside of Trat Province were excluded. Catch per unit of effort (CPUE) and species and length composition were analyzed as follows.

- *CPUE of pelagic fisheries (kg/day)* $= \frac{\textit{Catch of each species (kg)}}{\textit{Fishing effort (day)}}$

- *CPUE of demersal fisheries (kg/hour)* $= \frac{Catch\ of\ each\ species\ (kg)}{Fishing\ effort\ (hour)}$

- *Species composition (%)* $= \frac{Catch\ of\ each\ species\ (kg)}{Total\ catch} \times 100$

- Mean, maximum and minimum length and standard deviation (cm) were analyzed from length composition of a certain species. Mean length was analyzed as follows:

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i f_i}{\sum_{i=1}^{n} f_i}$$

where $\bar{X}$ = Mean length
x_i = Mid length of class interval *i*
f_i = Frequency of class interval *i*
n = Number of class interval

The length data of economically important species from all gear were pooled in order to show a complete picture of the status of each selected species. The length distribution of each species was compared with its predicted size at first maturity that was gathered from available reports. The proportion of fish that was smaller or larger than predicted size at first maturity, was also recorded.

3. Results

3.1. CPUE and species composition

3.1.1 Thai Purse Seine (TPS)

The number of TPS fishing days ranged from 1 – 6 days/trip (average of 1.7 days/trip). In most cases the fishing trip took one day. Average CPUE from TPS was 3,825kg/day. Pelagic fish formed the major part of the catch (CPUE of 3,015 kg/day) making up 79% of the total catch. Short mackerel, Goldstripe sardinella, and Indian mackerel were the main pelagic species caught, making up 18%, 17% and 8% respectively. Scads (Carangidae) formed a major part of the catch accounting for more than 11% of the total catch while neritic tunas, including frigate tuna, kawakawa and longtail tuna were also caught in Trat waters. Demersal fish accounted for 14% of the total catch, spine foots and croakers being the dominant demersal fish species. Pony fishes were the leading group of trash fish making up 6% of the total catch (Table 1).

Table 1. Catch composition and CPUE of Thai purse seine operated in Trat Province, 2014

Species/Group	Composition (%)	CPUE (kg/day)
Total	**100.00**	**3,825**

Sub-total pelagic fish		**78.84**	**3,015**
Short mackerel	*Rastrelliger brachysoma*	18.23	697
Gold stripe sardinella	*Sardinella gibbosa*	17.45	6673
Indian mackerel	*R. kanagurta*	7.58	290
Frigate tuna	*Auxisthazard*	5.46	209
Rainbow sardine	*Dussumieri aacuta*	4.67	179
Buccaneer anchovy	*Encrasicholina punctifer*	3.58	137
Torpedo scad	*Megalaspis cordyla*	3.36	129
Indian scad	*Decapterus russelli*	3.36	129
Yellowtail scad	*Atule mate*	3.36	128
Short head anchovy	*Encrasicholina heteroloba*	2.49	95
Chacunda gizzard shad	*Anodonto stomachacunda*	2.31	88
Kawakawa	*Euthynnus affinis*	1.26	48
Bigeye scad	*Selar crumenophthalmus*	1.18	45
Barracudas	*Sphyraena* spp.	1.13	43
Other pelagic fishes		3.42	131
Sub-total demersal fish		**14.12**	**540**
Spine foots	Siganus spp.	5.85	223
Croakers	Sciaenidae	5.44	207
Splendid pony fish	*Leiognathus splendens*	1.64	63
Other demersal fishes		1.19	46
Sub-total invertebrate		**1.22**	**47**
Squids		1.18	45
Cuttlefishes		0.02	0.6
Other invertebrates		0.02	0.8
Sub-total trash fish		**5.82**	**223**
Pony fishes	Leiognathidae	3.04	116
Moonfish	Menemaculata	0.88	34
Cornet fishes	*Fistularia* spp.	0.59	23
Other trash fishes		1.31	50

3.1.2 Thai purse seine with light luring (LPS)

The number of LPS fishing days varied from 1-5 days/trip (average 2.4 days/trip). The most common duration was a one day/trip. The catch of LPS was higher than for Thai purse seine without light luring (TPS). For TPS, the fish school was found by the naked eye or by using a fish finder, e.g. echo sounder and sonar, while light was used by the LPS to aggregate the fish. The average CPUE for LPS was 5,120 kg/day. Pelagic fish formed the main part of the catch at 5,120 kg/day equivalent to 87% of the total catch. The catch composition of LPS was different from TPS. Gold stripe sardinella made up almost one half of the total catch followed by Indian mackerel, short mackerel and torpedo scad, at 12%, 6% and 6% respectively. Similar to TPS, a small percentage of neritic tunas were also found in the LPS catch. Squid appeared at a higher percentage compared to TPS while moonfish was the major species among trash fish (Table 2).

Table 2. Catch composition and CPUE of Thai purse seine with light lure operated in Trat Province, 2014

Species/Group	Composition	CPUE

		(%)	(kg/day)
Total		**100.00**	**5,859**
Sub-total pelagic fish		**87.39**	**5,120**
Goldstripe sardinella	*Sardinella gibbosa*	48.31	2,830
Indian mackerel	*Rastrelliger kanagurta*	12.31	721
Short mackerel	*R. brachysoma*	6.14	360
Torpedo scad	*Megalaspis cordyla*	6.05	355
Yellowtail scad	*Atule mate*	5.91	346
Frigate tuna	*Auxisthazard*	2.10	123
Indian scad	*Decapterus russelli*	2.02	118
Longtail tuna	*Thunnustonggol*	0.89	52
Barracudas	*Sphyraena* spp.	0.86	50
Yellowstripe scad	*Selaroides leptolepis*	0.74	43
Other pelagic fishes		2.06	121
Sub-total demersal fish		**2.22**	**130**
Slender lizardfish	*Saurida elongata*	0.81	48
Largeheadhairtail	*Trichiuruslepturus*	0.42	25
Purple-spotted bigeye	*Priacanthus tayenus*	0.25	15
Otherdemersal fishes		0.74	43
Sub-total invertebrate		**3.61**	**211**
Squids		3.61	211
Sub-total trash fish		**6.78**	**397**
Moonfish	*Menemaculata*	4.09	240
Cornetfishes	*Fistularia*spp.	1.50	88
Other trash fishes		1.19	70

3.1.3 Anchovy purse seine (APS)

The number of APS fishing days varied from 1 – 10 days/trip (average of 4 days/trip) The most common duration was a 2 day/trip. The average CPUE from APS was 2,789 kg/day. Most of the catch was made up of pelagic fish,accounting for 94% of the total catch with a CPUE of 2,788 kg/day. The total catch was made up of around 60% anchovies and 20% mackerels, with the CPUE of 1,741 kg/day and 583 kg/day respectively. *Stolephorus* spp. was the dominant species of anchovy. Neritic tunas were also found in the catches in a small percentage. Trash fish, demersal fish and other invertebrates were rarely caught by APS (Table 3).

Table 3. Catch composition and CPUE of anchovy purse seine operated in Trat Province, 2014

Species/Group		Composition (%)	CPUE (kg/day)
Total		**100.00**	**2,949**
Sub-total pelagic fish		**94.56**	**2,789**
Anchovies	*Stolephorus* spp.	22.05	650
Shorthead anchovy	*Encrasicholina heteroloba*	18.68	551
Buccaneer anchovy	*E.punctifer*	18.32	540
Indian mackerel	*Rastrelliger kanagurta*	15.32	452

Torpedo scad	*Megalaspis cordyla*	4.56	135
Short mackerel	*R. brachysoma*	4.46	131
Goldstripe sardinella	*Sardinella gibbosa*	2.67	79
Longtail tuna	*Thunnustonggol*	1.65	49
Yellowtail scad	*Atule mate*	1.53	45
Barracudas	*Sphyraena*spp.	0.95	28
Frigate tuna	*Auxisthazard*	0.83	25
Rainbow sardine	*Dussumieriaacuta*	0.49	14
Bigeye scad	*Selar crumenophthalmus*	0.49	14
Other pelagic fishes		2.56	76
Sub-total demersal fish		**1.09**	**32**
Goatfishes	*Upeneus* spp.	0.29	8
Bigeye snapper	*Lutjanuslutjanus*	0.23	7
Largeheadhairtail	*Trichiuruslepturus*	0.16	5
Lizardfishes	*Saurida* spp.	0.12	4
Otherdemersal fishes		0.29	9
Sub-total invertebrate		**1.22**	**36**
Indian squid	*Photololigo duvaucelii*	0.83	25
Kobi squid	*Nipponololigosumatrensis*	0.34	10
Bigfin reef squid	*Sepioteuthislessoniana*	0.04	1.08
Other invertebrates		0.01	0.36
Sub-total trash fish		**3.13**	**91**
Cornetfishes	*Fistularia*spp.	0.49	14
Other trash fishes		2.64	78.

3.1.4. Anchovy falling net (AFN)

The number of AFN fishing day ranged from 1-11 days/trip (average of 5.3 days/trip). The most common duration was a 5 day/trip. The average CPUE from the AFN was 685 kg/day. Pelagic fish formed the main part of the catch with a CPUE of 647 kg/day. Anchovy made up 68% of the total catch. The major species of anchovy caught was *Stolephorus* spp. Mackerels were also caught by AFN at a CPUE of 119 kg/day, accounted for 17.5% of the total catch. Demersal fish and invertebrate were rarely found due to the shallow depth of the AFN. Ponyfishes were found in small quantities in the trash fish group.

Table 4. Catch composition and CPUE of anchovy falling net in Trat Province in 2014.

Species/Group		Composition (%)	CPUE (kg/day)
Total		**100.00**	**685**
Sub-total pelagic fish		**94.50**	**647**
Anchovies	*Stolephorus* spp.	40.99	281
Shorthead anchovy	*Encrasicholina heteroloba*	23.11	158
Indian mackerel	*Rastrelliger kanagurta*	10.47	72
Short mackerel	*R. brachysoma*	7.03	48
Buccaneer anchovy	*Encrasicholina punctifer*	4.36	29
Goldstripe sardinella	*Sardinella gibbosa*	1.72	11
Yellowtail scad	*Atule mate*	1.01	6.8

Rainbow sardine	*Dussumieriaacuta*	0.94	6.5
Indian scad	*Decapterusrusselli*	0.47	3.2
Yellowstripe scad	*Selaroides leptolepis*	0.45	3.1
Bigeye scad	*Selar crumenophthalmus*	0.36	2.4
Other pelagic fishes		3.59	25
Sub-total demersal fish		**0.94**	**6.5**
Lizardfishes	*Saurida* spp.	0.66	4.4
Otherdemersal fishes		0.29	1.9
Sub-total invertebrate		**0.98**	**6.7**
Indian squid	*Photololigo duvaucelii*	0.76	5.2
Kobi squid	*Nipponololigosumatrensis*	0.12	0.8
Other invertebrates		0.11	0.7
Sub-total trash fish		**3.58**	**24**
Ponyfishes	Leiognathidae	2.03	14.
Other trash fishes		1.55	10

3.1.5. Otter board trawls (OBT)

The number of OBT fishing days varied from 1 – 15 days/trip with an average of 7.44 days/trip. Fishing operations were typically carried out during the night. However, daytime fishing was also done. During the night, the fishing took 3 – 5.5 hours/haul and 2 - 3 hauls were done each night. For daytime fishing, 5 hours/hauls awith 2 hauls/day were used. The average CPUE from OBT was 24 kg/hour consisting of 15 kg/hour food fish and 8.6 kg/hour of trash fish. The percentage of food fish and trash fish was 64: 36, respectively (Table 5 – 6).

Table 5 CPUE and species composition of food fish from otter board trawl operated in Trat Province in 2014.

Species/Group		Composition (%)	CPUE (kg/hour)
Total		**100.00**	**15**
Sub-total pelagic fish		**11.15**	**1.6**
Barracudas	*Sphyraena*spp.	3.79	0.6
Needlescaledqueenfish	*Scomberoidestol*	3.34	0.5
Yellowtail scad	*Atule mate*	1.65	0.3
Short mackerel	*Rastrelliger brachysoma*	0.99	0.1
Shrimp scad	*Alepesdjeddaba*	0.69	0.1
Longfin trevally	*Carangoidesarmatus*	0.15	0.02
Indian mackerel	*Rastrelliger kanagurta*	0.15	0.02
Other pelagic fishes		0.39	0.05
Sub-total demersal fish		**42.95**	**6.5**
Goatfishes	*Upeneus* spp.	5.04	0.8
Tonguesoles	Cynoglossidae	4.85	0.7
Slender lizardfish	*Saurida elongata*	4.45	0.7
Brushtooth lizardfish	*Saurida undosquamis*	4.23	0.6
Ornate threadfin bream	*Nemipterus hexodon*	3.87	0.6
Lattice monocle bream	*Scolopsis taeniopterus*	3.28	0.5
Purple-spotted bigeye	*Priacanthus tayenus*	3.10	0.5

Mauvelip threadfin bream	*N. mesoprion*	2.36	0.4
Lunartail puffer	*Lagocephaluslunaris*	1.20	0.2
Jarbusterapon	*Teraponjarbua*	1.06	0.2
Snappers	*Lutjanus* spp.	1.03	0.2
Redspine threadfin bream	*Nemipterus nemurus*	0.91	0.1
Japanese threadfin bream	*Nemipterus japonicus*	0.81	0.1
Other demersal fishes		6.76	1
Sub-total cephalopod		**17.22**	**2.6**
Mitre squid	*Photololigo chinensis*	6.11	0.9
Indian squid	*Photololigo duvaucelii*	4.90	0.7
Octopuses		2.39	0.3
Curvespine cuttlefish	*Sepia recurvirostra*	0.95	0.1
Needle cuttlefish	*Sepia aculeata*	0.91	0.1
Bigfin reef squid	*Sepioteuthislessoniana*	0.76	0.1
Other cephalopods		1.20	0.2
Sub-total shrimp and prawn		**12.73**	**1.9**
Fiddler shrimp	*Metapenaeopsisstridulans*	5.46	0.8
Malayan rough shrimp	*Trachypenaeusmalaiana*	2.20	0.3
Green tiger prawn	*Penaeus semisulcatus*	1.24	0.2
Jinga shrimp	*Metapenaeus affinis*	0.60	0.1
Middle shrimp	*Metapenaeus intermedius*	0.42	0.1
Banana prawn	*Penaeus merguiensis*	0.42	0.1
Other shrimps and prawns		2.39	0.4
Sub-total other		**15.95**	**2.4**
Asian moon scallop	*Amusiumpleuronectes*	11.34	1.7
Swimming crab	*Charybdis* spp.	2.77	0.4
Blue swimming crab	*Portunuspelagicus*	0.93	0.1
Other invertebrates		0.91	0.1

Table 6 CPUE and species composition of trash fish from otter board trawl operated in Trat Province in 2014

Species/Group		Composition (%)	CPUE (kg/hour)
Total		**100.00**	**8.5**
Sub-total pelagic fish		**2.37**	**0.2**
Anchovies	*Stolephorus*spp.	0.92	0.1
Gold stripe sardinella	*Sardinella gibbosa*	0.59	0.1
Indian mackerel	*Rastrelliger kanagurta*	0.48	0.04
Obtuse barracuda	*Sphyraenaobtusata*	0.24	0.02
Yellowstripe scad	*Selaroides leptolepis*	0.14	0.01
Sub-total demersal fish		**30.10**	**2.6**
Splendid pony fish	*Leiognathussplenden*	9.59	0.8
Purple-spotted bigeye	*Priacanthus tayenus*	4.24	0.4
Longfin mojarra	*Pentaprionlongimanus*	3.17	0.3
Tonguesoles	Cynoglossidae	2.82	0.2
Lizardfishes	*Saurida* spp.	2.81	0.2
Lunartail puffer	*Lagocephaluslunaris*	1.68	0.1

Lattice monocle bream	*Scolopsis taeniopterus*	1.34	0.1
Half-smooth golden puffer fish	*Lagocephalusspadiceus*	1.07	0.1
Threadfin breams	*Nemipterus* spp.	0.51	0.04
Goatfishes	*Upeneus*spp.	0.51	0.04
Sixbar grouper	*Epinephelussexfasciatus*	0.50	0.04
Other demersal fishes		1.86	0.2
Sub-total cephalopod		**6.22**	**0.5**
Kobi squid	*Nipponololigosumatrensis*	3.15	0.3
Indian squid	*Photololigo duvaucelii*	0.94	0.1
Octopus		0.92	0.1
Curve spine cuttlefish	*Sepia recurvirostra*	0.69	0.1
Cuttlefishes		0.52	0.04
Sub-total other invertebrate		**1.72**	**0.1**
Crabs		1.37	0.1
Asian moon scallop	*Amusiumpleuronectes*	0.27	0.02
Mantis shrimps		0.05	0.005
Fiddler shrimp	*Metapenaeopsisstridulans*	0.02	0.001
Sub-total true trash fish		**59.59**	**5.1**
Pony fishes	Leiognathidae	36.58	3.1
Dwarf flathead	*Elates ransonnetii*	9.50	0.8
Cardinalfishes	Apogonidae	4.45	0.4
Scorpionfishes	Scorpaenidae	0.96	0.1
Moonfish	*Menemaculata*	0.86	0.1
Other true trash fishes		7.24	0.1

Demersal fish formed the highest part (43%) of the total food fish group. Thread fin breams (*Nemipterus* spp.) made up the highest portion (11%) followed by lizardfish, (8.7%) (*Saurida*spp.)andgoatfish (5%) (*Upeneus* spp.) with a CPUE of 1.7, 1.3 and 0.8 kg/hour respectively. Shrimp, prawn, squid and Asian moon scallops appeared as 12.7%, 11.8% and 11.3% of the total food fish, with the CPUE of 1.9, 1.8 and 1.7 kg/hour respectively. While pelagic fish made up a small proportion (11.15%) of the total food fish catch (Table 5).

Trash fish was made up of 40% of juvenile economic species and 60% true trash fish. For true trash fish, pony fishes dominated the catch, accounting for 37% of total trash fish followed by dwarf flathead, 9.5% (Table 6). Although most pony fish are classified as 'true trash fish', the splendid pony fish, *Leiognathus splenden*, can be classified as a food fish because larger fish are sorted and sold for human consumption, and surplus fish are used as raw materials for fishmeal. This species accounted for 9.59% of the total trash fish with a CPUE of 0.8 kg/hour. Other demersal fish species included purple-spotted big eye, long fin mojarra and tongue soles, making up 4.2%, 3.2% and 2.8% of the total trash fish catch respectively.

3.2 Length of some economically important species

Length data of some economically important species from all fishing gear were pooled and analyzed in order to analyse the current status of fisheries resources. Thirteen species were selected for comparison between mean length and predicted size at first maturity (Table 8). Only three of the 13species, i.e., Indian scad, short head anchovy and gold stripe sardinella,

had a mean length that was larger than predicted size at first maturity, whereas the mean length of the other ten species were smaller than their predicted size at first maturity. The results of length analysis of each species was as following:

3.2.1 Yellowtail scad
Mean length of yellowtail scad was 14.74 ± 0.06 cm while its predicted size at first maturity is 21.25 cm. Almost all fish caught was smaller than this size (Figure 3).

3.2.2 Indian scad
Mean length of Indian scad was 13.45 ± 0.08 cm that was larger than size at first maturity of 13.19 cm. Two-thirds of the fish caught were larger than this size. (Figure 4).

3.2.3 Shorthead anchovy
Mean length of short head anchovy was 6.52 ± 0.001 cm, which was larger than its predicted size at first maturity of 6.44 cm. Roughly half of fish caught was over this size (Figure 5).

3.2.4 Torpedo scad
Mean length of torpedo scad was 15.39± 0.10 cm while its size at first maturity is 21.55 cm. Almost all fish caught were smaller than this size (Figure 6).

3.2.5 Short mackerel
Mean length of short mackerel was 15.46± 0.03 cm while its size at first maturity is 17.95 cm. More than 90% of the fish caught were smaller than this size (Figure 7).

3.2.6 Goldstripe sardinella
Mean length of goldstripe sardinella was 12.27± 0.01 cm while its size at first maturity is 10.35 cm. Roughly one quarter of them were smaller than this size (Figure 8).

3.2.7 Yellowstripe scad
Mean length of yellowstripe scad was 8.65± 0.04 cm while its size at first maturity is 11.73. cm. Three-quarters of them were smaller than this size (Figure 9).

3.2.8 Purple-spotted bigeye
Mean length of purple-spotted bigeye was 6.99± 0.12 cm while its size at first maturity is 14.19 cm. Only 11% of them were larger than this size (Figure 10).

3.2.9 Lattice monocle bream
Mean length of lattice monocle bream was 11.11± 0.28 cm while its size at first maturity is 17.57 cm. Only a few fish, with length larger than this size, were caught (Figure 11).

3.2.10 Indian squid
Mean length of Indian squid was 7.46± 0.15 cm while its size at first maturity is 9.04 cm. More than four-fifths of them were smaller than this size, (Figure 12).

3.2.11 Needle cuttlefish
Mean length of needle cuttlefish was 8.69± 0.41 cm while its size at first maturity is 9.44 cm. About 60% of them were smaller than this size, (Figure 13).

3.2.12 Jinga shrimp

Mean length of jinga shrimp was 10.32 ± 0.05 cm while its size at first maturity is 12.18 cm. It was rare to find larger shrimp than this size in the survey (Figure 14).

3.2.13 Banana prawn
Mean length of banana prawn was 12.63 ± 0.09 cm while its size at first maturity is 13.38 cm. About 60% of them were smaller than this size, (Figure 15).

The results of fish size analysis showed that the mean length of three pelagic species was larger than their predicted size at first maturity. Meanwhile, the mean lengths of four pelagic species, two demersal species, two squid and cuttlefish species and two shrimp species were smaller than their predicted size at first maturity.

4. Conclusion

The CPUE of TPS, LPS, APS and AFN were 3,824, 5,858, 2,949 and 684kg/day respectively. Short mackerel and gold stripe sardinella were the highest percentage of catch of TPS and LPS respectively while anchovies were the main part of catch of APS and AFN. In addition, the CPUE of OBT was 23.7 kg/hour comprising of 15.131 kg/hour food fish, 63% of the total catch, and 8.5 kg/hour trash fish, 36% of the total catch. Threadfin breams were the major composition, 7.9% of the total food fish. In trash fish group, economic fish accounted for 40.4% whereas the remaining 59.5% was true trash fish. Pony fishes were the highest composition, 46.1% of the total trash fish split into 9.5% splendid pony fish in food fish group and 36.5% other pony fishes in true trash fish group.

The results of CPUE illustrated the CPUE in Trat waters were much higher than the average CPUE in the Gulf of Thailand (Table 7). Although, the comparison of AFN's CPUE was vague due to different pattern of data analysis, CPUE of small AFN in Trat was much higher than in the Gulf of Thailand but for large AFN it was less than average. These indicated that Trat waters are one of the high productive areas in the Gulf of Thailand.

Table 7 Comparison on CPUE of different fishing gear in this study (Trat Province) and previous study (Gulf of Thailand)

Gear	CPUE		Reference
	This study (Trat Province)	Previous study (Gulf of Thailand)	
TPS	3,824 kg/day	2,353 kg/day (2007)	Thongsila et al., 2012
LPS	5,858 kg/day	2,298kg/day (2007)	Thongsila et al., 2012
APS	2,949 kg/day	2,521kg/day (2008)	Sinanun et al., 2012
AFN	684[1] kg/day	499 kg/day[2] (2008)	Sinanun et al., 2012
		1,327kg/day[3] (2008)	Sinanun et al., 2012
OBT	23 kg/hour	23 kg/hour (2003-2005)	Kongpromet al., 2007

Remark: [1] CPUE of all sizes AFN
[2]CPUE of small-sized AFN (boat overall length less than 14 m)
[3]CPUE of large-sized AFN (boat overall length more than 14 m)
Years in parenthesis are data collection year.

The mean length of three pelagic species, namely Indian scad, short head anchovy and gold stripe sardinella, were larger than their size at first maturity while other ten economic species, including four pelagic species, two demersal species, two squid and cuttlefish species and two shrimp species, were smaller than their size at first maturity

As a consequence of large amount of small-sized fish caught and decreasing proportion of older fish in the catch together with high CPUE of high efficient commercial fishing gear, more effective management measure is urgently needed in order to prevent recruitment overfishing which may lead to decline of fisheries resources. Even though, there are some fisheries management measures currently being implemented in Trat waters; they do not cover all commercial fishing gear.

Effective since 1985, any kind, category or size of surrounding nets used with an electricity generator are prohibited in Trat Province (see the map attached in Appendix A). Furthermore, since 2001, lift nets and falling nets used with electricity generators are prohibited for fishing anchovy in some localities both in the Gulf of Thailand and the Andaman Sea, including the coastal area of Trat Province. These management measures aim to conserve pelagic fish resources. Consequently, the stocks of these three pelagic species are in relatively good condition, at least by the fact that larger fish rather than smaller fish were frequently caught. Since 2000, trawls, push nets and shellfish dredges of all kinds and sizes, with a motorised vessel are prohibited from fishing all year in the Straits of Chang Island, within a circular area connecting Point 1, Point 2 Point 3 and Point 4, as appearing on the map attached in Appendix B. These fishing gears are not allowed during the period June to November every year within the area surrounded by a circle beginning from Point 3 to Point 4 and Point 5 to Point 6. This regulation is intended to conserve the health of marine resources for sustainable utilization, particularly demersal fish and benthic fauna.

The prohibition of high efficient fishing gear in some season and area is a potential regulation, particularly in the coastal of Trat Province, to safeguard fisheries resources and use of the resources in a sustainable manner. The findings from this report can be used to adapt and develop new management measures for Trat Province.

5. Acknowledgement

I am grateful to staff in the Survey and Assessment of Fishery Resources and Fishing Status Unit, Eastern Gulf Marine Fisheries Research and Development Center (EMDEC) for their assistance with the data collection for this project.

Table 8. Mean length of some economically important species caught in Trat Province in 2014 and female from available technical papers

Common name	Scientific name	Range (cm)	Mean (cm)	Female size at first maturity(cm)	
Yellowtail scad	*Atule mate*	7.75 – 27.75	14.74 ± 0.06	21.25	P
Indian scad	*Decapterusrusselli*	4.25 – 22.75	13.45 ± 0.08	13.19	H
Shorthead anchovy	*Encrasicholina heteroloba*	2.50 – 9.00	6.52 ± 0.001	6.44	Y

Torpedo scad	*Megalaspis cordyla*	8.75 – 32.75	15.39 ± 0.10	21.55
Short mackerel	*Rastrelliger brachysoma*	4.75 – 22.25	15.46 ± 0.03	17.95
Goldstripe sardinella	*Sardinella gibbosa*	2.25 – 20.75	12.27 ± 0.01	10.35
Yellowstripe scad	*Selaroides leptolepis*	2.25 – 16.25	8.65 ± 0.04	11.73
Purple-spotted bigeye	*Priacanthus tayenus*	1.75 – 18.75	6.99 ± 0.12	14.19
Lattice monocle bream	*Scolopsis taeniopterus*	6.75 – 22.75	11.11 ± 0.28	17.57
Indian squid	*Photololigoduvaucelii*	2.75 – 24.25	7.46 ± 0.15	9.04
Needle cuttlefish	*Sepia aculeata*	3.25 – 13.75	8.69 ± 0.41	9.44
Jinga shrimp	*Metapenaeus affinis*	5.25 – 14.75	10.32 ± 0.05	12.18
Banana prawn	*Penaeus merguiensis*	8.75 – 20.25	12.63 ± 0.09	13.38

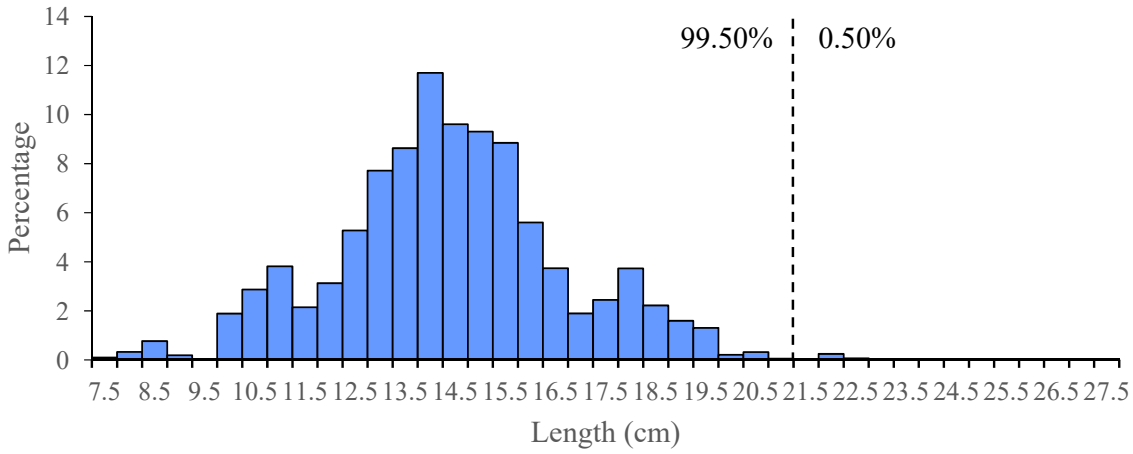


Figure 3 Length distribution of yellowtail scad, *Atule mate*, caught in Trat Province, 2014

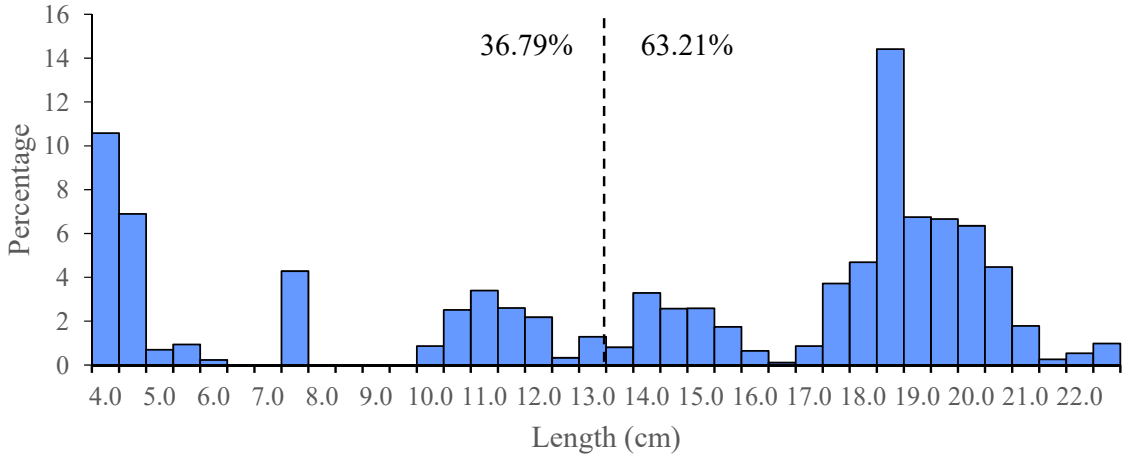


Figure 4 Length distribution of Indian scad, *Decapterusrusselli*, caught in Trat Province, 2014

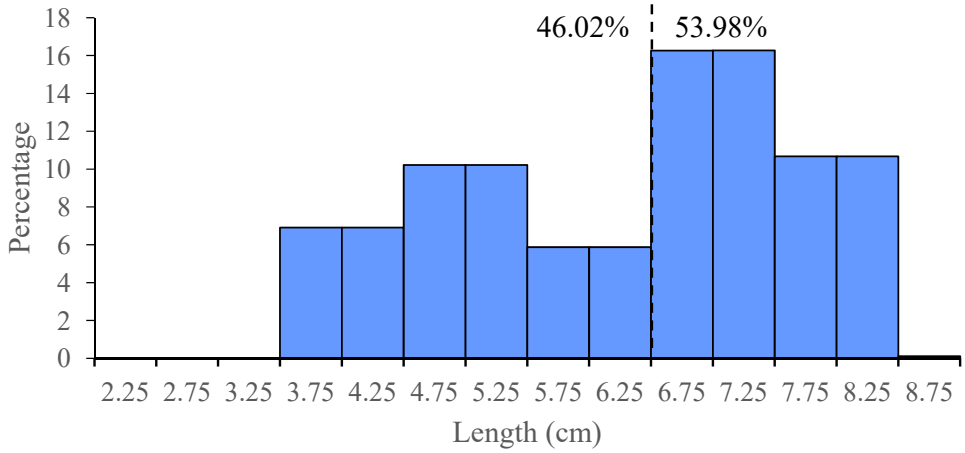


Figure 5 Length distribution of shorthead anchovy, *Encrasicholina heteroloba*, caught in Trat Province, 2014

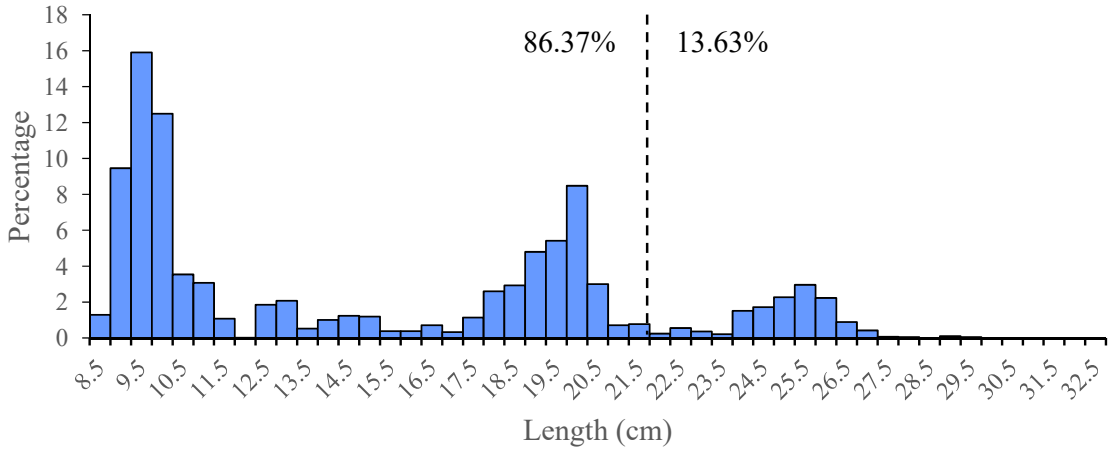


Figure 6 Length distribution of torpedo scad, *Megalaspis cordyla*, caught in Trat Province, 2014

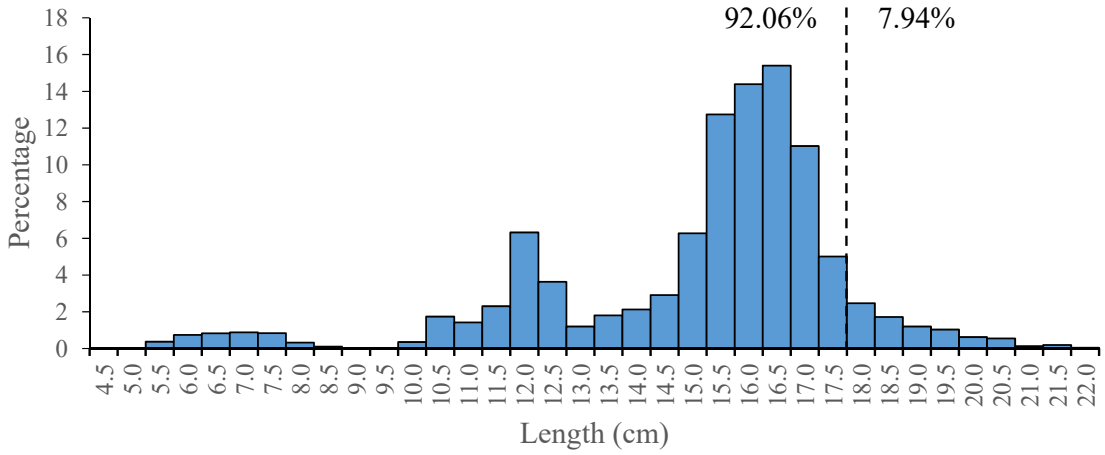


Figure 7 Length distribution of short mackerel, *Rastrelliger brachysoma*, caught in Trat Province, 2014

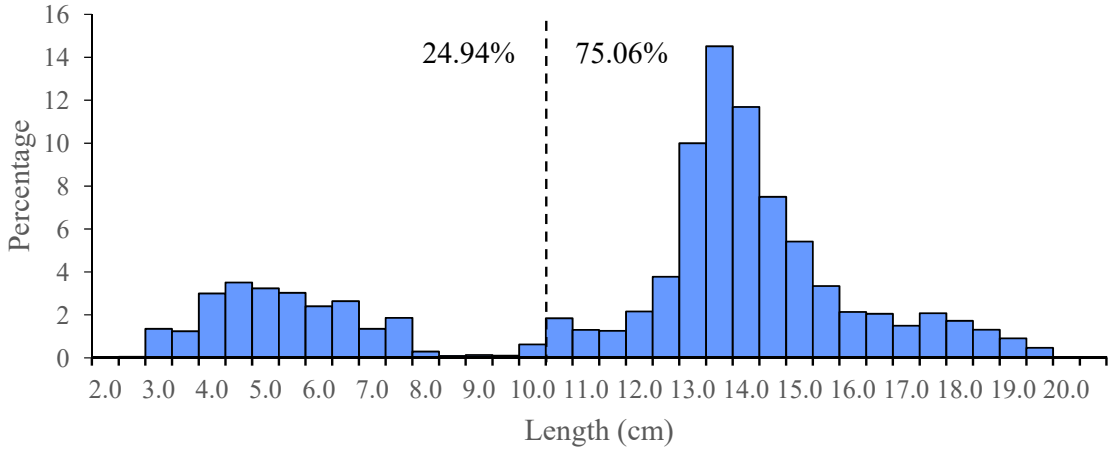


Figure 8 Length distribution of goldstripe sardinella, *Sardinella gibbosa*, caught in Trat Province, 2014

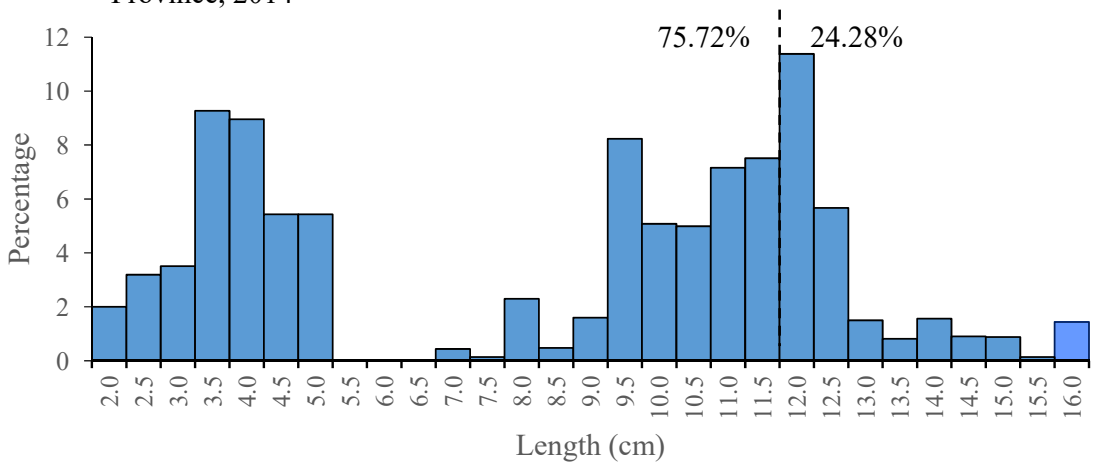


Figure 9 Length distribution of yellowstripe scad, *Selaroides leptolepis*, caught in Trat Province, 2014

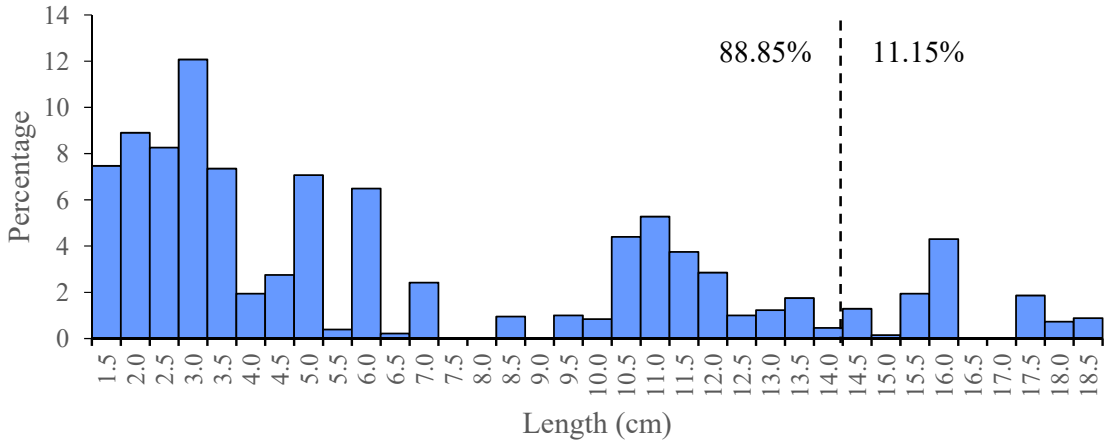


Figure 10 Length distribution ofpurple-spotted bigeye, *Priacanthus tayenus*, caught in Trat Province, 2014

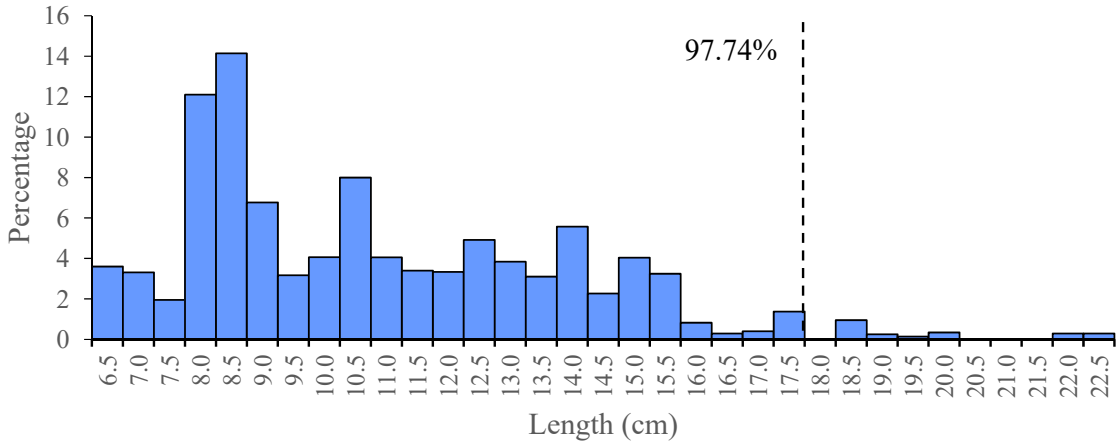


Figure 11 Length distribution oflattice monocle bream, *Scolopsis taeniopterus*, caught in Trat Province, 2014

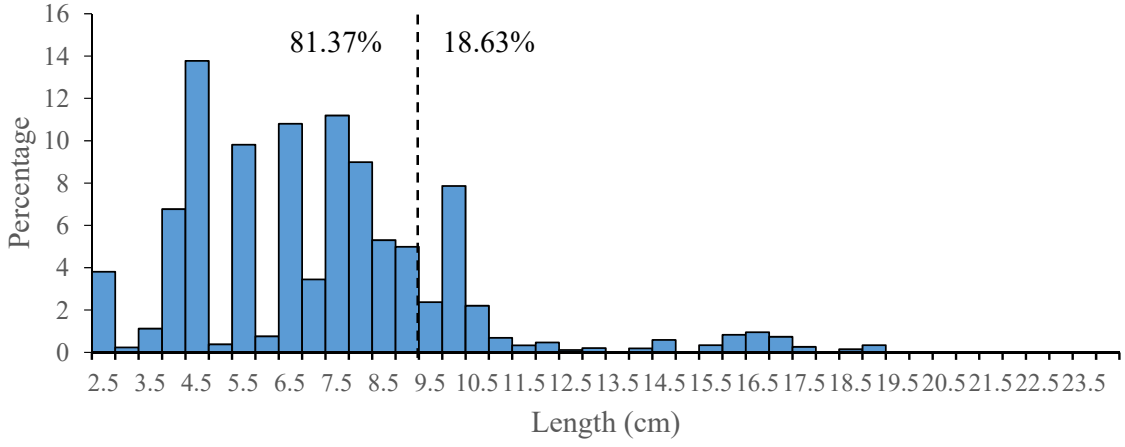


Figure 12 Length distribution of Indian squid, *Photololigo duvaucelii*, caught in Trat Province, 2014

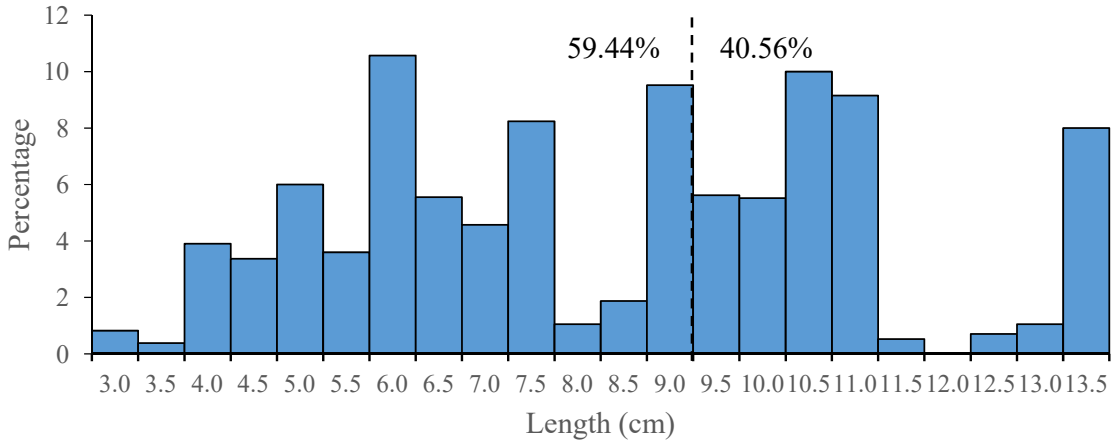


Figure 13 Length distribution of needle cuttlefish, *Sepia aculeata*, caught in Trat Province, 2014

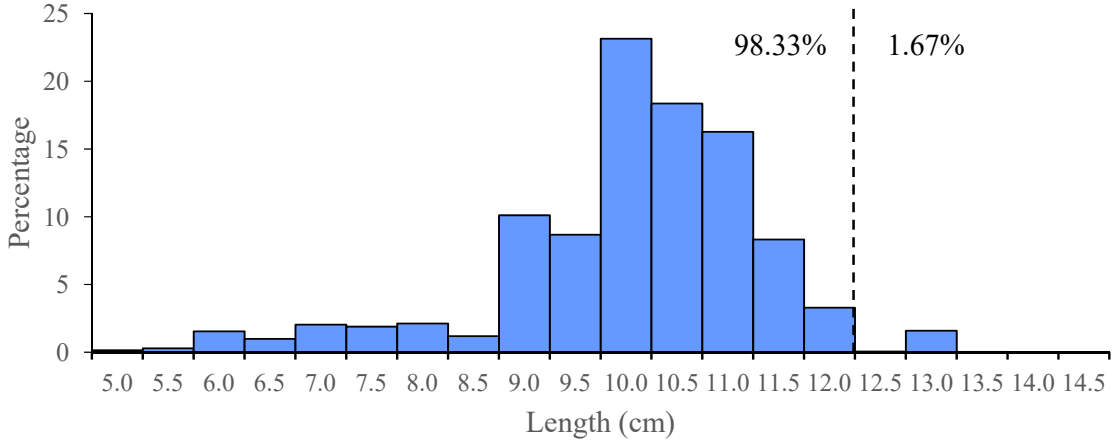


Figure 14 Length distribution of jinga shrimp, *Metapenaeus affinis*, caught in Trat Province, 2014

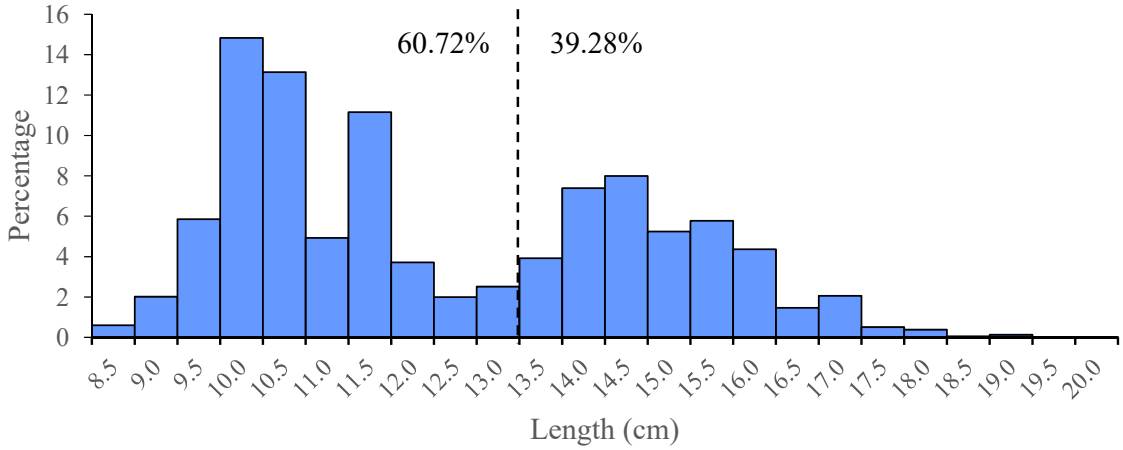


Figure 15 Length distribution of banana prawn, *Penaeus merguiensis*, caught in Trat Province, 2014

References

Coastal Habitats and Resources Management Project (CHARM). 2005. *Thai fishery laws*. Bangkok: CHARM, DOF.

Charoensombat, B., Khrueniam, U., Khongchai, T., Jindalikit, J. and Singharachai, C. 2013. *Reproductive biology of cuttlefish (Sepia aculeata and S. recurvirostra) in the Gulf of Thailand*. Technical Paper no. 4/2013. Bangkok: MFRDB, DOF.

Hussadee, P., Khongchai, T., Suppanirun, T., Charoensombat, B. and Khrueniam, U. 2015. *Reproductive biology of round scadDecapterusmaruadsi (Temminck& Schlegel, 1843) in the Gulf of Thailand*. Technical Paper no. 12/2015. Bangkok: MFRDD, DOF.

Kongprom, A., Phoonsawat, R., Tossapornpitakkul, S., Augsornpa-ob, U., Hoimuk, S., Loychuen, K, Sumontha, M. &Sripanpaibool, S. 2007. *Status of marine resources from commercial trawlers in the Gulf of Thailand and Andaman Sea*. Technical Paper no. 8/2007. Bangkok: MFRDB, DOF.

Krajangdara, T. andHemtanon, S. 2000. *Growth and reproductive biology of lattice monocle bream, Scolopsistaeniopterus (valenciennes, 1830), on the Andaman sea coast of Thailand*. Technical Paper no. 14/2000. Bangkok: MFD, DOF.

Krajangdara, T. andYakoh, A. 2005. *Reproductive biology of bigeye, Priacanthus tayenus Richardson, 1846 and P. macracanthus Cuvier, 1829 in the Andaman Sea of Thailand*. Technical Paper no. 6/2005. Bangkok: MFRDB, DOF.

Krajangdara, T., Puntuleng, P., Chalee, P. andHussadee, P. 2007. *Reproductive biology of short mackerel Rastrelligerbrachysoma (Bleeker, 1851) and Indian mackerel R.kanagurta (Cuvier, 1816) in Thai waters*. Technical Paper no. 19/2007. Bangkok:MFRDB, DOF.

Nasuchon, N.,Phuttharaksa, K.,Sritakon, T. and Hussadee, P. 2010. *Reproductive biology of Gold stripe Sardinella (Sardinellagibbosa (Bleeker, 1849)) in the Gulf of Thailand*. Technical Paper no. 16/2010. Bangkok: MFRDB, DOF.

Premkit, W., Dowreung, A. and Sereeruk, K. 2004. *Biological aspects of one finletscad (Atule mate) in the Upper Gulf of Thailand*. Technical Paper no. 1/2001. Bangkok: MFRDB, DOF.

Sinanun, P., Sinanun, T., Noranarttragoon, P., Boonjorn, N. and Tossapornpitakkul, S. 2012. *Anchovy fisheries in the Gulf of Thailand*. Technical Paper no. 18/2012. Bangkok: MFRDB, DOF.

Songkaew, N., Singhrachai, C., Pinputtasin, J. and Yangphonkhan, B. 2009. *Reproductive biology of torpedo scad (Megalaspis cordyla (Linnaeus,1758)) in the Gulf of Thailand*. Technical Paper no. 2/2009. Bangkok: MFRDB, DOF.

Sritakon, Y., Vibunpant, S., Chotitammo, U. and Songnui, J. 2012. *Biology of Jinga shrimp (Metapenaeus affinis H. Milne Edwards, 1837) from KoSamui to KoKra*. Technical Paper no. 12/2012. Bangkok: MFRDB, DOF.

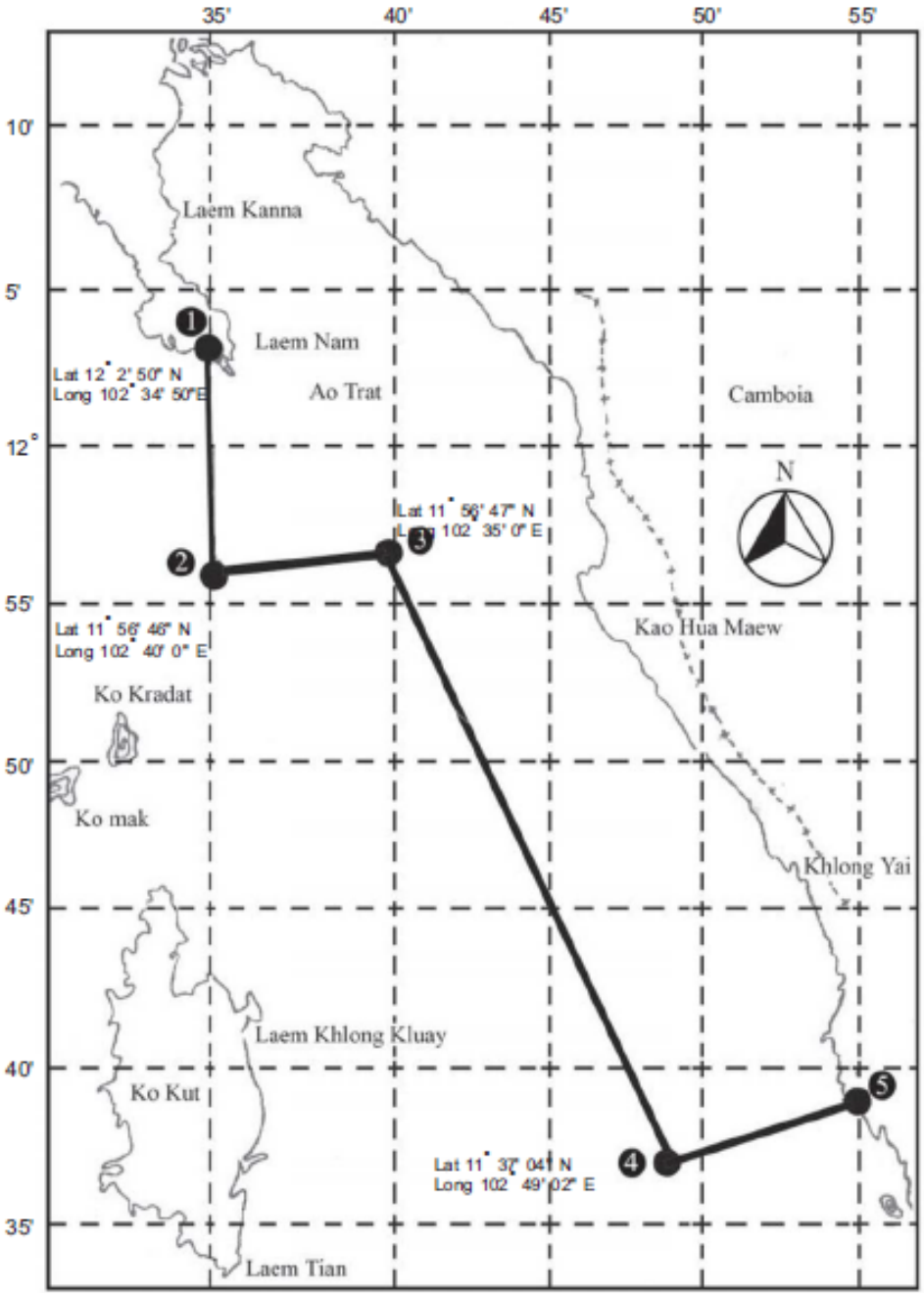
Suppanirun, T., Songkeaw, N., Khrueniam,U. and Pinputtasin, C. 2011. *Reproductive biology of Indian squid, Photololigoduvaucelii (d'Orbigny, 1835) and Mitresquid, P. chinensis (Gray, 1849) in the Gulf of Thailand*. Technical Paper no. 2/2011. Bangkok: MFRDB, DOF.

Thongsila, K.,Sinanun, T.,Noranarttragoon, P.,Boonjorn, N andKhemakorn, P. 2012. *Stock assessment of Indian mackerel (Rastrelliger kanagurta (Cuvier, 1817)) in the Gulf of Thailand.* Technical Paper no. 19/2012. Bangkok: MFRDB, DOF.

Yakoh, A. andChalee, P. 2008. *Reproductive biology of yellowstripe scad, Selaroides leptolepis (Cuvier, 1833) in the Andaman Sea along the Coast of Thailand*. Technical Paper no. 12/2008. Bangkok: MFRDB, DOF.

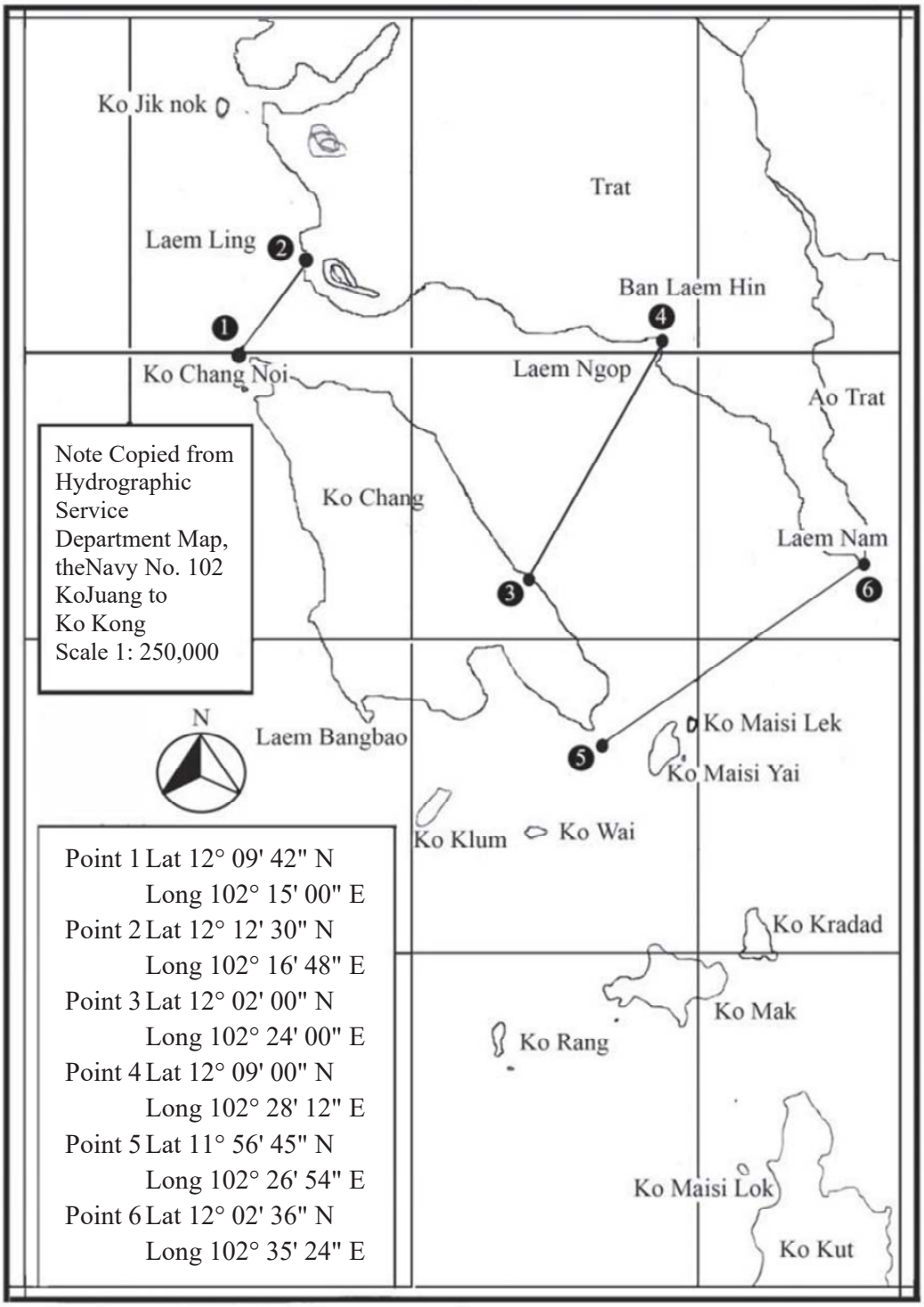
Yakoh, A., Chalee, P., Jithlang, I., Leartkaitratchata, T., Puewkhao, P. and Intharasuwan, T. 2013. *Biology of banana prawn (Penaeus merguiensis De Man, 1888) in Phang-nga Bay*. Technical Paper no. 20/2013. Bangkok: MFRDB, DOF.

Yakoh, A., Leartkaitratchata, T. and Tes-a-sen, K. 2014. *Reproductive Biology of Anchovies (Encrasicholina punctifer, E. heteroloba and E. devisi) in the Andaman Sea Coast of Thailand*. Technical Paper no. 10/2014. Bangkok: MFRDB, DOF.



Appendix A. Map attached to Notification of the Ministry of Agriculture and Cooperatives Re: Prohibition of Any Kind, Category and Size of Surrounding Netswith an Electricity Generator to Fish in Certain Areas of the Sea in TratProvince,B.E. 2538 dated on January 24, B.E. 2528

Source: CHARM, 2005



Appendix B. Map attached to Notification of Trat Province
Re: Determining the Area in which Trawls, Push Nets and Shellfish Dredges are Prohibitedin Fishing at Strait of Chang Island, Trat Province, B.E. 2543 dated on March 28, B.E. 2543

Source: CHARM, 2005