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 locality of Trat Province was conducted by collecting the data from commercial fishing boatlandings at fishing ports in the Province during January to December 2014. The results found that the CPUE of Thai purse seine, (TPS), Light luring purse seine, (LPS), Anchovy purse seine, (APS) andAnchovy falling net, (AFN) were 3,824.912, 5,858.824, 2,949.048 and 684.752 kg/day respectively. Short mackerel and goldstripe sardinella formed the highest composition of the catch from TPS and LPS respectively, while anchovies were the main component of APS and AFN. The CPUE of otter board trawl (OBT) was calculated as 23.726 kg/hour comprising of 15.131of food fish, (63.77% of the total catch), and 8.595 kg trash fish, (36.23% 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 40.41% of the catch, whereas the remaining 59.59% was made up of true trash fish. Ponyfishes made up the highest composition, (46.17%), of the trash fish catch.

Size measurements of 13 economically important species found that the mean length of three pelagic species were larger than the predicted size at first maturity while the other ten species were smaller than size at first maturity. There is some evidence to suggest thateffective management measures are urgently needed to prevent recruitment overfishing which may leadto a further decline of fisheries resources. The prohibition of high-efficiency fishing gear in some seasons and areas is a potential measure to conserve fisheries resources and sustainable use for the future.

1. Introduction

In an earlier study, the fisheries status of 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 in declining state. The current paper reports on the current status of fisheries resources caught by commercial fishing boats operating in Trat Province. The information presented in this paper is intended for policymakers to aid 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

Data were collected from commercial fishing boats, i.e., Thai purse seines (TPS), Thai light luring purse seines (LPS), Anchovy purse seines (APS), Anchovy falling nets (AFN) and Otter board trawls(OBT), during January - December 2014. The study sites were fishing ports in three districts of Trat province, i.e., Muang District, Laem Ngop District and KhlongYaiDistrict.

2.2 Sampling methods

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

a) Catchsampling. Catches were sampled from fishing boat landings at the sampling sites, in order to identify the species caught, (based on Carpenter and Niem (1998, 1999a,b, 2001a,b), to measure their weight (g) (using 500-g and 7-kg balances), and length (cm), (using punching paper with 0.5-cm class intervals), for trash fish and economically important species caught. The length measurement used for fishwas total length, for squid was mantlelength, and for shrimp was carapace length.

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

The catches from TPS and LPS purse seines werenot 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, 30-40kg samples were taken fromthe storage room or iced containers. For APS and AFN, 10 – 15 kg was taken. In high catch cases, the sample weight was higher. Species were identified and a hundred of the main species and/or economically important species masking up the catch was sampled, and measured for length and weight. For practical purposes, if the sampled fish were more than 100 in number, 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, andby size. The catch was divided into 2 main clusters; economic fish and trash fish (Figure 2). Economic fish were sorted by species, family or group, e.g., short mackerel, threadfin breams (Nemipteridae), or lizardfishes (Synodontidae), etc., which are of a similar size. These fish were kept in wooden or plastic trays or other types of containers,for convenienceofselling and

transferringtofish markets. Ice for keeping the fish fresh wasadded 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 economic fish species, such as mackerel, threadfin bream, and bigeyewere sorted out from economic 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 forlength 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 juvenilesof 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 thesize of the fish was small.

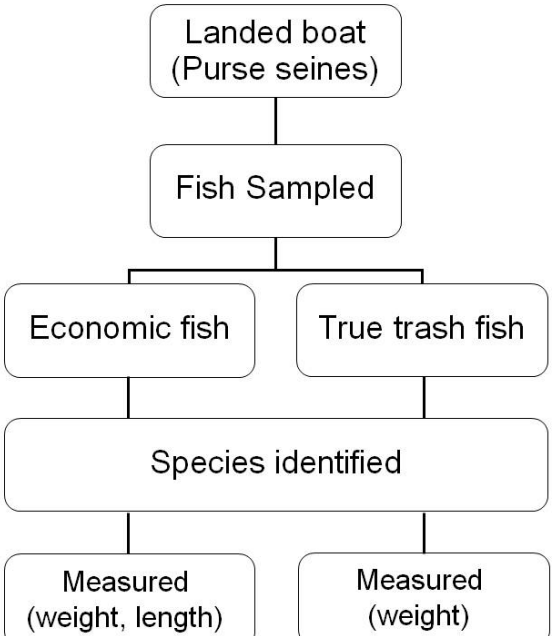

Figure 1 Sampling process of TPS, LPS, APS and AFN

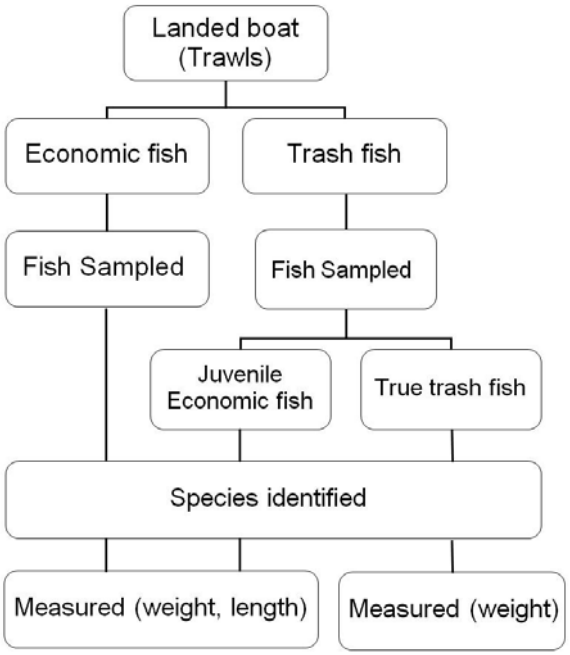

Figure 2 Sampling process of OBT

2.3 Data analysis

Data from fishing boats operating in Trat province were used to analyze fisheries status, while data from fishing boats landing at fishing ports in Trat Province may have includedcatches from fishing grounds outside of Trat Province were excluded.

Catch per unit effort (CPUE), 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)* $= \frac{\text{Catch of each species (kg)}}{\text{Fishing effort (hour)}}$

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

- 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 showa 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 1.73 days/trip). Normally,this was a one day/trip. Average CPUE fromTPS was 3,824.912 kg/day. Pelagic fish formed the major part of the catch(CPUE of 3,015.417 kg/day) making up 78.84% of the total catch. Short mackerel, Goldstripe sardinella and Indian mackerel were the main pelagic species caught, at 18.23%, 17.45% and 7.58% respectively. Scads (Carangidae) formed a major partof the catch accounting formore 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 14.12% of the total catch. Spinefoots and croakers being the dominantdemersal fish species.Ponyfishes were the leading group of trash fish making up 5.82% 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**	**3,824.912**
Sub-total pelagic fish	**78.84**	**3,015.417**

Short mackerel	*Rastrelliger brachysoma*	18.23	697.281
Goldstripe sardinella	*Sardinella gibbosa*	17.45	667.333
Indian mackerel	*R. kanagurta*	7.58	289.751
Frigate tuna	*Auxisthazard*	5.46	208.800
Rainbow sardine	*Dussumieriaacuta*	4.67	178.637
Buccaneer anchovy	*Encrasicholina punctifer*	3.58	137.085
Torpedo scad	*Megalaspis cordyla*	3.36	128.652
Indian scad	*Decapterusrusselli*	3.36	128.526
Yellowtail scad	*Atule mate*	3.36	128.359
Shorthead anchovy	*Encrasicholina heteroloba*	2.49	95.379
Chacunda gizzard shad	*Anodontostomachacunda*	2.31	88.207
Kawakawa	*Euthynnusaffinis*	1.26	48.035
Bigeye scad	*Selar crumenophthalmus*	1.18	45.239
Barracudas	*Sphyraena*spp.	1.13	43.393
Other pelagic fishes		3.42	130.740
Sub-total demersal fish		**14.12**	**540.068**
Spinefoots	Siganus spp.	5.85	223.872
Croakers	Sciaenidae	5.44	207.996
Splendid ponyfish	*Leiognathussplendens*	1.64	62.532
Other demersal fishes		1.19	45.668
Sub-total invertebrate		**1.22**	**46.763**
Squids		1.18	45.312
Cuttlefishes		0.02	0.622
Other invertebrates		0.02	0.829
Sub-total trash fish		**5.82**	**222.664**
Ponyfishes	Leiognathidae	3.04	116.122
Moonfish	Menemaculata	0.88	33.679
Cornetfishes	*Fistularia*spp.	0.59	22.515
Other trash fishes		1.31	50.348

3.1.2 Thai purse seine with light luring (LPS)

The number of LPS fishing days varied from 1-5 days/trip, (average 2.43 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 wasfound 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 5,120.018 kg/day. Pelagic fish formed the main part of the catch at 5,120.018 kg/day equivalent to 87.39% of the total catch. The catch composition of LPS was different from TPS.Gold stripe sardinella made upalmost one half of the total catch followed by Indian mackerel, short mackerel and torpedo scad, at 12.31%, 6.14% and 6.05% respectively. Similar to TPS, a small percentage of neritic tunas were also found in the LPS catch. Squid appeared at a higher percentage comparedto 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**	**5,858.824**
Sub-total pelagic fish		**87.39**	**5,120.018**
Goldstripe sardinella	*Sardinella gibbosa*	48.31	2,830.435
Indian mackerel	*Rastrelliger kanagurta*	12.31	721.276
Short mackerel	*R. brachysoma*	6.14	359.927
Torpedo scad	*Megalaspis cordyla*	6.05	354.709
Yellowtail scad	*Atule mate*	5.91	346.425
Frigate tuna	*Auxisthazard*	2.10	122.833
Indian scad	*Decapterusrusselli*	2.02	118.136
Longtail tuna	*Thunnustonggol*	0.89	51.942
Barracudas	*Sphyraena*spp.	0.86	50.300
Yellowstripe scad	*Selaroides leptolepis*	0.74	43.331
Other pelagic fishes		2.06	120.708
Sub-total demersal fish		**2.22**	**130.275**
Slender lizardfish	*Saurida elongata*	0.81	47.701
Largeheadhairtail	*Trichiuruslepturus*	0.42	24.817
Purple-spotted bigeye	*Priacanthus tayenus*	0.25	14.667
Otherdemersal fishes		0.74	43.090
Sub-total invertebrate		**3.61**	**211.395**
Squids		3.61	211.395
Sub-total trash fish		**6.78**	**397.136**
Moonfish	*Menemaculata*	4.09	239.616
Cornetfishes	*Fistularia*spp.	1.50	87.845
Other trash fishes		1.19	69.675

3.1.3 Anchovy purse seine (APS)

The number of APS fishing days varied from 1 – 10 days/trip, (average of 4.04 days/trip) The most common duration was a 2 day/trip. The average CPUE from APS was 2,788.501 kg/day. Most of the catch was made up of pelagic fish,accounting for 94.56% of the total catch with a CPUE of 2,788.501kg/day. The total catch was made up of around 60% anchoviesand 20% mackerels, with the CPUE of 1,741.205 kg/day and 583.198 kg/day respectively. *Stolephorus* spp.was the dominant species of anchovy. Neritic tunas were also found in the catchas 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 seineoperated in Trat Province, 2014

Species/Group		Composition (%)	CPUE (kg/day)
Total		**100.00**	**2,949.048**
Sub-total pelagic fish		**94.56**	**2,788.501**
Anchovies	*Stolephorus* spp.	22.05	650.127
Shorthead anchovy	*Encrasicholina heteroloba*	18.68	550.945
Buccaneer anchovy	*E.punctifer*	18.32	540.133
Indian mackerel	*Rastrelliger kanagurta*	15.32	451.707
Torpedo scad	*Megalaspis cordyla*	4.56	134.617
Short mackerel	*R. brachysoma*	4.46	131.491
Goldstripe sardinella	*Sardinella gibbosa*	2.67	78.681

Longtail tuna	*Thunnustonggol*	1.65	48.550
Yellowtail scad	*Atule mate*	1.53	45.003
Barracudas	*Sphyraena*spp.	0.95	28.093
Frigate tuna	*Auxisthazard*	0.83	24.576
Rainbow sardine	*Dussumieriaacuta*	0.49	14.415
Bigeye scad	*Selar crumenophthalmus*	0.49	14.380
Other pelagic fishes		2.56	75.783
Sub-total demersal fish		**1.09**	**32.220**
Goatfishes	*Upeneus* spp.	0.29	8.340
Bigeye snapper	*Lutjanuslutjanus*	0.23	6.811
Largeheadhairtail	*Trichiuruslepturus*	0.16	4.794
Lizardfishes	*Saurida* spp.	0.12	3.610
Otherdemersal fishes		0.29	8.665
Sub-total invertebrate		**1.22**	**36.026**
Indian squid	*Photololigo duvaucelii*	0.83	24.612
Kobi squid	*Nipponololigosumatrensis*	0.34	9.963
Bigfin reef squid	*Sepioteuthislessoniana*	0.04	1.088
Other invertebrates		0.01	0.363
Sub-total trash fish		**3.13**	**91.301**
Cornetfishes	*Fistularia*spp.	0.49	14.326
Other trash fishes		2.64	77.975

3.1.4 Anchovy falling net (AFN)

The number of AFN fishing day ranged from 1-11 days/trip, (average of 5.35 days/trip), The most common duration was a 5 day/tripThe average CPUE from the AFN was 684.752 kg/day. Pelagic fish formedthe main part of the catch with a CPUE of 647.101 kg/day. Anchovymade up 68.46% of the total catch.The major species of anchovy caughtwas *Stolephorus* spp. Mackerelswere also caught by AFN at a CPUE of 119.826 kg/day, accounted for 17.50% of the total catch. Demersal fish and invertebrate were rarely found due to the shallow depth of the AFN. Ponyfishes were found in small quantitiesin the trash fish group.

Table 4 Catch composition and CPUE of anchovy falling net inTrat Province, 2014

Species/Group		Composition (%)	CPUE (kg/day)
Total		**100.00**	**684.752**
Sub-total pelagic fish		**94.50**	**647.101**
Anchovies	*Stolephorus* spp.	40.99	280.703
Shorthead anchovy	*Encrasicholina heteroloba*	23.11	158.268
Indian mackerel	*Rastrelliger kanagurta*	10.47	71.678
Short mackerel	*R. brachysoma*	7.03	48.148
Buccaneer anchovy	*Encrasicholina punctifer*	4.36	29.859
Goldstripe sardinella	*Sardinella gibbosa*	1.72	11.767
Yellowtail scad	*Atule mate*	1.01	6.884
Rainbow sardine	*Dussumieriaacuta*	0.94	6.454
Indian scad	*Decapterusrusselli*	0.47	3.248
Yellowstripe scad	*Selaroides leptolepis*	0.45	3.114

Bigeye scad	*Selar crumenophthalmus*	0.36	2.477
Other pelagic fishes		3.59	24.501
Sub-total demersal fish		**0.94**	**6.459**
Lizardfishes	*Saurida* spp.	0.66	4.492
Otherdemersal fishes		0.29	1.967
Sub-total invertebrate		**0.98**	**6.723**
Indian squid	*Photololigo duvaucelii*	0.76	5.180
Kobi squid	*Nipponololigosumatrensis*	0.12	0.818
Other invertebrates		0.11	0.725
Sub-total trash fish		**3.58**	**24.469**
Ponyfishes	Leiognathidae	2.03	13.868
Other trash fishes		1.55	10.491

3.1.5Otter 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 at 2 hauls/day were used. The average CPUE from OBT was 23.726 kg/hour consisting of 15.131kg/hour food fish and 8.595 kg/hour of trash fish. The percentage of food fish and trash fish was 63.77 : 36.23 respectively (Table 5 – 6).

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

Species/Group		Composition (%)	CPUE (kg/hour)
Total		**100.00**	**15.131**
Sub-total pelagic fish		**11.15**	**1.687**
Barracudas	*Sphyraena*spp.	3.79	0.574
Needlescaledqueenfish	*Scomberoidestol*	3.34	0.506
Yellowtail scad	*Atule mate*	1.65	0.250
Short mackerel	*Rastrelliger brachysoma*	0.99	0.149
Shrimp scad	*Alepesdjeddaba*	0.69	0.104
Longfin trevally	*Carangoidesarmatus*	0.15	0.023
Indian mackerel	*Rastrelliger kanagurta*	0.15	0.023
Other pelagic fishes		0.39	0.058
Sub-total demersal fish		**42.95**	**6.499**
Goatfishes	*Upeneus* spp.	5.04	0.763
Tonguesoles	Cynoglossidae	4.85	0.734
Slender lizardfish	*Saurida elongata*	4.45	0.674
Brushtooth lizardfish	*Saurida undosquamis*	4.23	0.641
Ornate threadfin bream	*Nemipterus hexodon*	3.87	0.586
Lattice monocle bream	*Scolopsis taeniopterus*	3.28	0.496
Purple-spotted bigeye	*Priacanthus tayenus*	3.10	0.469
Mauvelip threadfin bream	*N. mesoprion*	2.36	0.357
Lunartail puffer	*Lagocephaluslunaris*	1.20	0.181
Jarbusterapon	*Teraponjarbua*	1.06	0.161
Snappers	*Lutjanus* spp.	1.03	0.156

Redspine threadfin bream	*Nemipterus nemurus*	0.91	0.137
Japanese threadfin bream	*Nemipterus japonicus*	0.81	0.122
Other demersal fishes		6.76	1.022
Sub-total cephalopod		**17.22**	**2.605**
Mitre squid	*Photololigo chinensis*	6.11	0.925
Indian squid	*Photololigo duvaucelii*	4.90	0.742
Octopuses		2.39	0.362
Curvespine cuttlefish	*Sepia recurvirostra*	0.95	0.143
Needle cuttlefish	*Sepia aculeata*	0.91	0.138
Bigfin reef squid	*Sepioteuthislessoniana*	0.76	0.115
Other cephalopods		1.20	0.180
Sub-total shrimp and prawn		**12.73**	**1.927**
Fiddler shrimp	*Metapenaeopsisstridulans*	5.46	0.827
Malayan rough shrimp	*Trachypenaeusmalaiana*	2.20	0.334
Green tiger prawn	*Penaeus semisulcatus*	1.24	0.187
Jinga shrimp	*Metapenaeus affinis*	0.60	0.091
Middle shrimp	*Metapenaeus intermedius*	0.42	0.064
Banana prawn	*Penaeus merguiensis*	0.42	0.064
Other shrimps and prawns		2.39	0.360
Sub-total other		**15.95**	**2.413**
Asian moon scallop	*Amusiumpleuronectes*	11.34	1.716
Swimming crab	*Charybdis* spp.	2.77	0.419
Blue swimming crab	*Portunuspelagicus*	0.93	0.141
Other invertebrates		0.91	0.137

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

Species/Group		Composition (%)	CPUE (kg/hour)
Total		**100.00**	**8.595**
Sub-total pelagic fish		**2.37**	**0.204**
Anchovies	*Stolephorus*spp.	0.92	0.079
Gold stripe sardinella	*Sardinella gibbosa*	0.59	0.051
Indian mackerel	*Rastrelliger kanagurta*	0.48	0.041
Obtuse barracuda	*Sphyraenaobtusata*	0.24	0.020
Yellowstripe scad	*Selaroides leptolepis*	0.14	0.012
Sub-total demersal fish		**30.10**	**2.587**
Splendid pony fish	*Leiognathussplenden*	9.59	0.824
Purple-spotted bigeye	*Priacanthus tayenus*	4.24	0.364
Longfin mojarra	*Pentaprionlongimanus*	3.17	0.273
Tonguesoles	Cynoglossidae	2.82	0.242
Lizardfishes	*Saurida* spp.	2.81	0.242
Lunartail puffer	*Lagocephaluslunaris*	1.68	0.145
Lattice monocle bream	*Scolopsis taeniopterus*	1.34	0.115
Half-smooth golden puffer fish	*Lagocephalusspadiceus*	1.07	0.092
Threadfin breams	*Nemipterus* spp.	0.51	0.044
Goatfishes	*Upeneus*spp.	0.51	0.044
Sixbar grouper	*Epinephelussexfasciatus*	0.50	0.043
Other demersal fishes		1.86	0.159

Sub-total cephalopod		**6.22**	**0.535**
Kobi squid	*Nipponololigosumatrensis*	3.15	0.271
Indian squid	*Photololigo duvaucelii*	0.94	0.081
Octopus		0.92	0.079
Curve spine cuttlefish	*Sepia recurvirostra*	0.69	0.059
Cuttlefishes		0.52	0.045
Sub-total other invertebrate		**1.72**	**0.147**
Crabs		1.37	0.118
Asian moon scallop	*Amusiumpleuronectes*	0.27	0.024
Mantis shrimps		0.05	0.005
Fiddler shrimp	*Metapenaeopsisstridulans*	0.02	0.001
Sub-total true trash fish		**59.59**	**5.122**
Pony fishes	Leiognathidae	36.58	3.144
Dwarf flathead	*Elates ransonnetii*	9.50	0.817
Cardinalfishes	Apogonidae	4.45	0.383
Scorpionfishes	Scorpaenidae	0.96	0.082
Moonfish	*Menemaculata*	0.86	0.074
Other true trash fishes		7.24	0.622

Demersal fish formed the highest part, (42.95%) of the total food fish group. Thread fin breams (*Nemipterus* spp.) made up the highest portion (11.23%) followed by lizardfish, (8.68%) (*Saurida* spp.) and goatfish (5.04%) (*Upeneus* spp.)with a CPUE of 1.698, 1.315 and 0.763 kg/hour respectively. Shrimp, prawn, squid and Asian moon scallopsalso appeared as 12.73%, 11.77% and 11.34% of the total food fish,with the CPUE of 1.927, 1.782 and 1.716 kg/hour respectively. While pelagic fish made upa small proportion(11.15%) of the total food fish catch (Table 5).

Trash fish was made up of 40.41% of juvenile economic species and 59.59% true trash fish.For true trash fish, pony fishes dominated the catch, accounting for 36.58% of total trash fish followed by dwarf flathead, 9.50% (Table 6). Although most ponyfish are classified as ‘true trash fish’, the splendid ponyfish, *Leiognathussplenden*, 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% ofthe total trash fish with a CPUE of 0.824 kg/hour. Other demersal fish species included purple-spotted bigeye, longfin mojarra and tonguesoles, making up 4.24%, 3.17% and 2.82% 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 goldstripe sardinella, had a mean length that waslarger thanpredicted 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 follow.

Table8 Mean length of some economically important species caught in Trat Province in 2014 and female size at first maturity complied from available technical papers

Common name	Scientific name	Range (cm)	Mean (cm)	Female size at first maturity(cm)	Source
Yellowtail scad	*Atule mate*	7.75 – 27.75	14.74 ± 0.06	21.25	Premkit et al., 2004
Indian scad	*Decapterusrusselli*	4.25 – 22.75	13.45 ± 0.08	13.19	Hussadee et al., 2015
Shorthead anchovy	*Encrasicholina heteroloba*	2.50 – 9.00	6.52 ± 0.001	6.44	Yakoh et al., 2014
Torpedo scad	*Megalaspis cordyla*	8.75 – 32.75	15.39 ± 0.10	21.55	Songkaew et al., 2009
Short mackerel	*Rastrelliger brachysoma*	4.75 – 22.25	15.46 ± 0.03	17.95	Krajangdara et al., 2007
Goldstripe sardinella	*Sardinella gibbosa*	2.25 – 20.75	12.27 ± 0.01	10.35	Nasuchon et al., 2010
Yellowstripe scad	*Selaroides leptolepis*	2.25 – 16.25	8.65 ± 0.04	11.73	Yakoh and Chalee, 2008
Purple-spotted bigeye	*Priacanthus tayenus*	1.75 – 18.75	6.99 ± 0.12	14.19	Krajangdara and Yakoh, 2005
Lattice monocle bream	*Scolopsis taeniopterus*	6.75 – 22.75	11.11 ± 0.28	17.57	Krajangdara and Hemtanon, 2000
Indian squid	*Photololigoduvaucelii*	2.75 – 24.25	7.46 ± 0.15	9.04	Suppanirun et al., 2011
Needle cuttlefish	*Sepia aculeata*	3.25 – 13.75	8.69 ± 0.41	9.44	Charoensombatet al., 2013
Jinga shrimp	*Metapenaeus affinis*	5.25 – 14.75	10.32 ± 0.05	12.18	Sritakon et al., 2012
Banana prawn	*Penaeus merguiensis*	8.75 – 20.25	12.63 ± 0.09	13.38	Yakoh et al., 2013

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 cmwhile 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 cmwhile its size at first maturity is 17.95 cm. More than 90% of the fish caughtwere smaller than this size (Figure 7).

3.2.6 Goldstripe sardinella

Mean length of goldstripe sardinella was 12.27± 0.01 cmwhile 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 cmwhile 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 cmwhile 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 cmwhile its size at first maturity is 17.57 cm. Only a few fish, with length larger than this size, were caught (Figure 11).

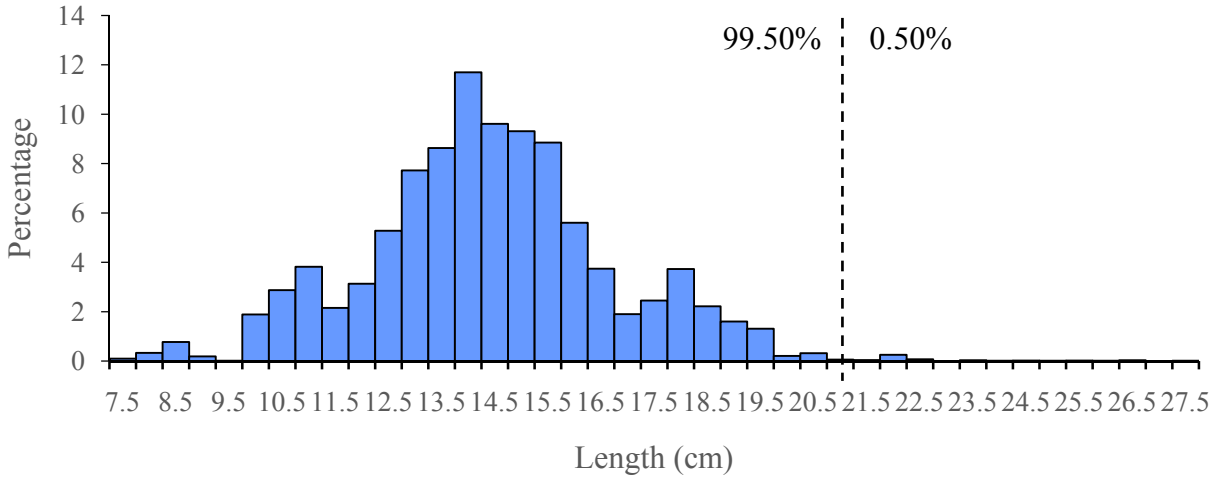

Figure3 Length distribution of yellowtail scad, *Atule mate*, caught in Trat Province, 2014

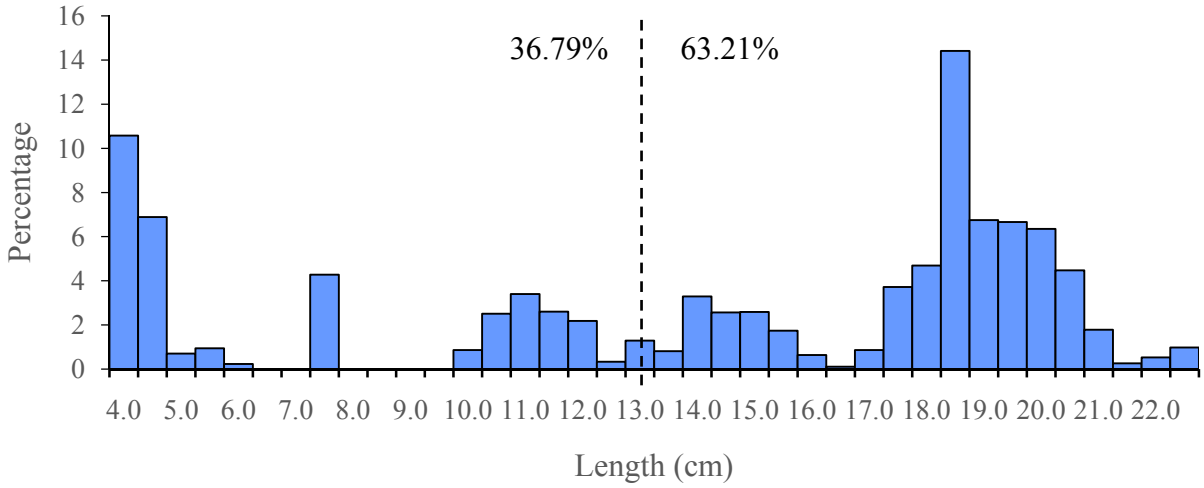

Figure4 Length distribution of Indian scad, *Decapterusrusselli*, caught in Trat Province, 2014

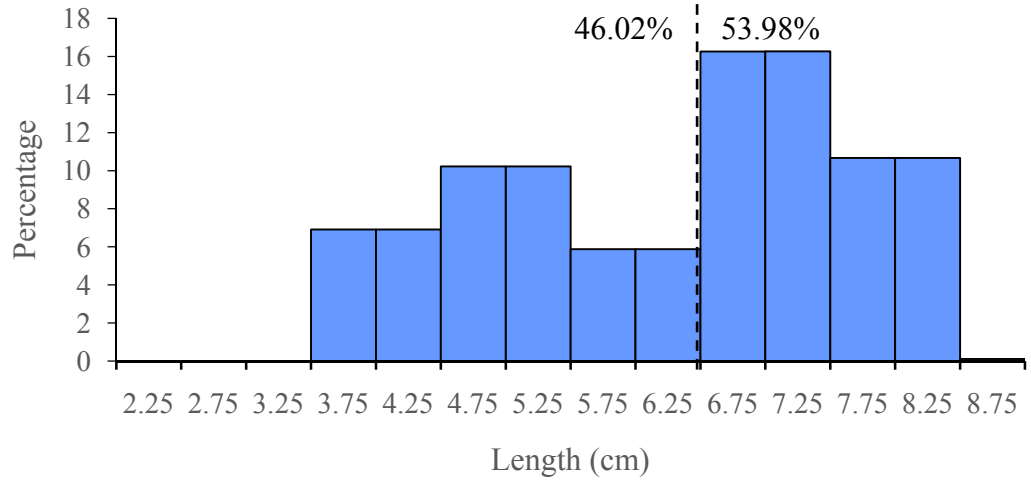

Figure5 Length distribution of shorthead anchovy, *Encrasicholina heteroloba*, caught in Trat Province, 2014

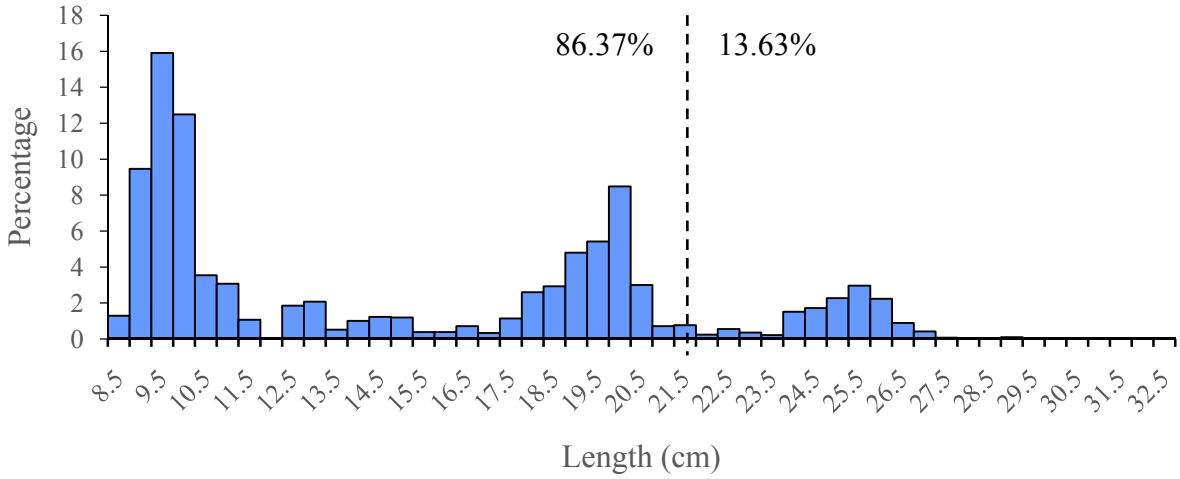

Figure6 Length distribution of torpedo scad, *Megalaspis cordyla*, caught in Trat Province, 2014

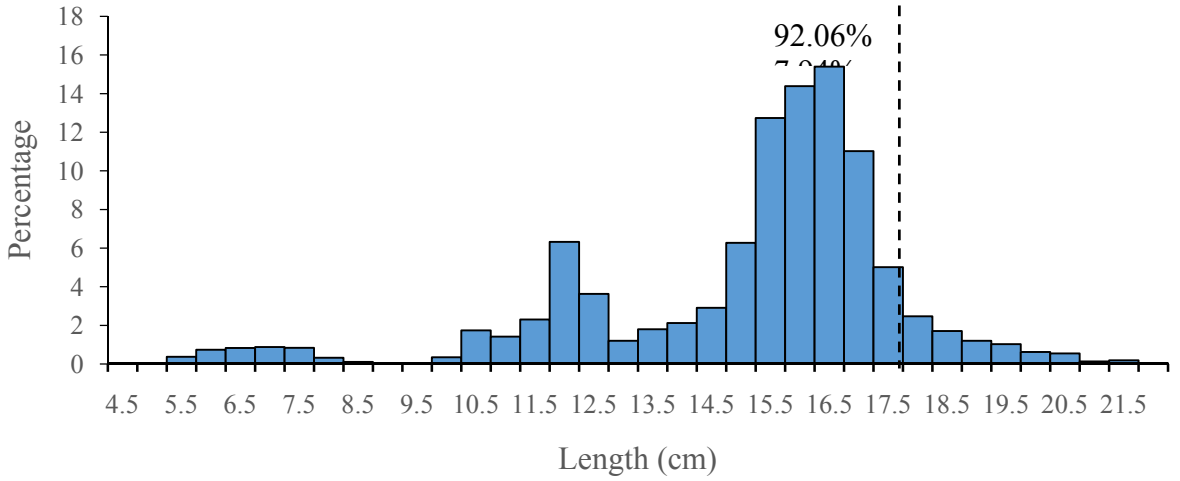

Figure7 Length distribution of short mackerel, *Rastrelliger brachysoma*, caught in Trat Province, 2014

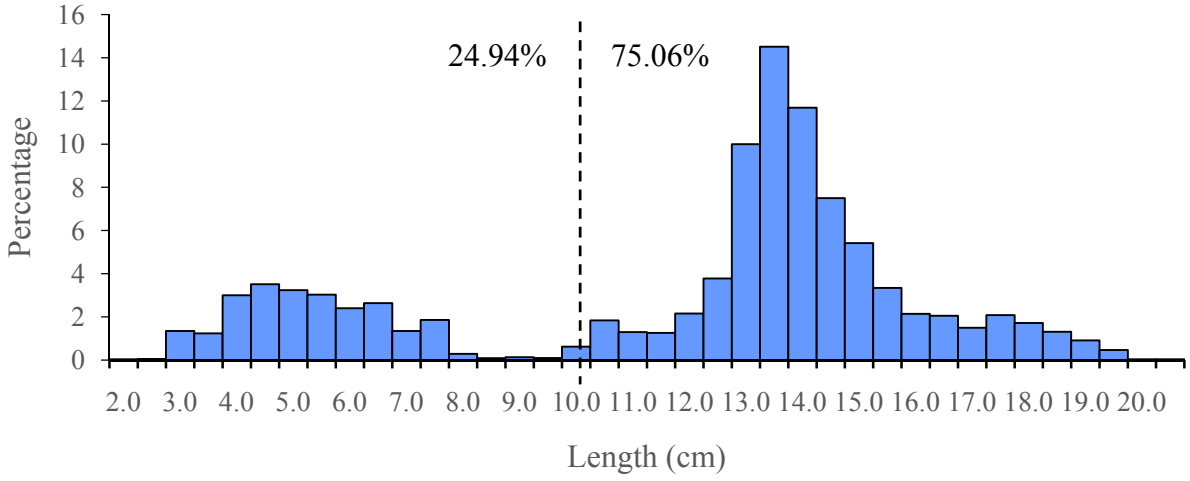

Figure 8 Length distribution of goldstripe sardinella, *Sardinella gibbosa*, caught in Trat Province, 2014

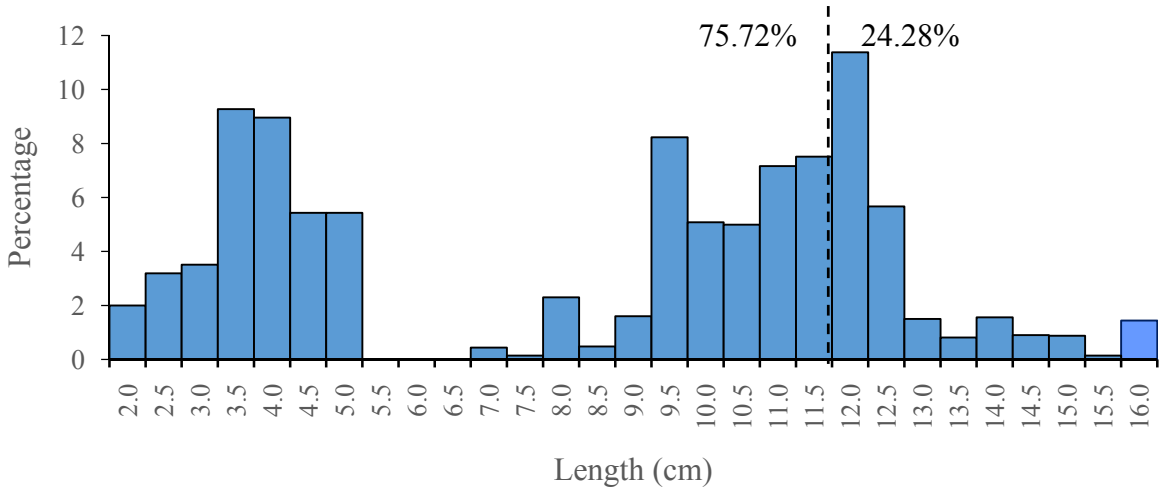

Figure9 Length distribution of yellowstripe scad, *Selaroides leptolepis*, caught in Trat Province, 2014

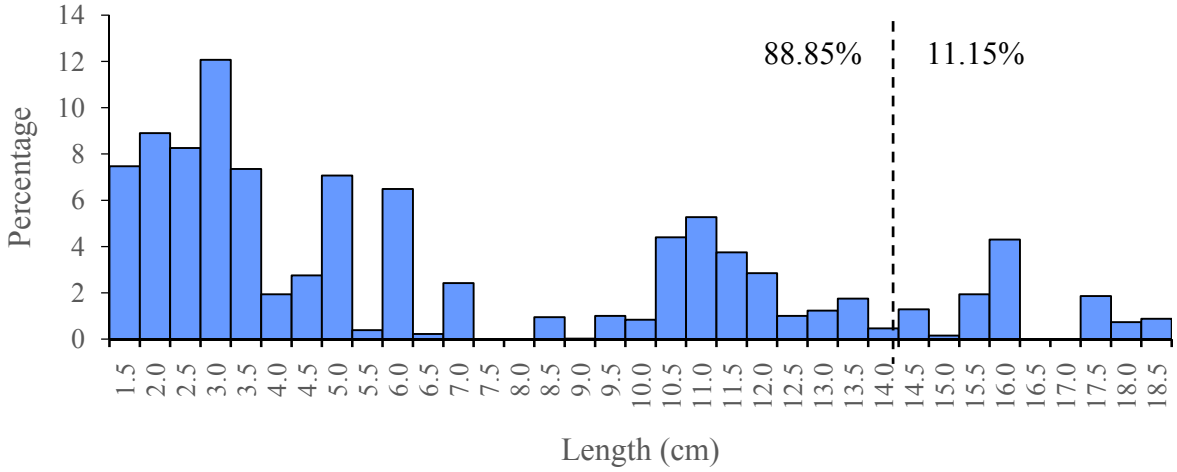

Figure10 Length distribution ofpurple-spotted bigeye, *Priacanthus tayenus*, caught in Trat Province, 2014

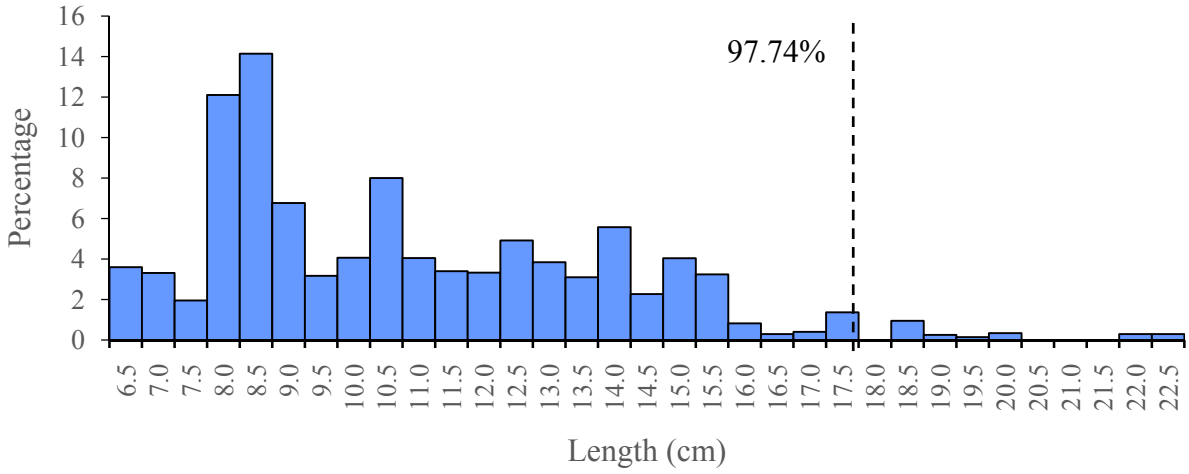

Figure 11 Length distribution oflattice monocle bream, *Scolopsis taeniopterus*, caught in Trat Province, 2014

3.2.10 Indian squid
Mean length of Indian squid was 7.46± 0.15 cmwhile 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 cmwhile 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 cmwhile 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 cmwhile 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.

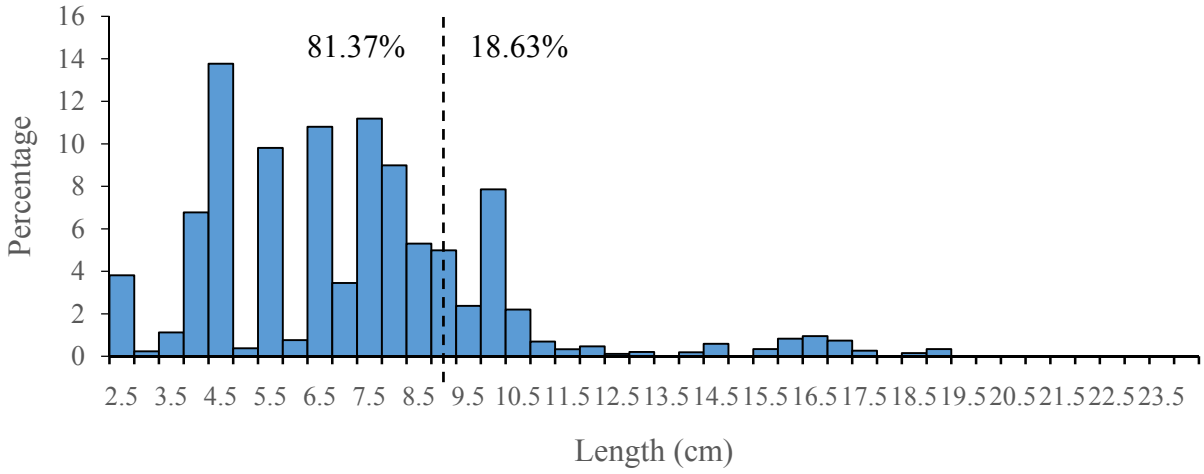

Figure12 Length distribution ofIndian squid, *Photololigoduvaucelii*, caught in Trat Province, 2014

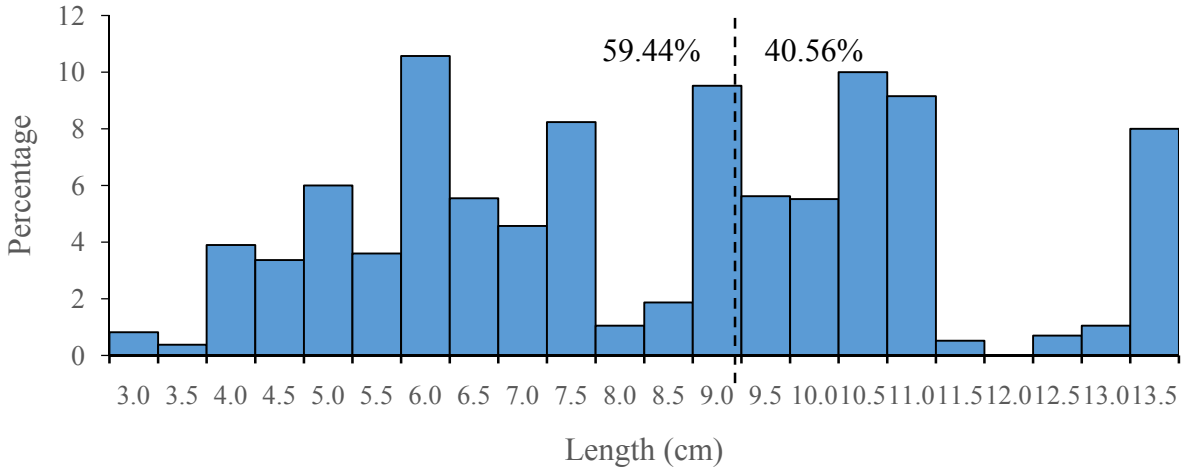

Figure13 Length distribution ofneedle cuttlefish, *Sepia aculeata*, caught in Trat Province, 2014

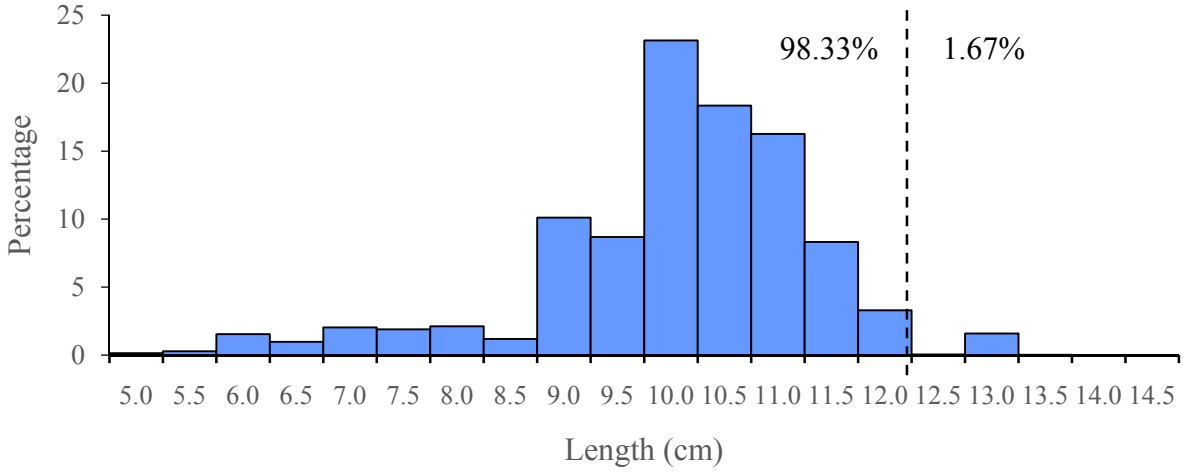

Figure14 Length distribution ofjinga shrimp, *Metapenaeus affinis*, caught in Trat Province, 2014

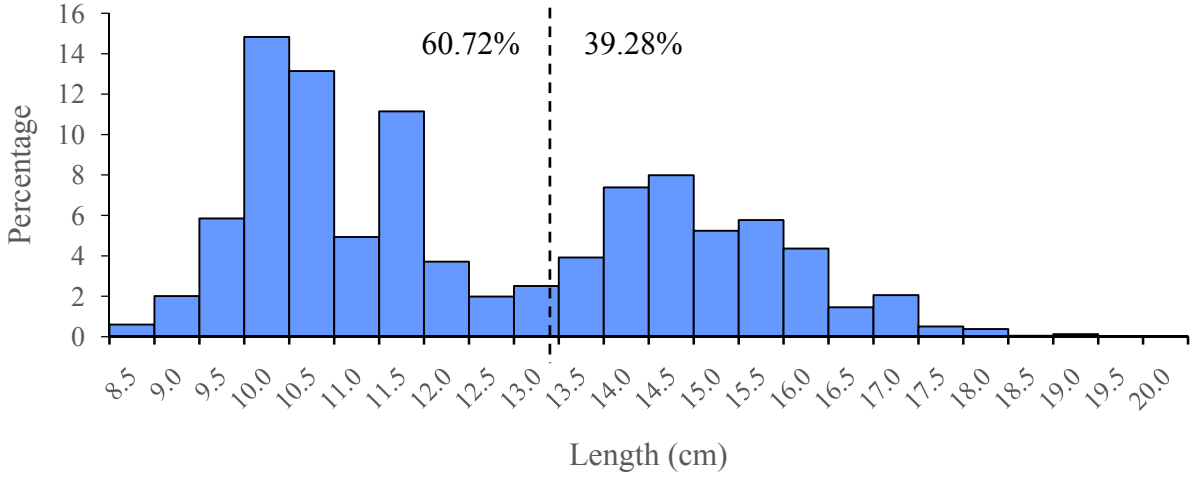

Figure15 Length distribution ofbananaprawn, *Penaeus merguiensis*, caught in Trat Province, 2014

4. Conclusion

The CPUE of TPS, LPS, APS and AFN were 3,824.912, 5,858.824, 2,949.048 and 684.752 kg/day respectively. Short mackerel and goldstripe 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 23.726 kg/hour comprising of 15.131 kg/hour food fish, 63.77% of the total catch, and 8.595 kg/hour trash fish, 36.23% of the total catch. Threadfin breams were the major composition, 7.95% of the total food fish. In trash fish group, economic fish accounted for 40.41% whereas the remaining 59.59% was true trash fish. Ponyfishes were the highest composition, 46.17%of the total trash fish split into 9.59% splendid ponyfish in food fish group and 36.58% other ponyfishes 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	3,824.912 kg/day	2,353.926 kg/day (2007)	Thongsila et al., 2012
LPS	5,858.824 kg/day	2,298.274kg/day (2007)	Thongsila et al., 2012
APS	2,949.048 kg/day	2,521.70kg/day (2008)	Sinanun et al., 2012
AFN	684.752[1] kg/day	499.46 kg/day[2] (2008)	Sinanun et al., 2012
		1,327.41kg/day[3] (2008)	Sinanun et al., 2012
OBT	23.726 kg/hour	23.642 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 highCPUE of high efficient commercial fishing gear, effective management measure is urgently needed in order to prevent recruitment overfishing which may leadto 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 measuresaim to conserve pelagic fish resources. Consequently, three pelagic species are in good condition seen by the fact that larger fish rather than smaller fish were frequently caughtSince 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 thehealth 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.

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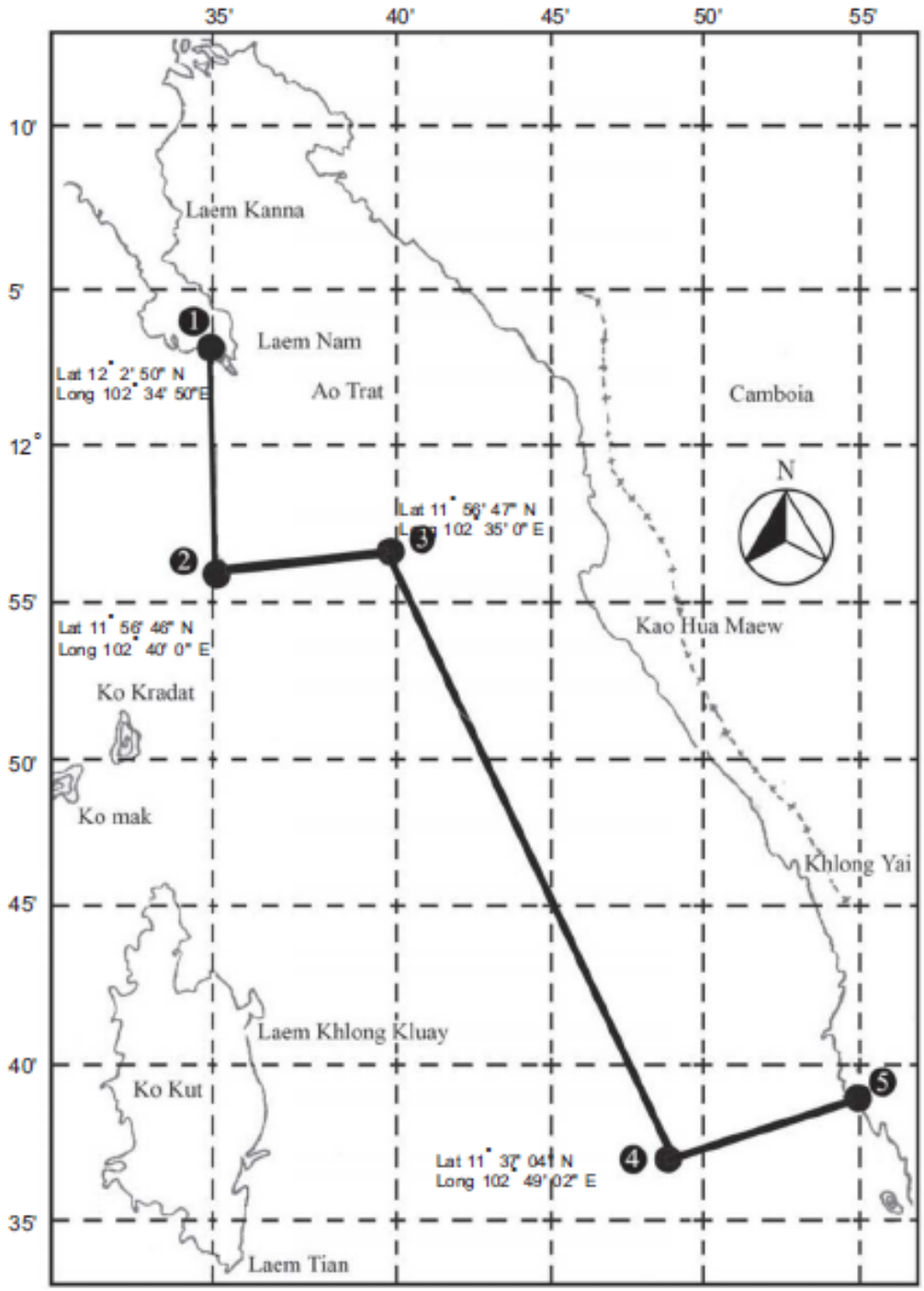
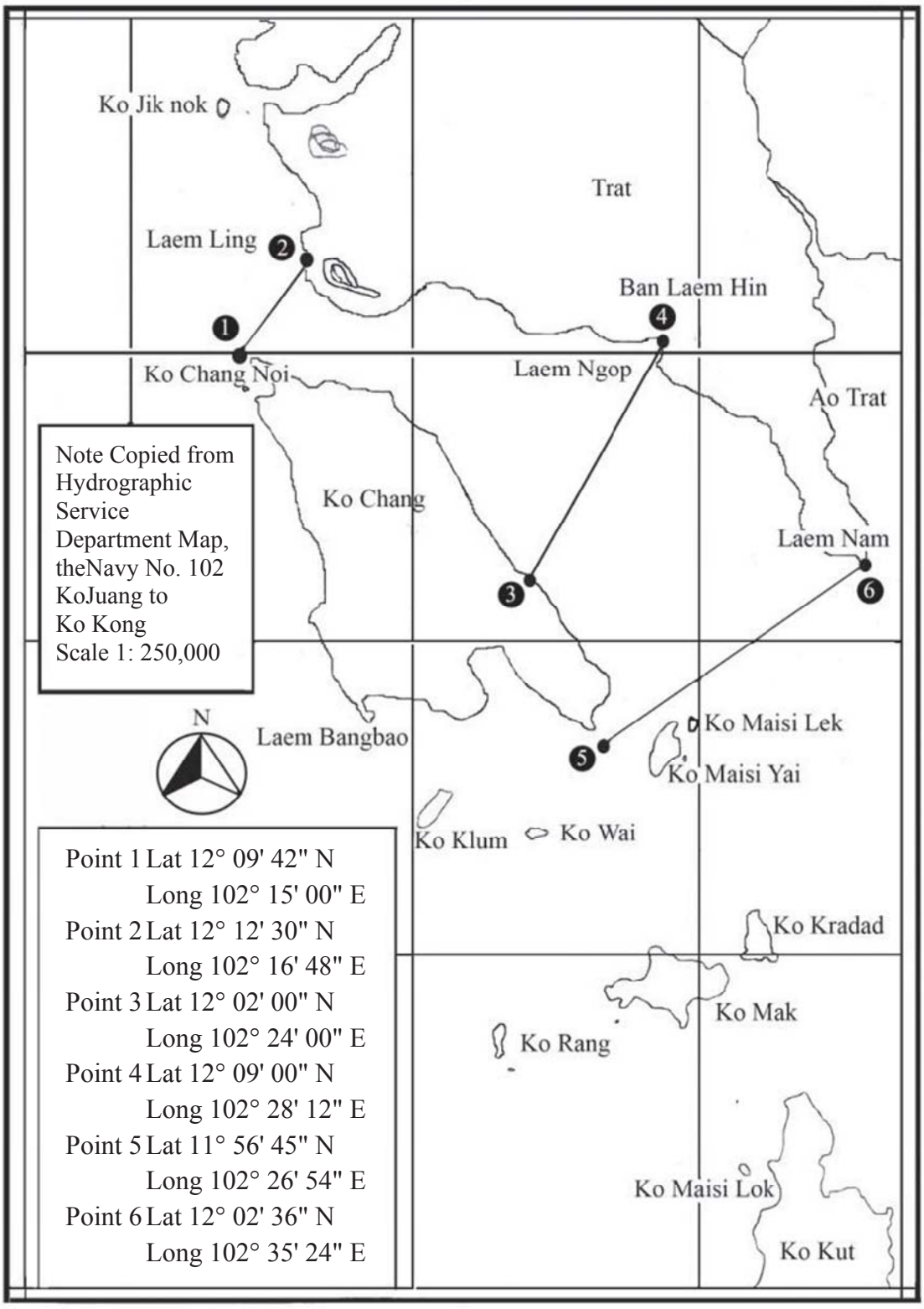


Appendix A Map attached to Notification of the Ministry of Agriculture and Cooperatives Re: Prohibition of Any Kind, Category and Size of Surrounding Netswith an Electricity Generator to Fish in Certain Areas of the Sea in TratProvince,B.E. 2538 dated on January 24, B.E. 2528

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 Prohibited,in Fishing at Strait of Chang Island, Trat Province, B.E. 2543 dated on March 28, B.E. 2543

Source: CHARM, 2005