



PROJECT
STRATEGIES FOR TRAWL FISHERIES BYCATCH MANAGEMENT
(REBYC-II CTI)

REPORT
DATA COLLECTION OF TRAWLFISHERIES BYCATCH IN
KIEN GIANG, VIETNAM - YEAR 2014

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1. INTRODUCTION

Increasing human populations and exploitation pressures, growing threats from pollution and major ecosystem change are particular concerns to marine fisheries in Vietnam in general and in KienGiang in particular. Also – as more widely in the global context – the non-targeted capture of fish and non-fish species (e.g. turtles, corals and other seabed fauna), commonly called bycatch and discards, and are also of concern. This part of the catch tends to be poorly monitored and unmanaged but could have an important impact on fishery resources, habitats and ecosystems. In some fisheries and regions, there is an increasing trend towards the retention of the bycatch consisting of juveniles and small-sized fish for use as food for human consumption or for utilization as aquaculture feed. This is therefore a complex issue, requiring resource and biodiversity aspects to be tackled alongside human needs and involving a mix of policy, technical and community support measures.

The project “Strategies for trawl fisheries bycatch management” (REBYC-II CTI) was conceived based on the successes of the 2002-2008 FAO/UNEP/GEF global project “Reduction of Environmental Impact from Tropical Shrimp Trawling through the Introduction of Bycatch Reduction Technologies and Change of Management”. The REBYC-II CTI project focuses on multispecies bottom trawling, where by catch issues are amongst the most serious, with potentially significant effects on ecosystems and livelihoods. The Project is addressing these challenges by promoting sustainable fishing practices and improved management of trawl fishing. The REBYC-II CTI project was developed under the leadership of FAO (the Project implementing agency) in close collaboration with its partners: Southeast Asian Fisheries Development Center (SEAFDEC) and the governments of the participating countries; Indonesia, Papua New Guinea, Philippines, Thailand and Viet Nam. KienGiang province was selected as a pilot site to implement the project in Vietnam.

Marine capture fisheries of Vietnam have developed strongly and have significantly contributed to the socio-economic development, food security and maritime sovereignty of Vietnam. Over the past few years, in KienGiang Province, marine capture fisheries have considerably increased and are contributing significantly to the economic development of the Province. However, these increases have revealed many problems such as unsustainable development, insufficient fisheries management, uncontrolled number of fishing boats and fragmented small-scale fishing operations. Illegal fishing has been occurring and is threatening marine resources sustainability, especially in the coastal areas. To overcome these shortcomings there is a need to manage capture fisheries better and maximize the efficiency of using these resources whilst conserving the marine ecosystem. For this the development the implementation of fishing capacity management mechanisms will be very important. It is also recognized that the fishing capacity management tools such as various fishing gear restrictions and closed fishing seasons/areas will likely be the most relevant so that marine fisheries can continue make significant contributions to socio-economic development, food safety and security, coastal community livelihoods, and generation of foreign exchange through the export of fish and other fisheries products.

The REBYC-II CTI Project in Vietnam works closely with DECAFIREP and Provincial staff in KienGiangProvince, which is amongst the provinces with the highest number of trawlers in Vietnam. According to a recent report of local authority of KienGiang province, there are total of 12,435 fishing vessels registered in the province. Of those, the number of trawlers is 3,265 accounting for about 26% of the total number. However, the total catch from the trawl fisheries in KienGiang (and Vietnam overall)is not known with any degree of certainty. There is a lack of operational-level data on catches for all regions and thereforethe trends in catch rates are difficult to monitor. Although a national legal framework has been established to implement a logbook program requiring the cooperation of fishing communities, implementation has been weak due to the lack of compliance and enforcement. The difficulty of catch monitoring is also exacerbated by the complex multi-species and multi-gear nature of the trawl fishery in KienGiang province.

This report was prepared underthe REBYC-II CTI activity ‘Data collection of trawl fisheries by catchinKienGiang waters of Vietnam’. The expected outputs are: (1) the collection of data relating tototal landings by selected trawl fishery fleets; (2) total bycatch by selected trawl fishery fleets (trash* fish, juveniles and sharks, rays and coral fragments); and (3)monthly species and size composition and volumes of catch and bycatch by selected trawl fishery fleets (by season, area, vessel type, gear type).

2. OVERVIEW OF TRAWL FISHERIES IN KIENGIANG

2.1. Fishing activities

The total fishing effort of commercial marine and coastal fisheries in KienGiang Province isestimated at 1,856,311 horsepower (HP)(**Appendix 1**).This is comprised of 10,189 fishing units that are licensed by the Department of Capture Fisheries. The major fishing gears used in the fishery are: bottom gillnet; pair trawl; squid handline; otter trawl; purse seines,andpots and traps.

The fishing fleets are concentratedin 15 districts with the major centres being; Phu Quoc, Rach Gia, Kien Hai, Kien Luong, Ha Tien, Hon Dat, Chau Thanh, An Minh and An Bien. Phu Quoc and Rach Gia have registrated the most trawlers, which account for 26.0% and 18.1% of the total fishing boats in Kien Giang province, respectively (

Table 1).

Table 1. Statistics of fishing units in numbers and total horsepower (HP) of trawlers amongst the districts in KienGiang Province in 2014.

No	District	Number of Fishing Unit		Total horsepower	
		N	%	HP	%
1	An Biên	234	2.3	38,562	2.1
2	An Minh	395	3.9	34,776	1.9
3	Châu Thành	404	4.0	189,367	10.2
4	Giồng Riềng	5	0.0	960	0.1
5	Gò Quao	4	0.0	451	0.0
6	Hà Tiên	940	9.2	104,381	5.6

* Trash fish are comprise of small and low value fishes

No	District	Number of Fishing Unit		Total horsepower	
		N	%	HP	%
7	HònĐất	742	7.3	235,440	12.7
8	KiênHải	1,476	14.5	145,264	7.8
9	KiênLương	1,438	14.1	116,342	6.3
10	PhúQuốc	2,652	26.0	161,202	8.7
11	RạchGiá	1,849	18.1	810,130	43.6
12	TânHiệp	20	0.2	9,966	0.5
13	VĩnhThuận	3	0.0	498	0.0
14	U Minh Thượng	2	0,0	204	0.0
15	GiangThành	25	0,2	8,768	0.5
	Tổng	10,189	100.0	1,856,311	100.0

From 2005 to 2014, the number of fishing boats and total fishing power in KienGiang Province gradually increased. In 2005 it was about 7,700 units, increasing to 12,286 units in 2012. In 2014, the total number of fishing boats was 10,189 units with a total fishing power of 1,856,311 HP(Appendix 1, Appendix 2).Over the past decade, the fishing fleet structure in KienGiang has changed, especially for trawl fisheries (Appendix 3). During this time, the number of otter trawlers has gradually decreased whilst the number of pair trawls has increased (Figure 1).

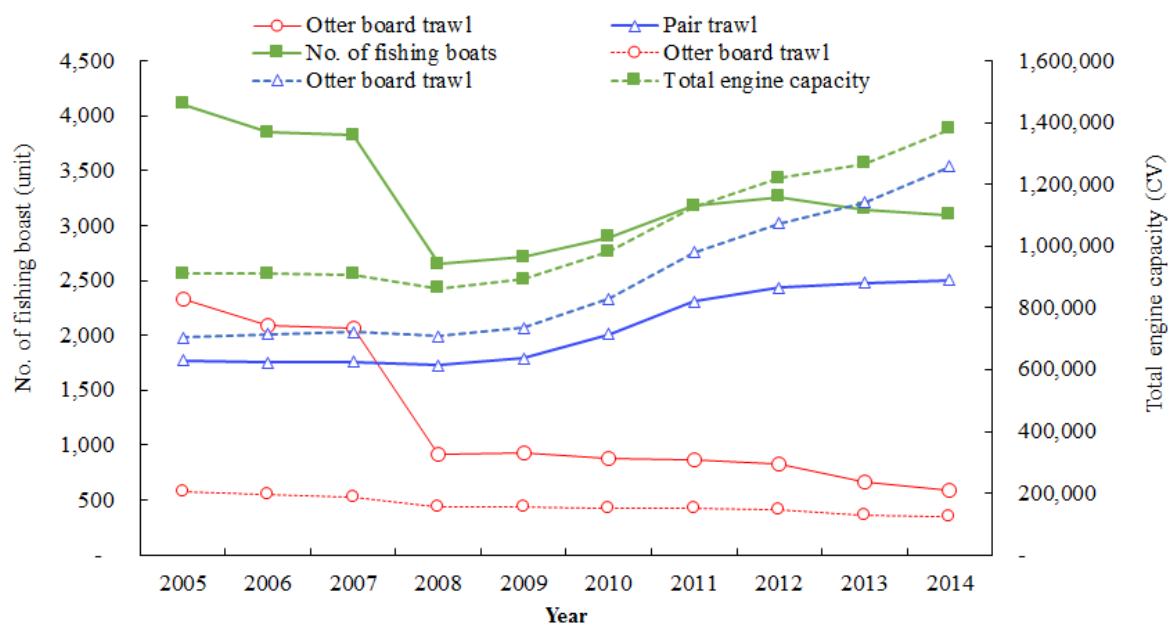


Figure 1.Changes in number of fishing unit and total engine capacity (HP) of trawl fisheries in KienGiang Province in 2005-2014.

Many of the trawlers using otter board trawl operate two fishing gearsalternatively i.e.shrimp otter trawlnet and fish otter trawlnet. In this way they are able tofishboth day and night during a fishing trip that typically lasts 3-5 days.

On small-sized trawlers there are usually 3-5 fisherman and 7-8 fishermen on larger vessels. Fishing boats often fish in pairs and alternatively deliver product to the shore. Pairtrawls can be

either a normal pairtrawl or a high speed pairtrawl. The first one targets the demersal fish while the second one targets small pelagic fish. About 10–12 fisherman work on the pair trawlers and 18-20 fisherman work on the bigger boats.

2.2. Fishing fleet and gear

The KienGiangTrawl fleet consists of 3,101 fishing units with 1,379,839 horsepower (HP), accounting for 30.4% of the number and 74.3% of the total fishing effort of the Province (**Appendix 2**). Trawlers are categorized into two groups: otter trawls and pair trawl. For management purpose, fishing boats are categorized based on their engine capacity and the type of fishing gear operated. Therefore the fishing fleet is made up of otter trawl <45 HP, otter trawl 45-90 HP, otter trawl 90-150 HP, otter trawl 150-250 HP, otter trawl 250-400 HP, otter trawl >400 HP, pair trawl <45 HP, pair trawl 45-90 HP, pair trawl 90-150 HP, pair trawl 150-250 HP, pair trawl 250-400 HP; and pair trawl >400 HP.

According to the statistics of the Department of Capture Fisheries of Kien Giang in 2014, the otter trawls are comprised of 594 units, of which the categories 150-250 HP, 250-400 HP and >400 HP accounted for 31.3%; 20.5% and 12.8%, of the total number respectively (Figure 2). There are 2,507 pair trawls with most of them using an engine of >400 HP.

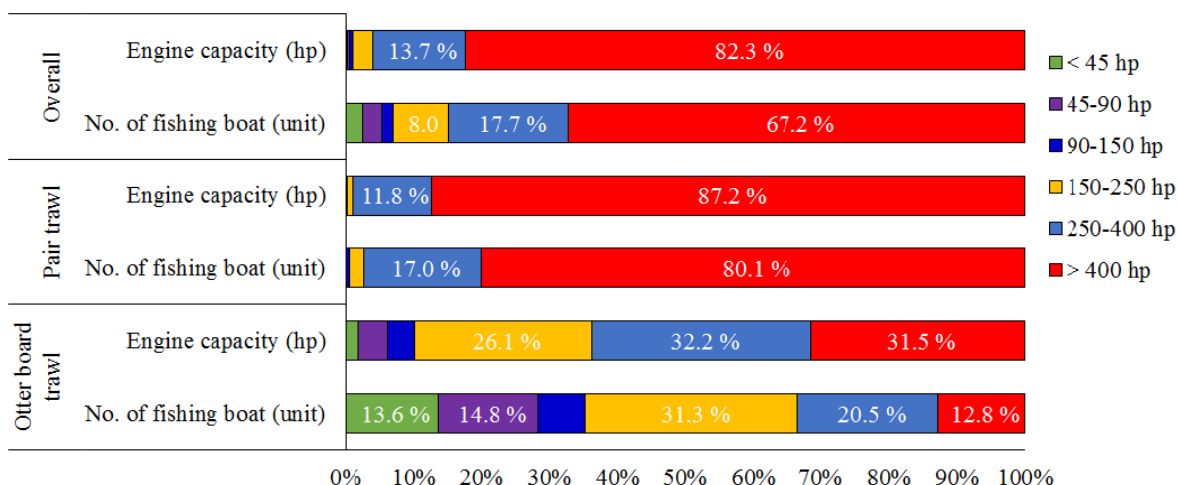


Figure 2. Fleet structure of trawl fisheries in KienGiang in 2014.

2.3. Fishing grounds

In KienGiangwaters, trawlers operate in a wide area in the exclusive economic zone of Vietnam in the Gulf of Thailand. Small pelagic fish are found in relatively high densities in the region from the south of PhuQuoc Islands to Tho Chu Islands (Figure 3). A high catch rate of demersal species occurs west of Camau Cape in the northeast monsoon season particularly around Nam Du Island to the south of Hon Khoai Islands (Figure 4).

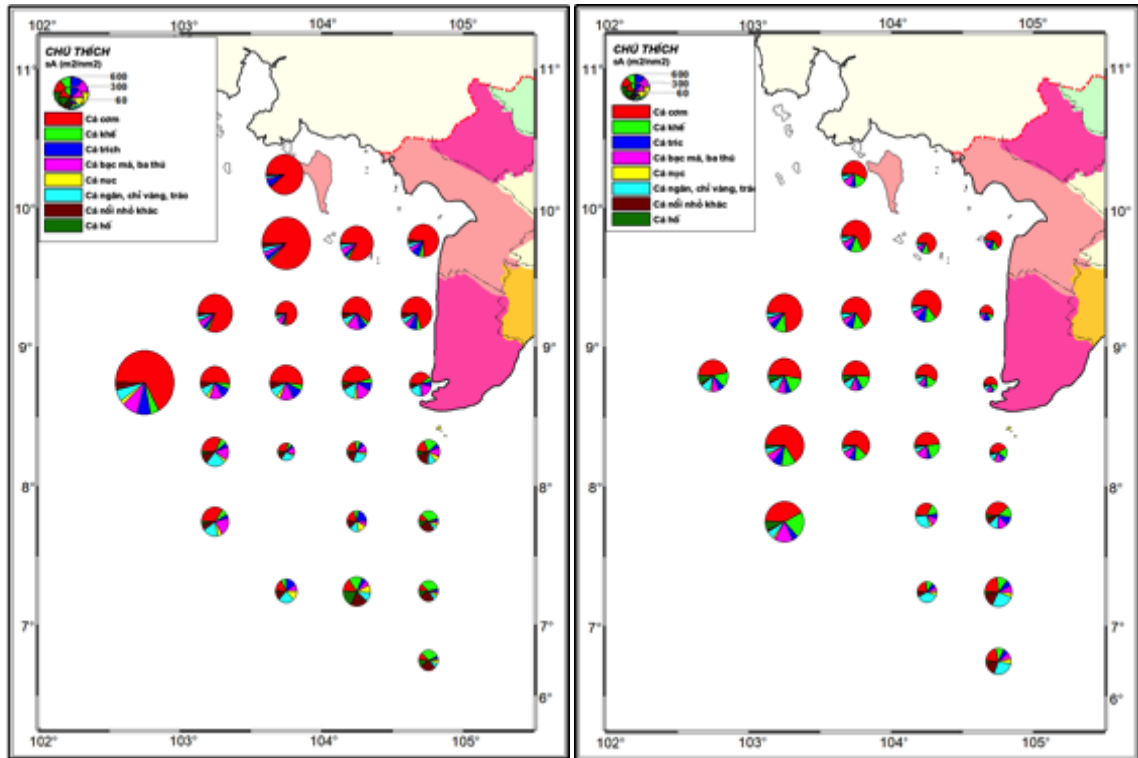


Figure 3. Distribution of small pelagic fish groups in southwestern waters of Vietnam based on the acoustic surveys in 2012.

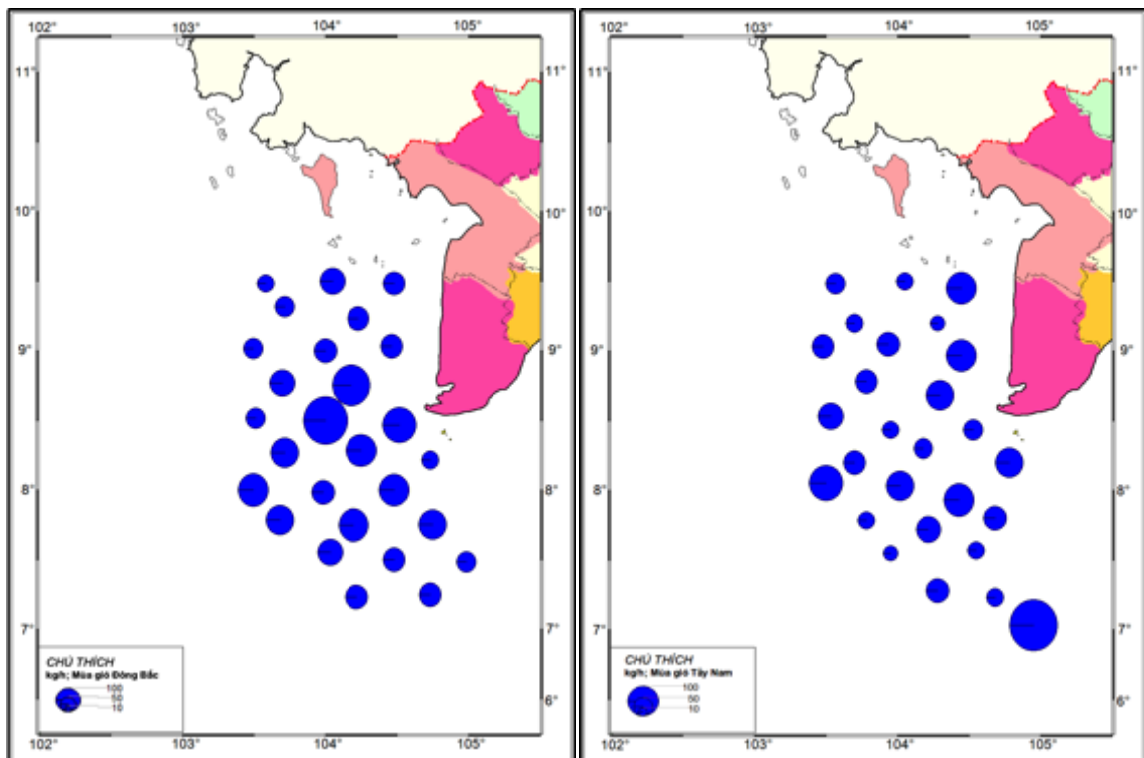


Figure 4. Catch per Unit of Effort distribution of the demersal fish in southwestern sea of Vietnam based on the bottom trawl surveys in 2012. Northeast monsoon season (left) and Southwest monsoon season (right).

2.4. Catch composition and status of stocks

The southwestern sea of Vietnam is a part of the Gulf of Thailand. It is a shallow area and the bottom is flat, muddy and sandy. Marine fish are diverse with 341 species belonging to 192 genus in 97 families having been identified in surveys (2011-2013). These included 120 species of demersal fish, 79 species of reef associated fish, 60 pelagic species, 20 species of crustacean and 23 species of cephalopods.

The major species groups caught in trawl fisheries in KienGiang waters are carangids, anchovies, lizardfish, croaker, squids and cuttlefish. The most abundant species being; *Sauridatumbil*, *S. undosquimis*, *Pennahiamacrophthalmus*, *P. macrocephalus*, *P. argentatus*, *Upeneusjaponicus*, *U. sulphureus*, *U. mollucensis*, *Nemipterus* spp., *Rastrelligerbrachysoma*, *Encrasichonilaheterroloba*, *E. devisi*, *E. punctifer*, *Sardinella* spp., *Megalaspiscordyla*.

Recently, fisheries resource surveys in the southwestern seas of Vietnam have shown that the catch per unit of effort (CPUE) of many commercial valuable species is declining and is being replaced by lower value species. The mean catch rate in bottom trawl surveys that was around 60 kg/h during the period 2000 – 2003 dropped down to around 40 kg/h in 2013 (Figure 5).

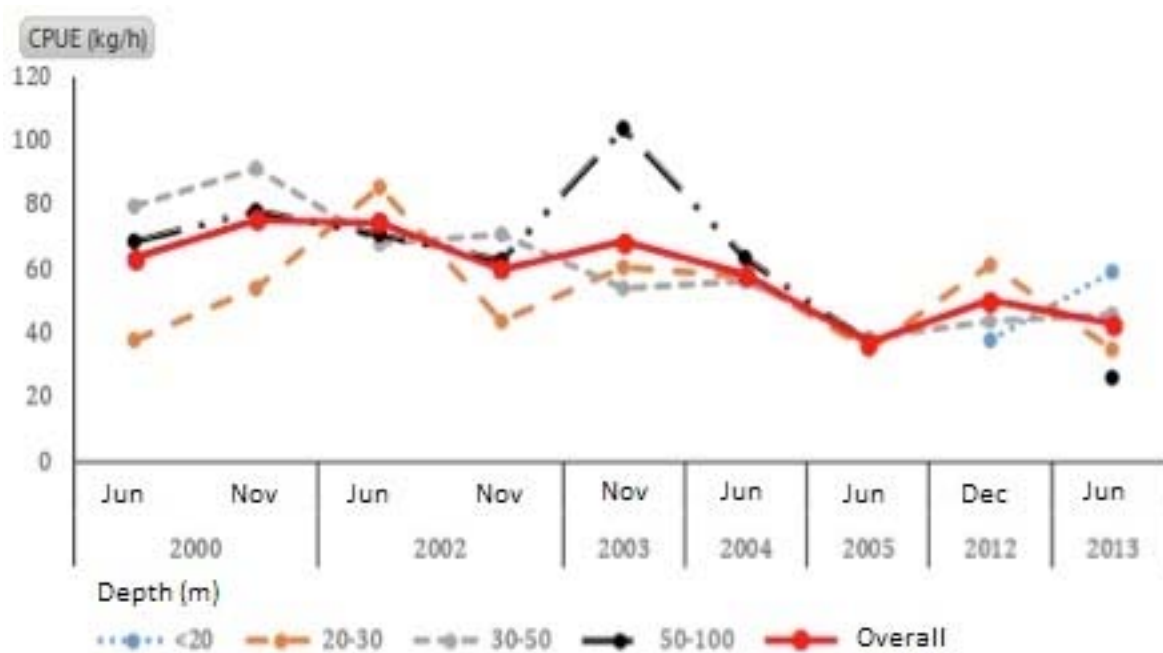


Figure 5. Trends of mean catch per unit of effort (kg/h) based on the bottom trawl surveys in period 2000-2013 in southwestern sea of Vietnam.

3. MATERIALS AND METHODS

3.1. Data collection

3.1.1. Logbook data collection

Logbook data for trawl fisheries in KienGiang Province was collected on a monthly basis from May to December 2014 in Ha Tien, KienLuong, Hon Dat, KienHai, ChauThanh and RachGia district (Figure 6). The logbook was designed by Department of Capture Fisheries (**Appendix 5**) and

sent directly to the local collaborators and distributed to the captain of fishing boat to record the fishing activities daily.

Trawler captains were asked to complete the logbook that consists of a cover page and the log sheets. Information recorded in the cover page includes: Province, landing site, vessel registration number, owner or captain, main engine horsepower, first day and last day of the fishing trip. The log sheets should include information about the fishing haul including: haul number, towing duration, date and time of fishing haul, fishing ground, fishing position, depth of fishing ground and catch of each commercial group.

Captains were briefed on how to record information in the log sheet and then to be responsible for recording all information related to fishing activities including fishing location, fishing time, catch of each commercial group and also discarded at sea. At the end of the month, local collaborators collected the logbook for encoding and analysis. Every month, 20 logbooks were distributed to 20 fishing boats to record the fishing activity information.



Figure 6. Sites for port sampling in Kien Giang Province in 2014.

3.1.2. Port sampling

Catch and effort data relating to trawl fisheries in Kien Giang Province were also collected monthly, from May to December 2014 in Ha Tien, Kien Luong, Hon Dat, Kien Hai, Chau Thanh and Rach Gia district by the Research Institute for Marine Fisheries (RIMF) in collaboration with Department of Fisheries of Kien Giang. The ‘sampling in time and space approach’ was applied (Constantine, 2002). During each month, local collaborators went to fisheries communities to interview fishermen about fishing activities and collected data on fishing grounds, catches of each commercial group, fishing trip duration, number of trips per month, number of active day per month (Table 2). Forms for port sampling are shown in **Appendix 6**.

Each month, 32 completed forms were collected from each category of their fishing fleet (<45 HP, 45-90HP, 90-150HP, 150-250 HP, 250-400HP and >400 HP) including otter trawl, pair trawl and high speed trawl fisheries. At the end of the month, all forms were sent to RIMF for encoding into the Fisheries Biology Database.

The species composition of the commercial group categorized as trash fish, mixed fish[†], lizard fish, carrangids, anchovies and shrimps were calculated monthly by RIMF. Samples were taken randomly from the catch to be sorted by species or species groups using the classification keys of FAO and Vietnam (Nguyễn Hữu Phụng và Trần Hoài Lan, 1994, Nguyễn Hữu Phụng và Nguyễn Nhật Thi, 1994, Nguyễn Hữu Phụng và nnk, 1995, Nguyễn Hữu Phụng, 1997, Carpenter and Niem 1998, Carpenter and Niem 1999, Nguyễn Hữu Phụng, 1999, Carpenter and Niem 1999a, Carpenter and Niem 1999b, Carpenter and Niem 2001)

After classification the number of individuals and the weight of each species were recorded separately. Some commercial important species in the catch of trawl fisheries were selected for length measurement such as shrimp (*Penaeus semisulcatus*), freckled goatfish (*Upeneus tragula*), bensasi goatfish (*Upeneus japonicus*), slender lizardfish (*Saurida elongata*), brushtooth lizardfish (*Saurida undosquamis*), fork-tail threadfin bream (*Nemipterus furcosus*), Lattice monocle bream (*Scolopsis taeniopterus*), Yellowstripe scad (*Selaroides leptolepis*), Yellowtail scad (*Atule mate*), Indian mackerel (*Rastrelliger kanagurta*), short mackerel (*Rastrelliger brachysoma*), shorthead anchovy (*Encrasicholina heteroloba*), Indian squid (*Loligo duvauceli*) and chinese squid (*Loligo chiensis*).

Table 2. Statistics of logbook, enumerator and biological samples collected in Kien Giang Province in 2014.

Data type	Otter trawl		Pair trawl		High speed pair trawl		Total	
	Boat [‡]	Log sheet [§]	Boat	Log sheet	Boat	Log sheet	Boat	Log sheet
Logbook	20	600	28	840	4	120	52	1.560
Enumerator	49	49	54	54	32	32	135	135

[†] Mixed fish group contains bigger size and higher value fish than ‘trash fish’

[‡] Number of boat record the logbook per month

[§] Number of sheet/sample record

Length measurement	20	50	13	21	16	30	49	101
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3.2. Data analysis

Trawl fisheries activities in KienGiang Province were expressed by fisheries indicators as introduced by FAO (Constantine 2002), including: fishing effort (average number of fishing days per month, number of fishing vessels, catch rate, catch composition, total catches and fishing grounds.

3.2.1. Catch composition and catch per unit of effort

Catch composition and catch per unit of effort were analyzed for each fishing fleet using descriptive statistical method. Catch composition is used to express proportion of catch of a commercial group to total catch of the fishing trip or proportion of catch of a species in total catch of a commercial group.

Catch per Unit Effort (CPUE, kg per day) was analyzed for each fishing fleet category as $CPUE_i = \frac{C_i}{D_i}$ and $\overline{CPUE}_i = \frac{1}{n} * \sum_{i=1}^n CPUE_i$, where C_i is the catch (kg) of the fishing trip i and D_i is number of fishing days in the trip i .

3.2.2. Catch estimates

The total catch of trawl fisheries was also estimated. The catch of fleet i (Y_i) was calculated as $Y_i = CPUE_i * F_i * A_i$ Where F_i is the number of fishing boats in the fleet i and A_i is the mean number of active days per month of fleet i . The mean number of active day per month was estimated as $A_i = \frac{\sum AD_i}{n_i}$ in which AD_i is number of fishing days in the previous month of the fishing fleet.

3.2.3. Fishing grounds

The fishing grounds of the trawl fisheries were identified for each category of fishing fleet based on the information from the logbooks. The main fishing grounds were identified as the region where the fishing boats concentrated for fishing.

3.2.4. Length frequency and average size of selected species.

Length frequency and average sizes of selected species sampled in the trash fish catch and in mixed fish catches were analyzed using the descriptive statistic method. The average size of species caught was calculated as:

$$\bar{X} = \frac{1}{n} * \sum_{j=1}^m F_j * L_j \qquad n = \sum_{j=1}^m F_j$$

Where \bar{X} is the mean fork length in centimeters of the fish or the mean carapace length of shrimp, L_j is length group j (cm), F_j number of individual of length group j and n is number of individual in sample.

4. RESULTS AND DISCUSSION

4.1. Fishing activities

The trip duration differed among the different fishing fleets. It is noted that larger fishing boats, (both otter trawl and pair trawl) spent longer time at sea than smaller vessels. Results from the survey also showed that the trip duration of fishing boats is longer in Quarter IV and III, and shorter in Quarter II (Table 3).

Table 3. Average trip duration of trawl fleets (day) by quarter in KienGiang waters in 2014.

Fishing Fleet	Average trip duration of trawl fleets (day)		
	Quarter II	Quarter III	Quarter IV
Otter trawl <45 HP	4.0	1.4	3.0
Otter trawl 45-90 HP	5.2	13.5	17.2
Otter trawl 90-150 HP	-	24.0	26.0
Otter trawl 150-250 HP	7.0	14.0	18.3
Otter trawl 250-400 HP	-	-	17.0
Otter trawl >400 HP	-	-	15.0
Pair trawl <45 HP	-	-	-
Pair trawl 45-90 HP	9.5	7.3	8.0
Pair trawl 90-150 HP	-	10.0	-
Pair trawl 150-250 HP	8.0	6.8	9.7
Pair trawl 250-400 HP	5.8	24.4	18.1
Pair trawl >400 HP	18.8	26.8	18.4

Note “-” is no information

The otter trawl fleets usually operate 3-4 hauls per day with the towing duration around 4 hours per haul. On average, the fleets operated 3.3–4.0 hauls per day in quarter II; 2.0–3.6 hauls per day in quarter IV and 2.0–3.8 hauls per day in quarter III. The haul duration in pair trawl fleets was about 5-6 hours and there were only 2-3 hauls per day in quarter II; 2.0–3.6 hauls per day in quarter III and 2.0–3.3 hauls per day in quarter IV, on average (Table 4).

Table 4. Average number of hauls per day of fishing fleets in KienGiang Province in 2014.

Fishing Fleet	Average number of hauls per day of fishing fleets (hauls)		
	Quarter II	Quarter III	Quarter IV
Otter trawl <45 HP	4.0	3.6	2.0
Otter trawl 45-90 HP	3.3	3.3	3.7
Otter trawl 90-150 HP	-	2.0	2.0
Otter trawl 150-250 HP	4.0	2.3	3.0
Otter trawl 250-400 HP	-	-	3.5
Otter trawl >400 HP	-	-	3.8
Pair trawl <45 HP	-	-	-
Pair trawl 45-90 HP	2.0	2.4	2.0

Fishing Fleet	Average number of hauls per day of fishing fleets (hauls)		
	Quarter II	Quarter III	Quarter IV
Pair trawl 90-150 HP	-	2.0	-
Pair trawl 150-250 HP	2.0	2.0	3.3
Pair trawl 250-400 HP	2.0	3.6	2.5
Pair trawl >400 HP	3.0	3.6	2.2

Note “-” is no information

There was some variation in the number of active days per month. In quarter II, the mean number of active days per month for the otter trawls was 14.8 – 25.0 days and for the pair trawls was 19.4 – 24.7 days per month. In quarter III and IV, the number of active days per month for otter trawls was > 20 days, up to 28 days per month in the 150-250HP range and 29 days per month for the 45-90HP of pair trawl (Table 5).

Table 5. Mean active day per month of fishing fleets in KienGiang Province in 2014.

Fishing Fleet	Mean active day per month of fishing fleets (day)		
	Quarter II	Quarter III	Quarter IV
Otter trawl <45 HP	16.5	24.7	25.5
Otter trawl 45-90 HP	14.8	24.7	26.1
Otter trawl 90-150 HP	25.0	-	25.0
Otter trawl 150-250 HP	20.0	28.0	24.3
Otter trawl 250-400 HP	-	-	21.5
Otter trawl >400 HP	-	21.0	23.5
Pair trawl <45 HP	-	-	-
Pair trawl 45-90 HP	24.5	22.0	29.0
Pair trawl 90-150 HP	24.7	-	-
Pair trawl 150-250 HP	23.7	24.0	21.7
Pair trawl 250-400 HP	23.0	24.3	24.0
Pair trawl >400 HP	19.4	25.5	23.6

Note “-” is no information

4.2. Catch per Unit of Effort

Catch per Unit of Effort of trawl fleets is indicated in Table 6. The catch rate of the otter trawl fleets was on average markedly lower than that of pair trawlers. The highest catch rate of otter trawls was observed in the size category 250-400HP at 397 kg/day in quarter IV and the lowest in the category 150-250HP, with only 56 kg/day in quarter II.

For pair trawls, the highest catch rate was about 2.8 tons per day for the category 250-400HP during quarter II and lowest value recorded was 400 kg/day for the category 45-90HP during quarter IV.

Table 6. Catch per Unit of Effort of trawl fleets in KienGiang Province in 2014.

Fishing Fleet	Catch per Unit of Effort of trawl fleets (kg/day)		
	Quarter II	Quarter III	Quarter IV
Otter trawl <45 HP	59	103	70

Fishing Fleet	Catch per Unit of Effort of trawl fleets (kg/day)		
	Quarter II	Quarter III	Quarter IV
Otter trawl 45-90 HP	199	225	209
Otter trawl 90-150 HP	-	201	235
Otter trawl 150-250 HP	56	146	136
Otter trawl 250-400 HP	-	-	397
Otter trawl >400 HP	-	-	222
Pair trawl <45 HP	-	-	-
Pair trawl 45-90 HP	654	1145	400
Pair trawl 90-150 HP	-	904	-
Pair trawl 150-250 HP	1,522	833	599
Pair trawl 250-400 HP	2,840	1,459	1,418
Pair trawl >400 HP	941	1,736	1,974

4.3. Catch composition

The relative catch composition of the otter and pairtrawlers in different species group categories is indicated in Table 7. In general, the catch composition in otter trawl and pair trawl is different and depends on the monsoon season.

Table 7. Catch composition (%) of trawl fisheries in KienGiang in 2014.

Fishing gear	Commercial group	Catch composition (%)			
		Quarter II	Quarter III	Quarter IV	Average
Otter trawl	Trash fish	61.4	39	28.7	39.3
	Mixed fish	2.2	20.2	24	17.9
	Rays	11.1	0	0.1	2.5
	Goatfish	9.3	0	0.9	2.4
	Mixed cephalopods	1.9	5.5	2.6	3.4
	Cuttlefish	1.7	1.8	0.3	1.1
	Green tiger prawn	4.7	1.4	3.5	3.1
	Mixed shrimp	5.1	29.7	38	28
	Others	2.5	2.4	1.9	2.2
Pair trawl	Trash fish	56.8	41.4	70.3	56.9
	Mixed fish	26.9	18.8	13.2	19.2
	Threadfin Bream	3.1	6	1.4	3.4
	Lizardfish	1	3	1.1	1.7
	Croaker	0.2	5.5	0	1.8
	Big eyes	1.1	2.8	0.4	1.4
	Squids	1.9	8.3	10.3	7.1
	Mixed cephalopods	7.8	10.5	1.5	6.3
	Cuttlefish	0.5	2	0.9	1.1
Others	0.7	1.7	0.9	1.1	

4.3.1. Otter trawl

In otter trawl catches, the catch samples taken from the trash fish group comprised of 135 species. The trash fish component contributed a relatively high portion (61.4%) in quarter II (April – June). It is known that this time is the post-spawning season of fish in this region whilst in quarter III and IV the ratio of trash fish reduced to 39% and 28.7%, respectively, because by this time the fish had grown and so could be sorted in with other catch groups, such as mixed fish or other valuable groups.

The species composition in the trash fish category is shown in Table 8. The most abundant species in this group was the luna tail puffer *Lagocephalus lunaris*; accounting for 7.4% of the total catches, followed by shortnose ponyfish *Leiognathus brevirostris* (6.0%), freckled goatfish *Upeneustragula* (5.8%), yellowfin goatfish *Mulloidichthys vanicolensis* (4.8%), ornate ponyfish *Leiognathus lineolatus* (3.7%), dwarf flathead *Elates ransonnetii* (3.7%), three-lined tongue sole *Cynoglossus interruptus* (3.6%) and slender lizardfish *Saurida elongata* (3.6%). The species composition may markedly change depending on the monsoon season.

Mixed fish category contributed high portion in the otter trawl catches in quarter III and IV, accounting for 20.2% and 24.0% of the total catch, respectively, while in quarter II, the catch of this group contributed only 2.2% of total catch.

A total of 147 species were identified in the catches of mixed fish (Table 8). The major species was *Saurida elongata* (23.1%), *Scolopsistaeniopterus* (16.0%), *Mulloidichthys vanicolensis* (9.1%), *Saurida undosquamis* (5.8%), *Muraenesox cinereus* (5.8%), *Atule mate* (2.8%), *Upeneustragula* (2.4%), *Nemipterus furcosus* (2.2%), *Parapercis sexfasciata* (2.1%) and *Lagocephalus lunaris* (2.0%).

Rays and goatfish were caught in significant numbers during quarter II but contributed less in quarter III and IV (Table 7). On the contrary, the catches of mixed cephalopods and mixed shrimps were higher in quarter III and IV.

4.3.2. Pair trawl

The catch composition of the pair trawls illustrates that the fishing grounds of these fishing fleets was different to that of the otter trawls (Table 7). Trash fish made up 70.3% of the total catches in quarter IV; 56.8% in quarter II and 41.4% in quarter III.

In the trash fish category, results from species composition analysis identified 93 species (Table 9). Some species made up most of catches in this group are *Encrasicholina heteroloba* (32.5%), *Stolephorus tri* (11.0%), *Stolephorus indicus* (7.9%), *Stolephorus commersonii* (3.8%), *Encrasicholina punctifer* (2.4%) and juveniles of *Rastrelliger kanagartha* (4.5%), *Rastrelliger brachysoma* (3.4%), *Sardinella gibbosa* (3.0%), *Selaroides leptolepis* (2.9%), *Paramonacanthus nipponensis* (2.8%), *Escualosathoracata* (2.3%).

There were 75 species found in mixed fish of pair trawl fisheries in Kien Giang waters (Table 8). The mixed fish group contributed from 13.2% to 26.9% of the catches, being highest in quarter II and lowest in quarter IV. The main species contributing to the catches in this group was *Rastrelliger kanagartha* (23.0%), *Mulloidichthys vanicolensis* (11.9%), *Scolopsistaeniopterus* (9.9%), *Saurida elongata* (6.7%), *Atule mate* (6.2%), *Rastrelliger brachysoma* (5.2%), *Nemipterus furcosus* (3.7%), *Selaroides leptolepis* (3.7%), *Sphyraena obtusata* (3.5%), *Nemipterus mesoprion* (3.1%) and *Pentapodus setosus* (2.7%).

Mixed cephalopods are a target group for the pair trawls. Catches of squids contributed 2-10% of the total catch and were highest in quarter III and IV while the mixed cephalopods made up 1.5 – 10.5% in quarter II and III. Threadfin bream, croaker, lizardfish and big eyes are commercially valuable fish groups but these catch normally contributed a low amount in comparison to other groups (Table 7).

Table 8. Species composition of the trash fish and mixed fish sampled in Otter trawl fleets in KienGiangProvince in 2014.

Trash fish (135 species)					Mixed fish (147 species)				
Latin name	Quarter (%)				Latin name	Quarter (%)			
	II	III	IV	Average		II	III	IV	Average
<i>Acentrogobiuscaninus</i>		1.4		1.1	<i>Apogontruncatus</i>	3.2		2.3	1.9
<i>Apistuscarinatus</i>		0.8	6.8	1.7	<i>Atule mate</i>			4.5	2.8
<i>Apogonsemiornatus</i>			1.5	0.2	<i>Callionymusvirgis</i>			1.2	0.7
<i>Apogontruncatus</i>			2.2	0.3	<i>Cociellacrocodila</i>	1.2	0.6		0.3
<i>Apogonichthyselliotti</i>		0.5	1.1	0.5	<i>Cynoglossusarel</i>	0.1	0.5	1.3	0.9
<i>Bathycallionymuskaianus</i>		3.6		2.8	<i>Inegocia japonica</i>	1.1	1.5	1.2	1.2
<i>Callionymusvirgis</i>			6.3	1.0	<i>Lagocephaluslunaris</i>		6.5	1.0	2.0
<i>Cynoglossusarel</i>		1.1	5.2	1.7	<i>Lutjanuslutjanus</i>	0.4	1.1	0.2	0.4
<i>Cynoglossuscynoglossus</i>			1.1	0.2	<i>Monacanthuschinensis</i>	1.2		0.6	0.5
<i>Cynoglossusinterruptus</i>		3.4	5.8	3.6	<i>Mulloidichthysvanicolensis</i>	37.6	1.4	4.2	9.1
<i>Cynoglossusitinus</i>		1.2		0.9	<i>Muraenesoxcinereus</i>	1.0	0.9	8.9	5.8
<i>Dactylopusdactylopus</i>		1.1		0.9	<i>Nemipterusfurcosus</i>	1.4	3.0	2.2	2.2
<i>Dendrophysarusseleii</i>		1.3		1.0	<i>Nemipterusmesoprion</i>		0.1	1.3	0.8
<i>Elates ransonnetii</i>		1.5	15.8	3.7	<i>Parapercisfilamentosa</i>			1.6	1.0
<i>Euprymnamorsei</i>		2.3	2.0	2.1	<i>Parapercissexfasciata</i>	3.2		2.6	2.1
<i>Inegocia japonica</i>		1.1	1.0	1.0	<i>Pentapodusemeryii</i>	1.2			0.2
<i>Lagocephaluslunaris</i>		9.4		7.4	<i>Rastrelligerkanagurta</i>		1.8	0.3	0.6
<i>Lagocephaluswheeleri</i>		1.1	1.7	1.2	<i>Rogadiusasper</i>	1.1		0.1	0.2
<i>Leiognathusberbis</i>		2.7	0.1	2.2	<i>Sauridaelongata</i>	19.2	32.7	20.6	23.1
<i>Leiognathusbrevirostris</i>		7.5		6.0	<i>Sauridatumbil</i>		5.8	0.8	1.8
<i>Leiognathuslineolatus</i>		4.4	1.7	3.7	<i>Sauridaundosquamis</i>	3.8	5.9	6.3	5.8
<i>Loligoduvauceli</i>			5.3	0.8	<i>Scolopsistaeniopterus</i>	11.1	24.0	14.5	16.0
<i>Loliolusnoctiluca</i>		1.4		1.1	<i>Selaroidesleptolepis</i>	0.9	0.3	1.1	0.9

Trash fish (135 species)					Mixed fish (147 species)				
Latin name	Quarter (%)				Latin name	Quarter (%)			
	II	III	IV	Average		II	III	IV	Average
<i>Monacanthuschinensis</i>		1.3	2.1	1.4	<i>Sillago japonica</i>	1.7			0.3
<i>Mulloidichthysvanicolensis</i>	72.1	1.3		4.8	<i>Upeneusjaponicus</i>	4.9		1.6	1.8
<i>Muraenesoxcinereus</i>		0.5	1.2	0.6	<i>Upeneusmoluccensis</i>	0.4		2.9	1.9
<i>Onigociaspinosa</i>		0.1	2.2	0.4	<i>Upeneussubvittatus</i>			3.0	1.8
<i>Ophichthurolophus</i>		0.1	4.3	0.8	<i>Upeneustragula</i>	1.4	6.7	1.1	2.4
<i>Parachaeturichthyspolynema</i>		2.4		1.9	Other species	4.0	7.3	14.9	11.4
<i>Paramonacanthusjaponicus</i>		1.1		0.9					
<i>Parapercissexfasciata</i>	1.4	0.7	0.2	0.7					
<i>Pseudorhombuslevisquamis</i>		1.4		1.1					
<i>Pseudorhombusoligodon</i>		3.3	2.2	2.9					
<i>Repomucenusvirgis</i>		1.5	3.5	1.7					
<i>Rogadiusasper</i>			1.4	0.2					
<i>Sauridaelongata</i>	1.3	4.3	0.8	3.6					
<i>Sauridatumbil</i>		1.4	1.9	1.4					
<i>Sauridaundosquamis</i>		0.5	4.8	1.1					
<i>Scolopsistaeniopterus</i>	7.0	2.3		2.2					
<i>Selaroidesleptolepis</i>			2.6	0.4					
<i>Sillago japonica</i>	15.9			0.8					
<i>Upeneusjaponicus</i>		1.2	5.3	1.8					
<i>Upeneustragula</i>	2.2	7.2		5.8					
<i>Yongeichthysthomasi</i>		1.6		1.3					
Other species		22.0	10.1	19.0					

Table 9. Species composition in the trash fish and mixed fish sampled in pair trawl fleets in KienGiangProvince in 2014.

Trash fish (93 species)					Mixed fish (75 species)				
Latin name	Quarter (%)				Latin name	Quarter (%)			
	II	III	IV	Average		II	III	IV	Average
<i>Clupanodon thrissa</i>		1.4	4.1	1.8	<i>Apogon truncatus</i>	3.9			0.4
<i>Encrasicholina heteroloba</i>	47.2	35.7	15.2	32.5	<i>Atule mate</i>		1.9	15.5	6.2
<i>Encrasicholina punctifer</i>		3.8		2.4	<i>Carangoides malabaricus</i>		1.1		0.6
<i>Escualosathoracata</i>		1.6	5.7	2.3	<i>Chirocentrus dorab</i>		1.3	1.1	1.1
<i>Gerres filamentosus</i>			1.3	0.3	<i>Elates ransonnetii</i>	1.4	0.1		0.2
<i>Hypoatherina woodwardi</i>	0.6	0.4	4.4	1.4	<i>Gerres japonicus</i>			1.5	0.5
<i>Leiognathus brevirostris</i>		0.5	2.7	0.9	<i>Hyporhamphus unifasciatus</i>			1.8	0.6
<i>Leiognathus lineolatus</i>	6.9	3.4	3.7	4.0	<i>Inegocia japonica</i>	1.1	0.3		0.3
<i>Loligoduauceli</i>	1.8	0.4	0.1	0.5	<i>Mulloidichthys vanicolensis</i>		20.9	0.7	11.9
<i>Mulloidichthys vanicolensis</i>	0.7	1.0	2.0	1.2	<i>Muraenesox cinereus</i>	1.2	3.0		1.8
<i>Paramonacanthus nipponensis</i>		4.4		2.8	<i>Nemipterus furcosus</i>	11.8	4.2	0.1	3.7
<i>Pelates quadrilineatus</i>			5.0	1.2	<i>Nemipterus mesoprion</i>	25.2	0.5		3.1
<i>Pseudorhombus oligodon</i>		1.1		0.7	<i>Paraperca filamentosa</i>	10.7	0.8		1.6
<i>Rastrelliger brachysoma</i>		5.5		3.4	<i>Pennahia aenea</i>		0.2	1.5	0.6
<i>Rastrelliger kanagurta</i>	9.3	1.4	9.9	4.5	<i>Pentapodus setosus</i>		1.6	5.5	2.7
<i>Sardinella gibbosa</i>	5.0	2.4	3.3	3.0	<i>Rastrelliger brachysoma</i>		3.0	10.5	5.2
<i>Secutorruconius</i>	1.1	1.2	4.0	1.9	<i>Rastrelliger kanagurta</i>		16.1	42.1	23.0
<i>Selaroides leptolepis</i>	2.0	4.2		2.9	<i>Saurida elongata</i>	13.5	9.2	0.4	6.7
<i>Sphyrna afforsteri</i>	1.3	0.4		0.4	<i>Saurida undosquamis</i>	1.6	0.6		0.5
<i>Stolephorus commersonii</i>	0.8	0.4	14.7	3.8	<i>Scolopsistaeniopterus</i>	19.6	13.8		9.9
<i>Stolephorus indicus</i>	18.7	8.1	0.8	7.9	<i>Selaroides leptolepis</i>		4.7	3.4	3.7
<i>Stolephorus tri</i>	2.9	12.1	12.9	11.0	<i>Sillago aeolus</i>			1.3	0.4
Other species	1.8	10.7	10.1	9.3	<i>Sillago sihama</i>		0.1	1.1	0.4

Trash fish (93 species)					Mixed fish (75 species)				
Latin name	Quarter (%)				Latin name	Quarter (%)			
	II	III	IV	Average		II	III	IV	Average
					<i>Sphyraenaobtusata</i>		5.3	1.7	3.5
					<i>Tylosurusacusmelanotus</i>			1.4	0.5
					<i>Upeneusjaponicus</i>	6.1	0.9		1.2
					<i>Upeneusmoluccensis</i>			3.0	1.0
					<i>Upeneussulphureus</i>		1.3	1.6	1.3
					<i>Upeneustragula</i>		1.7	0.5	1.1
					<i>Other species</i>	3.9	7.4	5.2	6.3

4.3. Catch estimates

The total catch from trawl fisheries in KienGiang Province in 2014 was estimated at approximately 444,000 tons with 95.04% exploited by pair trawl and 4.96% by otter trawls (Table 10). The pair trawl fleet of >400HP contributed about 328,000 tons, accounting for 74% of the total catch. Other trawler categories, such as 150-250HP and 250-400 HP contributed most to the remaining catch (Table 10).

Table 10. Total catch (tons) from trawl fisheries in KienGiang Province (2014).

Fishing fleet	Total catch (tons)	Proportion (%)
<i>Pair trawl</i>	<i>422,1300</i>	<i>95.04</i>
<45HP	-	0.00
45 - 90 HP	79	0.02
150 - 250 HP	6,312	1.42
250 – 400HP	86,293	19.43
90 – 150HP	786	0.18
>400HP	328,660	73.99
<i>Otter trawl</i>	<i>22,047</i>	<i>4.96</i>
<45HP	1,284	0.29
45 - 90 HP	3,679	0.83
150 - 250 HP	4,917	1.11
250 – 400HP	7,049	1.59
90 – 150HP	1,946	0.44
>400HP	3,172	0.71
Grand Total	444,177	100.00

The total catch of trawl fisheries, stratified by commercial groups is presented in Table 11. The trash fish dominated in the total catch from trawl fisheries in KienGiang, estimated at 246,000 tons, contributing to 55.5% of the total landing. This group contributed 56.3% and 39.6% of the total catch from pairtrawls and otter trawls, respectively. The mixed fish contributed 18.5% in total landing, estimated approximately 82,000 tons.

The economically valuable groups such as cuttle fish and squids contributed a small amount to the total landings. In 2014, the total catch of cuttle fish was estimated at 5,300 tons, comprising 1.2% of the total landings and almost all were caught by pairtrawls. Squids and cuttlefish were mixed into the cephalopod group when their size was small. The total landing of mixed cephalopods was 27,600 thousand tons with more than 90% of the catch taken by pair trawls. Larger size squid and cuttlefish were usually sorted out as individuals. The total landing of higher value squid and cuttlefish was 31,800 tons, accounting for 7.2% of the total catch.

The total landing of mixed shrimps was 6,100 tons, contributing a relative high proportion of the catches of otter trawls (27.8%) whilst they were negligible in catches from pairtrawls. The valuable Green Tiger Prawn contributed 2.9% to the total catches from otter trawls and the total landing in 2014 was estimated as 649 tons (Table 11).

The commercially important fish groups as lizardfish, threadfin breams, goatfishes, croacker and bigeyes made up a low portion in total landing of trawl fisheries, ranging from 0.1 to 3.3%

depending on the fishing gear used. The juvenile fish of these groups were sorted as trash fish or mixed fish.

Table 11. Total catch landing (tons) of commercial groups from trawl fisheries in KienGiang Province (2014).

Commercial group	Otter trawl		Pair Trawl		Total	
	Catch (tons)	%	Catch (tons)	%	Catch (tons)	%
Trash fish	8,733	39.6%	237,576	56.3%	246,309	55.5%
Mixed fish	3,953	17.9%	78,286	18.5%	82,239	18.5%
Croaker		0.0%	8,994	2.1%	8,994	2.0%
Rays	526	2.4%			526	0.1%
Threadfin breams			14,845	3.5%	14,845	3.3%
Lizard			7,544	1.8%	7,544	1.7%
Goatfishes	508	2.3%			508	0.1%
Bigeyes		0.0%	6,269	1.5%	6,269	1.4%
Cuttle fish	257	1.2%	5,055	1.2%	5,312	1.2%
Squids			31,857	7.5%	31,857	7.2%
Mixed cephalopods	793	3.6%	26,896	6.4%	27,689	6.2%
Mixed shrimp	6,139	27.8%			6,139	1.4%
Green tiger prawn	649	2.9%			649	0.1%
Others	488	2.2%	4,809	1.1%	5,297	1.2%
Grand Total	22,046	100.0%	422,131	100.0%	444,177	100.0%

4.4. Fishing ground

The fishing grounds for trawl fisheries are indicated in Figure 7. Both the otter trawl and pair trawl fleets exploited a region covering inshore and offshore waters in the southwestern sea of Vietnam. The otter trawlers mainly operated in rectangle C14, C15 with position from 8°N-10°N and 103°E-104°E and rectangle D14 limited from 9°N-10°N and 104°E-105°E (Figure 7). The pair trawls operated in a wider fishing area. The highest catch rate were observed in rectangles of C14, C15; position of 8°N-10°N and 103°E-104°E and in rectangles C16, D16, E16 covers from 7°N-8°N and 103°E-105° 30'E (Figure 7).

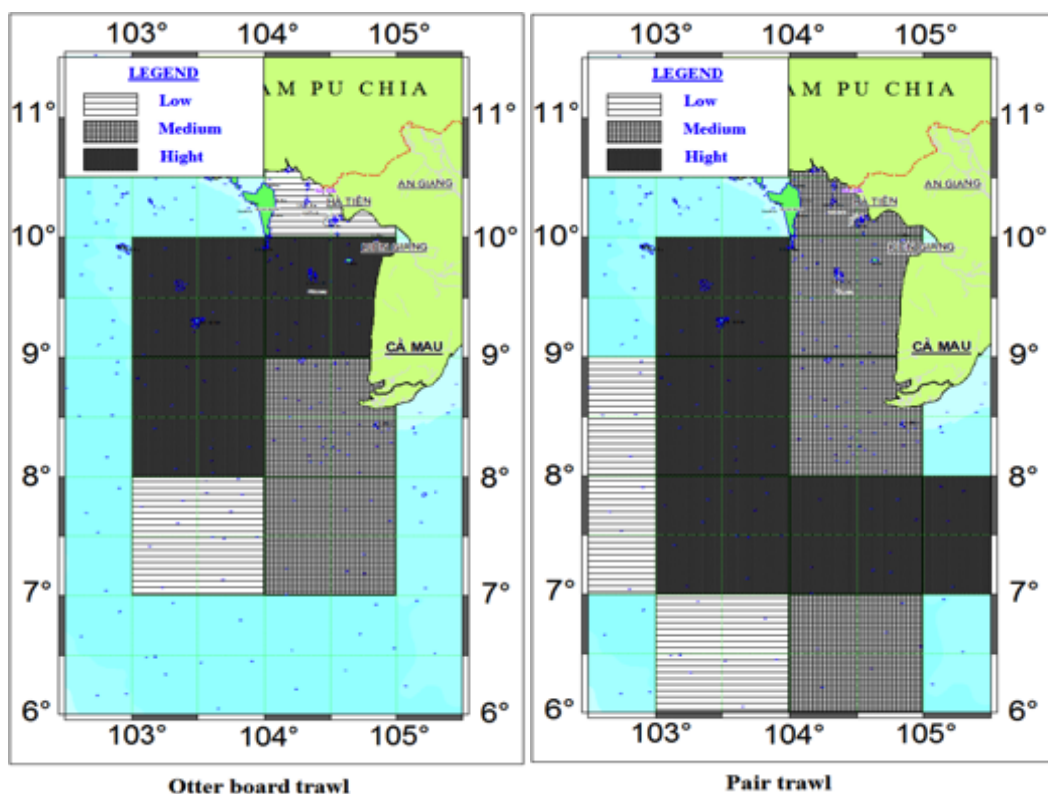


Figure 7. Fishing grounds of otter trawl (on the left) and pair trawl (on the right) based on information from logbook data collected in 2014.

4.5. Length frequency distribution and average size of selected species

There were 12 commercially important species selected for length measurement. Samples were also taken from trash fish group. It is noted most of fish caught were of a relatively small size (Table 12) including some juveniles of commercial valuable species such as short mackerel, Indian mackerel, slender lizardfish, greater lizardfish and lattice monocle bream. Length frequency distribution of these species is presented in Figure 8 - Figure 23.

Table 12. Average size (fork length in centimeter) of selected species sampled from trash fish in trawl fisheries in Kien Giang Province (2014).

No	Species name	Min	Max	Mean	SD	N
1.	<i>Parachaeturichthyspolynema</i>	4.7	7.5	6.3	0.6	83
2.	<i>Rastrelligerbrachysoma</i>	7.7	13.7	10.6	1.6	40
3.	<i>Rastrelligerkanagurta</i>	6.0	14.1	10.3	2.5	106
4.	<i>Mulloidichthysvanicolensis</i>	7.1	9.5	8.1	0.5	36
5.	<i>Sauridaelongata</i>	6.0	10.6	8.6	1.3	38
6.	<i>Sauridatumbil</i>	5.0	10.3	7.4	1.2	21
7.	<i>Encrasicholinaheteroloba</i>	4.3	7.5	5.6	0.7	269
8.	<i>Stolephorusindicus</i>	4.8	12.5	9.9	0.7	196
9.	<i>Stolephorus tri</i>	4.3	5.5	5.0	0.3	30
10.	<i>Upeneus japonicas</i>	4.0	7.3	5.9	0.9	29
11.	<i>Upeneustragula</i>	3.4	6.7	4.7	1.0	20
12.	<i>Upeneussulphureus</i>	8.0	9.9	8.9	0.4	33

Parachaeturichthyspolynema

The average size of this species found in the trash fish category was 6.3 ± 0.6 cm fork length. The minimum and maximum size were 4.7 cm and 7.5 cm, respectively.

Rastrelligerbrachysoma

The average size of this species was 10.6 ± 1.6 cm fork length. The minimum and maximum size were 7.7 cm and 13.7 cm, respectively. Two main cohorts of short mackerel in catches were 9 cm and 11-12 cm.

Rastrelligerkanagurta

The average size of Indian mackerel was 10.3 ± 2.5 cm fork length. The minimum and maximum size were 6 cm and 14.1 cm, respectively. Two main cohorts of Indian mackerel in catches were 7-9 cm and 12-13 cm.

Mulloidichthysvanicolensis

The average size of this species in the trash fish was 8.1 ± 0.5 cm fork length. The smallest fish was caught at 7.1 cm fork length and largest size in trash fish was 9.5 cm fork length.

Saurida elongate

The biggest size of slender lizardfish in the trash fish was 10.6 cm and smallest size was 6 cm fork length and the mean size was 8.6 ± 1.3 cm.

Sauridatumbil

The greater lizardfish sampled in the trash fish was of a small size. The mean fork length was 7.4 ± 1.2 cm.

Encrasicholinaheteroloba

The average size of this species in the trash fish group was 5.6 ± 0.7 cm fork length and the smallest size was 4.3 cm.

Stolephorusindicus

The size of this species in trash fish ranged from 4.8 – 12.5 cm with the mean fork length of 9.9 ± 0.7 cm.

Stolephorus tri

This is small size fish. The mean fork length of fish in trash fish was 5.0 ± 0.3 cm. Fishes caught were in the range of 4.3-5.5 cm.

Upeneus japonicas

The mean fork length of bensasi goatfish in the trash fish group was 5.9 ± 0.9 cm. The smallest and biggest sizes of fish were 4.0 cm and 7.3 cm, respectively.

Upeneustragula

The size of this species in trash fish group ranged from 3.4 cm to 6.7 cm fork length and average size is 6.7 ± 1.0 cm.

Upeneussulphureus

The size of this species in the trash fish group was around 8-9 cm fork length. The mean size was 8.9 ± 0.4 cm.

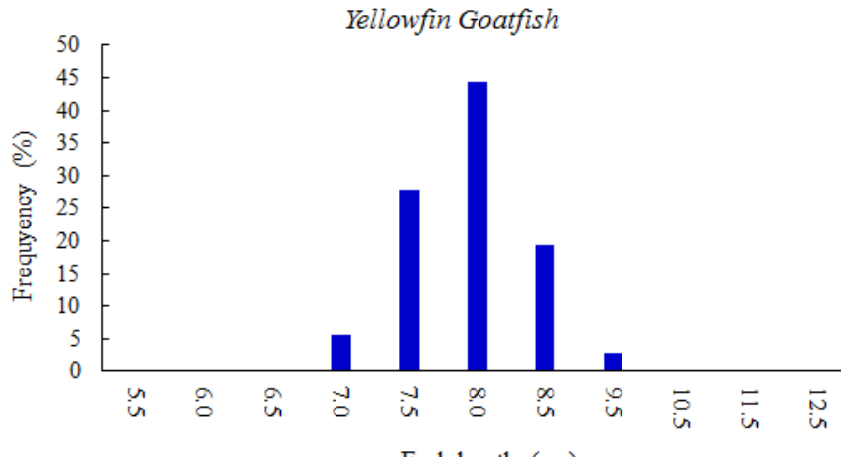


Figure 8. Length frequency distribution of Yellowfin goatfish caught in the trash fish from trawl fisheries in KienGiangProvince (2014).

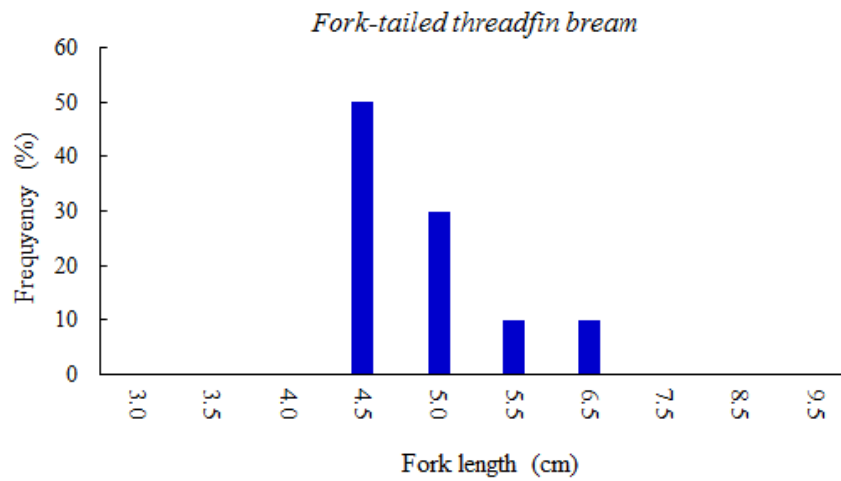


Figure 9. Length frequency distribution of fork-tailed threadfin bream caught in the trash fish from trawl fisheries in KienGiangProvince (2014).

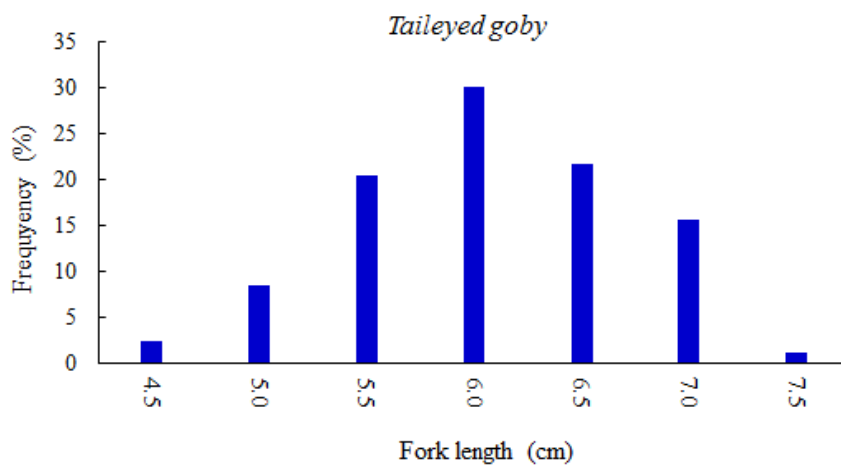


Figure 10. Length frequency distribution of taileyed goby caught in the trash fish from trawl fisheries in KienGiangProvince (2014).

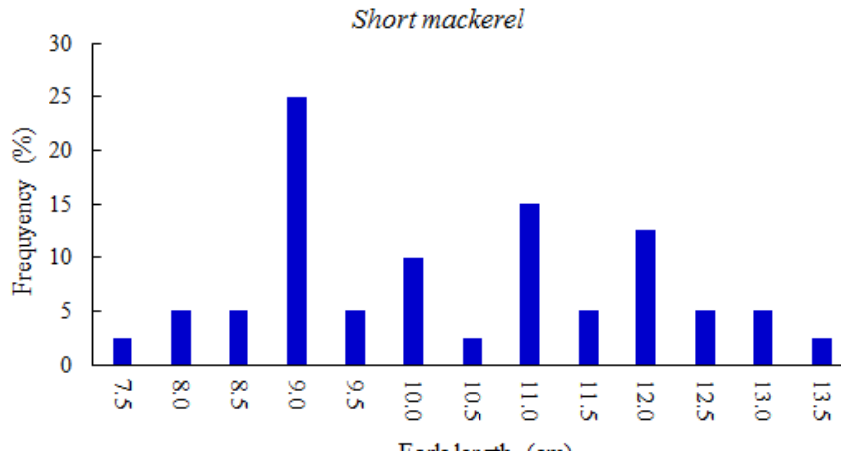


Figure 11. Length frequency distribution of short mackerel caught in the trash fish from trawl fisheries in KienGiang Province (2014).

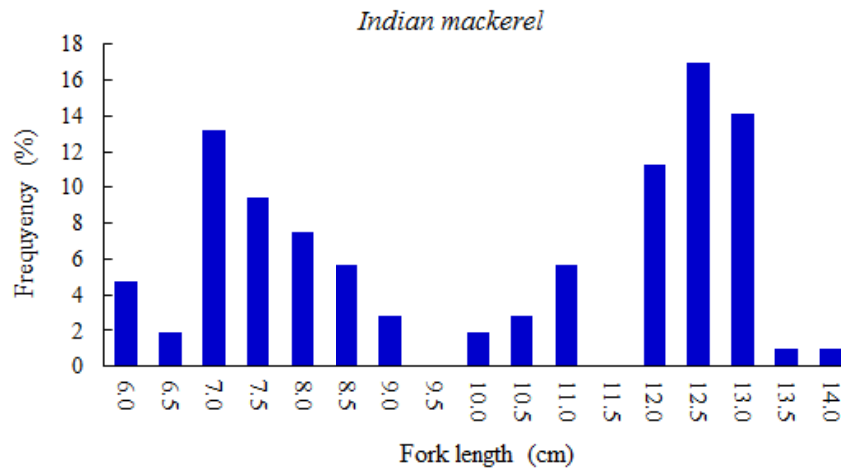


Figure 12. Length frequency distribution of Indian mackerel caught in the trash fish from trawl fisheries in KienGiang Province (2014).

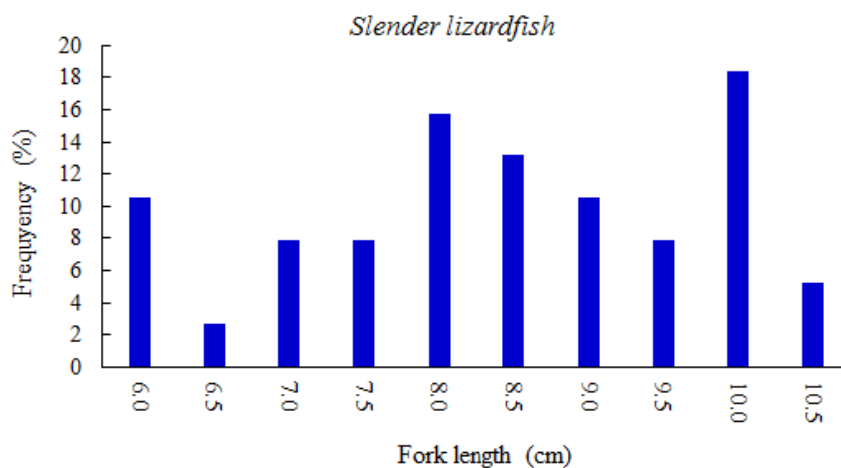


Figure 13. Length frequency distribution of slender lizardfish caught in the trash fish from trawl fisheries in KienGiang Province (2014).

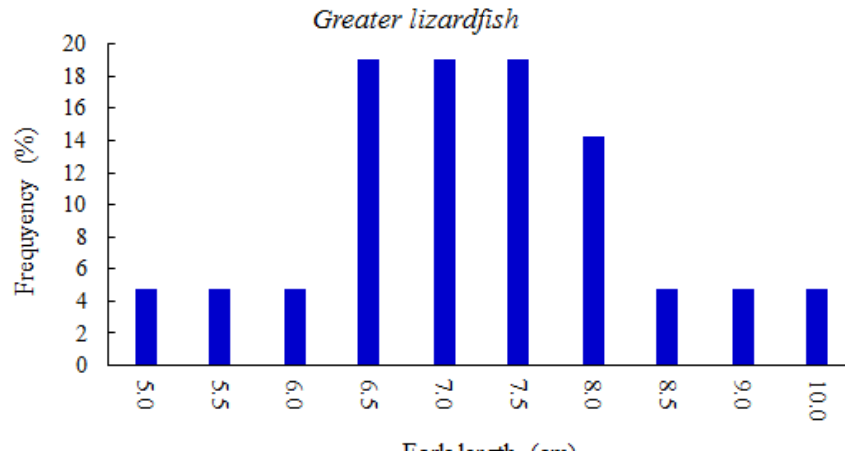


Figure 14. Length frequency distribution of greater lizardfish caught in the trash fish from trawl fisheries in Kien Giang Province (2014).

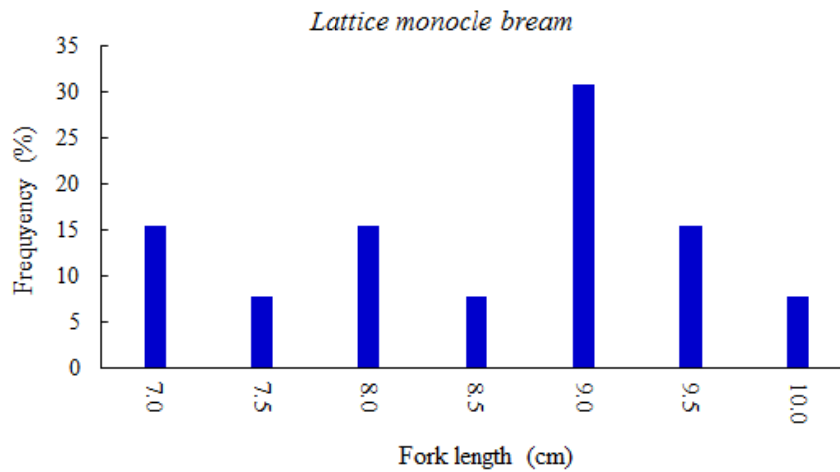


Figure 15. Length frequency distribution of lattice monocle bream caught in the trash fish from trawl fisheries in Kien Giang Province (2014).

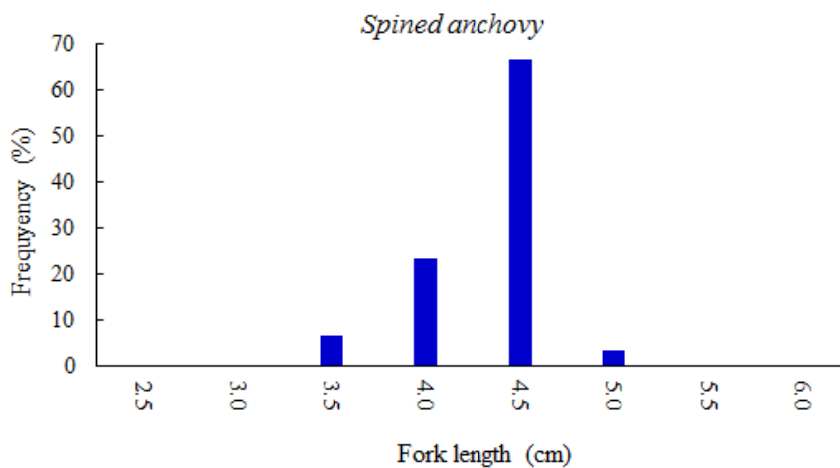


Figure 16. Length frequency distribution of spined anchovy caught in the trash fish from trawl fisheries in Kien Giang Province (2014).

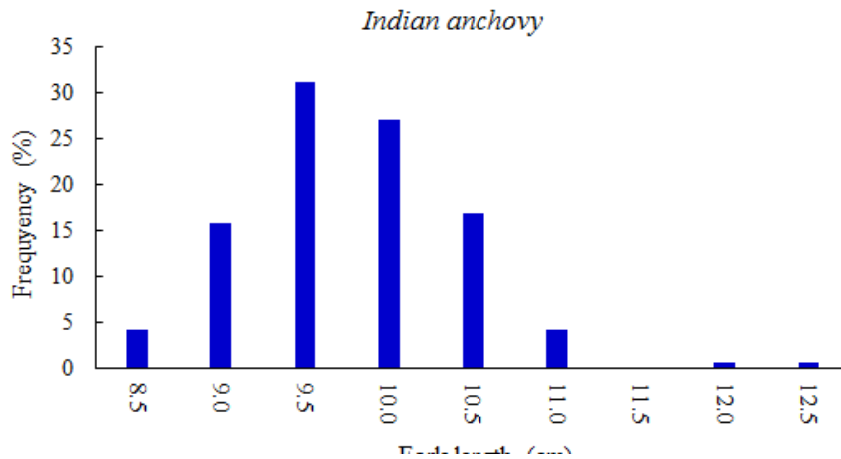


Figure 17. Length frequency distribution of Indian anchovy caught in the trash fish from trawl fisheries in Kien Giang Province (2014).

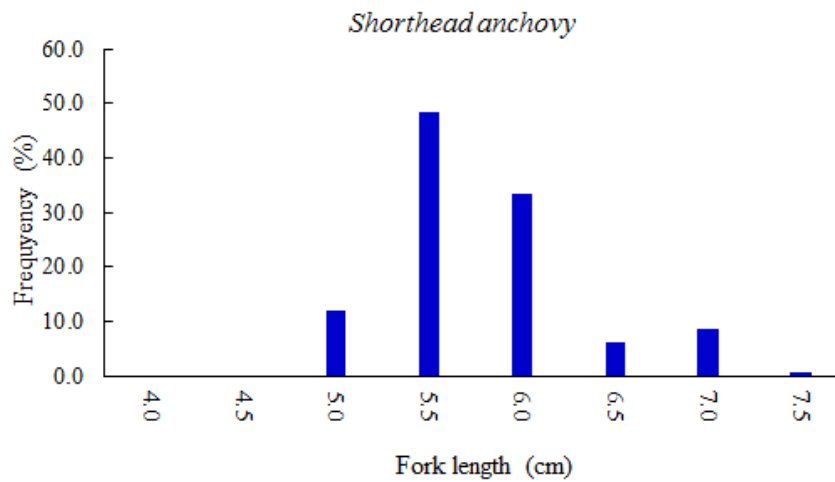


Figure 18. Length frequency distribution of shorthead anchovy caught in the trash fish from trawl fisheries in Kien Giang Province (2014).

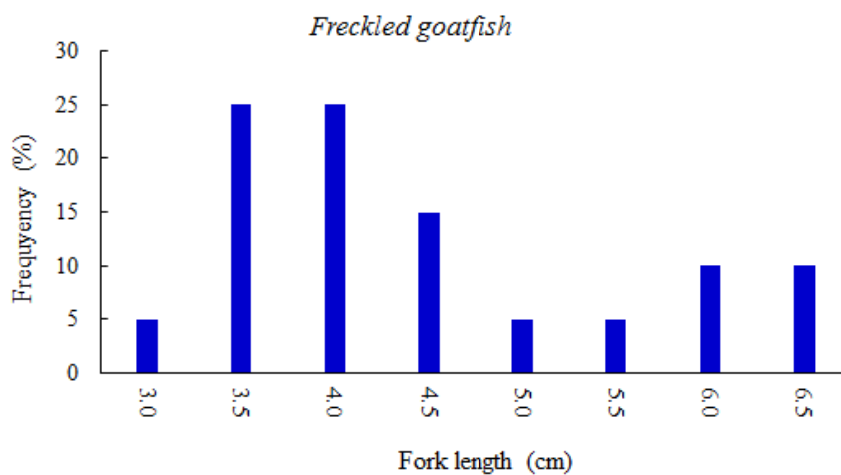


Figure 19. Length frequency distribution of freckled goatfish caught in the trash fish from trawl fisheries in Kien Giang Province (2014).

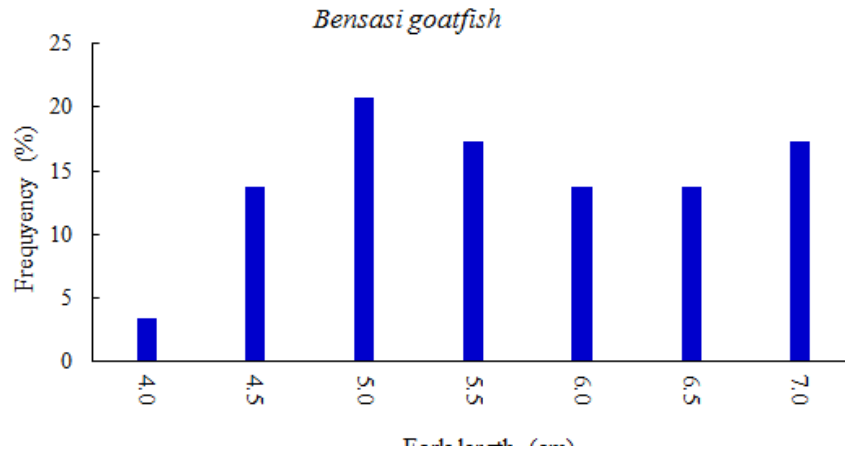


Figure 20. Length frequency distribution of bensasasi goatfish caught in the trash fish from trawl fisheries in KienGiangProvince (2014).

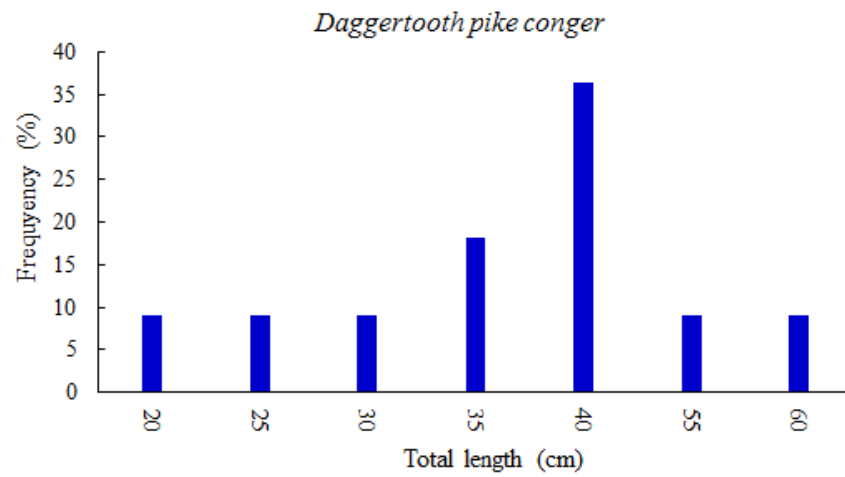


Figure 21. Length frequency distribution of daggertooth pike conger caught in the trash fish from trawl fisheries in KienGiangProvince (2014).

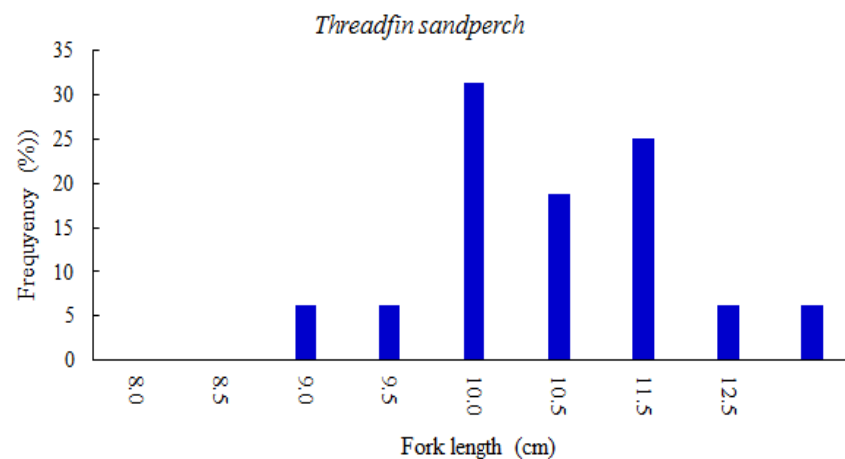


Figure 22. Length frequency distribution of threadfin sandperch caught in the trash fish from trawl fisheries in KienGiangProvince (2014).

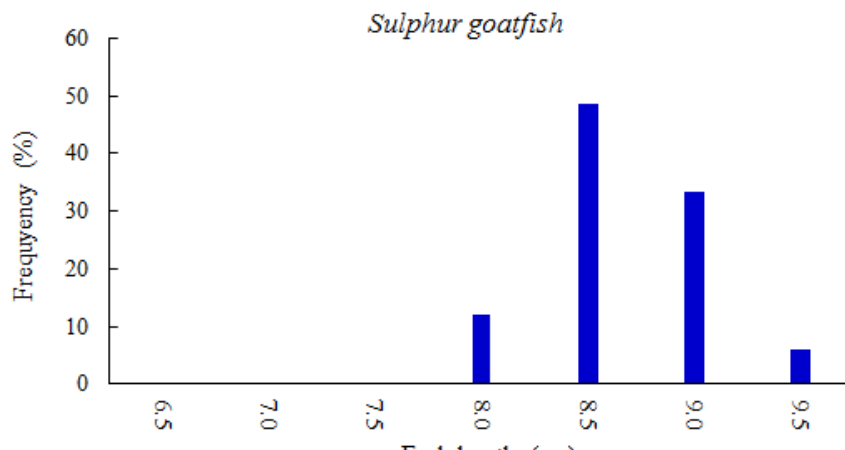


Figure 23. Length frequency distribution of sulphur goatfish caught in the trash fish from trawl fisheries in KienGiang Province (2014).

CONCLUSIONS.

Trawl fisheries plays an important role in the socio-economy of KienGiang Province. Total catch of trawl fisheries in KienGiang in 2014 was estimated at about 444,000 tons. Catches from pair trawl accounted for 95% of the total catch while the otter trawls contribute only 5% to the total landings. Trash fish and mixed fish accounted for 55.5% and 18.5% of the total catch, respectively. The catches of KienGiang’s trawl fisheries comprised of a large number of juvenile fish. Catch composition analyses also showed that there were a large number of commercial fish species in the trash fish category from trawl fisheries, including many commercial valuable species in an early life stage. Increasing the mesh size of trawls and avoidance of nursery grounds (zoning) is recommended to reduce the incidence of juveniles of commercially important species in the catches.

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APPENDICES

Appendix 1. Number of fishing boat and total horsepower of KienGiang Province in period of 2005-2014.

Year	Number of fishing boat (units)	Total Horsepower (HP)
2005	7,700	1,170,446
2006	7,330	1,281,651
2007	7,268	1,195,419
2008	11,142	1,257,325
2009	11,650	1,321,049
2010	11,904	1,425,733
2011	12,286	1,586,848
2012	12,425	1,696,254
2013	10,726	1,737,215
2014	10,189	1,856,311

Appendix 2. Number of trawl boat in KienGiang Province in 2014.

No.	HP group	Otter trawl		Pair trawl		Total	
		N	Total HP	N	Total HP	N	Total HP
1	<45	81	2,509	-	-	81	2,509
2	45 - 90	88	5,082	1	74	89	5,156
3	90 - 150	41	4,845	11	1,384	52	6,229
4	150 - 250	186	31,935	61	10,387	247	42,322
5	250 - 400	122	39,370	427	148,985	549	188,355
6	>400	76	38,430	2,007	1,096,838	2,083	1,135,268
	Total	594	122,171	2,507	1,257,668	3,101	1,379,839

Appendix 3. Changes in fishing fleet structure of trawl fisheries in KienGiang Province in period of 2004-2015.

Năm	Otter trawl		Pair trawl		Total	
	N	Total HP	N	Total HP	N	Total HP
2005	2,335	207,032	1,775	703,957	4,110	910,989
2006	2,095	195,686	1,756	715,208	3,851	910,894
2007	2,063	185,341	1,760	723,171	3,823	908,512
2008	917	154,631	1,732	708,743	2,649	863,374
2009	927	157,742	1,789	735,452	2,716	893,194
2010	883	151,969	2,012	830,324	2,895	982,293
2011	870	150,228	2,309	979,448	3,179	1,129,676
2012	831	145,539	2,434	1,074,467	3,265	1,220,006
2013	670	126,691	2,479	1,141,547	3,149	1,268,238
2014	594	122,171	2,507	1,257,668	3,101	1,379,839

Appendix 4. Trawl fisheries and catches



Figure 1. Pair trawlers in KienGiang Province.



Figure 2. Catch landed from trawl fisheries in Muong Dao landing site, Ha Tien District, KienGiang Province.



Figure 3. Major commercial groups from catches of trawl fisheries in KienGiang Province.



Figure 4. Major commercial groups from catches of trawl fisheries in KienGiang Province.




Figure 5. Major commercial groups from catches of trawl fisheries in KienGiang Province.





Figure 6. Sample taken from trash fish in catches of the pair trawl.

Appendix 5. The logbook.



TỔNG CỤC THỦY SẢN


SỔ NHẬT KÝ KHAI THÁC
(Nghề lưới kéo *Đai*.....)

Số đăng ký tàu: *K6: 92229 + 94122* Công suất (CV): *500CV + 710CV*
Họ và tên chủ tàu: *Viông Sơn*
Huyện: *Mỹ Lâm - Hòa Đạt* Tỉnh: Kiên Giang.

Ngày cấp sổ: *28.1.6*/2014; Ngày nộp sổ: *02.1.8*/2014;

Kiên Giang, tháng 1...../2014

Appendix 5(Continued). The logbook.



Mẫu số:03..... Mẻ lưới số:28..... Ngày 11 tháng 7 năm 2014

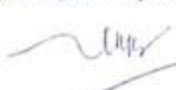
Người trường: Vương Hữu Tây Nam Vị độ: 7°34' Kinh độ: 103°29'

Độ sâu (m): 30 → 40 m Thời gian mẻ lưới: 8 h

Thông tin sản lượng:

Stt	Loại/nhóm thương phẩm	Sản lượng (kg)	Ghi chú
1	Cá sô (sọc, đũa I)	5	
2	Cá sô (sọc, đũa II)	61	
3	Cá Múi	13	
4	Cá Đổng múp	111	
5	Cá Ngăn chỉ I	8	
6	Cá lạt Thù, bạc má I	15	
7	Cá hồ	3	
8	Cá kình	16	
9	Cá đũa	8	
10	Cá Nọc	3	
11	Cá Thối	8	
12	Nước Nang	10	
13	Mực ống	166	
14	Cá Táp	301	
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
Tổng cộng		711	

Chữ ký
(Người ghi chép số liệu)



Appendix 6. Forms used for port sampling.

BIỂU SỐ 1

MẶT 1

BIỂU PHÒNG VẤN NGHỀ CÁ THƯƠNG PHẨM

Ngày.....thángnăm

Tỉnh.....

Điểm lên cá.....

Số liệu tàu cá	
Tên chủ tàu/thuyền trưởng:	Số đăng ký tàu:
Công suất máy (CV):	Chiều dài tàu (m):

Số liệu chuyến đánh cá	
Số nhân công	Thời gian đánh bắt: ngày <input type="checkbox"/> , đêm <input type="checkbox"/> , ngày&đêm <input type="checkbox"/>
Ngày cập bến cá:	Số mẻ/ngày:
Thời gian chuyển đi (ngày):	Tổng sản lượng (kg):
Số ngày hoạt động trong chuyến (ngày):	Số ngày đánh cá ở các tháng trước (ngày)
Ngư trường:	Tháng:
Độ sâu đánh bắt (m):	Tháng:
Đổi tượng đánh bắt:	Tháng:

Chi phí chuyến biển (1000đ)	
Nhiên liệu (dầu, nhớt...)	Đá/Muối:
Lương thực cho thủy thủ đoàn:	Môi:
Sửa chữa nhỏ:	Khác (ghi rõ):

Ngư cụ								
Loại ngư cụ		Thông số kỹ thuật						
		Thời gian kéo lưới	Mắt lưới (2a) (mm)	Số lượng lưới	Chiều cao (m)	Số lưới câu	Số dây câu	Chu vi miệng lưới
Lưới rê	Rê nổi			Số cheo:				1 cheo:
	Rê đáy			Số cheo:				1 cheo:
Lưới giã	Giã đôi	Giò/mê:	ở dẹt:					giếng phao: giếng chì:
	Giã đơn	Giò/mê:	ở dẹt:					giếng phao: giếng chì:
Lưới vây	Vây tự do		ở từng:					
	Vây kết hợp		ở từng:					
Câu vàng								1 dây gành:
Câu tay								
Mành								Đó mở ngang:
Lồng bẫy				Số lồng:				
Đăng đáy			ở dẹt:	Số dây:				Độ dài miếng dây:
Chụp				Số lượng đèn: Công suất (W):				Chiều dài tăng gỗ:
Nghề khác (ghi rõ loại nghề)								

Appendix 6(Continued). Forms used for port sampling.

BIỂU SỐ 2

MẶT 2

BIỂU PHÒNG VẤN SẢN LƯỢNG KHAI THÁC

STT	Nhóm thương phẩm	Sản lượng (kg)	Giá bán (1000đ)	Thành tiền (1000đ)	Ghi chú
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
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22					
23					
24					
25					

Appendix 6(Continued). Forms used for port sampling.

BIỂU SỐ 3

MẪU SỐ...

BIỂU PHÂN TÍCH THÀNH PHẦN LOÀI TRONG NHÓM THƯƠNG PHẨM

Ngày.....thángnăm

Tỉnh..... Điểm lên cá.....

Số Đăng ký tàu..... Nhóm thương phẩm.....

Khối lượng nhóm thương phẩm:..... Khối lượng mẫu (kg).....

STT	Tên khoa học	Mẫu		Hệ số nhân mẫu	Sản lượng		Ghi chú
		Khối lượng (g)	Số con		Khối lượng (kg)	Số con	
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
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28							
29							
30							

Appendix 6(Continued). Forms used for port sampling.

BIỂU SỐ 4

MẪU SỐ...

BIỂU ĐO CHIỀU DÀI HÀNG LOẠT CÁC LOÀI CÁ

Ngày.....thángnăm

Tỉnh..... Điểm lên cá.....

Số Đăng ký tàu.....

Nhóm thương phẩm..... Khối lượng nhóm thương phẩm (kg):.....

Tên loài: Khối lượng của loài trong nhóm thương phẩm (kg):

Tên Việt Nam: Khối lượng mẫu (kg):

Đo chiều dài: Toàn thân (TL) Đén chẻ vây đuôi (FL) Thân (BL) Đơn vị: mm cm

L	Tần suất	Số con	L	Tần suất	Số con
0			0		
1			1		
2			2		
3			3		
4			4		
5			5		
6			6		
7			7		
8			8		
9			9		
0			0		
1			1		
2			2		
3			3		
4			4		
5			5		
6			6		
7			7		
8			8		
9			9		
0			0		
1			1		
2			2		
3			3		
4			4		
5			5		
6			6		
7			7		
8			8		
9			9		

Appendix 6(Continued). Forms used for port sampling.

BIỂU SỐ 5

MẪU SỐ...

BIỂU PHÂN TÍCH SINH HỌC CÁ

Ngày.....thángnăm

Tỉnh..... Điểm lên cá.....

Số Đăng ký tàu.....

Nhóm thương phẩm..... Khối lượng nhóm thương phẩm (kg):.....

Tên loài: Khối lượng của loài trong nhóm thương phẩm (kg):

Tên Việt Nam: Khối lượng mẫu (kg):

STT	BL (mm)	FL (mm)	TL (mm)	W (g)	W _{sd} (g)	Giới	Độ chín tuyến sinh dục	Ghi chú
1								
2								
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