Kasetsart J. (Nat. Sci.) 44 : 631 - 642 (2010)

Systematic Data Collection on and Status of Thai Industrial Tuna Purse Seine Operations in the Indian Ocean

Praulai Nootmorn[1], Saran Petpiroon[2]* and Kanokwan Maeroh[3]

ABSTRACT

Six Thai industrial tuna purse sein fishing vessels operated in the Indian Ocean from 2005 to 2006. Fishery information and logistical data were gathered from log books, port sampling and interviews to create a systematic diagram of data collection and processing. The results will be used to support and implement responsible fishery operations under a resolution of the Indian Ocean Tuna Commission. The total catch reported was 12,216 metric tonne (tonne) in 2005 and 23,161 tonne in 2006, with the main fishing ground being off Somalia and the main fishing practice was with associated schools. The highest values for catch data, catch per unit effort (CPUE) and the number of sets were obtained during February to April and September to November in 2006. The monthly catch, CPUE and number of sets ranged from 383-4539 tonne, 15 to 61 tonne/set and 15 to 144 sets, respectively. Skipjack tuna was the main target fish, followed by bigeye tuna, yellowfin tuna and bonito. Skipjack tuna made up a high proportion of the catch during March to September, while bigeye and yellowfin tuna made up a high proportion from September to December 2005 and from January to February in 2006. The size range of skipjack, bigeye and yellowfin tuna varied from 39-75, 45-133 and 33-152 cm, respectively, whilst the length of 50% of capture fish was 60, 66 and 81 cm, respectively. Most of the bigeye and yellowfin tuna were juvenile. The status of bigeye tuna from tuna purse seine fishing was stable in terms of catch and CPUE.

Keywords: systematic of data collection, Thai industrial tuna purse seine, Indian Ocean

INTRODUCTION

Thailand has been well-known as the leading country for canned tuna production and export for more than 10 y. In 2007, total canned tuna exports amounted to 497,173.54 metric tonne (tonne) and were valued at 49,604.32 million baht. The major markets were the USA, Canada, Australia and Japan. The raw material used for canned tuna was 725,632.74 tonne in 2003 and more than 80% was imported from various tuna catch countries (INFOFISH, 2004). It is of concern that Thailand relies on foreign countries for the majority of its tuna raw material. In addition, trade barriers have been implemented under many guises, such as taxation increases (rule of origin, certificated of origin), standards of food safety and combating illegal unregulated unreported fishing

1 Andaman Sea Fisheries Research and Development Center, 77 Tumbon Vichit, Muang District, Phuket 83000, Thailand.

2 Department of Marine Science, Faculty of Fisheries, Kasetsart University, Bangkok 10900, Thailand.

3 Upper Gulf Marine Fisheries Research and Development Center, 49 Phrarachveriyaporn 16, Bangpeung, Phrapradaeng, Sumut Prakan 10130, Thailand.

* Corresponding author, e-mail: ffissap@ku.ac.th

Received date : 07/09/09 Accepted date : 02/03/10

vessels. These actions will impact on the sustainable capacity of the Thai canned tuna industry in the world market.

However, the development of an oceanic tuna fishery in Thailand has been very sluggish. This has been due the major problems associated with a lack of knowledge, experience and reliability concerned with the outcomes/cost-benefits. In late 2005, Thailand's industrial tuna purse seine fleet was established by the private sector to undertake oceanic tuna fishing and is currently operating in the Indian Ocean.

Tuna resources have become very important for marine capture fisheries due to the increased demand of canneries in the USA, Canada, Australia and Japan. It was imperative to undertake comprehensive studies on tuna because there have been only a few studies on the topic. Particular attention has been paid to study on basic tuna biology, fisheries and other data collection to assess the exploitation of tuna stocks along the western coast of Thailand and in the Indian Ocean. The Department of Fisheries (DOF) focused on designing a proper sampling scheme to collect the catch/effort, size composition, biological and other relevant data for the evaluation of tuna stocks.

Bigeye tuna (*Thunnus obesus*) in the Indian Ocean is mainly caught by industrial fisheries and appears occasionally in the catches of artisanal fisheries (IOTC, 2008). Total annual catches have increased steadily since the start of the fishery, reaching the 100,000-tonne level in 1993 and peaking at 150,000 tonne in 1999. Total annual catches averaged 123,000 tonne over the period 2001 to 2005. Bigeye tuna has been caught by industrial longline fleets since the early 1950' s, but before 1970 they were only an incidental catch. After 1970, the introduction of fishing practices that improved access to the bigeye tuna resource and the emergence of a sashimi market made bigeye tuna a target species for the main industrial longline fleets. Since the early 1990s, bigeye tuna has been caught by purse seine vessels with tuna aggregated floating objects. The total catch of bigeye tuna by purse seiners in the Indian Ocean reached 40,700 tonne in 1999, but the average annual catch for the period from 2002 to 2006 was 26,000 tonne. Forty to sixty fishing vessels have been operating in this area since 1984 (IOTC, 2007).

The objectives of the present study were to undertake systematic data collection on Thai tuna industrial purse seine fishing and to assess the status of the fleet in the Indian Ocean, in particular with respect to bigeye tuna. The results from this study should be used to support and implement sustainable industrial purse seine operations by the Thai tuna fleet in the Indian Ocean.

MATERIALS AND METHODS

Data collection on the fishery and activity information on the Thai industrial tuna purse seiners involved interviewing officers from the Department of Fisheries, Indian Ocean Tuna Commission and the Manager from the Procurement Department, Thai Union Manufacturing Co. Ltd. Data and information were sourced from logbook reports. The logbook data have been established and developed since 1999 by the Andaman Sea Fisheries Research and Development Center. All information was gathered and used to create a systematic dataset.

Data from port-sampling surveys and logbooks were used to estimate annual catches by the purse seiners from October 2005 to December 2006. Nominal catch (tonne), catch per unit effort, CPUE (tonne/set) and effort (number of sets) were analyzed and illustrated using Excel, Access (Serial no: WO 015400/001-031606) and ArcView software (free download from internet).

RESULTS AND DISCUSSION

Fleet operation

The operation of industrial Thai purse seiners is summarized in Figure 1 as follows:

Purse seiner in port: The Thai purse seine fleet is usually in port twice a year:

– December-January: Thai purse seiners call in at Victoria (the Seychelles) to change crews. They spend one or two weeks in port.

– June-July: Thai purse seiners call in at Singapore/Phuket, Thailand to upload or/and change crews or/and for repairs (to gear or ships). They may stay in port between one and two months.

Catches will not be offloaded at Singapore, as all vessels are offloaded at the Seychelles or Phuket ports. Thai vessels seldom call in to ports, except during the two periods listed above.

Purse seiner fishing: The Thai purse seiners spend most of the year searching for fish or fishing. They fish for two different types of tuna schools:

– Unassociated schools: Free swimming tuna, tuna feeding on baitfish or other. Schools were usually mono-specific, although sometimes other species were caught. The catches from schools were usually the same size.

– Associated schools: Tuna associated with natural (log, floating grass or other floating objects), or human-made objects, or associated with living or dead animals (whale or whale-shark for example). Schools are usually pluri-specific, containing different sized catches with a higher proportion of smaller sizes.

At sea transfer of catches between two purse seiners: In some circumstances, a purse seiner might collect catches from other purse seiners, with the transfer of catches occurring on the high sea. This operation does not take more than one day. The empty vessels resume fishing after this event.

At sea trans-shipment of catches from a purse seiner to a cargo freezing vessel: Thai purse seiners trans-ship their catches to cargo freezers on the high sea. Either the complete or part of the catches might be trans-shipped. At sea trans-shipments usually take from one to four days, depending on the amount of catch to be trans-shipped. A cargo vessel might receive the catches from one or more purse seiners. The catches from different purse seiners are usually stored in different rooms, so they can be identified when uploaded. The empty purse seiner either resumes fishing after trans-shipment or sails to port (**A**).

Cargo freezer in port for uploading: All catches collected on the high sea from Thai purse seiners are unloaded in Bangkok. The cargo freezers unload all catches for the Thai Union canning factory. The unloading can take several days depending on the number of catches.

Type of data collected on industrial tuna purse seiners from Thailand

Different types and sources of data and

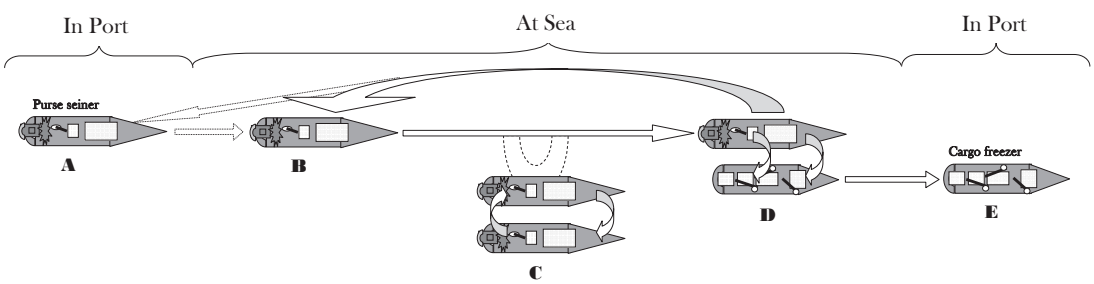

Figure 1 Operation of Thai industrial tuna purse seiners.

information were generated concerning the activities of Thailand's industrial purse seine fleet. Firstly, data was collected on vessel records and ship identification, ownership, vessel dimensions and gear attributes, as recorded in the vessel documents, fishing license or other official documents. Secondly, vessel activity/ship operator data were collected from fishing logbooks and information on the activity of industrial Thai purse seiners including:

– details regarding vessel identification, vessel owner, fishing license and duration of the fishing trip (from one transhipment to next);

– the position (latitude-longitude) of each fishing set or a position per day for non fishing days (normally at noon);

– the catches retained per species and/or size class per set

– the catches discarded per type of fish (tuna or other) per set;

– catches trans-shipped per species, name of the cargo-freezer collecting the catches and number of days spent trans-shipping catches;

– details on the catches collected/transferred from/to other vessels, if any

The vessel activity and fishing master details were collected from logbooks containing the same type of information. Data entry was required to be completed/verified prior to information being recorded in the fishing logbook. Thirdly, for uploaded catches and cargo-freezer contents, data was collected from the vessel plan (catches stored in each vessel room), the record details from the purse seiner per species and size category**.** Fourthly, data on uploaded catches at the canning factory was collected involving the uploaded cargo-freezer per species and size category**.** Fifthly, length (weight) frequency data of tuna specimens were taken from port sampling during the uploading of purse seine catches from cargo-freezers, including vessel room details. Species, fork length and individual weight were recorded.

Data tables and database relationships

Figure 2 shows an example of a flowchart of the database design using Access or SQL, involving some data tables and the relationships among them. For the industrial tuna purse seine fishery of Thailand, a Microsoft Access database was created with a user interface including computerized forms of the data collected from tuna purse seiners and different types of reports, such as the estimation of catches, distribution of catch by species by position and catches-at-size. This program will assist the DOF of Thailand in the implementation of the database.

Status of Thai industrial tuna purse seine fishing in the Indian Ocean

Six tuna purse seiners operated under the Thai flag in the Indian Ocean. These vessels had Length Overall (LOA) and Gross Registered Tonnage (GRT) ranges from 72.5 to 85 m and 1,413 to 2,660 tonne. They were authorized to fish for tuna in the IOTC areas from September 2005 to 2006. The operating areas ranged from 10°58.5′ N to 8°22.4′S and 42°28′E to 85°36.3′E (Figure 3); with the main fishing ground in the western Indian Ocean coinciding with that of the Spanish and French fleets (IOTC, 2008), while the Japanese fleet had their main fishing ground in the eastern Indian Ocean (Nootmorn *et al*., 2007). The activities of these fleets were classified as one of: fishing success, searching, no fishing (bad weather, fishing breakdown, net repairing and bunkering), visiting in port (at Victoria, Seychelles; Phuket, Thailand; Singapore), in transit (at Victoria, Seychelles; Phuket, Thailand; Singapore), loading to other fleets or carrier, loading from other fleets and repairing at shipyard. During the fourth quarter in 2005, the main activities were: uploading to other vessels at sea (71.7%), fishing (10.3%) searching (7.5%), in transit (4.2%), and no fishing activity (1.5 %). In 2006, the main activities in the first and second quarters were similar to the previous year. The first

quarter involved activities, such as uploading to other vessels at sea (56.2%), in transit (26.4%), searching (9.5%) fishing (4.1%) and no fishing (0.9%). Tasks in the second quarter were uploading to other vessels at sea (80.2%), fishing (7.4%) searching (4.6%), in transit (4.0%), and no fishing activity (3.8%). The fishing activities in the third and fourth quarters were concerned more with fishing (100 and 96.9%, respectively) and to a much lesser extent there was no fishing activity in the fourth quarter (3.1%). Most of the fishing involved associated schools (99.71%) and operations in unassociated schools were very rare (0.29%), as was the case with ex-Thai and Japanese vessels (Nootmorn *et al*., 2001; Nootmorn *et al*., 2007). In contrast, the EU purse seine fleets operated more in unassociated schools than associated schools in the western Indian Ocean (Dorizo *et al*., 2008). Nootmorn *et al*. (2001) reported on the activities of the ex-Thai tuna purse seiners during 1998 to 2000, with main activities being fishing (65%), searching (13%),

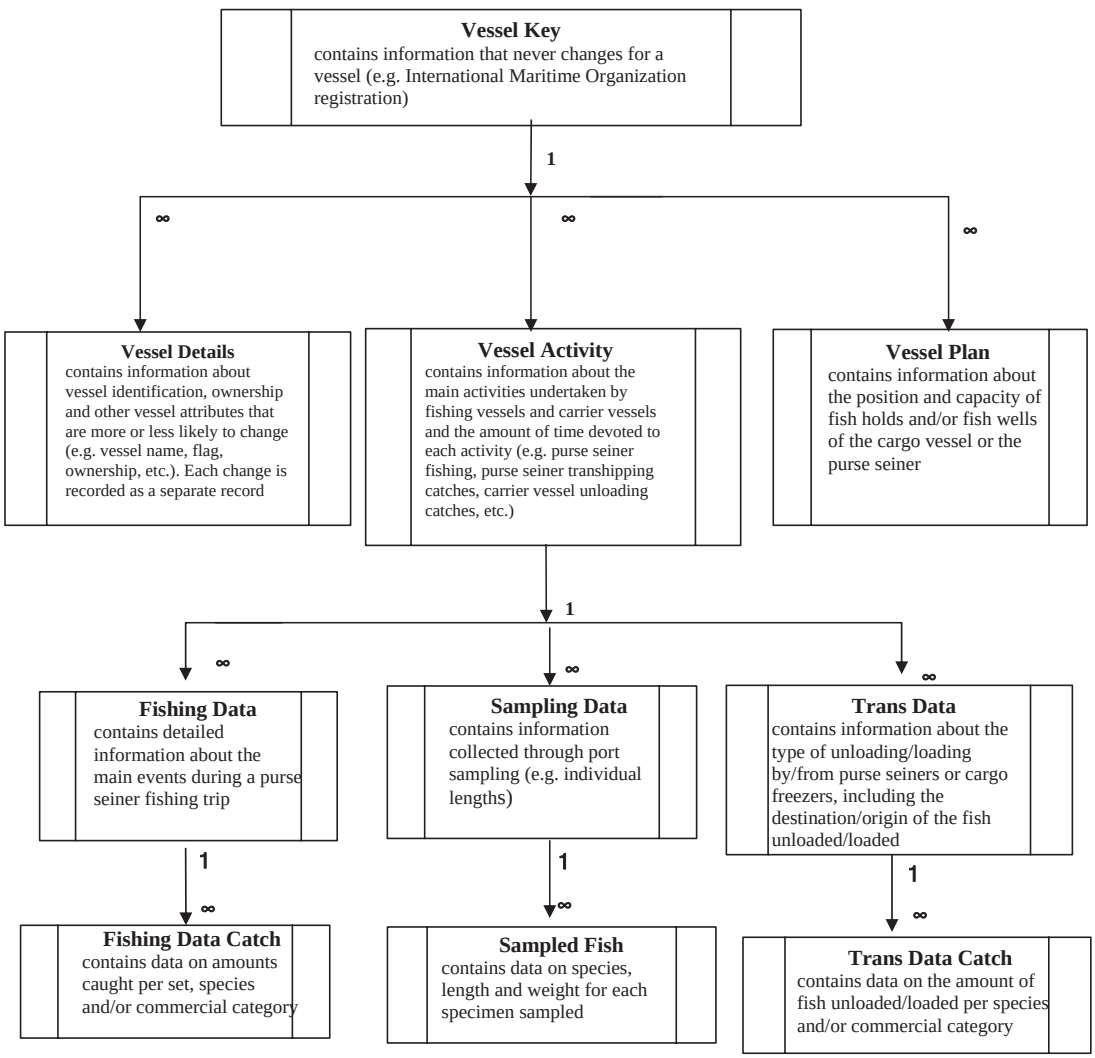

Figure 2 Main data tables and types of data gathered.
Note: relationships may be one (1)-to-many (∞).

sailing (8%), fishing equipment and net preparation (6%) and no fishing (5%).

Tuna caught by the fleet were taken back to Thailand as raw material for tuna canning. Before the commencement of activity by the current fleet in 2005, the total annual catch of Thai tuna purse seine was less than 2,000 tonne (Sujittosakul, 2007). After the entry of the six tuna purse seiners, production rose sharply to 12,216 tonne in 2005 and increased almost twofold in 2006 (23,161 tonne). The highest catches, CPUE and number of sets were taken during February to April and September to November in 2006 (Figure 4). Monthly catches of all tuna, CPUE and number of sets ranged from 383 to 4,539 tonne, 15 to 61 tonne/set and 15 to 144 sets, respectively. Skipjack tuna made up 70.65% of the total catch during 2005 and 2006, followed by bigeye tuna 15.27%, yellowfin tuna 13.57% and bonito 0.51%. The monthly catch composition of skipjack tuna was high from March to September, while bigeye and yellowfin tuna numbers were high from September to December and January to February in 2006. Furthermore, the proportion of yellowfin tuna during September to December in 2005 was higher than in 2006 because the catch composition of bigeye tuna decreased in this period (Figure 5).

Figure 3 Fishing location of Thai tuna purse seiners in the Indian Ocean from 2005 to 2006.

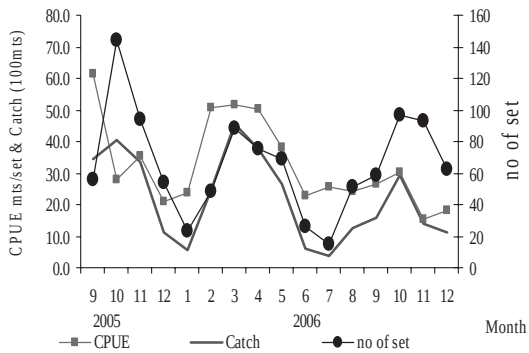

Figure 4 Monthly change of total catch, CPUE and fishing effort in 2006.

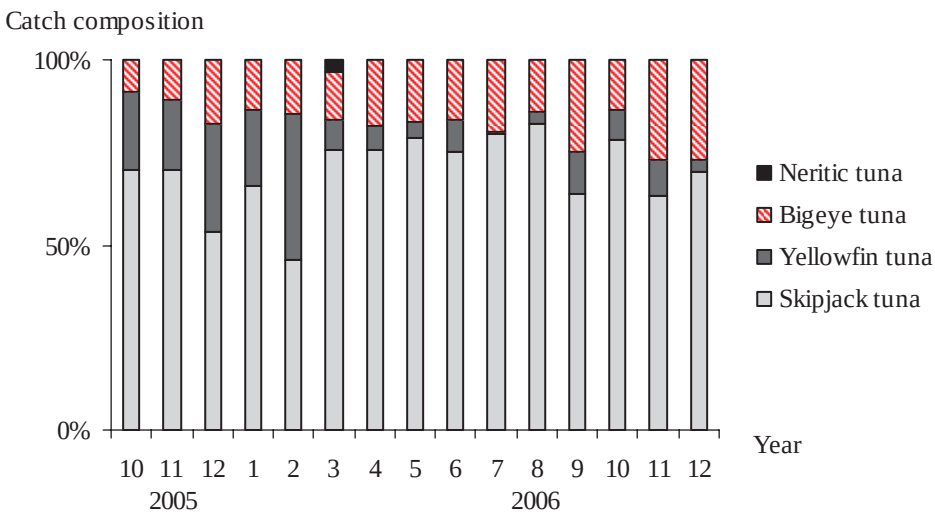

Figure 5 Monthly change of catch composition by species in 2006.

The results show that the average CPUE of 32.81 tonne/set or 33.35 tonne/day were similar to those of the Spanish and Japanese tuna purse seiners of 31.03 and 36.78 tonne/day, respectively (IEO, 2007; NRIFSF, 2007). Skipjack tuna comprised the majority of the catch for the tuna purse seine fleets that had catches in associated schools, followed by yellowfin and bigeye tuna. Yellowfin tuna was the target species of tuna purse seiners that fished in unassimilated schools, followed by skipjack and bigeye tuna (Dorizo *et al*., 2008).

Spatial and temporal of catch rate distribution

Thai purse seiners spent most of the time of the year searching for fish and fishing. They fished for two different types of tuna schools, namely associated and unassociated schools. Usual fishing practice involved associated schools, while unassociated schools were very rare in Thai tuna purse seine fishing.

Figure 6 shows the quarterly catch distribution from associated schools of Thai tuna purse seiners from 2005 to 2006. The main fishing ground was the western Indian Ocean. In 2005, the vessels only fished off the west coast of Somalia during quarter 3 (Figure 6a), whereas the wider fishing group fished intensively in the west of the Indian Ocean, but extensively in the east of the Indian Ocean (Figure 6b) during quarter 4. A high abundance of skipjack, yellowfin and bigeye tuna was found along the west coast of Somalia. Fonteneau (2008) reported that the Somalian upwelling was the most powerful because of biological productivity. Seasonal and location activity of tuna fisheries are directly related to this upwelling: small tuna off Somalia, such as yellowfin, skipjack and bigeye tuna, seasonally feed on the Somalia upwelling. In 2006, during quarters 1 and 2, the catch distribution and main fishing ground (Figures 6c and d) were similar to those of quarter 4 in 2005. The catch distribution during quarters 3 and 4 show that the densest fishing ground was along the western coast of Somalia and the southeast Seychelles (Figures 6f and g). Figures 7a, b and c show the quarterly catch distribution from unassociated schools of the Thai tuna purse seiners. The catch distribution from this practice was very low, with only one set during quarters 1, 2 and 4 in 2006. IOTC (2008) reported the main fishing ground of the tuna purse seiners was in the west of the Indian Ocean, which was the same as that of the Thai tuna purse seiners. In contrast, the Japanese tuna purse seine operations were in the east of the Indian Ocean during 2005-2006 (Nootmorn *et al*., 2007).

Size distribution of tuna

Figure 8 shows the size distribution of folk length of skipjack, yellowfin and bigeye tunas.

Skipjack tuna size ranged from 39 to 75 cm, while the mode of size and Lc_{50} were 60 to 66 cm and 60 cm, respectively (Figure 8a). The range (30-63 cm) and mode (39-42 and 45-51 cm) of size frequency distribution from the Japanese purse seiners that were fishing in the east of the Indian Ocean was less than in the current study (Nootmorn *et al*., 2008). The size at the first mature stage of this species was reported to be 41-42 cm (Stequert and Ramchrrun, 1995), while Nootmorn *et al*. (2001) reported the size at the first mature stage of skipjack females and males was 43.80 and 47.60 cm, respectively, which indicates that 99% of skipjack tuna caught from Thai purse seining were bigger than the size at the first mature stage. This was consistent with the IOTC's recommendation with regard to the increasing trend in the skipjack tuna catch in the Indian Ocean (IOTC, 2007), where the size of fish was bigger than 40 cm. This situation shows the healthy status of the skipjack tuna population in this area.

Yellowfin tuna showed a size distribution from 33 to 152 cm, with three modes at 61-63 cm, 75-87 cm, and 105-117 cm, while Lc_{50} was 81 cm (Figure 8b). The range and mode of size frequency distribution from Japanese purse seining (30-114

cm and 39 and 51-57 cm, respectively) were less than in the present study (Nootmorn *et al*., 2008). Nootmorn *et al*. (2005) reported the size at the first stage of maturity of yellowfin tuna females and males was 109.69 and 104.95 cm, respectively. Yellowfin tuna caught from Thai tuna purse seining were mainly smaller (constituting 78% of the size distribution) and less than the size at the first stage of maturity. IOTC has reported on the status of this species, which has been over fished (IOTC, 2007), and more recently have stated that the increase in the fishing practice of using purse seining with fish aggregating devices will have a negative impact on the yellowfin tuna population, as it will result in more juvenile yellowfin tuna being caught (IOTC, 2008).

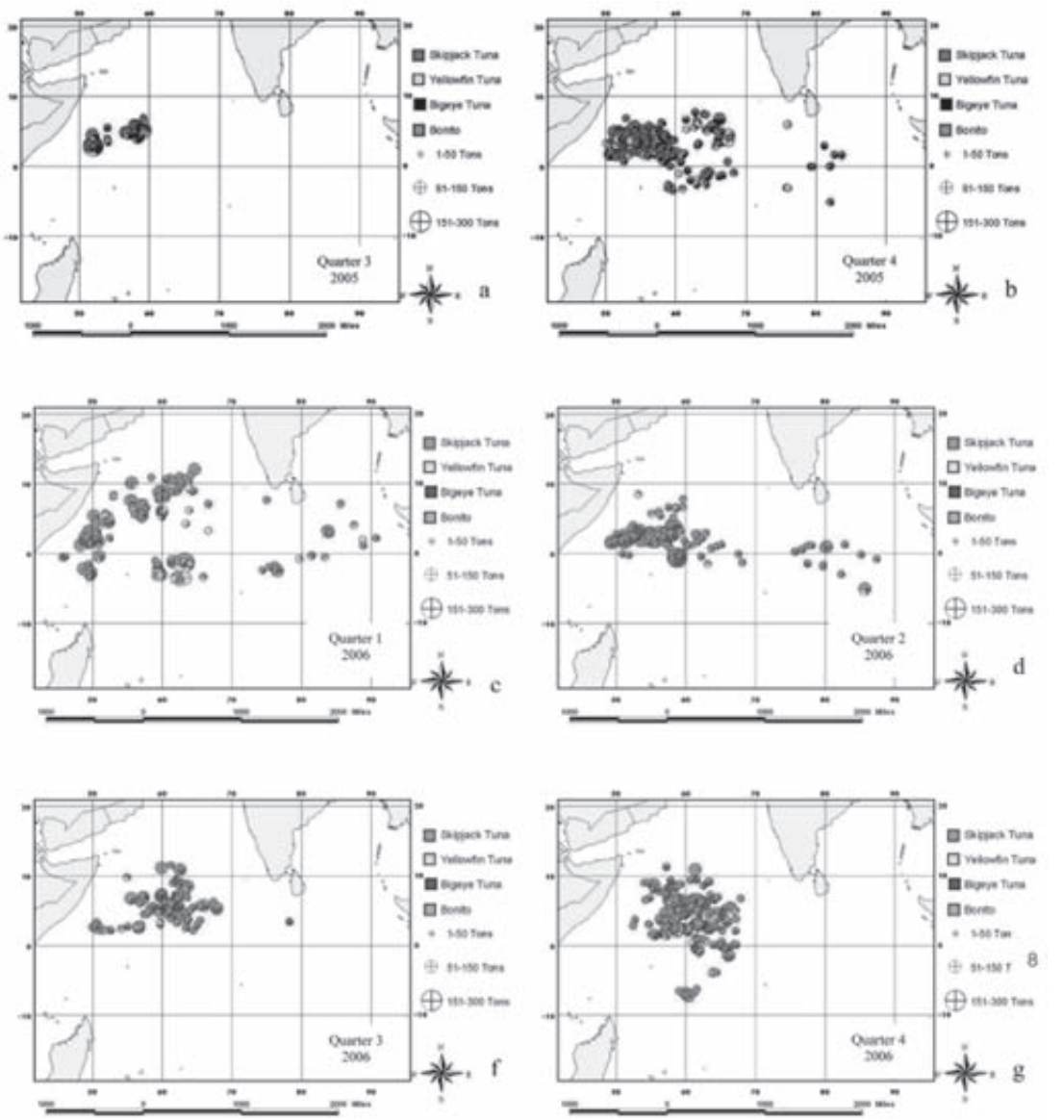

Figure 6 Catch of Thai tuna purse seiners during 2005-2006 by the distribution of the associated schools of major species.

The size range of bigeye tuna varied from 45 to 133 cm, with modes of size at 57-65 cm, 83-93 cm and 108-120 cm, while Lc_{50} was 66 cm (Figure 8c). The range (30-87 cm) and mode (39-45, 48-63 and 72-75 cm) of the size frequency distribution from Japanese purse seining was less than in the current study (Nootmorn *et al*., 2008). The size at the first stage of maturity of this species was reported for females and males as 88.1 and 86.9 cm, respectively (Nootmorn and Petpiroon, 2006). Meanwhile, 80% of bigeye tuna caught from Thai purse seining were smaller than the size at first maturity, similar to yellowfin tuna. IOTC have reported on the status of this species, which has been over fished (IOTC, 2007) and more recently advised that the increase in the fishing practice of using purse seining with fish aggregating devices will have a negative impact, as it will result in more juvenile bigeye tuna being caught (IOTC, 2008).

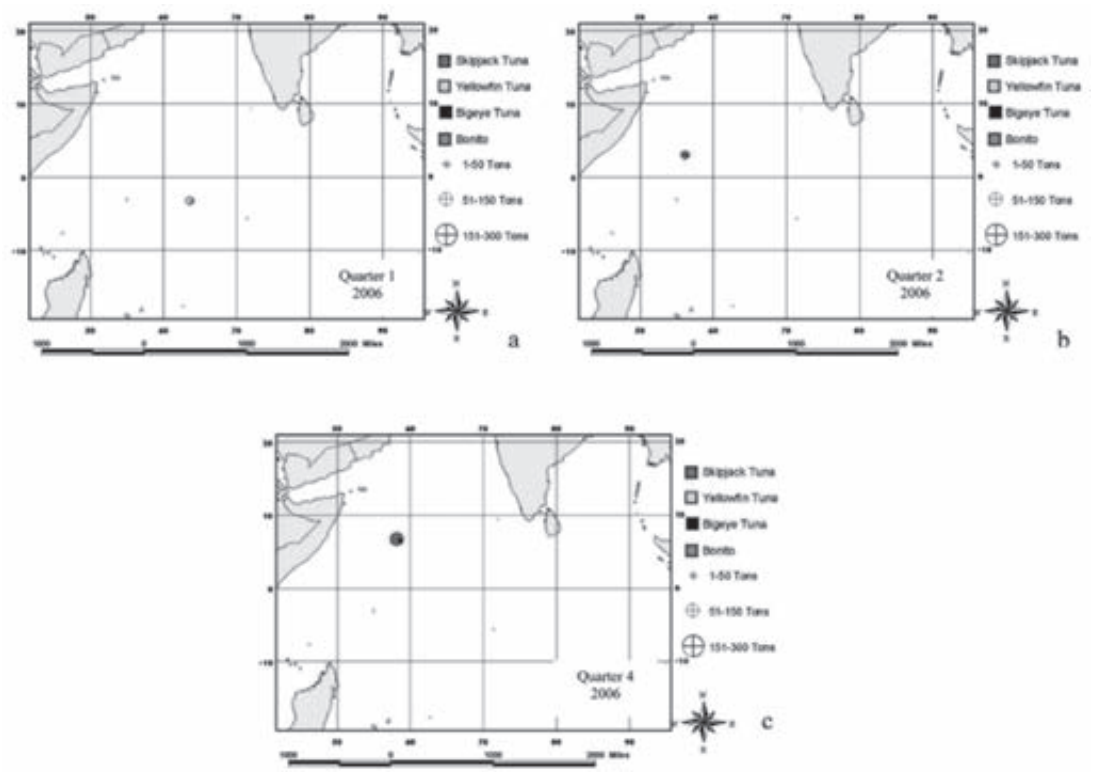

Figure 7 Catch of Thai tuna purse seiners in 2006 by the distribution of unassociated schools of major species.

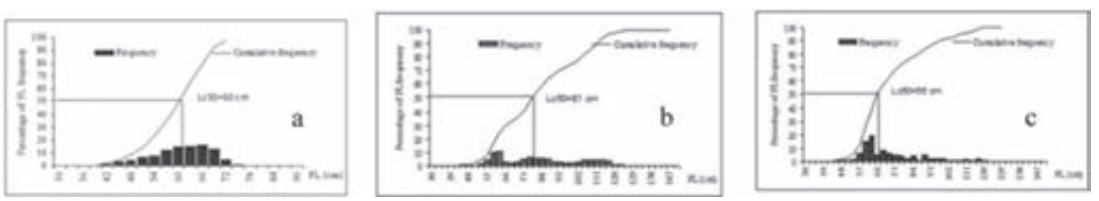

Figure 8 Frequency distribution of the length of (a) skipjack; (b) yellowfin and (c) bigeye tuna caught by Thai tuna purse seining in the Indian Ocean.

Bigeye tuna caught by Thai tuna purse seining

Bigeye tuna are one component (15.27%) of the Thai tuna purse seine catch, in the main fishing ground in the western Indian Ocean. The proportion of catch shows two peaks, during January and February and secondly from September to December (Figure 5). The spatial distribution of bigeye tuna was off the coast of Somalia and in the western Indian Ocean. IOTC (2007) reported that the annual catches of bigeye tuna by longline and purse seine vessels were high in the western Indian Ocean during 2000-2006. The Thai vessels used purse seining with FADs for associated schools, with juveniles of this species making up more than 80% of the catch, even though this gear aimed to catch skipjack tuna as raw material for tuna canning factories. However, the habitat of the juveniles of bigeye and yellowfin tuna is the same as that of the associated schools of skipjack tuna that swim under logs, in floating grass and among other floating objects or human-made objects. Purse seiners mainly take small, juvenile bigeye (averaging around 5 kg) whereas longliners catch much larger and heavier fish; while purse seiners take much lower tonnages of bigeye tuna compared to longliners, they take larger numbers of individual fish (IOTC, 2007). In addition, Ardill (1984) reported a characteristic of the tuna species under consideration is the limited development of their swim bladders. Skipjack tuna have no swim bladder, while in the bigeye and yellowfin tuna, only the older individuals develop one concurrent with an increase in body fat, which reduces density.

Dorizo *et al*. (2008) reported that bigeye tuna catches and CPUEs from EU tuna purse seiners in the western Indian Ocean tended to be stable from 1983 to 2008, but the relatively high catches of bigeye tuna taken from unassociated schools (and the lower bigeye catches taken from associated schools) were rather surprising and they deserved an in-depth study taking into consideration the sizes of bigeye tuna caught and fish strata.

CONCLUSION

Six Thai purse seiners have operated in the Indian Ocean from 2005 to 2006. Information was gathered from port sampling, log books and interviews, which was aggregated to create a systematic database to monitor the progress of Thai tuna purse seine fishing.

The activity of this fleet was categorized into eight activities: fishing success, searching, no fishing, visiting port, in transit, loading to other fleets or carriers, loading from other fleets and repairing at shipyard. The main activities during the fourth quarter in 2005 until the second quarter in 2006 were unloading to other vessels at sea, followed by fishing and searching, in transit and no fishing. In contrast, the fishing activities in the third and fourth quarters were concerned more with fishing. Most fishing practice involved catches from associated schools.

The total catch by Thai tuna purse seiners, was 12,216 tonne in 2005 and increased almost twofold in 2006 (23,161 tonne). The highest catches, CPUE and number of sets were taken during February to April and September to November in 2006. Monthly catch, CPUE and the number of sets ranged from 383 to 4,539 tonne, 15 to 61 tonne/set and 15 to 144 sets, respectively. Skipjack tuna was the main target species, followed by bigeye tuna, yellowfin tuna and bonito. Skipjack tuna made up a high proportion of the catch from March to September, while bigeye and yellowfin tuna made up a high proportion from September to December 2005 and from January to February in 2006.

Spatial and temporal data of CPUE showed the quarterly catch distribution from associated schools by Thai tuna purse seining during 2005 and 2006. The main fishing ground was off Somalia, where there was a productive area with a high abundance of skipjack, yellowfin and bigeye tuna.

Skipjack tuna size was in the range from 39 to 75 cm, while the mode of size and Lc_{50} were

60-66 cm and 60 cm, respectively. Ninety-nine percent of skipjack tuna were larger than the size at the first mature stage, which were caught by Thai tuna purse seining. The range in size of yellowfin varied from 33 to 152 cm, while the three modes were 61-63 cm, 75-87 cm, and 105-117 cm, and Lc_{50} was 81 cm. Seventy-eight percent of yellowfin tuna were smaller than the size at the first mature stage. The size range in bigeye tuna varied from 45 to 133 cm, the modes of size were 57-65 cm, 83-93 cm and 108-120 cm, while Lc_{50} was 66 cm. In particular, 80% of bigeye tuna were smaller than the size at the first stage of maturity, similar to yellowfin tuna.

Bigeye tuna was the second most abundant species caught by Thai tuna purse seining, with most of them being juvenile. They were caught mainly with associated schools off Somalia, when the peak of catch occurred during January to February and September to December. The status of this species from a tuna purse seine perspective was stable in terms of catch and CPUE.

ACKNOWLEDGEMENTS

The authors are especially grateful to Mr Miguel Herrera, Data Coordinator of IOTC and OFCF for technical support on Thai purse seine data collection.

LITERATURE CITED

Ardill, J.D. 1984. **Tuna Fisheries in the South West Indian Ocean.** RAF/79/065/WP/9/83. [Cited 2009 April 25]. Available from: http://www.fao.org/docrep/field/255095.htm.

Dorizo, J., C. Assan and A. Fonteneau. 2008. **Analysis of Tuna Catches and CPUEs by Purse Seiners Fishing in the Western Indian Ocean Over the Period Jauary to July 2008**. IOTC 2008-WPPTT-20. 42 pp.

Fonteneau, A. 2008. **What Effects of the New Somalian MPA on Stocks and Fisheries?** Paper presented at the tenth Working Party on Tropical Tunas at Bangkok, Thailand. 23-31 October 2008. 13 pp.

Indian Ocean Tuna Commission. 2007. **Report of the tenth session of the Scientific Committee**. Victoria, Seychelles. 5-9 November 2007. IOTC-2007-SC-R[E]. 133 pp.

Indian Ocean Tuna Commission. 2008. **Report of the Tenth Session of the IOTC Working Party on Tropical Tuna**. Bangkok, Thailand. 20-31 October 2008. IOTC-2008-WPTT-R[E]. 49 pp.

INFOFISH. 2004. Tuna 2004 Bangkok. Programme and Abstracts, pp. 39-49. *In* **8th INFOFISH World Tuna Trade Conference and Exhibition**. Bangkok, Thailand.

Instituto Espanol de Oceanografía. 2007. **National Report 2007 UE-Spain.** IOTC-2007-SC-INFO4. 6 pp.

National Research Institute of Far Seas Fisheries. 2007. **National Report of Japan (2007)**. Victoria, Seychelles. 5-9 November 2007. IOTC-2007- Sc-INF09. 10 pp.

Nootmorn, P. and S. Petpiroon. 2006. **Reproductive Biology of Bigeye Tuna in the Eastern Indian Ocean**. Available from: elib.fisheries.go.th/LIBCAB/DRAWERS/ARTICLE/DATA0003/00003701.PDF. 11 pp.

Nootmorn, P., A. Yakoh and K. Kawises. 2005. **Reproductive Biology of Yellowfin Tuna in the Eastern Indian Ocean**. IOTC-2005-WPTT-14. 8 pp.

Nootmorn, P., S. Panjarat, S. Hoimuk and W. Singtongyam. 2001. **Thai Tuna Purse Seine Fishery, Mukmanee, in the Indian Ocean, 1998 to 2000**. Paper presented at the Department of Fisheries annual seminar in 2001 at Bangkok, Thailand. 18-21 September 2008. 17 pp.

Nootmorn, P., S. Panjarat, S. Hoimuk, T. Jaiyen,P.Keereerut, N. Nakosiri and W. Singtongyam. 2007. **Tuna Purse Seine Landings in Phuket, Thailand, from 1993 to 2006**. IOTC-2007-WPTT-25. 7 pp.

Nootmorn, P., T. Jaiyen, S. Panjarat, S. Hoimuk, P. Keereerut, N. Nakosiri, K. Maeroh and W. Singtongyam. 2008. **Change of Tunas Size Distribution from Tuna Purse Seiner Landing in Phuket, Thailand, from 2003 to 2007**. IOTC-2008-WPTT-33. 7 pp.

Stequert, B. and B. Ramcharrun. 1995. The fecundity of skipjack tuna (*Kastsuwonus pelamis*) from the western Indian Ocean. **Aquatic Living Research** 8: 79-89.

Sujittosakul, R. 2007. **Some Scientific Information of Tunas Harvested by Thai Purse Seiners**. IOTC-2007-WPTT-22. 6 pp.