RECENT TRENDS IN THE SEYCHELLES INDUSTRIAL FISHERY

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INTRODUCTION

Distant-water fishing nations (DWFNS) began longlining for tuna in the western Indian Ocean (WIO) in the early 1950s. First were the Japanese, followed by the Taiwanese in 1954 and the Koreans in 1960. Large-scale industrial purse seining began in 1983, when French and Spanish fleets moved into the WIO from the tropical Atlantic. By 1986 the WIO purse seiners were producing 143,099 t of tunas, or some 6% of the world tuna catch of 2,400,000 t; by 1993 this had risen to 8.6% (276,911 t out of 3,200,000 t). Virtually all the purse seiners active in the WIO are licensed to fish in the Seychelles EEZ, and therefore the entire WIO purse-seine catch is reflected the Seychelles Fishing Authority's (SFA) data, which are based upon the daily catch and effort reports, or logbooks, which must be provided to SFA by all licensed vessels. At present about 50 vessels per year are licensed. SFA has detailed reports of over 90% of their total transhipments and can therefore calculate very accurate catch figures by correcting visual estimates with transshipment records. Unfortunately, SFA only has data from some of the longliners fishing in the WIO which take out a license to fish in the Seychelles EEZ. Not all licensed longliners provide SFA with catch and effort report forms and almost none of those which report catches actually tranship in the Seychelles.

In 1985 some 95% of the WIO purse-seine catch was transshipped through Port Victoria; by 1994 this had fallen to 63%. This reflects a change in the geography of the fishery. In the early 1980s Mahe was at the centre of the area fished all year round, but now there is a very strong movement into the Mozambique Channel during the second quarter, making Antsiranana a more convenient port than Victoria for that period of the year, and a tendency for many vessels to fish off the Somali coast in the third quarter tends to favour Mombassa as a transshipment port in that period .

The major tuna species discussed in this report are yellowfin (*Thunnus albacares*), skipjack (*Katsuwonus pelamis)*; bigeye (*Thunnus obesus),* and albacore (*Thunnus alalunga).* All weights are expressed in metric tonnes (t).

This paper reviews the data contained at present in the SFA and ORSTHON databases, the latter operated by ORSTOM, a French overseas research organisation. The data, taken from daily catch and effort report forms and transshipment records, are entered via a double-entry system into the ORSTHON database, which is very comprehensive and includes a considerable amount of scientific data. Numbers from a selection of fields are transferred to the NEWTUNA[1] system, developed for SFA by the Indo-Pacific Tuna Programme with financial aid from *Association Thonière* . NEWTUNA is used to generate tables for a variety of reports, including monthly confidential reports for internal use by SFA and the SFA Tuna Bulletin. Scientific data, for compiling length-frequency diagrams, for example, is available to SFA from the ORSTHON database via the ORSTON2 suite of programs.

THE PURSE-SEINE FISHERY

The SFA database contains detailed records of the purse-seine fishery since 1984. Trends can therefore be clearly identified over long periods.

The Fleet

a] The physical composition of the fleet

The International Commission for the Conservation of Atlantic Tunas classifies purse seiners into several categories , of which the following four have fished in the WIO:

Class	*Carrying Capacity*
5	400-600 t
6	600-800 t
7	800-1200 t
8	>1200 t

In the early days of the fishery there were some Class-5 vessels in the WIO, but they have now been replaced by larger vessels. By the 1994-1995 season the majority of vessels fishing in the WIO were of Class 7 or 8. About five Class-6 vessels remain in the French fleet.

[1] A new version of this database, WINTUNA, is being developed by IPTP in close collaboration with SFA.

Table 1. **Nationality of vessels licensed to fish in the Seychelles EEZ in 1994.**

Country	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
Belize	4	4	4	4	4	4	4	4	4	4	4	4
France	17	17	17	17	17	17	17	17	17	17	17	17
Iran	2	2	2	2	0	0	0	0	0	0	0	0
Japan	2	2	2	2	2	1	1	1	1	1	1	0
Liberia	4	4	4	3	3	3	0	1	1	2	4	4
Mauritius	3	3	3	3	2	2	2	3	3	3	3	3
Panama	3	3	3	3	3	3	3	3	3	3	3	3
Spain	19	18	18	18	18	18	18	18	18	18	18	18

Table 2**. Number of purse seiners licensed per month, 1984-1994**

	1984	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*
Jan	14	49	38	33	39	49	49	43	50	59	54
Feb	17	49	38	33	37	49	54	42	55	58	53
Mar	22	46	36	33	33	47	54	39	55	57	53
Apr	27	45	35	31	38	46	53	40	55	57	52
May	32	35	34	29	39	45	51	39	55	56	49
June	32	34	31	30	38	44	39	42	53	56	48
July	27	28	29	30	43	46	42	44	53	58	45
Aug	29	30	32	33	44	46	43	45	53	57	47
Sept	37	33	34	38	46	49	46	45	53	57	47
Oct	41	36	33	41	43	49	44	52	55	57	48
Nov	46	37	33	41	47	50	43	54	52	53	50
Dec	49	38	33	41	48	47	43	51	52	51	49
Mean	31	38	34	34	41	47	47	45	53	56	50

b] The nationality of the fleet

In 1994 the majority of the fleet were Spanish and French vessels fishing under an agreement with the European Community (Table 1). Other vessels were registered in Liberia (owned by interests in the former USSR), Belize, Panama, Japan, Mauritius and Iran. In the past the fleet has also included vessels from the United Kingdom, the Ivory Coast and India.

c] Size of the fleet

Since 1984 there has been steady increase in the number of vessels taking licenses to fish in the Seychelles EEZ (Table 2). This reached a peak in 1993, when the average number licensed per month was 56. The maximum number of vessels licensed in any one month was 59 in January 1993. Since the departure of the Japanese fleet in late 1993 and early 1994 the average number licensed per month has decreased slightly, to 50.

Fishing effort

Fishing effort is measured in days fished, defined as days spent at sea minus days on passage and days adrift due to mechanical breakdown and other stoppages. It includes days spent searching even if no fish were actually caught.

Between 1984 and 1993 fishing effort rose from 7,604 to 14,368 days fished, a rise of 89% over 10 years. Table 3 and Figure 1 show the steady increase in total effort between 1984 and 1994 of about 400 days per year. Table 4, which combines the totals from Table 3 and the means from Table 2, shows that this was mainly due to an increase in the number of vessels operating in the fishery, but also partly because of a tendency for individual vessels to fish more days per year. The tuna stock has therefore been subjected to increased fishing pressure since the start of the large-scale industrial fishery in the early 1980s. Continued close monitoring of the situation is therefore important, so that management action may be taken if necessary to adjust the pressure.

The catch

Table 5 and Figure 2 show that 1992, 1993, and 1994 were all record years for catch in the WIO, with landings over 270,000 t each year. At this high level of catch, close and detailed monitoring of the stock, with the full co-operation of the whole international fishing fleet, remains very important.

Catch per unit of effort

Table 6 and Figure 3 show the upward trend of the CPUE in the fishery between 1984 and 1994. In 1994 it reached a record level of 22.32 t. Some of the factors

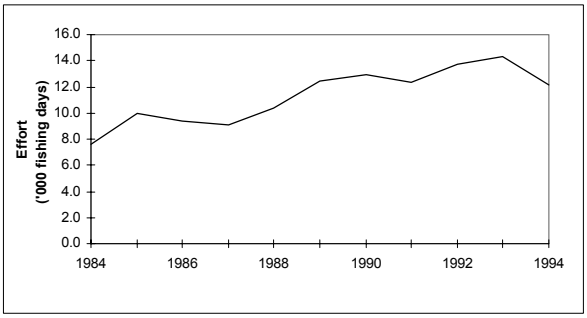
Table 3**. WIO purse-seine effort in days fished per month, 1984-1994**

	1984	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*
Jan	247	1,105	944	840	938	873	1290	1,025	1,304	1,420	940
Feb	236	900	790	671	782	1,076	1177	804	1214	1,177	882
Mar	471	1,120	881	811	715	923	1326	945	1,275	1,333	1,024
Apr	499	935	849	639	865	915	1,121	874	1224	1,279	932
May	795	853	710	573	818	936	1,031	900	1,169	1,111	949
June	631	724	623	615	745	1,017	906	934	1,124	1,171	840
July	519	518	629	574	814	1,010	918	994	1,167	1,247	1,022
Aug	618	567	663	654	1,033	1,077	1,013	1,095	1,123	1,288	1,094
Sept	756	659	808	794	861	1,121	1,099	1,067	1,017	1,177	1136
Oct	744	755	804	948	857	1,088	1,102	1,150	1,075	1,151	1,146
Nov	1035	841	790	995	946	1,188	888	1,301	1,109	1,033	1,022
Dec	1,053	1,038	843	968	958	1,218	1,083	1,249	923	981	1,209
Total	7,604	10,015	9,334	9,082	10,332	12,442	12,954	12,338	13,724	14,368	12,196

Table. 4. *Average annual effort per vessel, in days fished, 1984-1994.*

	1984	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*
Mean vessels per month	31	38	34	34	41	47	47	45	53	56	50
Total days fished	7,604	10,015	9,334	9,082	10,332	12,442	12,954	12,338	13,724	14,368	12,194
Average annual effort	245	263	274	267	252	275	275	274	259	256	243

Figure 1*. Purse seine effort in the WIO, 1984 - 1994.*



that have led to this increase over the ten-year period are probably:

1. A better knowledge of the patterns of annual migration of the tuna;
2. Use of bird radar;
3. Faster gear setting and recovery technology (30% faster over 5 years);
4. Exploitation of new fisheries (Chagos, *etc.*);
5. Improved electronic fish finders and sonar;
6. Use of larger vessels.

If effort is expressed very simply as the annual average number of vessels licensed per month, the direct relationship between the size of the fleet, catch, and CPUE can be clearly shown (Figure 4). The different number of vessels catching the same quantity of tuna in different years is a clear reflection of different annual CPUEs. For example, the annual catch in 1992, 1993, and 1994 was over 270,000 t; however, this was achieved with an average of 56 vessels per month in 1993, but with only 50 vessels per month in 1994.

Hallier (1993, 1995) considers that the fishing day as a measure of fishing effort is not suitable for a fishery in which a considerable catch is obtained by fishing around floating objects, or ”logs” (see 2.5(b) below). In the WIO fishermen often mark floating objects, natural or artificial, with radio 'beepers', and this may in some cases reduce searching time virtually to zero. It has therefore been proposed that catch-per-set might be a better index of abundance than catch-per-fishing day. However, this measure of effort is not easy to apply, because only part of the effort is directed toward fish associated with logs, the frequency of repeated sets on the same objects is an important factor, and some national fleets do not indicate in all their logbooks whether a set was made on a free school or a log. Crude as it may be, the 'fishing day' remains the practical unit of effort used in the fishery for management purposes.

Catch composition variation between log and free schools

Over the years skipjack tuna has become an increasingly important part of the total catch (Figure 5). This is probably the result of more fishing taking place on floating objects. These objects may be natural, such as trees washed down from African rivers in the rainy season or dead whales, or artificial, such as rafts launched by purse seiners and perhaps followed with the aid of radio "beepers". There are two main types of beeper: the old ones emit a continuous electronic signal which can be followed with a radio direction finder on the parent ship, while the modern "sleeping beepers" emit their signal only when triggered by a radio signal from the parent vessel, thus preventing competitors from benefiting from

Table 5. **WIO purse-seine catch, 1984 - 1994.**

	1984	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*
Jan	5,560	16,111	15,887	12,197	16,826	17,874	14,226	18,629	20,472	22,053	29,408
Feb	4,332	6,079	13,032	10,616	14,345	23,358	20,270	21,290	22,446	21,733	20,251
Mar	8,271	13,096	11,114	11,217	12,324	33,930	23,463	21,006	23,168	27,356	26,186
Apr	5,347	6,864	10,141	13,508	13,359	23,194	20,380	10,420	27,638	25,026	20,729
May	6,462	8,169	7,952	8,883	15,254	12,216	10,052	14,281	23,458	20,517	24,201
June	3,231	8,437	8,813	6,361	16,625	13,896	12,309	15,993	11,342	15,441	10,790
July	4,191	6,691	10,959	16,801	13,987	10,850	16,836	17,628	27,217	19,395	13,919
Aug	5,452	7,034	11,381	14,566	21,078	13,584	15,063	17,120	20,422	24,301	22,456
Sept	11,967	16,603	15,722	16,941	26,139	27,694	25,231	21,071	29,700	27,975	29,304
Oct	14,983	19,560	17,997	20,320	28,742	28,198	25,597	28,255	38,738	29,305	37,277
Nov	20,100	10,357	12,483	18,269	19,714	11,891	12,493	19,011	21,066	17,113	17,834
Dec	8,883	9,608	7,618	13,164	29,262	10,069	25,977	14,400	12,551	26,696	19,832
Total	98,779	128,609	143,099	162,843	227,655	226,754	221,897	219,104	278,218	276,911	272,187

Table 6. **CPUE of purse seiners in the WIO (t/fishing day), 1984- 1994**

	1984	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*
Jan	22.51	14.58	16.83	14.52	17.94	20.47	11.03	18.17	15.70	15.53	31.29
Feb	18.36	6.75	16.50	15.82	18.34	21.71	17.22	26.48	18.49	18.46	22.96
Mar	17.56	11.69	12.62	13.83	17.24	36.76	17.69	22.23	18.17	20.52	25.57
Apr	10.72	7.34	11.94	21.14	15.44	25.35	18.18	11.92	22.58	19.57	22.24
May	8.13	9.58	11.20	15.50	18.65	13.05	9.75	15.87	20.07	18.47	25.50
June	5.12	11.65	14.15	10.34	22.32	13.66	13.59	17.12	10.09	13.19	12.85
July	8.08	12.92	17.42	29.27	17.18	10.74	18.34	17.73	23.32	15.55	13.62
Aug	8.82	12.41	17.17	22.27	20.40	12.61	14.87	15.63	18.19	18.87	20.53
Sept	15.83	25.19	19.46	21.34	30.36	24.70	22.96	19.75	29.20	23.77	25.80
Oct	20.14	25.91	22.38	21.43	33.54	25.92	23.23	24.57	36.04	25.46	32.53
Nov	19.42	12.32	15.80	18.36	20.84	10.01	14.07	14.61	19.00	16.57	17.45
Dec	8.44	9.26	9.04	13.60	30.54	8.27	23.99	11.53	13.60	27.21	16.40
Mean	12.99	12.84	15.33	17.93	22.03	18.22	17.13	17.76	20.27	19.27	22.32

***Figure 2**. WIO purse seine catch, 1984 - 1994.*

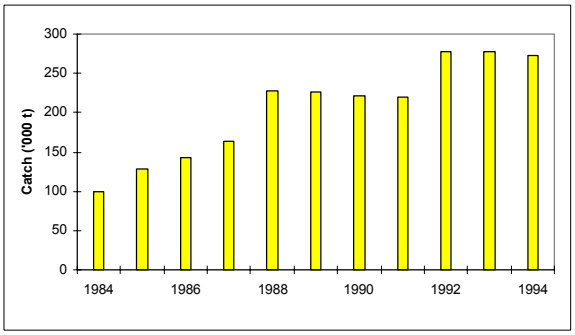
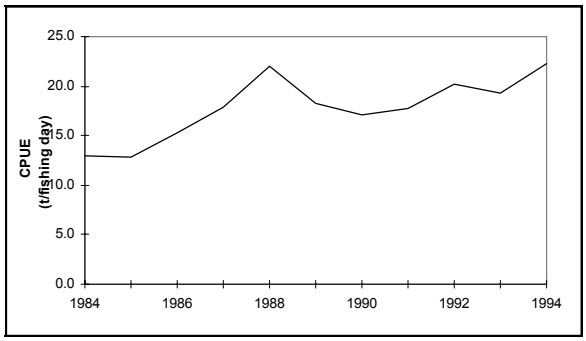


***Figure 3**. WIO purse seine CPUE, 1984 - 1994.*



the parent vessel's efforts by giving them the minimum time to home in on the beeper.

The difference in the proportion of species caught in log and free schools is shown in Table 7. Skipjack tends to predominate in log catches, and yellowfin in free-school catches.

Besides varying between log and free schools, the catch composition also varies between geographic areas, months, and national fleets.

Catch composition, length frequency, and geographic area

The concentration of activity of the purse-seine fleet shifts in a clockwise direction around the WIO during the year. The proportion of the catch from log or free schools also varies, and this is reflected in the composition and length frequency of the catch. The difference in length frequency between skipjack caught on logs and in free schools is very slight. However, in yellowfin the variation in length frequency between log and free

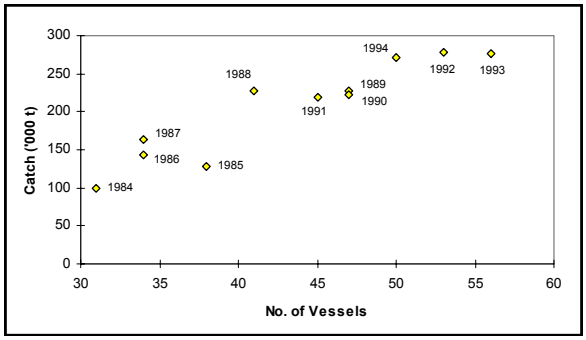
***Table 7**. Percentage catch composition on free schools and logs, 1993-94*

	LOG CATCH					*FREE-SCHOOL CATCH*				
Year	YFT	SKJ	BET	ALB	Annual mean	YFT	SKJ	BET	ALB	Annual mean
1993	33	59	7	1	48	64	31	4	1	52
1994	19	75	5	1	40	50	44	4	2	60

Table 8. **Relationship of year group to length group**

Year group	*Length group*		
	Slow	***Medium***	***Fast***
1	30-61	-	44-80
2	62-105	-	81-113
3	106-135	-	114-134
4	-	140	-
5	-	154	-

***Figure 4**. Annual purse seine catch related to the average number of vessels licensed per month in the WIO, 1984 - 1994.*



school catches is very considerable. Figures 6 to 12 illustrate this variability in the WIO tuna fishery and show how the geographic area of catch, length frequency of yellowfin, and the proportion of the yellowfin catch coming from free schools and logs varies during the year. The maps at the top of each figure show the total tuna catch by one-degree square. The size of the circle is proportional to the catch in that square.

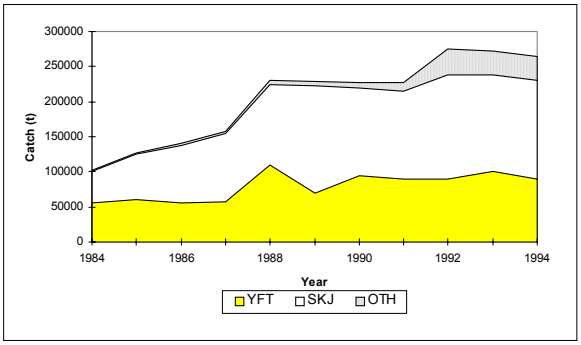
Although the pattern of fishing is not exactly the same every year, Figures 6 to 12 serve to illustrate the general movements that occur in each quarter.

In the first quarter of 1993 considerable catches were made just west of the Chagos area (Figure 6) as well as in other areas well away from the coast of Africa. Eighty percent of the yellowfin catch came from free schools, and contained a wide range of length groups; the catch from logs was most frequently composed of smaller fish. A comparison of Figure 6 with the age-length-group data in Table 8 shows that there was a heavy catch of one-year-old fish, especially on logs, and many 4-year-olds, especially from free schools, but few 2- to 3-year-olds. Sexual maturity in yellowfin is usually reached between about 100 cm and 120 cm (IPTP, 1992), or about 2 to 3 years of age.

The absence of two- to three-year-old fish in WIO yellowfin catches is well known (Marsac, 1992). It may be because the geographical zone from which the catch is derived is limited and the samples are obtained only from purse seiners and not other types of fishing vessel. Data in a paper (IPTP, 1992) showing the size frequency of yellowfin from Oman waters suggests that the missing age groups may perhaps migrate to the north, around Oman and Sri Lanka, where they could benefit from richer feeding grounds, associated with upwelling, and thus achieve full sexual maturity more rapidly than if they had stayed in the open ocean. Two- to three-year-old fish may therefore not be caught very frequently in the WIO simply because they are not available in very large numbers, having migrated elsewhere to feed and mature. Alternatively, they may remain in the area of the fishery but perhaps change their behaviour pattern and become less vulnerable to capture for and example, they may disperse and no longer be concentrated in identifiable shoals. The situation will continue to be very closely monitored by all agencies involved.

Figure 10 shows that during the first quarter of 1994 a large proportion (88%) of the yellowfin catch again came from free schools, and only a small proportion (12%) from logs. Large catches came from east and west of the Seychelles, well away from the African coast. The 2- to 3-year age groups again formed a very small proportion of the catch.

***Figure 5**. Composition of purse seine catches in the WIO, 1984-1994.*



The second quarter of 1993 saw the usual substantial movement of the fleet into the Mozambique Channel (Figure 7). This first occurred in 1986 (IPTP, 1991) and has since become a regular feature of the annual fishing pattern. Closer to the coast of Africa more natural floating objects are available, and the proportion of yellowfin

Table 9. **Transshipments at Port Victoria ,1984-1994**

	1984	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*
Jan	6,062	17,499	13,894	7,679	14,290	24,910	11,739	16,775	16,304	18,293	12,822
Feb	5,389	10,358	16,529	15,313	15,193	17,855	15,235	20,669	16,744	17,751	14,085
Mar	5,635	5,217	9,986	7,574	14,990	29,712	17827	9,707	14,864	14,122	20,902
Apr	7,749	14,341	7,344	9,597	6,044	24,351	9,340	608	9,394	11,829	6,403
May	4,085	4,853	4,581	1,610	15,369	7,472	1,519	5,958	5,920	6,111	150
June	4,938	5,976	2,988	3,735	10,193	9,029	6,248	9,783	4,505	9,554	6,266
July	4,906	7,729	4,662	14,864	16,922	11,075	15,910	18,770	9,441	12,782	10,949
Aug	3,950	6,784	10,952	13382	11,963	12,888	12,866	16,958	10,009	17,701	11,364
Sept	5,561	10,108	15,113	13,878	26,820	19,801	17,390	16,358	13,260	21,420	23,371
Oct	14,100	18,708	16,854	20,155	25,183	28,818	22,366	27,531	25,810	24,224	30,267
Nov	11,429	14,023	14032	13,059	22,518	16,872	22,017	22,123	25,363	15,936	20,389
Dec	13,230	7,101	9,885	16,326	21,088	9,398	13,246	14,999	10,413	19,234	14,075
Total	87,034	122,697	126,820	137,172	200,573	212,181	165,703	180,239	162,027	188,957	171,043

Table 10. *Transshipments at Port Victoria as percentage of WIO purse-seine catch, 1984-1994*

	1984	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*
Jan	109	109	87	63	85	139	83	90	80	83	44
Feb	124	170	127	144	106	76	75	97	75	82	70
Mar	68	40	90	68	122	88	76	46	64	52	80
Apr	145	209	72	71	45	105	46	6	34	47	31
May	63	59	58	18	101	61	15	42	25	30	1
June	153	71	34	59	61	65	51	61	40	62	58
July	117	116	43	88	121	102	94	106	35	66	79
Aug	72	96	96	92	57	95	85	99	49	73	51
Sept	46	61	96	82	103	71	69	78	45	77	80
Oct	94	96	94	99	88	102	87	97	67	83	81
Nov	57	135	112	71	114	142	176	116	120	93	114
Dec	149	74	130	124	72	93	51	104	83	72	71
Mean	88	95	89	84	88	94	75	82	58	68	63

caught on logs rose to 58% and the free school catch decreased to 48%. One-year-olds were again prominent in both the free school and the log catch. A mode in the frequency of both catches at about 100 cm suggests that 2- to 3-year-olds may have been better represented than usual. The frequency of the 4-year-old age group in the catch was relatively low. The second quarter of 1994 saw a similar movement of vessels into the Mozambique Channel from the north (Figure 11), but the proportion of yellowfin caught on logs, 32%, was not as great as in 1993. Most of the catch (68%) continued to come from free schools. One-year-olds were very frequent in both types of catch. A double mode in the catch of fish from free schools, at 42 and 52 cm, suggests the presence of two cohorts in the year 1 group.

The third quarter of 1993 (Figure 8) saw the fleet concentrating its effort to the north and west of the Seychelles. The yellowfin catch was evenly split between logs and free schools. There were three very prominent modes in the log catch, at 44, 54, and 64 cm, suggesting three cohorts. This high frequency of juveniles characterised by pronounced modes is typical of the third quarter (Marsac, in IPTP 1991). The 64-cm length group may represent cohort progression, the 54-cm length group (Figure 7) from the previous quarter having grown at a rate of approximately 3 cm per month, about the rate expected for yellowfin at this stage (IPTP, 1992). In the third quarter of 1994 (Figure 12) 79% of the yellowfin catch came from logs, in contrast to only 50% in the corresponding quarter of the previous year. This might have been because the fleet was much more concentrated in the Somali basin in third quarter in 1994 than it was in 1993, and being nearer to the African coast was more likely to encounter natural floating objects washed down from rivers in the monsoon. Both the log and the free school catch showed very similar modes in length frequency in the 50-cm group.

The fourth quarter of 1993 (Figure 9) saw much of the fleet spreading out away from the African coast and towards Chagos. However, many vessels stayed to fish in the Somali basin. Consequently, although the proportion of the catch from free schools went up relative to the third quarter, to 47%, 53% still came from logs. Yellowfin in the 50-cm group remained prominent in the log

catch, while the 124-cm group (about age group 3) dominated the free-school catch. The fourth quarter of 1994 (Figure 13) saw the fleet spreading out away from the African coast, as in 1993. However, unlike the previous year, there was no concentration of catch in the Chagos area. Sea temperatures in the Chagos area were reported to be higher than usual, and this may have caused a change in yellowfin behaviour or migration patterns which made the fish unavailable in the fishery (MRAG, London, pers. comm., July 1995). Fishing in the Chagos area during the first and last quarters of the year cannot therefore be said to be established as a regular feature of the WIO tuna fishery; it depends on prevailing ocean 'climate' conditions

Transshipments

In the early days of the industrial purse-seine fishery in the WIO, up to 95% of the catch was transhipped through Port Victoria. By 1994 this had been reduced to some 63%. However, this is a smaller slice of a bigger cake. In 1985 95% of the catch amounted to 122,697 t (Table 9), whereas the 63% handled in 1994 (Table 10) represented 171,043 t (Table 9). Thus, although the proportion of the catch passing through Port Victoria has declined, the actual quantity has averaged about 174,000 t for the last 5 years (Table 9 and Figure 13).

The change in the proportion passing through Port Victoria is probably due to a combination of factors. The geography of the fishery began to change in 1986-1987, when serious fishing started in the Mozambique Channel during the second quarter. There was no immediate impact on the quantity or proportion of the catch transhipped at Port Victoria until 1990, when labour problems[2] obliged some ship owners to transship in other ports. This helped to precipitate a switching of some transhipments to Antsiranana during the second quarter and others to Mombassa in the third and fourth quarters, when there is much fishing activity in the Somali basin.

The potential catchment area of these three main ports in the WIO, superimposed on the catch by one-degree squares for 1994, is shown in Figure 15. Any point on the lines is equidistant from Victoria/Antsiranana, Antsiranana/Mombassa and Mombassa/Victoria. In the fishing area to the northeast of the Victoria/Antsiranana line and the east of the Mombassa/Victoria line, Victoria is generally the closest port to the point of capture. West of the Mombassa/Victoria line and west of the Antsiranana/Mombassa line, Mombassa is generally closest to the fishing points. South of the Victoria/Antsiranana line and the Antsiranana/Mombassa line, Antsiranana is the closest port to the main fishing area. Although distance from port is not the only factor to be considered when deciding where to transship, it is very important. Figure 14 clearly shows that although Port Victoria cannot expect to get all the transhipment business in the WIO, it is at the centre of most fishing activity and is therefore likely to remain the most important transhipment port.

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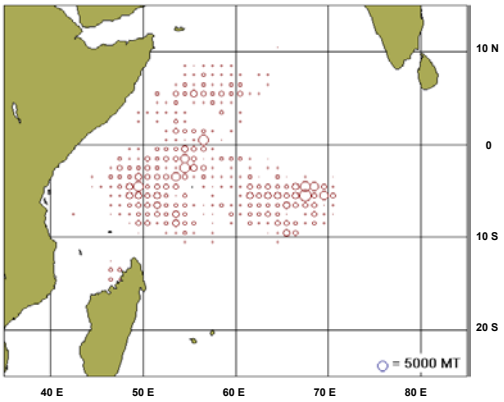
[2] The Government of the Republic of the Seychelles has since taken major steps to re-organise the port and make it more competitive.

Figure 6. *Catch per one degree square of YFT in the WIO for the 1st Quarter of 1993.*



Length frequency of YFT on Log and Free schools.

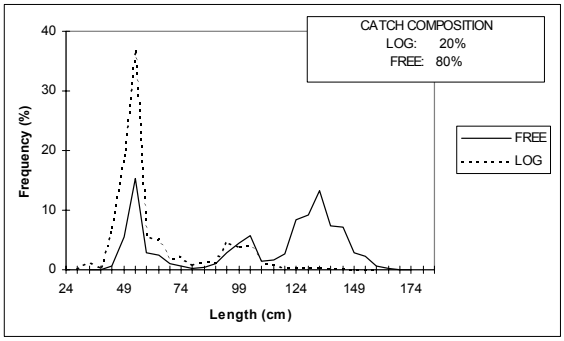
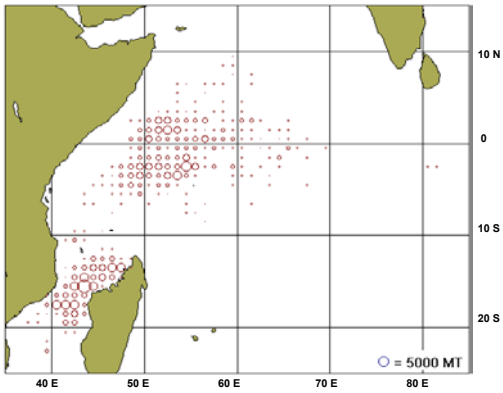


Figure 7. *Catch per one degree square of YFT in the WIO for the 2nd Quarter of 1993.*



Length frequency of YFT on Log and Free schools.

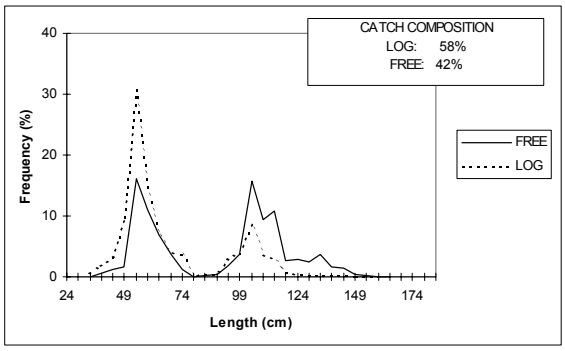
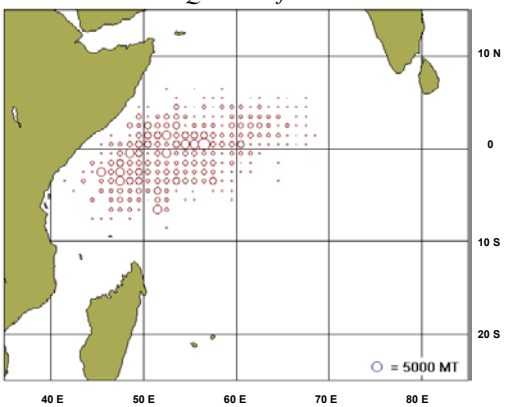


Figure 8. *Catch per one degree square of YFT in the WIO for the 3rd Quarter of 1993.*



Length frequency of YFT on Log and Free schools

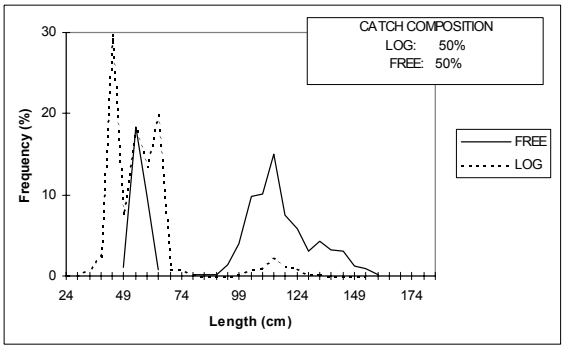
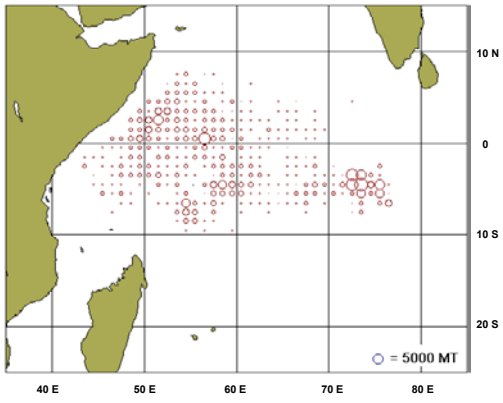


Figure 9. *Catch per one degree square of YFT in the WIO for the 4th Quarter of 1993.*



Length frequency of YFT on Log and Free schools.

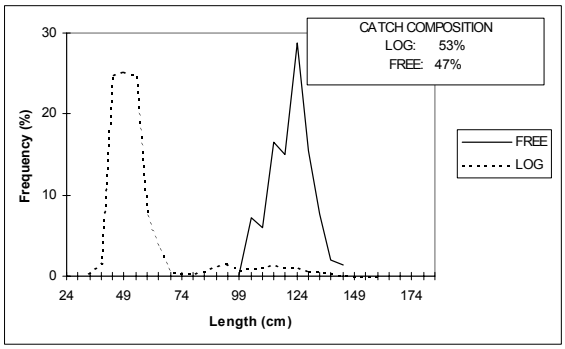
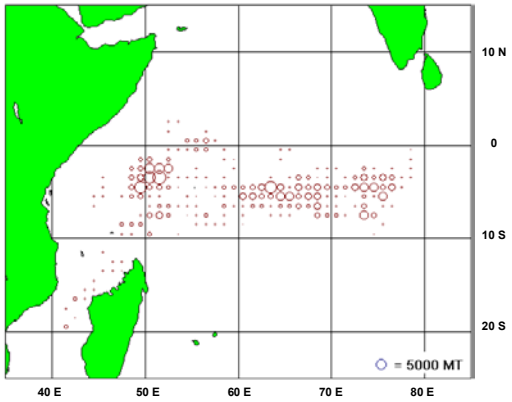


Figure 10. *Catch per one degree square of YFT in the WIO for the 1st Quarter of 1994.*



Length frequency of YFT on Log and Free schools.

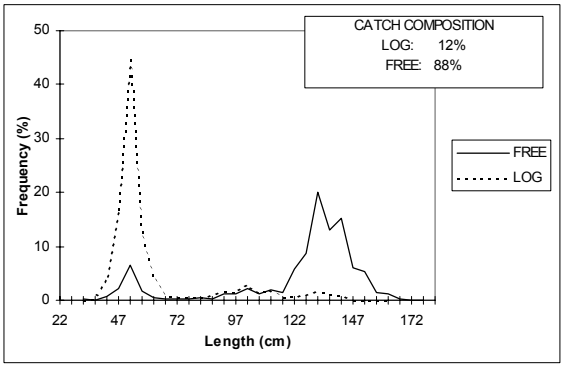
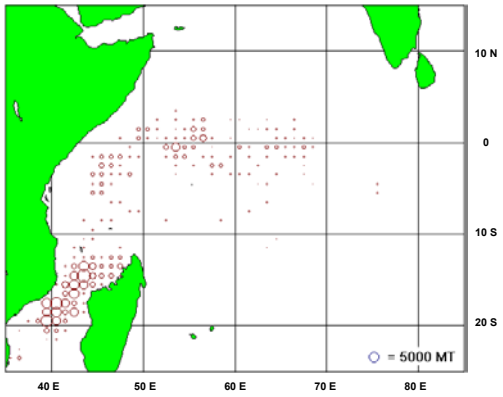


Figure 11. *Catch per one degree square of YFT in the WIO for the 2nd Quarter of 1994.*



Length frequency of YFT on Log and Free schools.

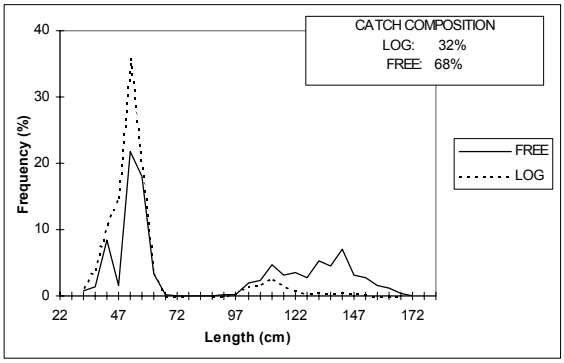
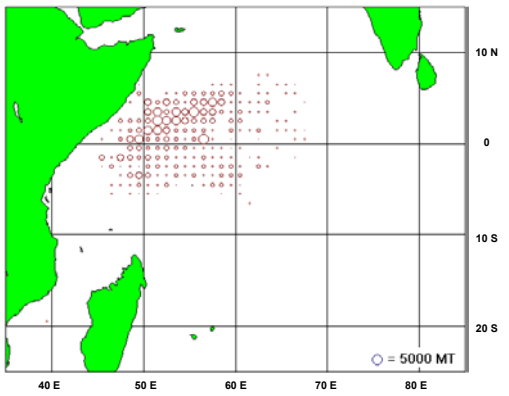


Figure 12. *Catch per one degree square of YFT in the WIO for the 3rd Quarter of 1994.*



Length frequency of YFT on Log and Free schools.

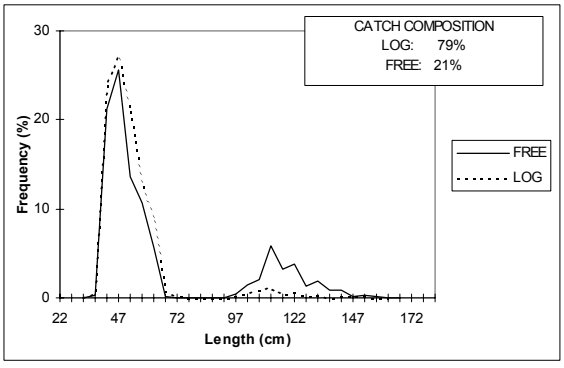
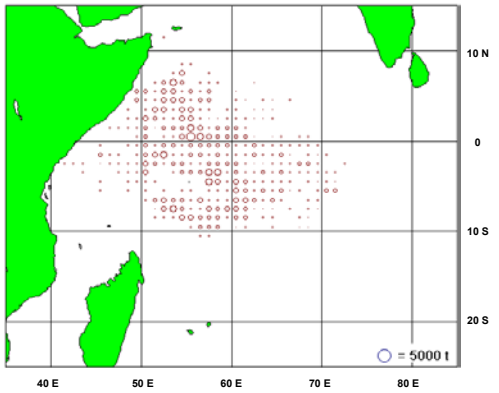


Figure 13*. Catch per one degree square of YFT in the WIO for the 4th Quarter of 1994.*



Length frequency of YFT on Log and Free schools.

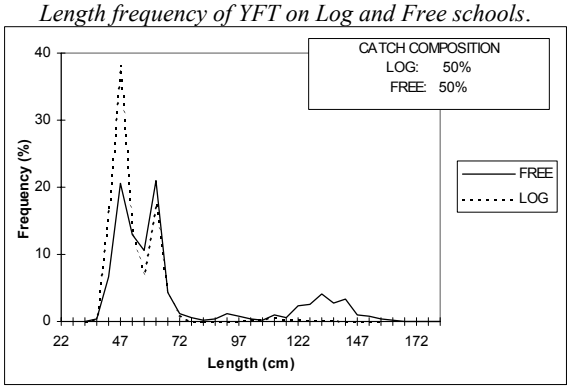


Table 11(a) *Number of licences issued, by nation per month, in 1993*

	Vessel flag					
1993	***Japan***	***S. Korea***	***Taiwan***	***Mauritius***	***France***	***Total***
Jan	3	11	18	1	0	33
Feb	0	1	11	0	0	12
Mar	0	0	0	0	0	0
Apr	0	0	0	0	0	0
May	0	0	0	0	0	0
Jun	0	4	0	0	1	5
Jul	0	0	4	0	0	4
Aug	0	4	0	0	0	4
Sep	6	15	4	0	0	25
Oct	1	4	33	0	0	38
Nov	8	11	46	1	0	66
Dec	5	5	25	0	0	35
Total	23	55	141	2	1	222

Table 11(b). *Number of licences issued, by nation per month, in 1994*

	Vessel flag			
1994	***Japan***	***S. Korea***	***Taiwan***	***Total***
Jan	0	3	16	19
Feb	4	2	4	10
Mar	0	0	0	0
Apr	1	0	0	1
May	0	1	0	1
Jun	1	3	0	4
Jul	0	3	2	5
Aug	0	2	0	2
Sep	1	10	6	17
Oct	10	29	27	66
Nov	5	41	29	75
Dec	2	24	10	36
Total	24	118	94	236

THE LONGLINE FISHERY

The fishery

The longliners licensed to fish in the Seychelles EEZ are from distant-water fishing nations (DWFN). In 1993 and 1994 Japan, South Korea and Taiwan were the most important nations receiving licenses from the Seychelles Government. Taiwan has become a significant purchaser of these fishing licenses only in the last few years.

Tables 11(a) and 11(b) show the frequency of licence purchases by nation, while Tables 12(a) and 12(b) detail the number of individual vessels of each nation in the fishery. In 1993 a total of 222 licences were issued to 149 vessels, and in 1994 236 licences to 150 vessels.

Licences are issued throughout the year; however, all nation purchase licences for a short period, ranging from one to three months. South Korean and Taiwanese vessels are usually licensed for one month, while Japanese vessels are usually licensed for three months at a time. The average rate of licence renewal for all nations is approximately 1.5 times a year.

The Fleet

a) Fleet Activity

The overall number of longliners licensed to fish in the Seychelles EEZ (Tables 12(a) and 12(b)) has remained stable over the past two years. However, in 1994 there was a slight increase in the rate of licence renewal. The Taiwanese fleet, which until recently did not feature in the list of vessels licensed by the Seychelles Government, was the most active nation in the fishery in 1993, accounting for just over 60% of all licenses issued to

Figure 14*. Purse seine transshipment at Victoria, 1984-1994. Percentage of total WIO purse seine catch shown for each year.*

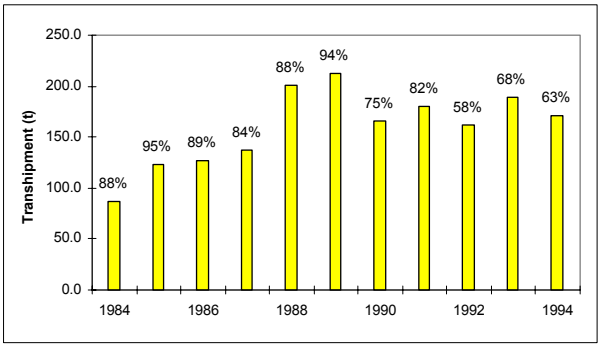


Figure 15*. Catch by one degree square for 1994. Also shown are the equidistant lines between the main regional transshipment ports and likely port catchment areas.*

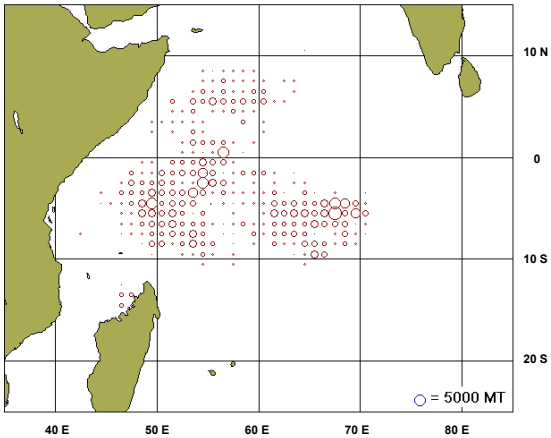


Table 12(a) *Number of individual vessels licensed in 1993, by nation and by month.*

	Vessel flag					
1993	***Japan***	***S. Korea***	***Taiwan***	***Mauritius***	***France***	***Total***
Jan	3	11	18	1	0	33
Feb	0	1	8	0	0	9
Mar	0	0	0	0	0	0
Apr	0	0	0	0	0	0
May	0	0	0	0	0	0
Jun	0	3	0	0	1	4
Jul	0	0	2	0	0	2
Aug	0	4	0	0	0	4
Sep	5	9	4	0	0	18
Oct	1	3	27	0	0	31
Nov	6	7	24	0	0	37
Dec	1	1	9	0	0	11
Total	16	39	92	1	1	149

Table 12(b)*. Number of individual vessels licenced in 1994, by nation and month.*

	Vessel flag			
1994	***Japan***	***S. Korea***	***Taiwan***	***Total***
Jan	0	3	16	19
Feb	4	1	1	6
Mar	0	0	0	0
Apr	1	0	0	1
May	0	1	0	1
Jun	0	2	0	2
Jul	0	0	2	2
Aug	0	1	0	1
Sep	1	10	6	17
Oct	6	23	25	54
Nov	4	14	19	37
Dec	1	4	5	10
Total	17	59	74	150

Table. 13*. Catch composition by species, 1993-1994.*

	Yellowfin t (%)	*Bigeye t (%)*	*Billfish t (%)*	*Others t (%)*	*Total t*
1993	6207 (45)	6,018 (44)	1,042 (8)	463 (3)	13,730
1994	6947 (48)	5,288 (36)	1,799 (13)	480 (3)	14,514

longliners. The South Koreans took 25% and the Japanese only 10% of the total number of licences issued.

In 1994 the number of Taiwanese vessels fishing in and around the Seychelles waters had decreased by 20%, and accounted for only 40% of the total number of licences issued. However, South Korea had increased the number of its vessels by 50%, and they accounted for 50% of all licences issued. The number of Japanese vessels remained constant over the two years in both number of licences purchased and number of vessels in the fishery.

b) Fleet Composition

The longline fleet is composed of vessels ranging from 25-58m in overall length and 200-735 Gross Registered Tonnage.

c) Seasonality

As in the past, there is a strong seasonal trend in fishing activity by longliners in and around Seychelles waters. This is illustrated by Figure 15, which shows the tendency for more vessels to take out licences between September and February.

Fishing Results

a) Catch Statistics (Catch and CPUE)

Since longliners are licensed for short periods they seldom put into Port Victoria at the end of their licence period, and for that reason the return of logbooks is generally poor. On the whole the Japanese vessels have a better record of returning logbooks than the South Koreans and Taiwanese. In 1993 and 1994 logbook returns for the whole longline fleet stood at 36% and 23%, respectively. Compared to the mid-1980s, when logbook returns were at around 65%, this is a significant decrease. Coverage of the Japanese fleet was 95% and 40% in 1993 and 1994, respectively, of the South Koreans 25% and 7%, and of the Taiwanese 30% and 27%. The general trend observed for all nationalities over the past two years is a decline in the return of logbooks. However, the coverage rate for 1994 is expected to increase when the vessels return towards the end of the current year.

Estimated catches by longliners, calculated *pro rata*, are 13,730 t and 14,514 t for 1993 and 1994, respectively.

Catch rates for 1993 and 1994, also calculated *pro rata* are 0.39 t/1000 hooks and 0.35 t/1000 hooks, respectively.

***Figure 16**. Monthly variation in number of longliners licensed in the Seychelles.*

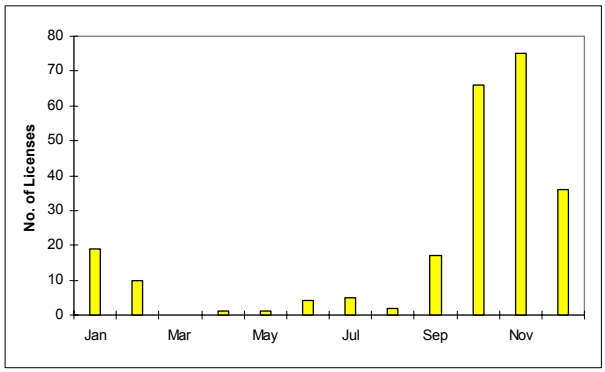
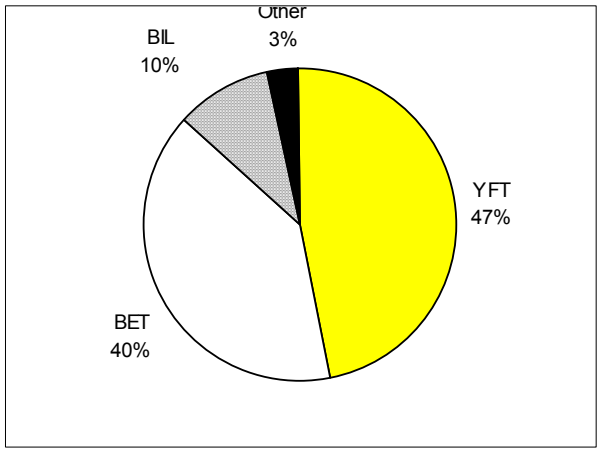


***Figure 17**. Catch composition of longliners for 1993 and 1994.*



Average catch rates for all nations, by species, for 1993 and 1994 are:

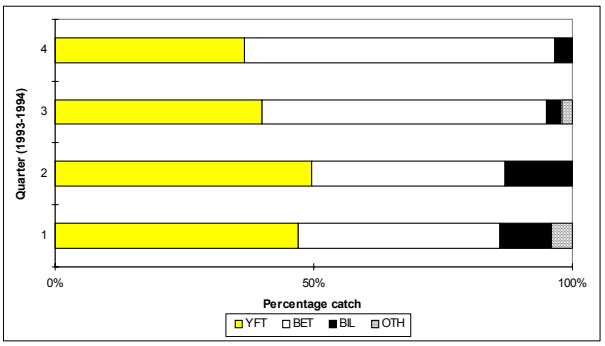
- Yellowfin: 0.19 t/1,000 hooks and 0.17 t/1,000 hooks, respectively; and
- Bigeye 0.17 t/1,000 hooks and 0.13 t/1,000 hooks, respectively.

Catch rates for all species, by country, for 1993 and 1994 are:

- Japan: 0.53 t/1,000 hooks and 0.17 t/1,000 hooks, respectively;
- South Korea: 0.40 t/1,000 hooks and 0.29 t/1,000 hooks, respectively; and
- Taiwan: 0.30 t/1,000 hooks and 0.21 t/1,000 hooks, respectively;

On average the catch rates for the two years combined are 0.36t/1000 hooks for the total catch, and 0.17t/1000 hooks for yellowfin and 0.15t/1000 hooks for bigeye.

***Figure 18**. Seasonal variation in catch composition by quarter for longliners.*



These figures compare fairly well with those obtained in the mid- to late 1980s (Lablache, 1990).

b) Species Composition

Catches by longliners licensed in the Seychelles during 1993 and 1994 consist mainly of yellowfin (47%), bigeye (41%), and billfish (9%). Monthly figures indicate that yellowfin is the target species for the Japanese vessels, whereas the South Koreans and Taiwanese mainly target bigeye.

It can be seen from Table 13 that yellowfin is the most significant species caught by the longliners. The catch of yellowfin in 1994 increased slightly, by 3%, while the catch of bigeye decreased by the same amount Billfish catches also increased, by 6% in 1994, while the "other" species category has remained virtually stable over the two years.

Figure 17 illustrates the catch composition for the four quarters of the two years combined. In the first two quarters yellowfin is the dominant species in the catch, representing 46% and 49% of the total catch in each of the two quarters, whereas in the last two quarters bigeye is predominant, with 54% and 64%, respectively, of the total catch. Billfish were more significant in the second quarter, with a tendency to become less so in the last two quarters.

CONCLUSION

Since the beginning of longline fishing in the western Indian Ocean in 1952 and the start of industrial purse-seine fishing in 1983, the fishery has expanded considerably in terms of effort by DWFNs, catch, and contributions to the local economies. By 1993 approximately 9% of the world's tuna catch came from the WIO. The

industrial purse-seine fishery is very well documented, and consequently clear trends are identifiable. Unfortunately, the longline fishery is not so well documented, due to, among other factors, the difficulty of retrieving logbooks. In the purse-seine fishery virtually 100% of licensed days are accounted for by logbook returns, whereas only about 20% of licensed days are accounted for by longliners in recent years. Better documentation of the longline fishery is seen as an urgent problem if the tuna stocks they target are to be monitored in a responsible way.

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