Overview of Tuna Purse Seine Fisheries by MV SEAFDEC in the Eastern Indian Ocean

Southeast Asian Fisheries Development Center
Training Department

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By

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Abstract

Tuna purse seine surveys in the Eastern Indian Ocean have been conducted by MV SEAFDEC of the Training Department of SEAFDEC since 1993. There were 87 fishing operations. The total catches was 1,945.55 tons with averaged catch 6.53 tons/ fishing days. Catch composition was consisted of skipjack tuna, the most dominant specie caught at 65.56 % , followed by yellowfin tuna at 20.26%, bigeye tuna at 12.82% and other species at 1.36 %, respectively. The size range of skipjack tuna, yellowfin tuna and bigeye tuna were within ranged between 31-80, 20-136, 31-122 cm FL. The relative length-weight was determined using allometric equation for skipjack tuna ($W=0.000006L^{3.3067}$), yellowfin tuna ($W=0.00003L^{2.9175}$) and bigeye tuna ($W=0.00001L^{3.1699}$)

Keywords: Tuna purse seine, skipjack tuna, yellowfin tuna, bigeye tuna, catch composition, length frequency distribution, length-weight relationship

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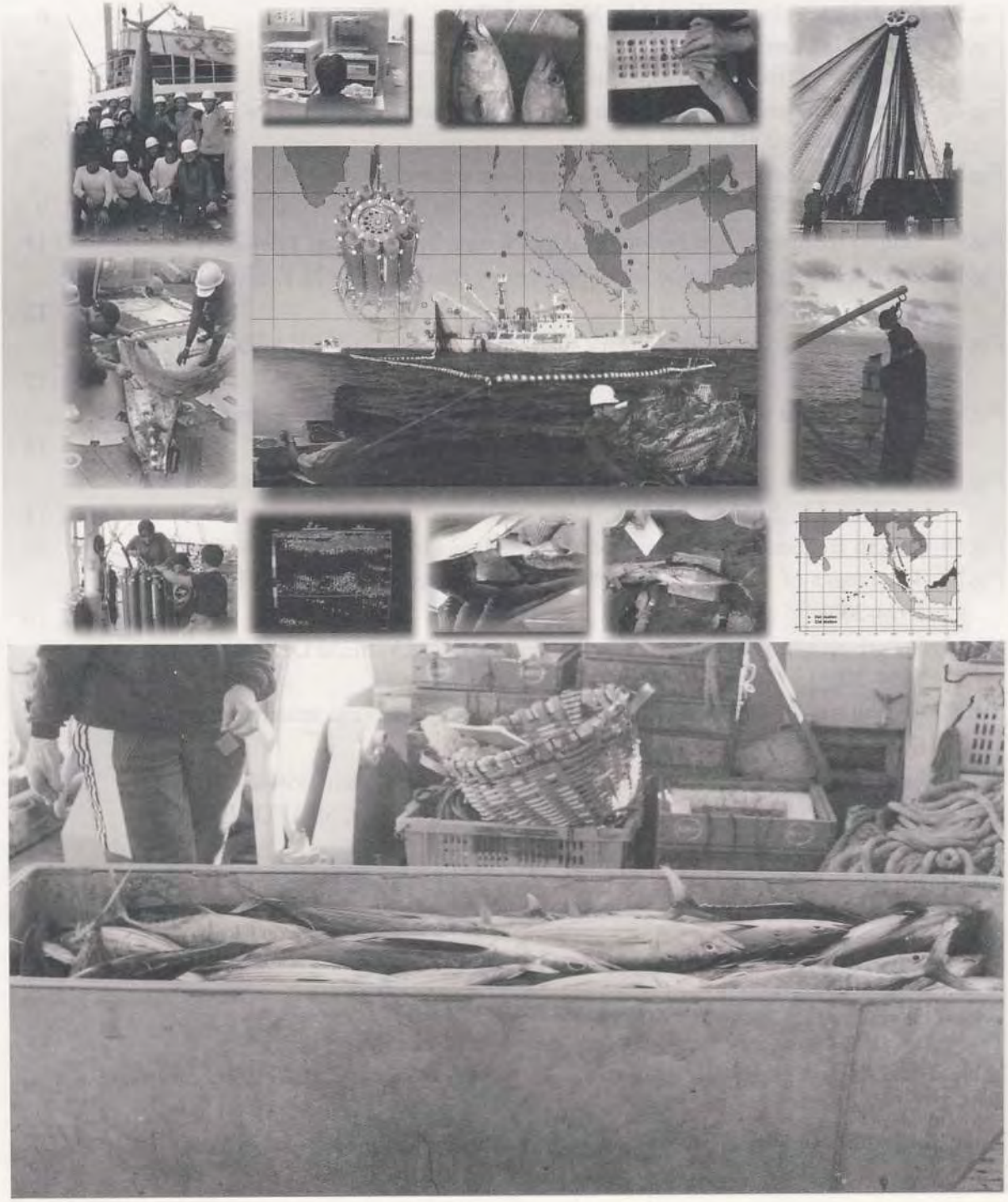

Introduction

Because of the exploitation of coastal resources and habitats in the Southeast Asia countries, which is function of human population size and its level of socio-economic development, the controlling coastal development and resource protecting habitats require improvement. At the same time new fishery resources like tuna and oceanic fish are being investigated as alternatives for the fishermen. Tuna plays a vital role as a product of the fish canning industry, also fresh tuna is extensively used for " Sashimi". During the last decade, tuna have become one of the most important high value fish species and could be a new resource to take the place of coastal resources because it is distributed worldwide in tropical and subtropical waters: Pacific, Atlantic and Indian Oceans.

In the Indian Ocean, tuna fisheries were initiated in 1973 by tuna longline, tuna purse seine and pole and line fishing gear operated by French, Russian, Japanese and Taiwanese fleets (Chantawong, 2000). The main tuna fishing ground is in the western Indian Ocean, where many commercial fleets concentrated their operations, but they changed to the eastern part in 1991(Okamoto,1997) to save the expense of transshipments, Southeast Asia countries became the important and major tuna market of the world. As many fleets unloaded in Singapore, Indonesia and Malaysia before 1994 they then moved to Phuket. (Chantawong, 2000). However, the trend of tuna catch by Japanese purse seiners in the Indian Ocean, decreased from 45,000 mt in 1992 to 7,000 mt in 1999, because of the development of purse seine fishery, reported by Matsumoto (2000).

To utilize tuna resource for regional benefit, SEAFDEC, an intergovernmental organization, has conducted tuna resources surveys since 1993 using M.V. SEAFDEC, the purpose being to promote tuna as a new resource for member countries. M.V. SEAFDEC is the training and research vessel of the SEAFDEC training department and is designed for the basic requirement of tuna purse seine operation in the japanese style. The ship has a capacity of 100 tons for frozen fish storage. The method of fishing used relies greatly on the use of fish aggregating devices. The purpose of the surveys was to collect all possible information of species composition, distribution and abundance of tuna species.

This report provides an overview of tuna fisheries in the Eastern Indian Ocean, with emphasis on the catch data of M.V. SEAFDEC from 1993 to the present.

Methodology

1. Fishing vessel, M.V. SEAFDEC

The fisheries training and research vessel, started her duties in February 1993 and started to conduct tuna purse seine operations in October of the same year. She is a japanese designed purse seiner employing the extensive use of FADs or other drifting objects. The principal particulars, including length overall, tonnage and other details are given in Appendix 1.

2. M.V. SEAFDEC purse seine net

The purse seine net of M.V. SEAFDEC was made by Nichimo Co., Ltd. It has a total net length of 1,155.9 m. Prajakjitt and Munprasit (2001) reported that the net is composed of 20 portions and has 3 developed sections. In the first part, the netting yarn is all nylon and the bunt part (portions 1-2) are constructed of 90-160 ply/90 mm mesh size and 40 ply/105 mm mesh size in the body part of the net (portions 5-18). The wings that are attached to the bunt (portion 3-4) are made of 60 ply/90 mm mesh size and the right wing (portion 19-20) is 60 ply/105mm and 90 ply/ 105 mm. The upper and lower selvages are made in polyethylene Ultra Cross(PE UC) 320 ply/150 mm 5 meshes deep. The yellow floats are made of plastic EVA, with the dimensions of 160 (L) x190(D) x33 (H.D) and a buoyancy of 4,000 g. The chain is of Super alloy, with a diameter of 11,13 mm attached with a bridle chain with 10 pieces of single rope and plus bridle chain doubled is 64 pieces. The purse ring is made of Galvanized Iron, 22 mm-diameter x 260 mm.

In June 1994, the Japanese Master Fisherman modified the seine net by changing the portions 7-15 from nylon netting of 40 ply/105 mm to tetron 60 ply/210 mm and 70 ply/210 mm. Two double bridle chains alternated with a bridle chain with a single rope. The other component were retained

Subsequently, the floats (Model E-40) on the purse seine net were replaced in August 1997 with model E-50 that has a buoyancy of 5,000 g.

Lastly, the net was improved in August 1998, When two portions were added to the body part of the net. At the present, the M.V. SEAFDEC purse seine net has 22 portions and its length is increased to 1,266.9 m. (Appendix 2)

3. Fishing area

The tuna resource surveys have been conducted in the Eastern Indian Ocean from 1993 to 2001 between latitude 2°N-8°S and longitude 81°-97° E, radiating around the Ninety East Ridge (Fig. 1). It takes 3 days to travel from Phuket to this fishing ground.

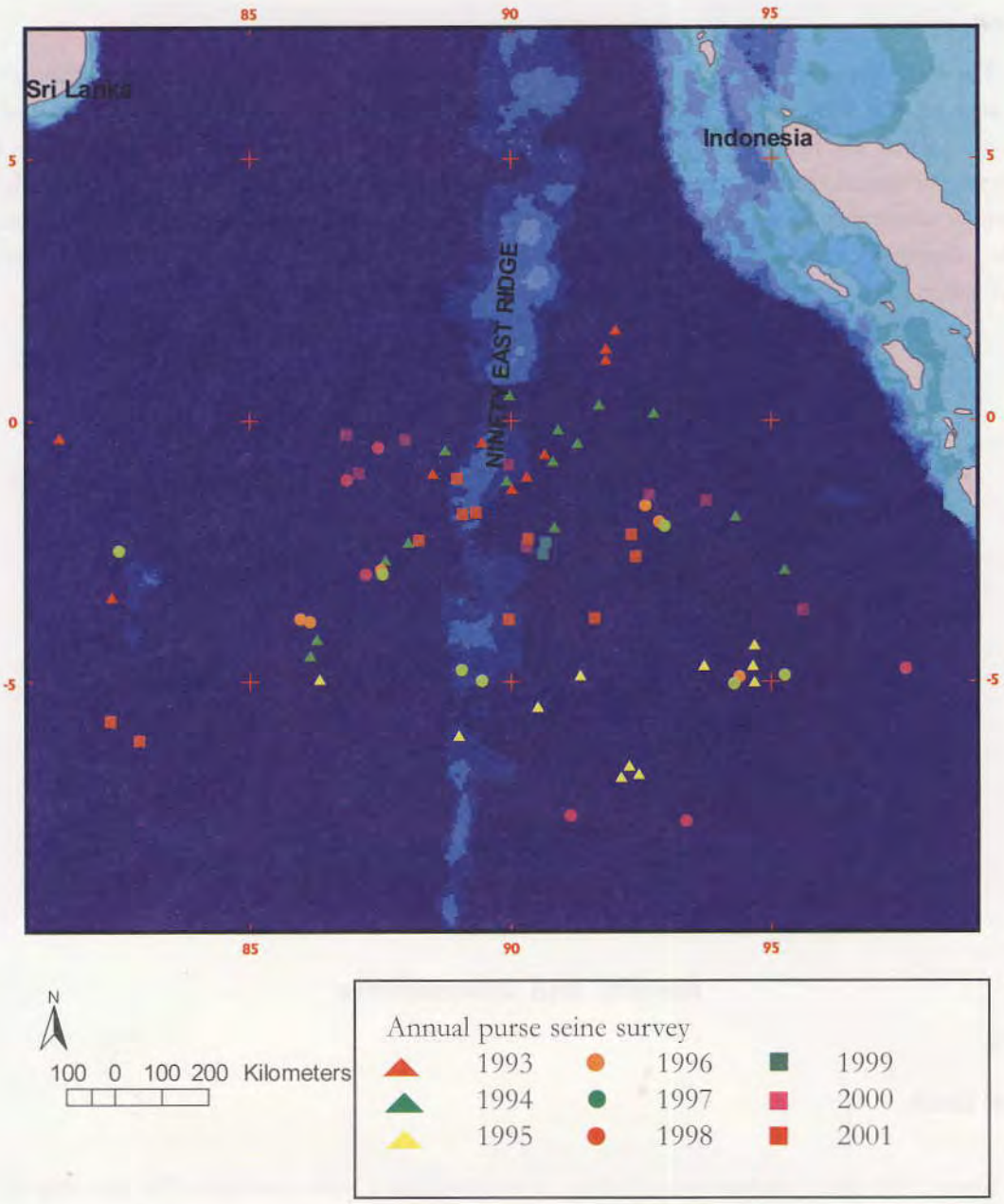

Fig.1 The tuna purse seine fishing ground of M.V. SEAFDEC in the Eastern Indian Ocean from 1993-2001.

4. Fishing season

The tuna resource surveys of M.V. SEAFDEC, are most frequently conducted from October to March of following year (Appendix III), as the northeast monsoon period is the most suitable season for the operations. Generally, the fishing season for tuna in Eastern Indian Ocean is throughout the year, but high peak of production during the northeast monsoon, October to December (Chantawong et,al, 1996). It also found that tuna catch in this area during the southwest monsoon was very poor (Pokapunt, et. al,1999), because of the changing of sea conditions and strong winds affect to the tuna purse seine operations

Data collection

The tuna resource surveys are conducted to collect catch effort, catch composition, individual length and weight data. Tuna and other species samples are collected to determine species composition from the first or second scoop. The variables of tunas recorded are individual fork length (cm) measured from the most anterior part of the fish to the tip of the median caudal fin rays using a measuring board (Fig. 2), and the weight (kg) is measured by spring balance for length frequency distribution and length and weight relationship studies. Fishing effort is considered in terms of catch per unit effort for the numbers of operation in each year.

Fig.2 Girth measurement on board M.V. SEAFDEC.

Results and Discussions

1. Catch

1.1 Total catch

Since 1993-2001, eighty-seven fishing operations have been conducted by the ship in the Eastern Indian Ocean. The majority of catches were skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*) and bigeye tuna (*T. obesus*) (Fig. 3), while other species appear in small quantities. The total catch being 1,945.55 tons; averaged out at a catch per unit effort of 6.53 tons/ fishing day. The catch was greatest in 1994 at 635.4 tons, it then decreased between 1995 and 2001, similar to the results of Nootmorn et, al (2002). However, it is noticeable that in 1999, the catch was very poor because there were only two operations and effort were 27 fishing days during this year. Meanwhile, the trend of catch per unit effort (CPUE), reached a peak of 20.5 tons per fishing days in 1994, decreased from 1995-1999 and increased again from 2000, decreasing again in 2001. It was observed that CPUE in 1999 was very poor, only 0.85 tons/fishing day. Comparison between the year of 2000 and 2001, found that even though fishing days in 2000 were less than in 1999, CPUE was higher. Especially in 2001, there were many operations and fishing days but the catch was small.(Table 1, Fig. 4)

Fig.3 The main tuna species caught by M.V. SEAFDEC: a) Skipjack tuna (*Katsuwonus pelamis*), b) Bigeye tuna (*Thunnus obesus*) and c) Yellowfin tuna (*T. albacares*)

Table 1 Catch, effort and CPUE (tons/fishing day) by year from 1993-2001.

Year	Catch (ton)	No. of operation	Effort (Fishing days)	CPUE (tons/Fishing day)
1993	138	10	42	3.29
1994	635.4	17	31	20.50
1995	356	16	26	13.69
1996	218	9	30	7.27
1997	220	7	36	6.11
1998	188	6	36	5.22
1999	23	2	27	0.85
2000	96.648	9	19	5.09
2001	70.5	11	51	1.38

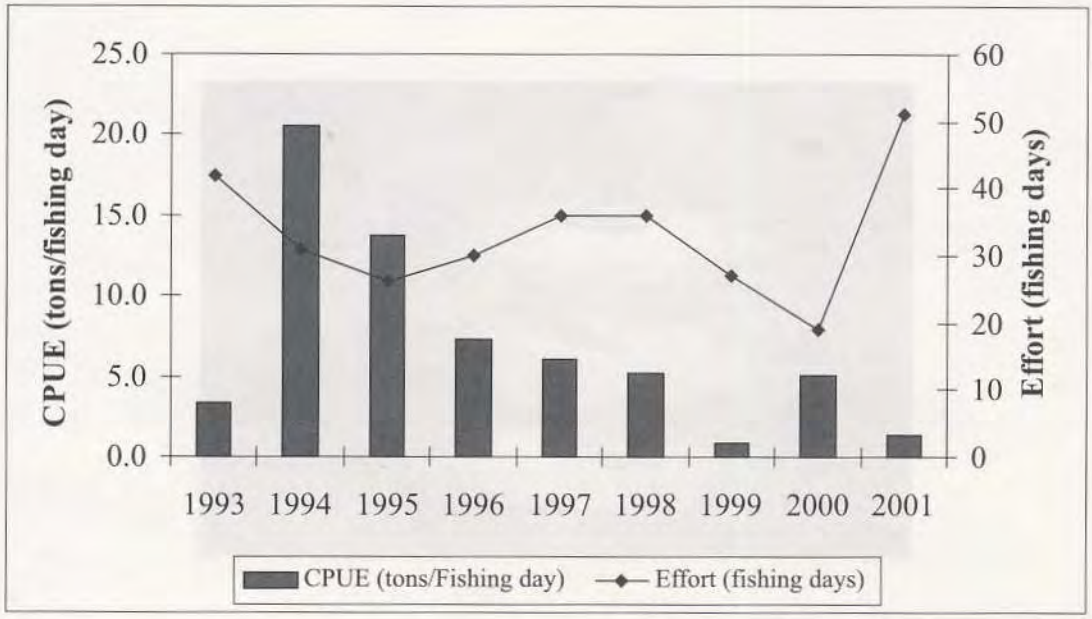

Fig. 4 Comparison between CPUE (ton/fishing day) and effort (fishing day), conducted by M.V. SEAFDEC from 1993-2001.

The amount of catch by species, reached a peak in 1994, then reduced from 1995, except for bigeye tuna the catch of which reduced in 1995 then increased in 1996, after that it reduced again similarly with other species. (Fig 5 a, b and c).

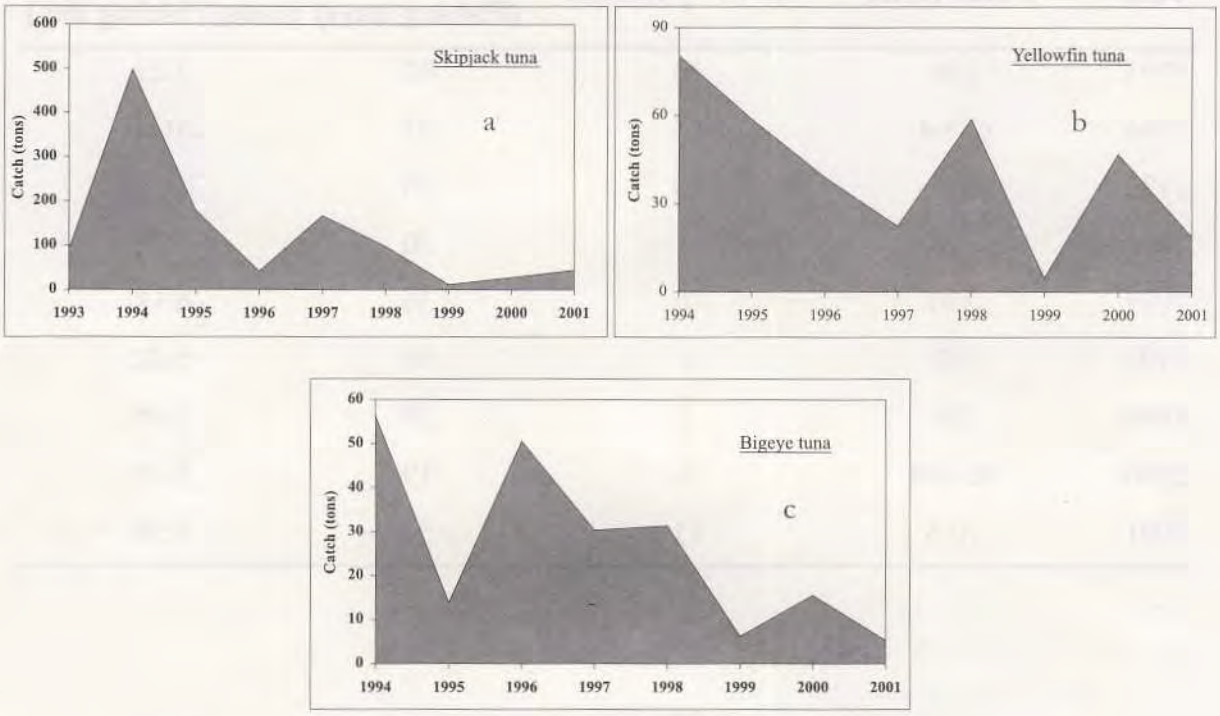

Fig. 5 Catches by species, conducted by M.V. SEAFDEC from 1993-2001.

1.2 Catch composition

From 1993 to 2001, the catch of tuna species by M.V. SEAFDEC was based upon, skipjack tuna, yellowfin tuna and bigeye tuna. Also, other species were caught incidentally in smaller quantities and the catches of non-tuna species are unreported in 1994, 1998 and 1999.

Since 1994, the tuna catches have been identified by species including: skipjack tuna, bigeye tuna and yellowfin tuna but before that year they were not thus defined. As a results of the overall proportions of the catch by species during 1994-2001 shows skipjack tuna was the principal species caught with 65.56 %, followed by yellowfin tuna at 20.26 %, bigeye tuna at 12.82 % and other species at 1.36 % (Fig. 6). In accordance with these results, the proportions of catch by year was the same, that is skipjack tuna, a target species, was the highest percentage of the catch, followed by yellowfin tuna, bigeye tuna and other species (Fig.8). Contrarily, in 1996, bigeye tuna was caught more than skipjack tuna and in 2000, yellowfin tuna was more prevalent than skipjack tuna (48.52 % and 28.59 %,). The proportions of catch by stations of different position doesn't shows any trend (Fig.7).

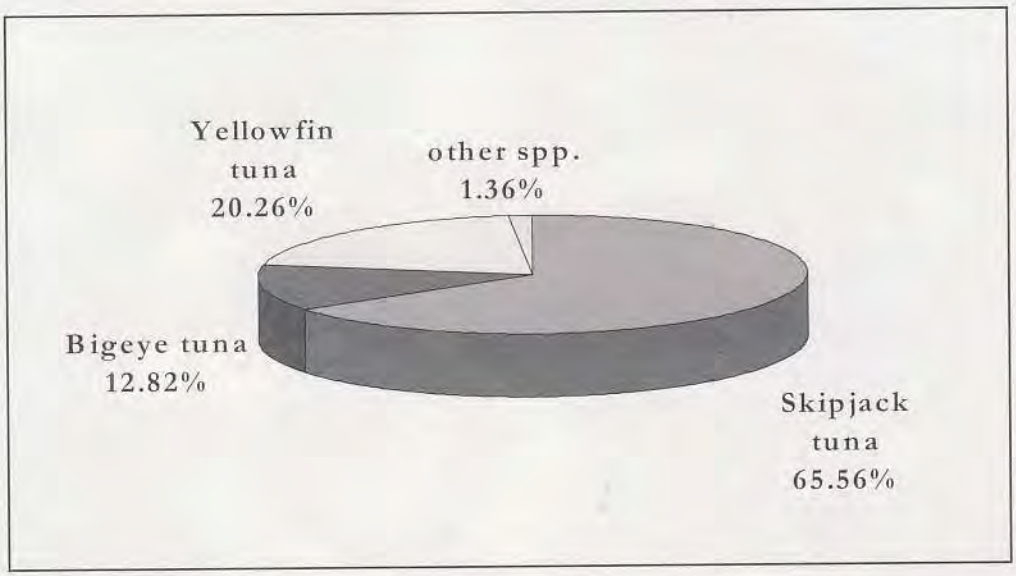

Fig. 6 The overall catch composition of tuna purse seine conducted by M.V. SEAFDEC since 1994 until 2001.

More than 30 non target species were caught during the operation including: rainbow runner, common dolphinfish, triggerfish, carcharinid sharks, wahoo and mackerel scad were predominant aggregated under logs or/and FADs.(Table 2), in consonance with Romanov (2002) and Pokapant (1997). In addition, the purse seine operation conducted in 2001 caught and returned to the sea a rare megamouth shark (*Megachasma pelagios*), just about the first ever recorded in the Indian Ocean (SEAFDEC, 2002) and as the sixteenth specimen in the world (Boonyapiwat and Vithayanon, 2002).

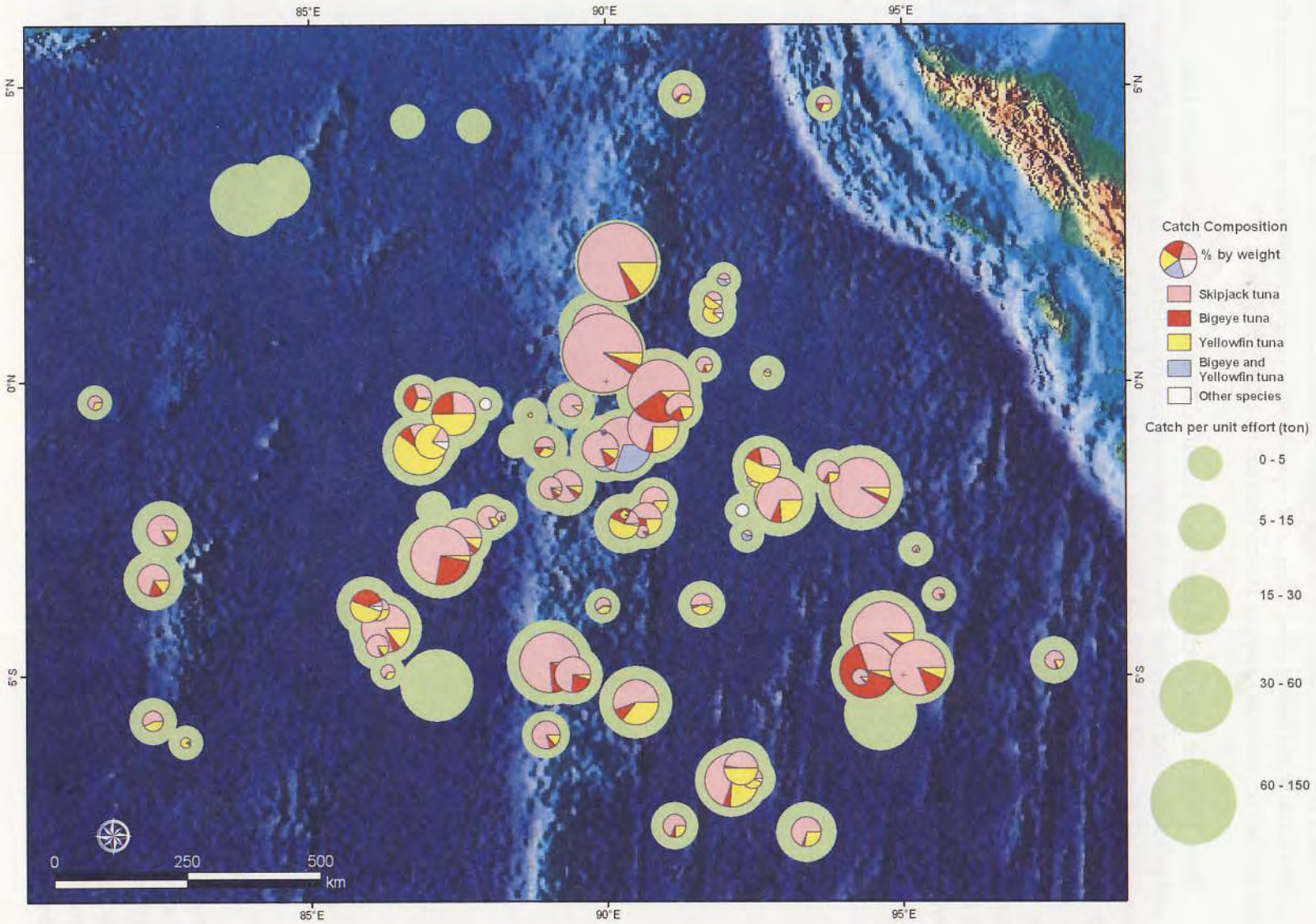

Fig. 7 Catch composition by operation of tuna purse seine conducted by M.V. SEAFDEC during 1994-2001

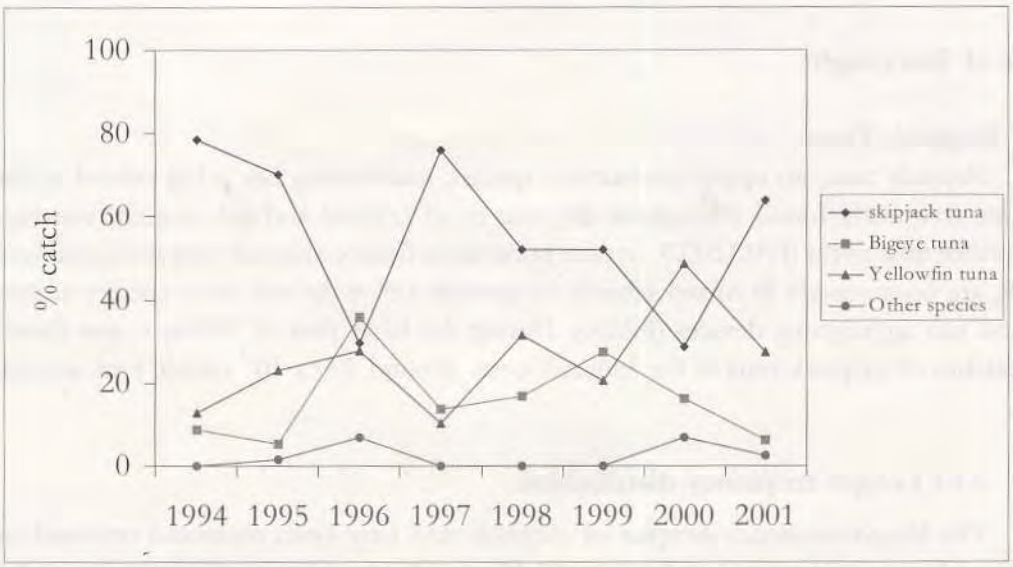

Fig. 8 Annual catch composition of tuna purse seine conducted by M.V. SEAFDEC from 1994-2001.

Table 2 List of non target species were caught by the net of M.V. SEAFDEC from 1993 - 2001.

Family	Scientific name	Common name
Fish		
Alopiidae	*Alopias* sp.	Pelagic tresher shark
Carcharhinidae	*Carcharhinus* sp.	Shark
Megachasmidae	*Megachasma pelagios*	Megamouth shark
Belonidae	*Tylosurus crocodilus crocodilus*	Needlefish
Carangidae	*Elagatis bipinnulata*	Rainbow Runner
	Seriola rivoliana	Longfin yellowtail
	Decapterus macarellus	Mackerel scad
	Decapterus muroadsi	Trevally
	Uraspis helvora	White-tongued trevalle
	Caranx lugubris	Trevally
	Carangoides orthogrammus	Trevally
	Caranx sp.	Trevally
	Brama dussumieri	Pomfret
Coryphaenidae	*Coryphaena hippurus*	Common dolphinfish
	Coryphaena equiselis	Dolphinfish
Lobotidae	*Lobotes surinamensis*	Tripletail
Kyphosidae	*Kyphorus vaigiensis*	Brassy chub
	Kyposus cinerascens	Blue seachub
Ephipididae	*Platex tiera*	Batfish
Sphyraenidae	*Sphyraena barracuda*	Great barracuda
Istiophoridae	*Makaira indica*	Black marlin
	Makaira mazara	Blue marlin
Scomberomoridae	*Acanthocybium solandri*	Wahoo
Scombridae	*Auxis thazard*	Frigate tuna
	Katsuwonus pelamis	Skipjack tuna
	Thunnus albacares	Yellowfin tuna
	Thunnus obesus	Bigeye tuna
Balistidae	*Canthidermis maculatus*	Rough triggerfish
Monocanthidae	*Alutera monoceros*	Unicorn leatherjack
	Aluterus scriptus	Unicorn leatherjack
Other		
Octopotidae	*Octopus* sp.	Octopus

2. Size of fish caught

2.1 Skipjack Tuna

Skipjack tuna, an epipelagic-oceanic species, manifesting like a big school at the surface. They are frequently found throughout the year in all tropical and sub tropical waters, and their spawn twice time a year (FAO,2002). In tuna purse seine fishery, skipjack tuna is the main component species, are often caught in mixed schools of juvenile yellowfin and other species around drifting logs and fish aggregating devices (FADs). During the latter part of 1990s, it was found that the total catches of skipjack tuna in the Indian Ocean around 300 x 10^3 metric tons annually (Anon, 2000).

2.1.1 Length frequency distribution

The length-frequency samples of skipjack tuna have been measured onboard since 1994. Their length were within a range between 31-80 cm FL, the average size being around 46-54 cm. The length frequency distribution of skipjack tuna caught is shown in Fig. 9. There are two sizes of skipjack, small and large size in each year, especially in 1999, the proportion of frequency in a small group was greater than in other years. In 1994, the numbers of fish in each group were not different, after that small skipjack were frequently caught. Fig. 10 presents the overall picture of skipjack length distribution that is bimodal, the mode is 45 cm for small size with an average weight of 1.8 kg and is 63 cm for large sizes with an average weight of 4.3 kg.

2.1.2 Weight

Fig. 11 shows the range of sizes of skipjack tuna. It is found that in the year 2000, the individual weight ranged widely from between 0.8 to 11 kg. In 1994, it is noticeable that the average weight of skipjack tuna was bigger than in other years.

2.1.3 Length-weight relationship

The length and weight data were obtained from 5,999 skipjack tuna.The length-weight relationship of the skipjack is as shown in Fig.12. The coefficient for this species is 3.3067, r^2=0.9458. Comparison with several papers indicates that this is similar with previous studies in the same area (Table 3).

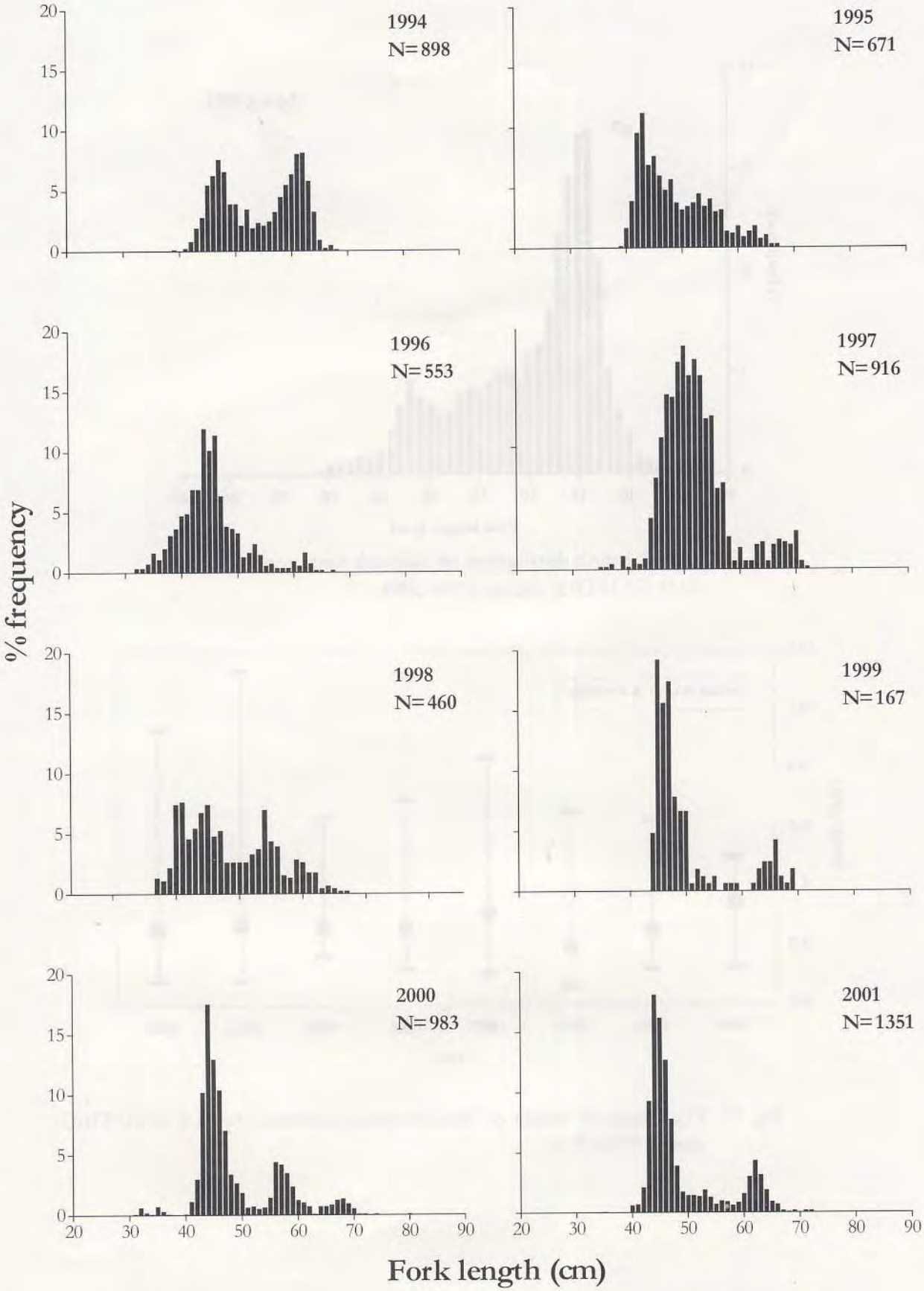

Fig.9 Length frequency distribution of Skipjack tuna by year from 1994-2001.

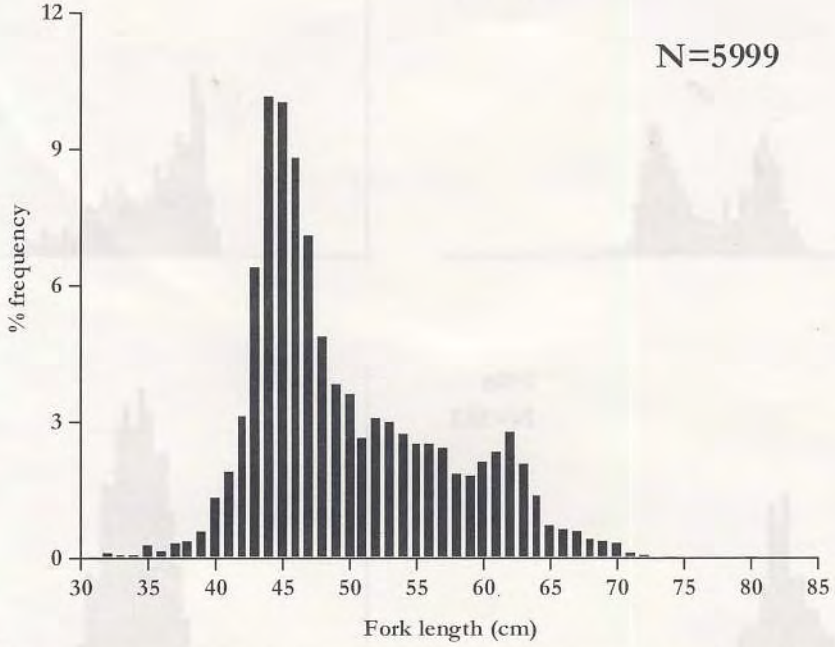

Fig. 10 Overall length distribution of Skipjack tuna, conducted by M.V. SEAFDEC during 1994-2001.

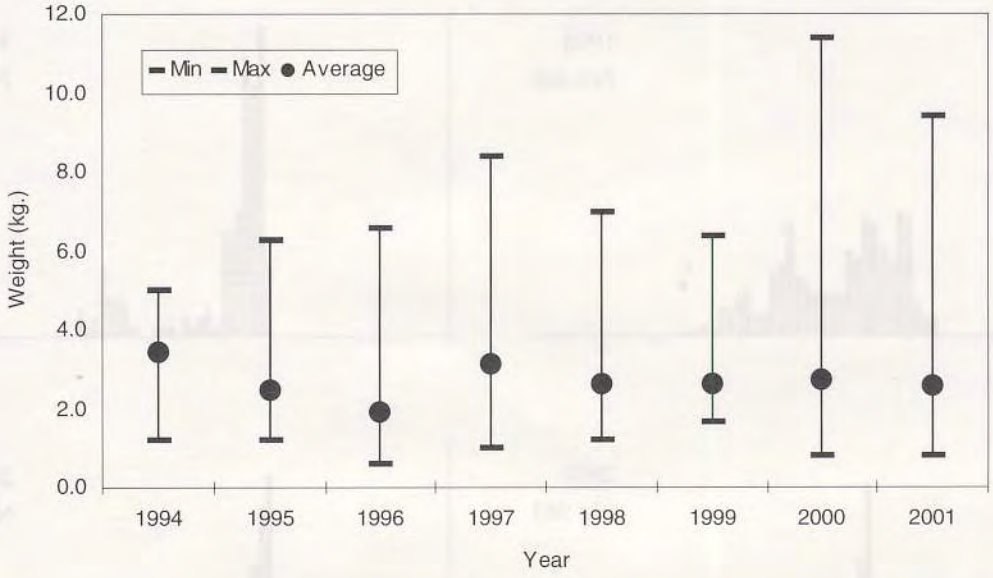

Fig. 11 The ranges of weight of Skipjack tuna, conducted by M.V. SEAFDEC during 1994-2001.

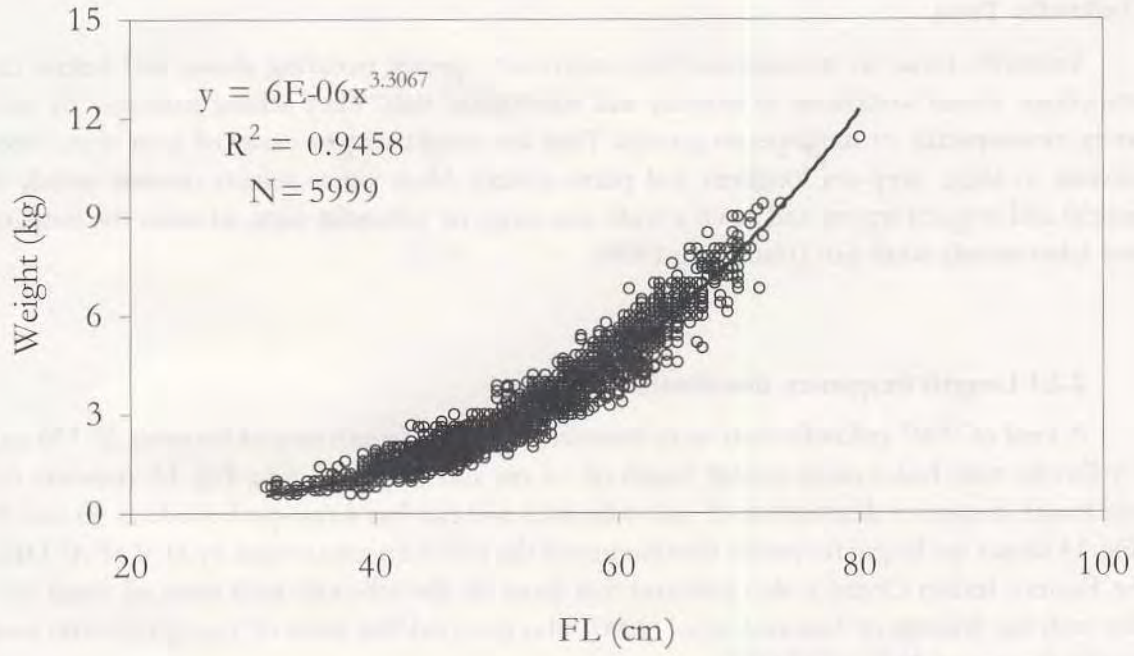

Fig.12 Length-weight relationship of Skipjack tuna by M.V. SEAFDEC from 1994-2001.

Table 3. Length- Weight relationship data of tuna species by area and authors.

Tuna species	Fishing area	a	b	n	Gear	Source
Skipjack tuna	Eastern Indian Ocean	$6*10^{-6}$	3.307	5999	PS	the present data of M.V. SEAFDEC
	Eastern Indian Ocean	$5*10^{-6}$	3.350	355	PS	Nootmorn *et al.*(2000)
	Eastern Indian Ocean	$5*10^{-6}$	3.326	179	PS, male	Pokapunt *et al.* (1999)
	Eastern Indian Ocean	$5*10^{-6}$	3.323	142	PS, female	Pokapunt *et al.* (1999)
	Eastern Indian Ocean	$1.7*10^{-5}$	3.014	-	PS	Tantivala (1997)
Yellowfin tuna	Eastern Indian Ocean	$3*10^{-5}$	2.916	1744	PS	the present data of M.V. SEAFDEC
	Eastern Indian Ocean	$3*10^{-5}$	2.900	565	PS	Nootmorn *et al.*(2000)
	Eastern Indian Ocean	$1.4*10^{-5}$	3.018	113	PS, male	Pokapunt *et al.* (1999)
	Eastern Indian Ocean	$3.35*10^{-4}$	2.341	107	PS, female	Pokapunt *et al.* (1999)
	Eastern Indian Ocean	$6.91*10^{-5}$	2.740	1398	LL	Chantawong (1997)
	Eastern Indian Ocean	$4.4*10^{-5}$	2.771	-	PS	Tantivala (1997)
Bigeye tuna	Eastern Indian Ocean	$1*10^{-5}$	3.170	1294	PS	the present data of M.V. SEAFDEC
	Eastern Indian Ocean	$1.4*10^{-5}$	3.110	419	PS	Nootmorn *et al.*(2000)
	Eastern Indian Ocean	$2.17*10^{-5}$	3.000	2707	LL,PS	Chantawong *et al.* (1999)
	Eastern Indian Ocean	$2.7*10^{-5}$	2.922	-	PS	Tantivala (1997)
	Eastern Indian Ocean	$1.89*10^{-5}$	3.040	574	LL	Chantawong (1996)
	Indian Ocean	$2.74*10^{-5}$	2.910	-	PS	Poreeyanond (1994)

* PS- Purse seine
LL- Longline

2.2 Yellowfin Tuna

Yellowfin tuna, an oceanic and high migratory species occuring above and below the thermoclines, found worldwide in tropical and subtropical seas. They school primarily by size, either in monospecific or multispecies groups. They are caught with a varity of gear types from small-scale to large, deep-sea longliner and purse seiners. Many purse seiners operate widely in equatorial and tropical waters and catch a wide size range of yellowfin tuna, whereas the longline fishery takes mostly adult fish (Hampton, 1999).

2.2.1 Length frequency distribution

A total of 2007 yellowfin tuna were measured and their length ranged between 20-136 cm. The yellowfin tuna had a mean overall length of 62 cm and weight of 6 kg Fig. 13. presents the overall length frequency distribution of yellowfin tuna and this has a two-peak mode at 50 and 80 cm Fig. 14 shows the length frequency distribution of the yellowfin tuna caught by M.V. SEAFDEC in the Eastern Indian Ocean it also indicates that most of the yellowfin tuna were of small size, similar with the findings of Sukramongkol (2000) who reported that most of young yellowfin tuna caught by the net of M.V. SEAFDEC.

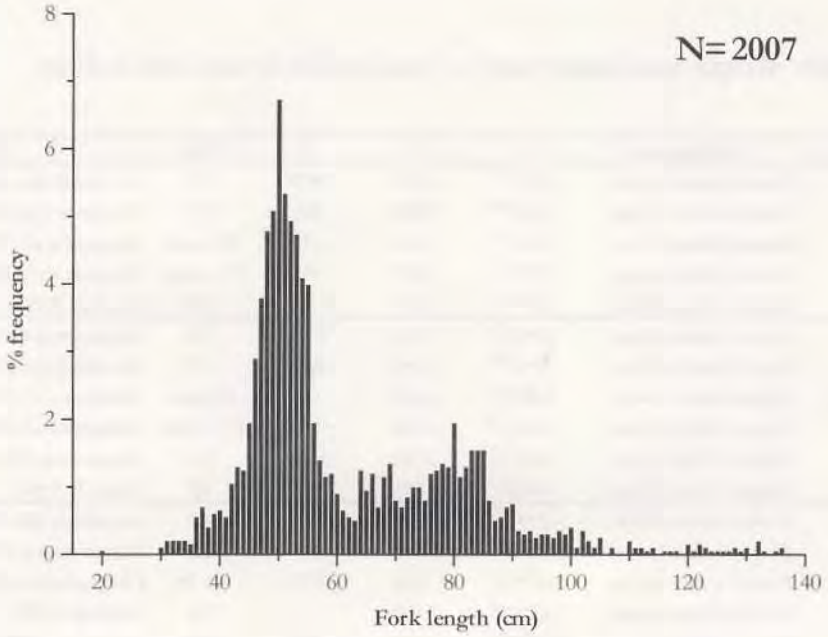

Fig. 13 Overall length distribution of Yellowfin tuna from tuna purse seine conducted by M.V. SEAFDEC during 1994-2001.

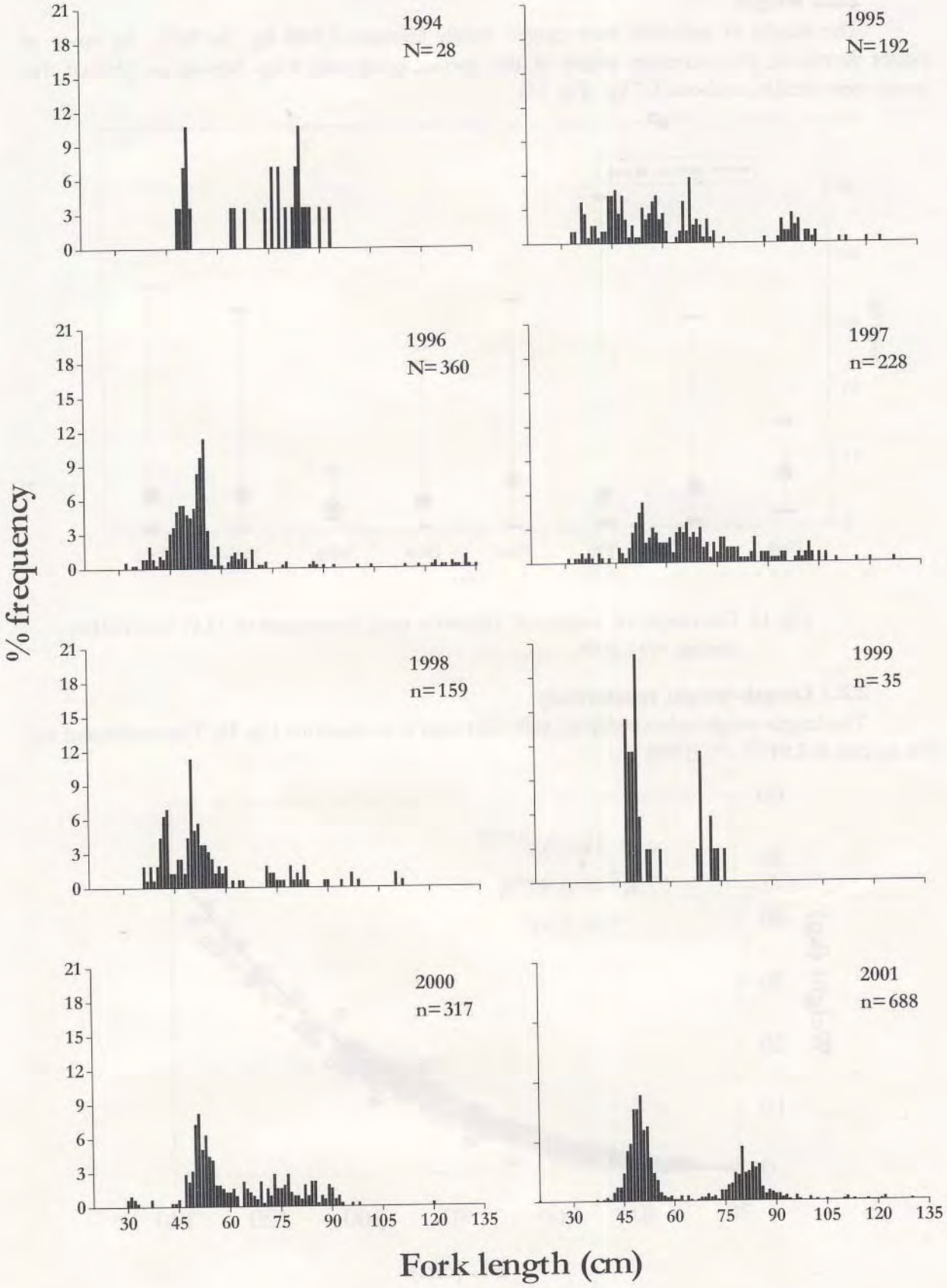

Fig. 14 Length frequency distribution of yellowfin tuna by year from 1994-2001.

2.2.2 Weight

The weight of yellowfin tuna ranged widely between 0.5-49 kg. In 1999, the range of weight decreased, the maximum weight of this species being only 9 kg. Average weights of this specie were similar, at about 3-7 kg. (Fig. 15)

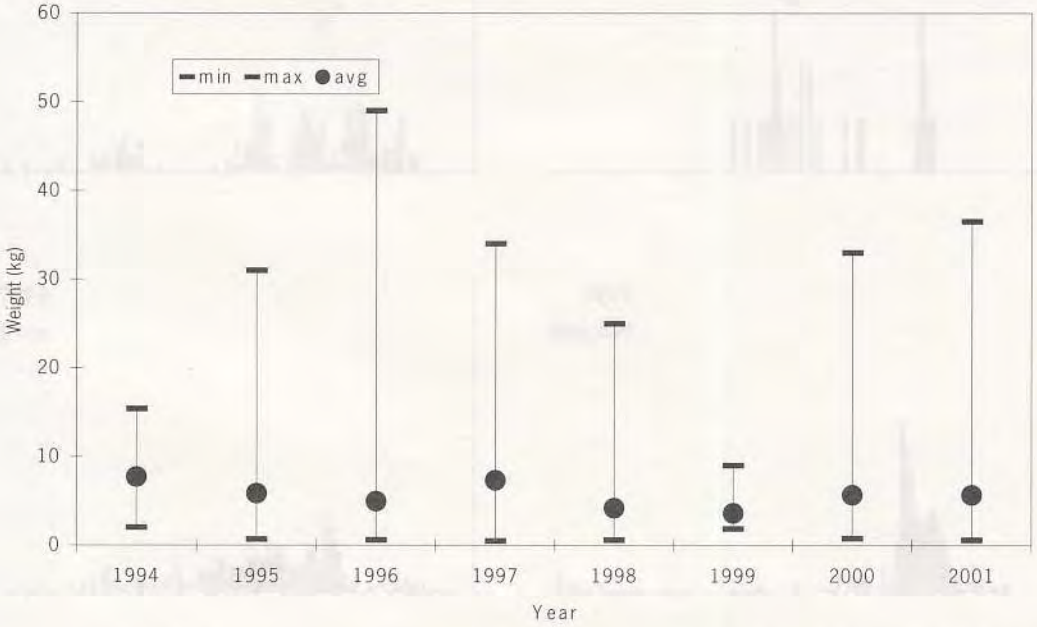

Fig. 15 The ranges of weight of Yellowfin tuna, conducted by M.V. SEAFDEC during 1994-2001.

2.2.3 Length-weight relationship

The length-weight relationship of yellowfin tuna is as shown in Fig. 16. The coefficient for this species is 2.9175, $r^2 = 0.978$.

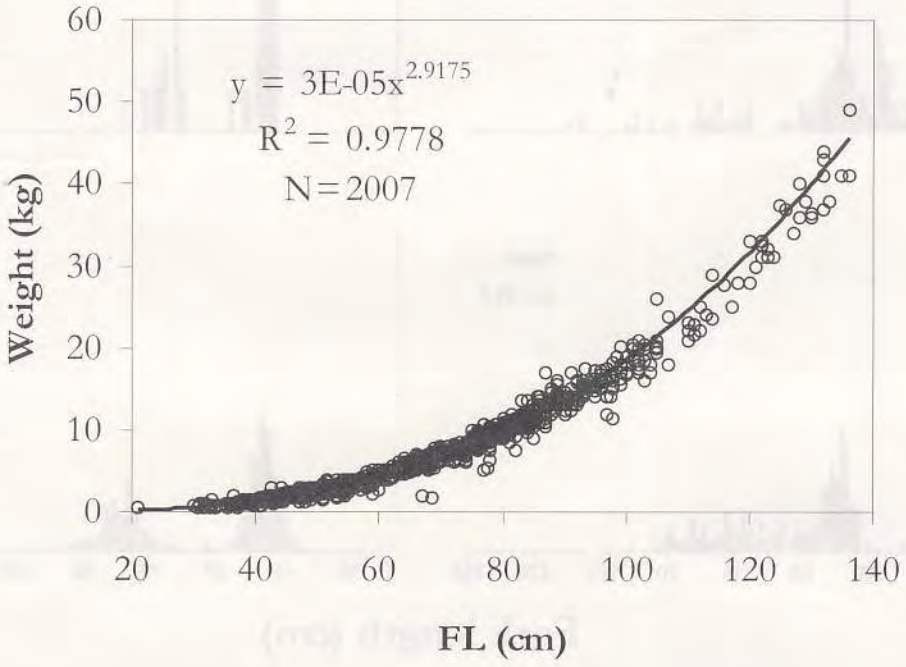

Fig.16 Length-weight relationship of Yellowfin tuna by M.V. SEAFDEC from 1994-2001.

2.3 Bigeye Tuna

Bigeye Tuna is an oceanic fish, very similar in appearance to yellowfin tuna. It is found worldwide in tropical and subtropical waters and are an important component in tuna fisheries throughout the Indian Ocean. The seine net caught juvenile bigeye tuna that most were immature, similarly to the yellowfin tuna. Previous studies reported by Sukramongkol(2002), that the seine net of M.V. SEAFDEC caught all young bigeye tuna and yellowfin tuna, while 80% of the skipjack tuna caught were adult.

2.3.1 Length frequency distribution

A total of 1,336 bigeye tunas were caught ranging between 31-122 cm. Fig.17 presents the overall length distribution of bigeye tuna and has a dominant size mode ranging between 21-99 cm, with a high peak at 50 cm. Fig. 18 shows the length frequency distribution by year. Kikawa (1953) reported that the maturity size by bigeye tuna ranged between 91-100 cm, therefore almost tuna caught by the seine net of M.V. SEAFDEC were juveniles.

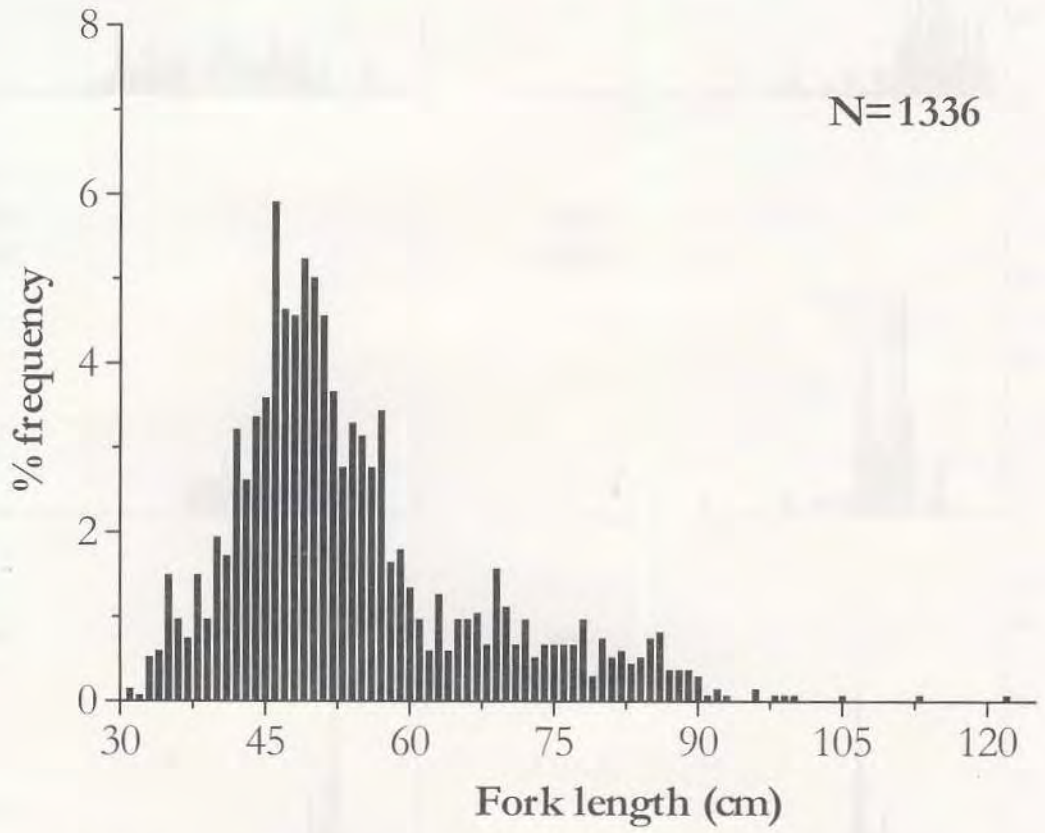

Fig. 17 Overall length distribution of Bigeye tuna from tuna purse seine, conducted by M.V. SEAFDEC during 1994-2001.

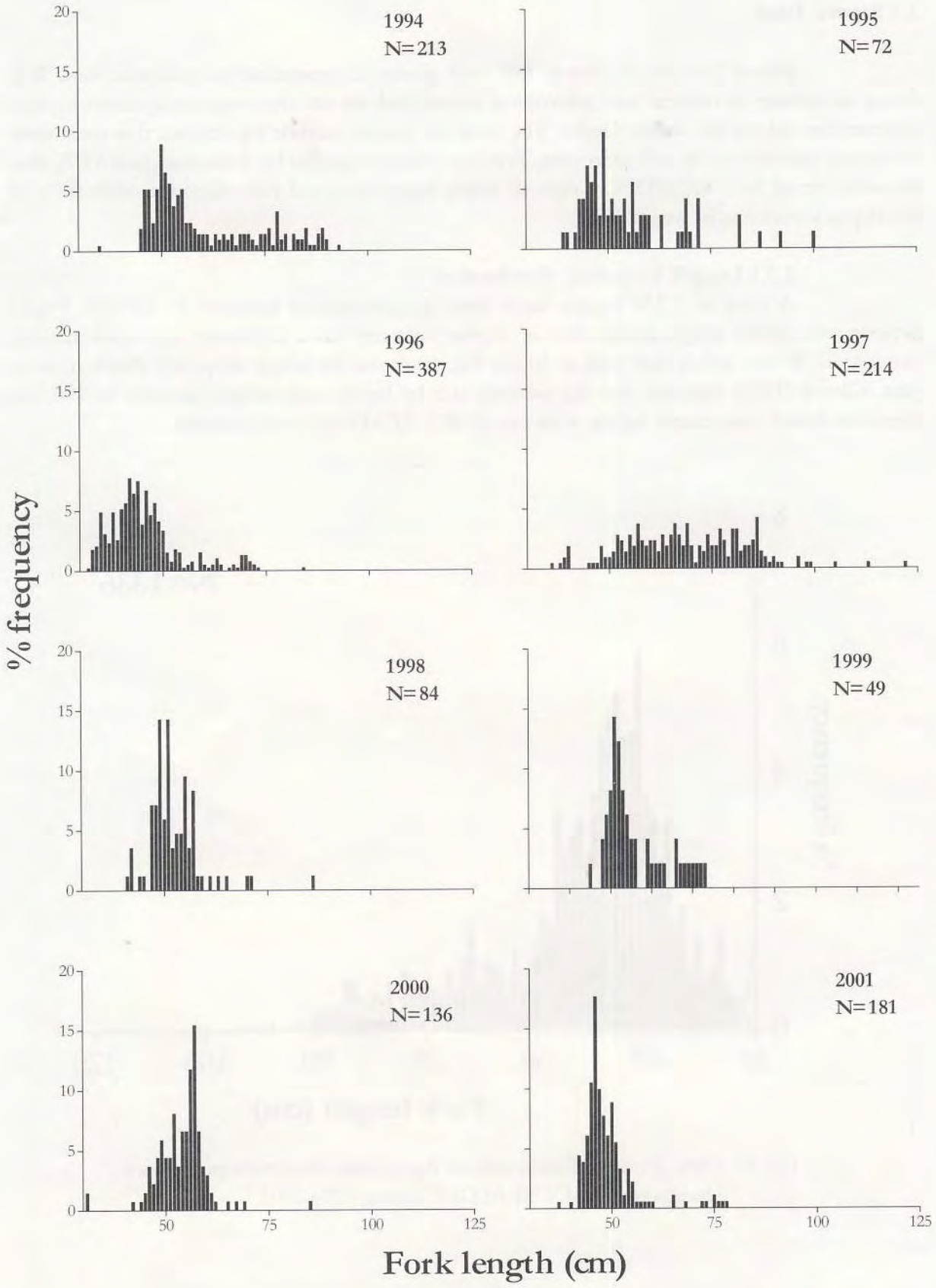

Fig. 18 Length frequency distribution of Bigeye tuna by year from 1994-2001.

2.3.2 Weight

The weights ranged widely between 0.5-38 kg. In 1997, there was widely ranged of weight, the maximum weight of this year was 38 kg. The average weights of this specie were similar, about 2-8 kg. (Fig. 19)

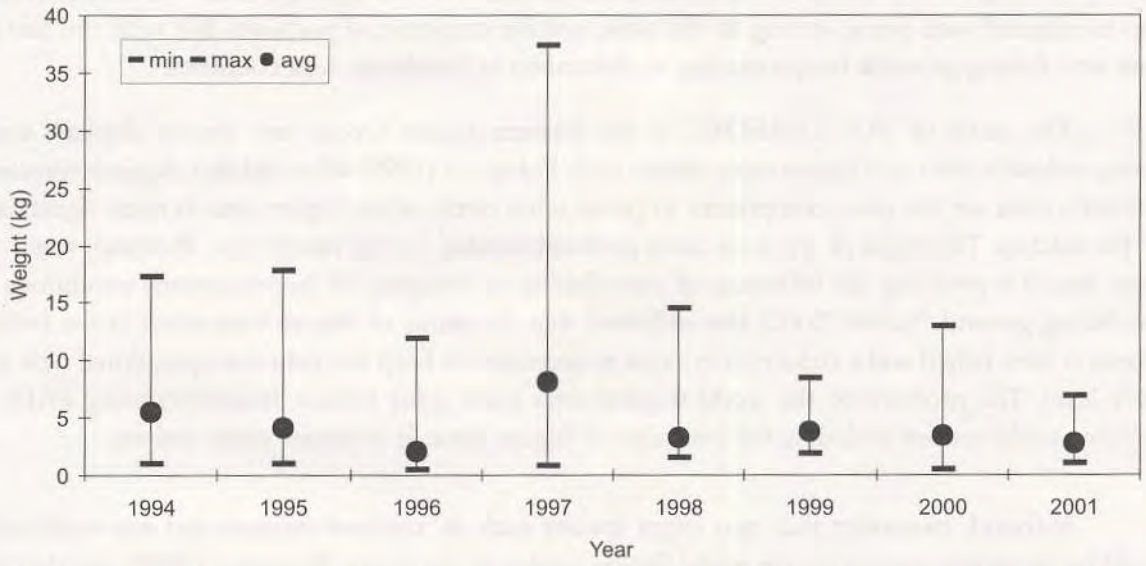

Fig. 19 The ranges of weight of Bigeye tuna, conducted by M.V. SEAFDEC during 1994-2001.

2.3.3 Length-weight relationship

The length-weight relationship of bigeye tuna is as shown in Fig 20. The coefficient for this species is 3.1699, $r^2 = 0.9747$.

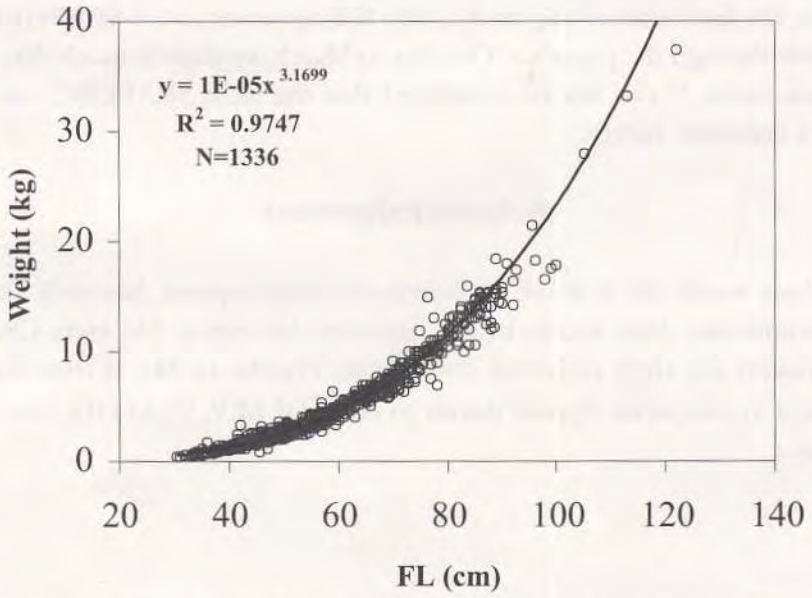

Fig. 20 Length-weight relationship of Bigeye tuna by M.V. SEAFDEC from 1994-2001

Conclusions

Purse seining started in the Indian Ocean in the early 1980s, developed rapidly as for industrial purse seine fisheries (Bertignac, 1995). Mostly non-Indian Ocean countries conduct this fishery, although a few local vessels operate under joint-venture arrangements. M.V. SEAFDEC also conducted tuna purse seining in this area, not for commercial purposes but with the aim to seek new fishing grounds for promoting to fishermen in Southeast Asia countries.

The catch of M.V. SEAFDEC in the Eastern Indian Ocean was mainly skipjack tuna, young yellowfin tuna and bigeye tuna similar with Pokapunt (1999) who said that skipjack tuna and yellowfin tuna are the main component in purse seine catch, while bigeye tuna is none significant of the catches. The trend of the tuna catch declined steadily. In this recent year, the catch was very poor, which is probably the influence of over-fishing or changing of environmental conditions in the fishing ground. Suzuki (2002) also indicated that the status of bigeye tuna stock in the Indian Ocean is over-fished and a reduction in catch is necessary to keep the fisheries operational near the MSY level. The problem of the world tropical tuna purse seine fishery, frequently using FADs is catching multi-species including the juveniles of bigeye tuna. It becomes more serious.

It found, moreover, that non target species such as rainbow runners and mackerel scads could be important species for the world fishing market in the future. Romanov (2002) said that by-catch of associated and non-associated species during purse seine fishing for tropical tuna may be rather high, and generally depends on fishing tactics. That it could be supported as new resources in the future, although they are not the main target for tuna purse seines, but during some operations they were caught in large quantities.

Though this fishing ground still is efficient for tuna purse seine fishery, proper management is necessary, to retain and extend these new resources.

However, the limitation of this study is the fishing season, M.V. SEAFDEC worked in the Indian Ocean only through the period of October to March, so there is much data for that period, but not for other times. It can not be concluded that the M.V. SEAFDEC working period is appropriate for a complete survey.

Acknowledgments

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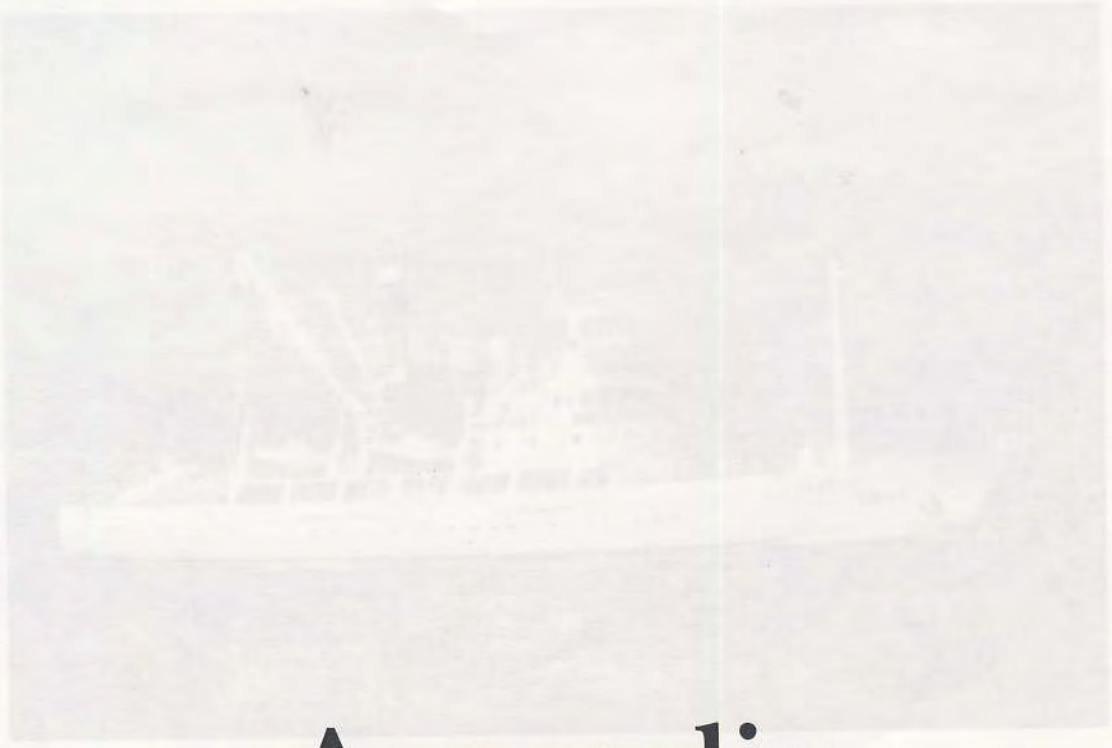


Appendix

Appendix I Research vessel, M.V. SEAFDEC

Principle Particulars of M.V. SEAFDEC

Length over all	65.02 m
Length between perpendiculars	57.00 m
Breadth, molded	12.00 m
Depth to superstructure deck, molded	7.10 m
Depth to upper deck, moldedranged	4.70 m
Draft, molded	4.658 m
Service speed at 4.50 m draft	14.3 knots
Gross tonnage	1178 t
Net tonnage	354 t
Fish hold capacity (bale)	145.38 m^3
Freezing room capacity (grain)	20.48 m^3
Freezing ability (brine)	20 t/day
Freezing ability (airblast)	1.6 t/day

ANNEX I : Purse Seine Net

TUNA and SKIPJACK PURSE SEINE NET

P = Portion
1 P = 75 meter
DR = Tuffline (Polypropylene) Rope
DCR = Tuffline (: :) Cross Rope

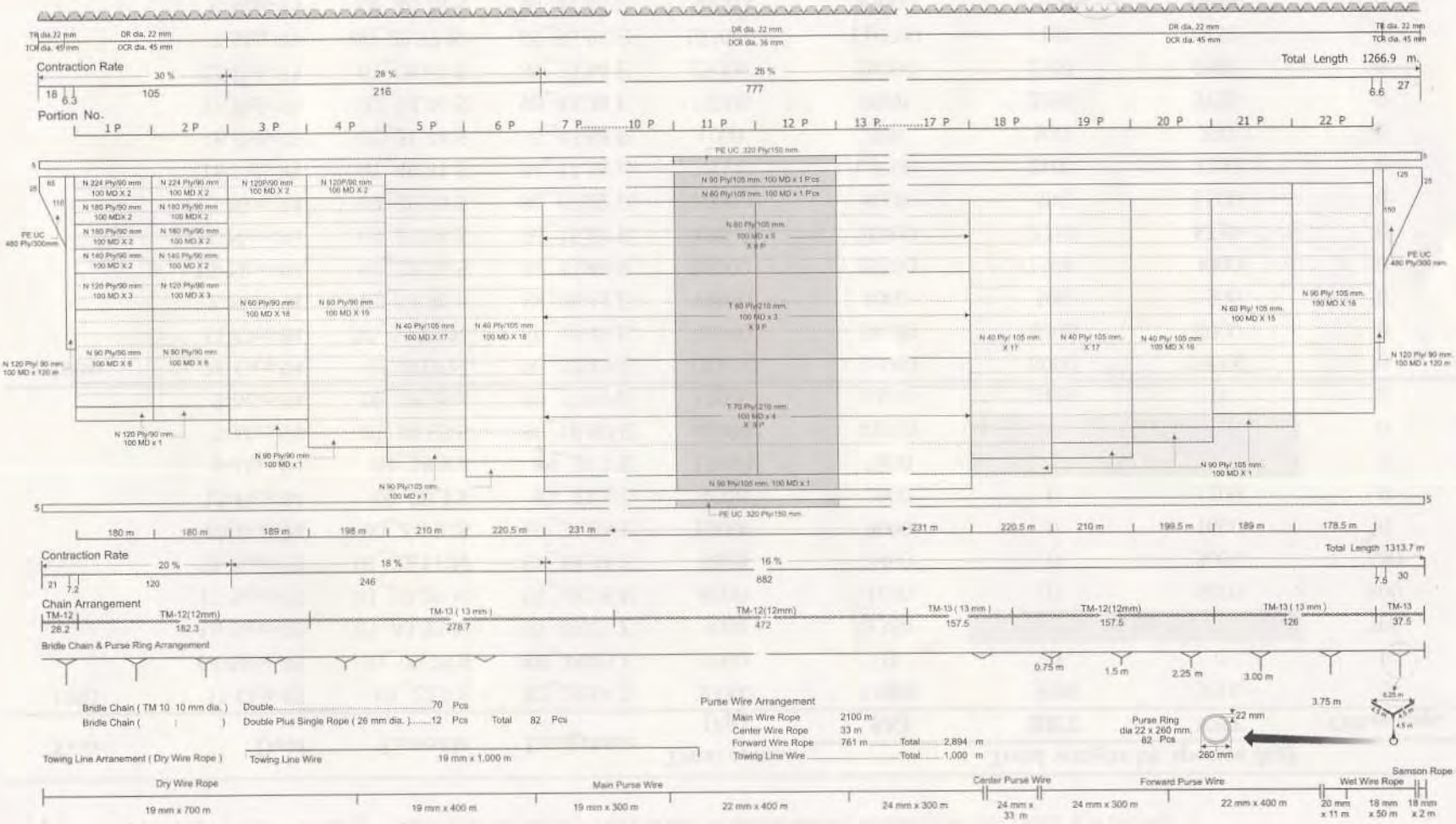
T = Tetron Net
TR = Tetron Rope
TCR = Tetron Cross Rope
TM = Super Alloy Chain Size

N = Nylon Net
MD = Mesh Depth
PE UC = Polyethylene Ultra Cross Net
EVA - 5 = Plastic Float EVA Model E - 50 Buoyancy 5,000 gram Yellow Colour

EVA
E - 50

TR & DR
TCR & DCR

The Third Improve
(1998)



Appendix III Purse seine fishing operations of M.V. SEAFDEC in the Eastern Indian Ocean from 1993-2001

Year	Date	Latitude	Longitude	Total catch (kg)	Total weight by species (kg)			
					SKJ	BET	YFT	Other spp.
1993	31-Oct-93	03_22.0 S	82_20.54 E	20000	14000	3000	3000	0
	04-Nov-93	01_00.79 S	88_28.13 E	2000	0	0	0	0
	16-Nov-93	01_43.32 N	91_59.75 E	3000	1350	1350		300
	17-Nov-93	01_09.29 N	91_48.75 E	8000	1600	0	5600	800
	18-Nov-93	01_22.11 N	91_48.94 E	6000	2400	0	3000	600
	10-Feb-94	00_24.62 S	89_24.88 E	10000	9000	0	1000	0
	15-Feb-94	00_20.3 S	81_21.8 E	4000	2800	0	1200	0
	6-Mar-94	01_18.9 S	89_59.1 E	13000	7800	5200		0
	7-Mar-94	01_04.85 S	90_16.90 E	60000	42000	18000		0
	9-Mar-94	00_39.26 S	90_37.89 E	12000	9600	2400	0	0
1994	26-Oct-94	02_00.9 N	90_12.10 E	120000	96000	6000	18000	0
	31-Oct-94	00_54.72 N	89_49.46 E	40000	28000	4000	8000	0
	12-Nov-94	02_18.81 S	88_00.42 E	10000	8000	500	1500	0
	13-Nov-94	02_39.71 S	87_33.40 E	30000	25500	1500	3000	0
	14-Nov-94	04_11.68 S	86_15.63 E	45000	36000	2250	6750	0
	15-Nov-94	04_29.90 S	86_07.22 E	10000	8000	500	1500	0
	16-Feb-95	01_49.31 S	94_17.36 E	70000	63700	2100	4200	0
	18-Feb-95	02_51.74 S	95_13.82 E	1000	700	100	200	0
	21-Feb-95	02_02.06 S	90_48.36 E	15000	9000	2250	3750	0
	22-Feb-95	01_08.88 S	89_53.84 E	25000	20000	2500	2500	0
	7-Mar-95	00_28.77 N	89_56.84 E	123000	110700	6150	6150	0
	8-Mar-95	00_46.76 S	90_47.45 E	50000	35000	2500	12500	0
	22-Mar-95	00_08.20 N	92_43.7 E	1000	400	0	600	0
	23-Mar-95	00_10.0 S	90_53.43 E	75000	45000	22500	7500	0
	26-Mar-95	00_34.40 S	88_43.2 E	400	0	0	400	0
	27-Mar-95	00_26.5 S	91_14.6 E	15000	9000	3000	3000	0
	28-Mar-95	00_16.88 N	91_39.98 E	5000	3500	500	1000	0

Appendix III (cont.) Purse seine fishing operations of M.V. SEAFDEC in the Eastern Indian Ocean from 1993-2001

Year	Date	Latitude	Longitude	Total catch (kg)	Total weight by species (kg)			
					SKJ	BET	YFT	Other spp.
1995	25-Oct-95	04_19.7 N	87_47.0 E	5000	-	-	-	-
	26-Oct-95	04_24.5 N	86_40.1 E	3000	-	-	-	-
	27-Oct-95	03_20.3 N	84_30.7 E	30000	-	-	-	-
	28-Oct-95	03_05.8 N	83_56.7 E	40000	-	-	-	-
	30-Oct-95	03_17.0 N	84_27.0 E	22000	-	-	-	-
	10-Nov-95	04_41.43 N	93_41.79 E	5000	2500	850	1640	10
	11-Nov-95	04_51.49 N	91_17.89 E	7000	4214	546	2058	182
	12-Nov-95	05_28.05 S	90_29.0 E	40000	21840	3680	14120	360
	14-Nov-95	04_56.35 S	86_17.71 E	4000	2612	200	1188	0
	2-Mar-96	06_01.12 S	88_57.84 E	15000	11850.00	1170.00	1950.00	30.00
	5-Mar-96	06_47.69 S	92_05.70 E	55000	38280.00	2420.00	11715.00	2585.00
	6-Mar-96	06_45.80 S	92_26.60 E	8000	2632.00	1608.00	3312.00	448.00
	7-Mar-96	06_35.50 S	92_15.10 E	22000	10406.00	418.00	11176.00	0.00
	19-Mar-96	05_00.5 S	94_39.3 E	15000	10275.00	1155.00	3285.00	285.00
	20-Mar-96	04_41.47 S	94_37.38 E	10000	7250.00	0.00	2700.00	50.00
	21-Mar-96	04_17.56 S	94_39.93 E	75000	67500.00	1875.00	5625.00	0.00
1996	25-Oct-96	05_40.1 S	94_36.8 E	32000	-	-	-	-
	28-Oct-96	05_10.1 S	87_07.1 E	40000	-	-	-	-
	31-Oct-96	02_09.2 S	87_04.6 E	5000	-	-	-	-
	11-Nov-96	01_38.6 S	92_33.4 E	8000	4688.00	56.00	1976.00	1280.00
	12-Nov-96	01_58.9 S	92_51.6 E	35000	11025.00	0.00	16695.00	7280.00
	14-Nov-96	04_55.9 S	94_24.3 E	60000	18420.00	38580.00	3000.00	0.00
	14-Mar-97	02_53.6 S	87_29.0 E	8000	1448	2432	3976	144
	15-Mar-97	03_52.6 S	86_07.9 E	10000	4990	1860	3140	10
	16-Mar-97	03_49.3 S	85_56.24 E	20000	1140	7660	10220	980

Appendix III (cont.) Purse seine fishing operations of M.V. SEAFDEC in the Eastern Indian Ocean from 1993-2001

Year	Date	Latitude	Longitude	Total catch (kg)	Total weight by species (kg)			
					SKJ	BET	YFT	Other spp.
1997	26-Oct-97	02_57.67 S	87_29.93 E	2000	586	450	956	8
	28-Oct-97	02_31.05 S	82_29.55 E	18000	14580	882	2538	0
	21-Feb-98	05_02.3 S	94_16.3 E	5000.00	4325.0	175.0	500.0	0.0
	23-Feb-98	04_47.3 S	89_02.0 E	70000.00	53270.0	12810.0	3710.0	210.0
	25-Feb-98	04_59.5 S	89_24.9 E	25000.00	18575.0	5425.0	1000.0	0.0
	12-Mar-98	02_01.7 S	92_55.6 E	40000.00	27240.0	3120.0	9640.0	0.0
	13-Mar-98	04_53.3 S	95_14.9 E	60000.00	48420.0	7560.0	4020.0	0.0
1998	27-Nov-98	04_45.3 S	97_33.4 E	7000.00	5481.0	280.0	1239.0	0.0
	29-Nov-98	07_33.8 S	91_07.6 E	10000.00	6880.0	770.0	2350.0	0.0
	1-Dec-98	07_40.1 S	93_21.4 E	17000.00	11801.4	533.8	4664.8	0.0
	20-Feb-99	02_57.6 S	87_11.5 E	67000.00	48240.00	16750.00	2010.00	0.00
	6-Mar-99	01_09.1 S	86_50.2 E	50000.00	15750.00	4000.00	30250.00	0.00
	8-Mar-99	00_32.7 S	87_25.3 E	37000.00	9583.00	9065.00	18352.00	0.00
1999	29-Nov-99	02_20.6 S	90_39.8 E	20000.00	9352.00	5888.00	4760.00	0.00
	1-Dec-99	02_33.6 S	90_36.3 E	3000.00	2615.10	384.90	0.00	0.00
2000	6-Feb-01	01_01.1 S	87_03.2 E	648	95.00	158.10	172.60	222.30
	10-Feb-01	00_16.6 S	86_49.3 E	15,000	4515.00	5805.00	4260.00	420.00
	11-Feb-01	00_22.8 S	87_57.7 E	2,500	0.00	0.00	0.00	2500.00
	27-Feb-01	01_01.1 S	87_03.2 E	22,000	3432.00	0.00	16786.00	1782.00
	1-Mar-01	02_25.4 S	90_17.7 E	18,000	3186.00	4500.00	9882.00	432.00
	3-Mar-01	03_37.8 S	95_36.5 E	3,000	2466.00	432.00	0.00	102.00
	5-Mar-01	01_26.3 S	92_38.5 E	25,000	7010.00	3665.00	13540.00	785.00
	6-Mar-01	01_33.0 S	93_44.8 E	10,000	6666.00	978.00	2140.00	216.00
	20-Mar-01	00_52.0 S	89_57.5 E	500	257.00	28.00	117.50	97.50

Appendix III (cont.) Purse seine fishing operations of M.V. SEAFDEC in the Eastern Indian Ocean from 1993-2001

Year	Date	Latitude	Longitude	Total catch (kg)	Total weight by species (kg)			
					SKJ	BET	YFT	Other spp.
2001	18-Dec-01	02_37.6 S	92_22.4 E	2000.00	792.00	1150.00		58.00
	19-Dec-01	02_12.1 S	92_17.6 E	3000.00	946.74	113.70	1721.01	218.55
	20-Dec-01	03_47.9 S	91_36.1 E	9000.00	4657.50	417.60	3553.20	371.70
	21-Dec-01	03_49.4 S	89_56.0 E	5000.00	2945.00	95.50	1843.50	116.00
	23-Dec-01	05_46.0 S	82_19.5 E	8000.00	4576.00	0.00	3388.00	36.00
	24-Dec-01	06_08.0 S	82_52.5 E	2000.00	132.40	0.00	1716.40	151.20
	1-Jan-02	02_16.3 S	90_18.1 E	1500.00	0.00	0.00	1427.40	72.60
	2-Jan-02	01_46.9 S	89_19.1 E	20000.00	17100.00	1304.00	1520.00	76.00
	3-Jan-02	01_48.8 S	89_03.3 E	10000.00	7970.00	930.00	740.00	360.00
	4-Jan-02	01_07.2 S	88_57.3 E	8000.00	3952.00	1136.00	2592.00	320.00
	18-Jan-02	02_17.9 S	88_12.7 E	2000.00	1519.40	186.20	294.40	0.00


SEAFDEC