ANALYSIS OF THE PURSE SEINE FISHERY OF MAURITIUS, 1990 - 1994, AND COMPARISON OF CATCH RATE AND SPECIES COMPOSITION OF CATCHES OF MAURITIAN PURSE SEINERS TO THOSE OF THE FRENCH FLEET

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ABSTRACT

Tunas, like most pelagic fishes, commonly aggregate around drifting objects or floating logs, and surface tuna-fishing vessels take advantage of this behaviour to exploit tuna schools. More than half of the total purse-seine catch of the western Indian Ocean is made on log schools. The floating objects can be either natural or artificial. Natural floating objects are often wooden planks, boxes and tree trunks. Artificial devices are often in the form of floating platforms or rafts.

INTRODUCTION

The catches made by purse seiners on schools associated with logs constitute more than half of the total catch of the purse-seine fishery of the western Indian Ocean. In the purse-seine fishery on log-associated schools of tuna, either natural logs are spotted by vessels and are marked with radio beacons, or artificial logs are set at sea to concentrate the tuna prior to fishing operations.

The first attempt at commercial purse seining was successfully carried out in the Indian Ocean in 1979 by a joint-venture Mauritian vessel using the same technique as the Japanese, who had traditionally fished on schools associated with logs in the Pacific Ocean. They started fishing in the Indian Ocean after experimental purse-seine fishing was conducted by the Japan Marine Fishery Resource Centre (JAMARC) for the purpose of providing similar fishing patterns to those in the Pacific Ocean using artificial logs (*payao,* or raft).

The purse-seine fishery was further boosted around 1984 when French and Spanish vessels operating in the Atlantic shifted fishing grounds and started operating in the western Indian Ocean. Since then, the catch of tuna in the region has followed a sharp upward trend. The total catch of the purse seiners operating in the western Indian Ocean in 1994 amounted to 271,922 t (Anon., 1994).

At present three commercial Mauritian purse seiners of about 2000 t total carrying capacity operate in the western Indian Ocean, and during the past five years have landed an annual average of about 8,800 t of tuna.

In this paper are presented:

1. Catch and effort data for Mauritian purse seiners, 1990-1994.
2. A comparative analysis of the catch rate and species composition data of Mauritian purse seiners and those of the French fleet.
3. Spatial distribution of the purse-seine catch.
4. Analysis of the length-frequency distribution of the catch made during 1993.

CATCH AND EFFORT DATA ANALYSIS OF MAURITIAN PURSE SEINERS (1990-1994)

Landings by Mauritian purse seiners

The catch data of the Mauritian purse seiners from 1990 to 1994 are summarised in Table 1. Analysis of the table shows that the landings fluctuated over the years under review. They increased sharply from 6453 t in 1990 to 10635.7 t in 1991, then decreased slightly to 9006.6 t in 1992 before increasing again in 1993 to reach 10279 t. In 1994 the catch fell to 7689.2 t.

Effort of the Mauritian purse seiners

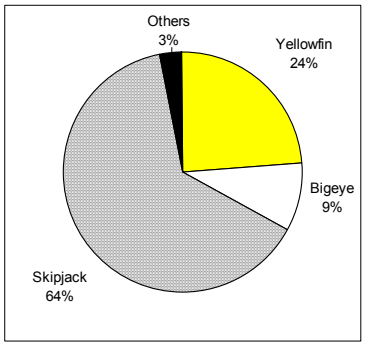
The effort exerted by Mauritian purse seiners is expressed in fishing days, which correspond to the days spent fishing and searching. However, it excludes days adrift due to mechanical breakdowns and days spent travelling to and from fishing grounds. Effort had increased markedly to 595.5 days in 1991, but declined to 487 days the following year. During 1993 it rose to a peak of 605 days before decreasing again in 1994 to 467 days.

Comparing catch and effort data (Table 1), it can be seen that increases in effort corresponded to increases in landings.

Table 1. *Catch, effort and species composition of catches by Mauritian purse seiners, 1990-1994*

Year	*No. of Landings*	*Effort (fishing days)*	*Yellowfin mt (%)*	*Skipjack mt (%)*	*Bigeye mt (%)*	*Others mt (%)*	*Total mt*	*CPUE (mt/day)*
1990	14	402.33	1356.7 (21.02)	4083.5 (63.28)	815.7 (12.64)	197.1 (3.05)	6453	16
1991	20	595.5	2621 (24.64)	6489.9 (61.02)	1059.3 (9.96)	465.5 (4.38)	10636	17.9
1992	16	487	2130.4 (23.65)	6020.2 (66.84)	727.1 (8.07)	128.9 (1.43)	9007	18.5
1993	21	605	2454.3 (23.88)	6861.6 (66.75)	618.9 (6.02)	344.2 (3.35)	10279	17
1994	17	467	1776.7 (23.11)	5125.7 (66.66)	646.4 (8.40)	140.9 (1.83)	7690	16.5

Figure 1. *Species composition of the catches of Mauritian purse seiners. Annual average percentage from 1990 to 1994.*



Catch rate

The catch rate of the Mauritian purse seiners fluctuated from 16 t/day to 18.5 t/day (Table 1). With the exception of 1992, when an exceptionally high CPUE was observed, CPUE seems to be proportional to effort. The relatively high CPUE observed for 1992 was probably due to favourable environmental conditions.

SPECIES COMPOSITION OF THE CATCH OF MAURITIAN PURSE SEINERS

The species composition of the catch of the Mauritian purse seiners is shown in Table 1 and Figure 1. The species breakdown indicates a regular dominance of skipjack (61.02-66.48%) over yellowfin (21.02-23.88%) and bigeye tuna (6.02-8.4%).

COMPARISON OF CATCH RATE AND SPECIES COMPOSITION OF THE CATCH OF THE MAURITIAN PURSE SEINERS TO THOSE OF THE FRENCH FLEET FISHING ON LOG AND FREE SCHOOLS

The catch data (1989-1994) for the French fleet operating in the southwest Indian Ocean are presented in Table 2 (Pianet, 1992; Anon., 1994). The overall CPUE of the French vessels, ranging from 18.24 t/fishing day to 23.92 t/fishing day, was higher than that of the Mauritian purse seiners, which fluctuated from 16t/fishing day to 18.5 t/fishing day during 1990-1994. However, the CPUE of the Mauritian purse seiners operating exclusively on artificial logs was much higher than that of French vessels fishing on natural logs. The latter fluctuated from 7.95 t/fishing day to 13.78 t/fishing day during 1989 to 1992.

The average species composition of the catch of the Mauritian purse seiners over the past five years (skipjack 64.86%, yellowfin 23.46%, bigeye 8.77%) differs completely from that observed in the French purse-seine catches made on free schools (skipjack 19.8%, yellowfin 76.9%, bigeye 3.3%) (Table 3). However, it is more comparable to the species composition of the catches made on natural logs (skipjack 61.4%, yellowfin 31.2%, bigeye 7.4%).

SPATIAL DISTRIBUTION OF THE CATCH OF THE MAURITIAN PURSE SEINERS, 1990-1994

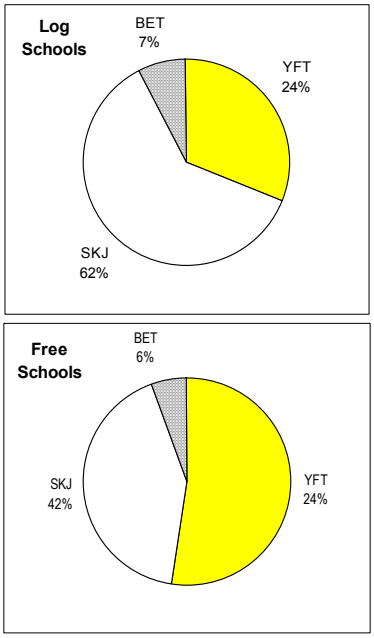
The main fishing ground of the Mauritian purse seiners during 1990-1994 was the western part of the Indian Ocean, from 47°E to 82°E and 9°N to 8°S. Fishing operations were spread over the entire area but, comparing the spatial distribution of effort to the distribution of catches, certain areas seem to be more productive (Figures 3 and 4).

***Table 2**. Species composition of the catches by the French purse seine fleet, 1989-1992.*

Species	*Log schools*		*Free schools*		*Total catches*	
	Catches (000 mt)	*Species composition*	*Catches (000 mt)*	*Species composition*	*Catches (000 mt)*	*Species composition*
YFT	56.1	31.20%	117.9	76.90%	173.9	51.90%
SKJ	110.4	61.40%	30.3	19.80%	140.7	42.00%
BET	13.4	7.40%	5	3.30%	18.5	5.50%
MISC	-	-	-	-	2.2	0.60%
Total	179.9		153.2		335.3	

During 1990, the purse-seine catches were obtained in the area between 0° and 5°N from 57°E to 64°E. The following year, the catches were better in the area between 5°N and 5°S from 59°E to 69°E. In 1992 the productive zone seems to have moved southward, lying between 1°S and 7°S from 59°E to 70°E. During 1993 it moved north, to between 0° and 5°N from 60°E to 67°E. In 1994 the area from 2°N to 4°S between 60°E and 66°E was very productive for Mauritian purse seiners.

***Figure 2**. Species composition of the catches of French purse seiners in the Indian Ocean. (Source: National report of France, Pianet 1993).*



ANALYSIS OF THE SIZE STRUCTURE OF THE CATCH OF THE MAURITIAN PURSE SEINERS FOR 1993

A regular morphometric sampling program of the catch of the Mauritian purse seiners has been carried out since 1989. About 600 to 800 tuna, irrespective of species but of known date and place of capture, are measured so as to assess both the size frequencies of each species and the species composition of the catches. During 1993, 14,380 tunas were sampled, made up of 2,060 yellowfin, 11,436 skipjack, and 884 bigeye.

The Mauritian purse seiners' fishing zone during 1993 was divided into 8 areas (Figure 5); samples were taken from each area to ensure a representative sample of the of the whole fishing zone.

Yellowfin:

The size frequencies of the yellowfin are presented in Figure 6. In general, they ranged from 40 to 108 cm in size.

During the first quarter, the majority of the yellowfin tuna caught belonged in the 47-55 cm modal group; fish smaller than 40 cm and bigger than 100 cm were rare. All catches in the first quarter were made in Area 1.

Analysis of the yellowfin catches of the second quarter, caught in Areas 2, 3 and 4, shows two modal groups, one between 56 and 62 cm and the other at 70 cm. Some bigger fish of over 100 cm were also present in the catch.

In the third quarter there are two prominent modal groups, one at 47-49 cm and the other at 57-63 cm. A few bigger fish were also found in the catches, which came mainly from Areas 4 and 5.

The length-frequency distribution of yellowfin in the fourth quarter, caught in Areas 5, 7 and 8, shows two modal groups. The first one is formed by medium-size fish of 46-49 cm, and the second is at 90 cm. Note that a significantly larger number of bigger yellowfin were caught during the fourth quarter.

From this analysis it appears that the size composition of yellowfin is not homogenous, and differs between periods of the year. It was observed that the majority of the catch was composed of yellowfin of fork length ranging from 40 to 70 cm. Fish over 70 cm were less frequent in the catch.

Table 3. **Effort and catches of the French purse seine fishery in the Indian Ocean, 1989-1994. Effort: PS: number of purse seiners; CC: fleet carrying capacity (000 mt); FD: 000 fishing days**

EFFORT				*CATCHES (000 mt)*														*CPUE (mt/fishing day)*	
				Log schools				*Free schools*				*Total*						*Log*	*Free*
Year	*PS*	*CC*	*FD*	*YFT*	*SKJ*	*BET*	*Total*	*YFT*	*SKJ*	*BET*	*Total*	*YFT*	*SKJ*	*BET*	*ALB*	*Total*	*Total*	*schools*	*schools*
1989	20	142.5	4.4	15.4	27.0	2.8	45.2	23.1	16.1	0.8	40.0	38.4	43.1	3.6	0.0	85.1	19.34	10.25	9.09
1990	21	129.4	4.1	9.8	20.4	2.4	32.6	33.3	7.0	1.8	42.1	43.1	27.4	4.3	0.0	74.8	18.24	7.95	10.29
1991	18	128.4	3.9	11.5	30.9	4.6	47.0	27.7	2.4	1.7	31.8	39.2	33.3	6.3	0.8	79.6	20.41	12.07	8.35
1992	17	138.6	4.0	19.4	32.1	3.6	55.1	33.8	4.8	0.7	39.3	53.2	36.9	4.3	1.4	95.8	23.92	13.75	10.18
1993	17	-	4.8	-	-	-	-	-	-	-	-	-				93.1	19.39		
1994	17	-	4.7	-	-	-	-	-	-	-	-	-	-	-		99.8	21.23		-

Seychelles Fishing Authority Statistical Bulletin, 1994
Sources: National Report of France by R. Pianet (IPTP 1993)

This is contrary to what is observed in free schools, in which the vast majority of the yellowfin caught are over 70 cm long, and almost half the catch is above 100 cm (Hallier, 1990).

Skipjack:

The size frequencies of the catches in the eight areas by quarter are illustrated in Figure 7. The majority of the fish caught in all four quarters were of a modal class centered around 50 cm. The size composition of the skipjack sampled seems less variable among quarters and area. This type of size distribution, which shows little or no modal progression, indicates a continuous recruitment-growth-migration process (Marcille & Stequert, 1976).

Bigeye:

As the number of bigeye tuna present in the samples was very small (884), and as they were widely distributed through the different areas, it is difficult to analyse them on a quarterly and spatial basis. The samples were therefore grouped (Figure 8). The fork lengths varied from 40 to 107 cm, but the majority of the bigeye were small, with the mode centering around 50 cm.

CONCLUSION

More than half of the total catch of tuna from the western Indian Ocean comes from log-associated schools. The Mauritian purse seiners use artificial logs to concentrate the fish before setting. The Japanese purse seiners operate almost exclusively on log schools, and more than 50% of the catches of the French fleet are made on log schools. The Spanish fleet is also fishing more on log schools than on free schools.

Fishing on log schools or with artificial logs considerably reduces searching time, and hence has a positive effect on the yield. It is also an excellent technique for the exploitation of skipjack tuna. However, it also has some drawbacks. Unlike skipjack, most of the yellowfin and bigeye caught in log schools are immature, measuring less than 100 cm, which may produce a lower yield per recruit for yellowfin as more small fish are caught. Bigeye will be less affected, as its percentage in the catch is less.

The increase in fishing on log-associated schools should be managed very carefully, as suggested by Hallier (1989). Regular sampling for species composition and length-frequency analysis should be carried out during landings by purse seiners in order to gain a precise idea of the status of the stocks.

Figure 3. *Spatial distribution of Mauritian purse seine catches (t). From 1990 to 1994 consecutively.*

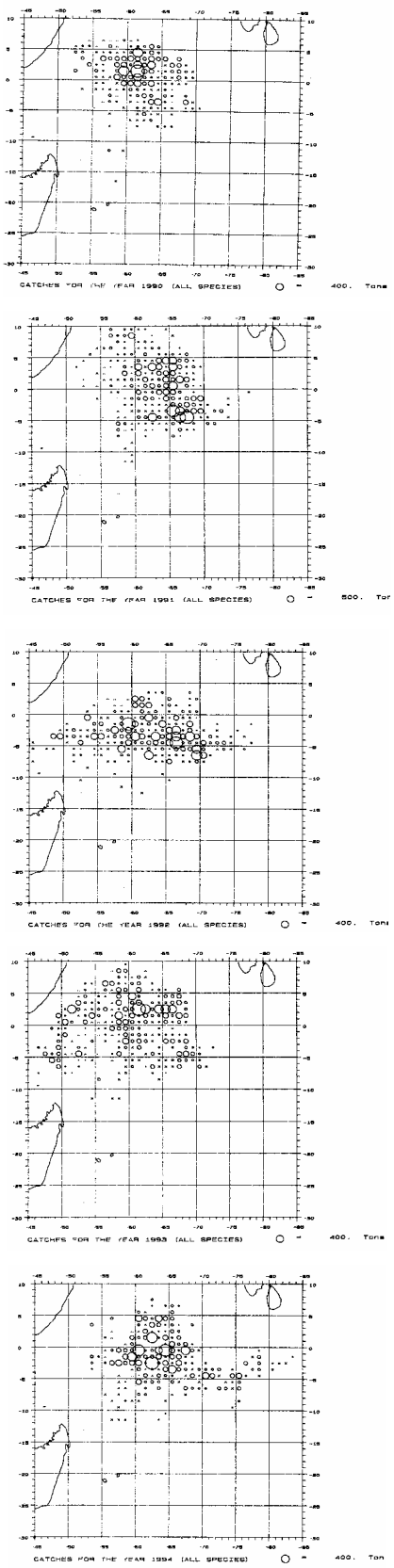


Figure 4. *Distribution of effort (hours) of Mauritian purse seiners. From 1990 to 1994 consecutively.*

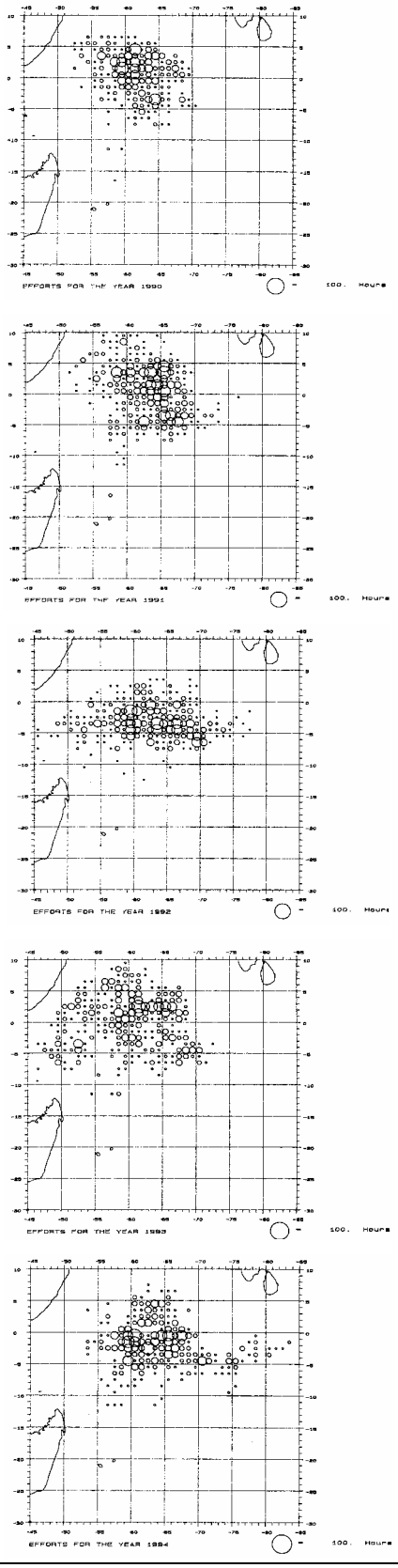


Figure 5. *Eight areas involved in the catch of Mauritian purse seiners made during 1993.*

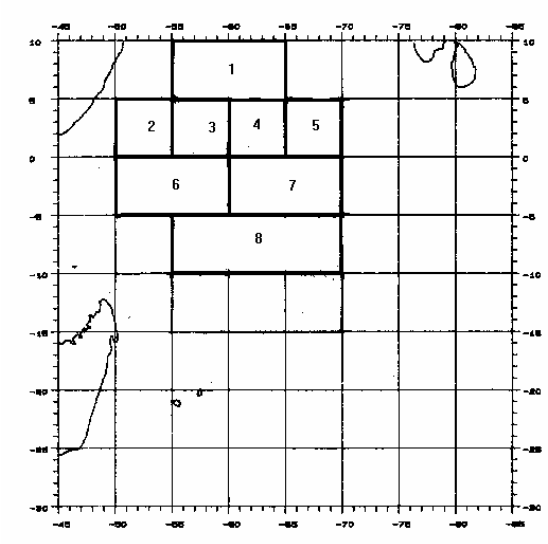


Figure 6*. Quarterly length frequency distribution of yellowfin tuna during 1993. Length range: 30 - 130 cm.*

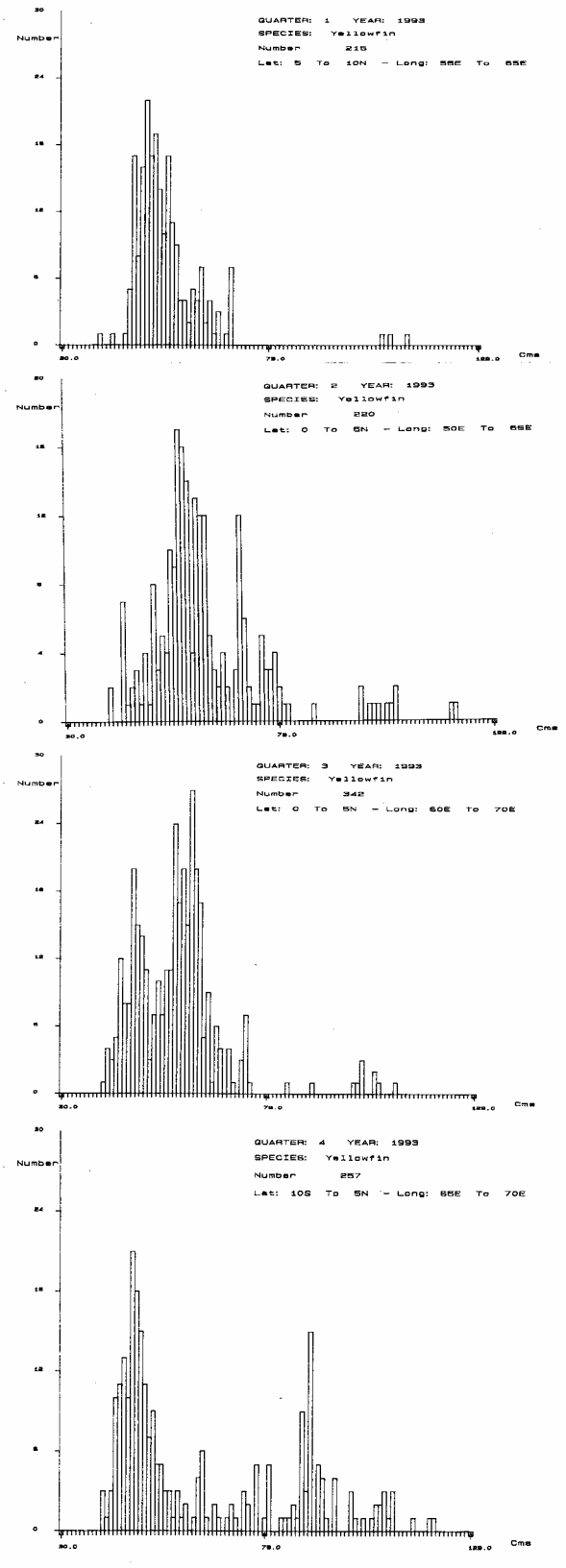


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***Figure 7**. Quarterly length frequency distribution of skipjack during 1993. Length range: 30 - 130 cm.*

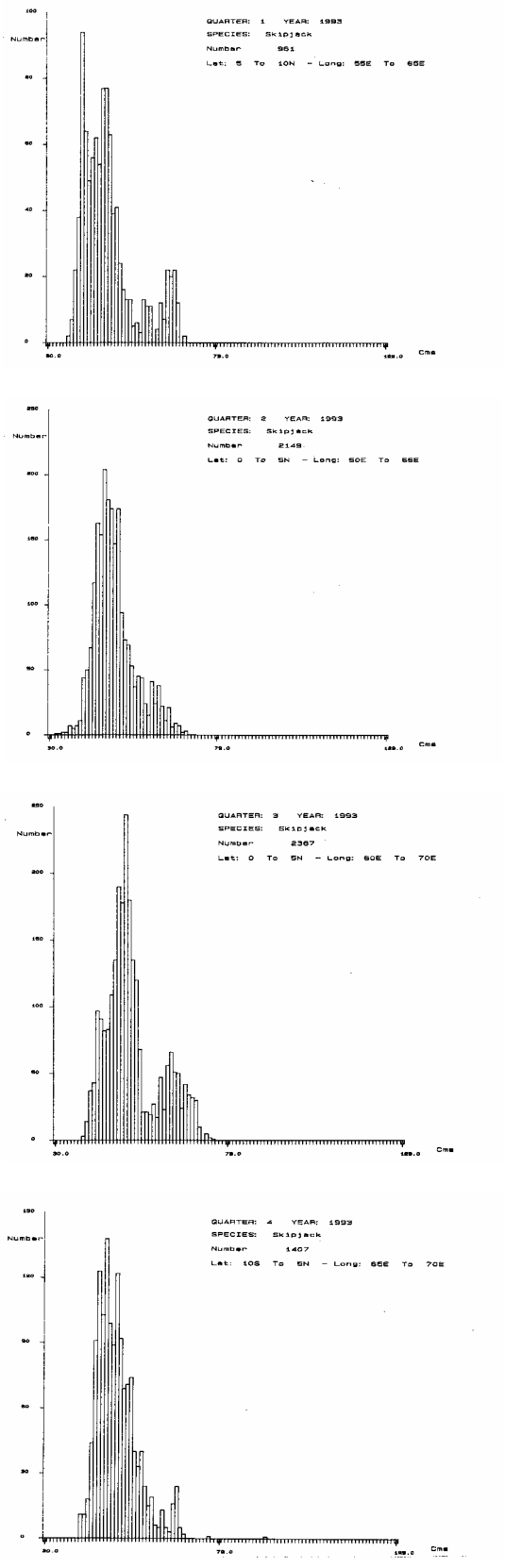

***Figure 8**. Length distribution of bigeye tuna during 1993. Length range: 30 - 130 cm.*