ESTIMATION OF BYCATCH AND DISCARDS IN CENTRAL AND WESTERN PACIFIC TUNA FISHERIES: PRELIMINARY RESULTS

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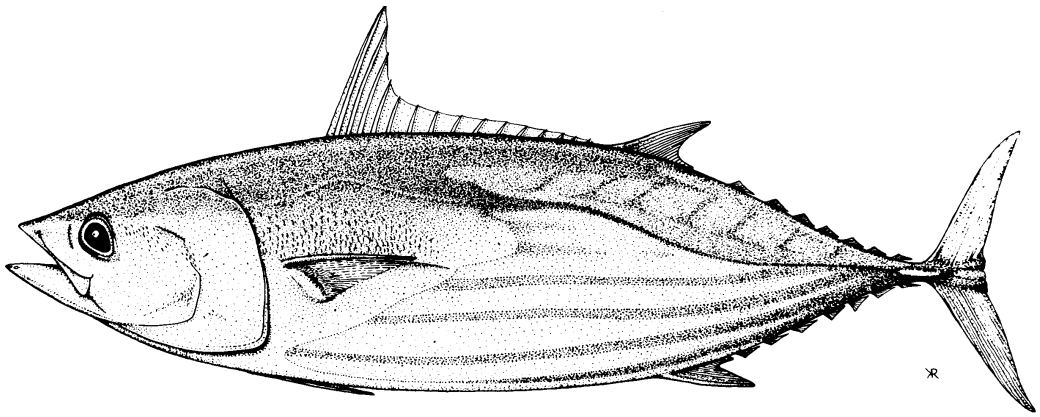

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INTRODUCTION

Recent interest in the species composition of tuna fisheries is perhaps best exemplified by the Implementing Agreement[1] of the United Nations Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks, which concluded in August 1995. In Article 1, General Principles, of Annex 1, Standard Requirements for the Collection and Sharing of Data, we find that, in addition to catch and effort data for straddling fish stocks and highly migratory fish stocks, "data collected should also include information on non-target and associated or dependent species." This paper examines species composition data collected by observers aboard tuna fishing vessels in the western and central Pacific Ocean during 1992–1997. Formulae are presented for estimating total catches, for both target and non-target species, including the retained catch and discards, for longliners and purse seiners, together with standard errors of the estimates.

The amount of observer data held by the South Pacific Commission on 1 May 1997 is summarised for purse seiners and longliners in Tables 1 and 2. Only observer data which can be used to estimate bycatch have been included in Tables 1 and 2. These data have been collected under several national observer programmes, in addition to the programmes managed by the South Pacific Commission (SPC) and the South Pacific Forum Fisheries Agency (FFA). For purse seiners, these data cover the period from August 1994 to November 1996, and for longliners, they cover the period from June 1992 to February 1997.

METHOD

Estimates of the catch of target and non-target species can be obtained from an estimate of the total effort, and estimates of the catch rate for each species determined from observer data.

Let C_i be the catch of species i in all strata, and let $C_{i,j}$ be the catch of species i in stratum j. In the preliminary analysis of longline bycatch presented below, the observer data are stratified by fishing nation, while in the analysis of purse-seine bycatch, the data are stratified by fishing nation and set type. Stratification by other factors, such as year, quarter or area, could also be incorporated. We have

$$C_i = \sum_j C_{i,j} \tag{1}$$

$$= \sum_j E_j \cdot U_{i,j} \tag{2}$$

where E_j is the effort in stratum j and where $U_{i,j}$ is the catch rate for species i in stratum j. The effort in stratum j can be estimated from an independent estimate of the catch in stratum j and an estimate of the catch rate:

$$\hat{E}_j = \frac{C_j}{U_j} \tag{3}$$

In the analyses of purse-seine and longline bycatch below, C_j is an estimate of the retained catch of target species in stratum j based on landings and/or logsheet data, and U_j is an estimate of the catch rate for retained catches of target species in stratum j based, for purse seine, on logsheet data held at SPC, and, for longline, either on observer data or on catch and effort data, stratified by time-area, provided by the fishing nation. For purse seine, the units of E_j and U_j are number of sets and metric tonnes per set respectively, while for longline the units are number of hooks and kilogrammes per 100 hooks respectively.

Estimates of the $U_{i,j}$ can be obtained from the observer data using

[1] Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks. Document A/CONF.164/37, United Nations Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks. United Nations, New York, 8 September 1995.

$$\hat{U}_{i,j} = \frac{\sum_k u_{i,j,k}}{n_j} \quad (4)$$

where the subscript k refers to the k^{th} replicate used to estimate the catch rate, and where n_j is the number of replicates for stratum j. In the longline and purse seine analyses presented below, a replicate is defined as each set sampled by an observer.

In order to derive a relationship between the number of replicates for each stratum, n_j, and the standard error of the estimate of C_i (the catch of species i in all strata), let us assume, first, that the C_j (the retained catch of target species in stratum j) are known without error, and, second, that the U_j (the catch rate for retained catches of target species in stratum j) are also known without error. The first assumption is reasonable, since the retained catch of target species, which accounts for most of the catch, is often known precisely from either logsheet or landings data. The second assumption is also reasonable, in most cases, since the target species account for most of the catch, and the catch rate for target species can be reliably estimated from logbook or observer data. These assumptions break down when discards of target species, and/or catches of non-target species, are relatively large and not known with precision. If we also assume that the estimates of the $U_{i,j}$ (the catch rate for species i in stratum j) are independent random variables, then the standard error of the estimate of C_i is given by

$$SE\left(\hat{C}_i\right) = \sqrt{\sum_j E_j^2 \cdot V\left(\hat{U}_{i,j}\right)} \quad (5)$$

where $V\left(\hat{U}_{i,j}\right)$ is the variance of the estimate of $U_{i,j}$. The $V\left(\hat{U}_{i,j}\right)$ are given by

$$V\left(\hat{U}_{i,j}\right) = \frac{V\left(u_{i,j,k}\right)}{n_j} \quad (6)$$

where $u_{i,j,k}$ is the catch rate for species i observed in the k^{th} replicate in stratum j, and where $V\left(u_{i,j,k}\right)$ is the variance of the $u_{i,j,k}$.

It is of interest to derive a formula relating the coefficient of variation[2] of the estimate of $C_{i,j}$ (the catch of species i in stratum j) to the number of replicates. First, it can be shown that an estimate of the coefficient of variation can be obtained from

$$CV\left(\hat{C}_{i,j}\right) = \frac{\sqrt{V\left(\hat{U}_{i,j}\right)}}{\hat{U}_{i,j}} \quad (7)$$

$$= CV\left(\hat{U}_{i,j}\right)$$

That is, given the assumptions mentioned above, the coefficient of variation of the $\hat{C}_{i,j}$ is equivalent to the coefficient of variation of the $\hat{U}_{i,j}$. Second, from equations (6) and (7), we have

$$n_j = \frac{V\left(u_{i,j,k}\right)}{\left[CV\left(\hat{C}_{i,j}\right) \cdot \hat{U}_{i,j}\right]^2} \quad (8)$$

Equation (8) can be used to estimate the number of sets that must be sampled in order to achieve a given coefficient of variation of the estimate of the catch of species i in stratum j.

[2] The coefficient of variation is the ratio of the standard error of an estimate to the estimated value. For example, a coefficient of variation of 0.10 would mean that the standard error is equal to 10 percent of the value of the estimate. A 95 percent confidence interval can be approximated by plus or minus twice the coefficient of variation. If the coefficient of variation is 0.10, then the confidence interval would be the estimate plus or minus 20 percent, i.e. from 80 percent of the estimate to 120 percent of the estimate.

PRELIMINARY RESULTS FOR PURSE SEINE

Quality of observer data

It can be seen from Table 2 that the observer data held at SPC have been collected by observers in several national programmes and from the observer programme of the United States treaty. A major problem in analysing the data collected by non-SPC observers is that SPC has been unable to debrief the observers or even, for trips for which the data have been provided to SPC electronically, to examine the original data collection forms.

In an attempt to circumvent this problem, SPC has either examined the forms, where possible, or contacted the supervisors of the observer programmes to ask for their judgement of the quality of the observer data. As a result, one trip by one MMA observer and five trips by five NFA observers were eliminated from the analysis.

It was considered that the average number of species recorded by observers might be indicative of the quality of the data, such that bycatch data from observers which record more species, on average, would be more accurate. Table 3 presents the ranking of 48 observers by the average number of species recorded for sets associated with floating objects. The range is considerable, from 1.4 species per set to 7.4 species per set. The ranking does not appear to be related to the programme to which the observer belongs.

However, this information is of limited use due to the small number of trips for most observers. SPC observers confirm that there can often be only a small number of species caught even in associated sets; hence the ranking of certain observers may not be indicative of poor quality data. For most observers, a greater number of trips is necessary before the information presented in Table 3 can be considered useful.

Comparison of observer estimates of retained catches of target species and estimates recorded on logsheets

It is of interest to compare the observers' estimates of retained catches of target species to an independent estimate. While estimates recorded on logsheets submitted by the captains may not necessarily be more accurate than observers' estimates, the comparison may still shed some light on the quality of the observer data.

In order to conduct such a comparison, the logsheet data which corresponds to an observer trip must be available. Of the 74 trips covered by observer data that were used in this analysis, 38 trips, or 51 per cent, are also covered by logsheet data held at SPC. Furthermore, the start of set time recorded by the observer must be matched to the start of set time recorded on the logsheet. Of the 545 positive sets sampled by observers for which the trip was covered by logsheet data, 20 sets, or 3.7 per cent, were matched to sets in the logsheet data having the same start of set time. An additional 106 sets, or 19.4 per cent, were matched to set times in the logsheet data that fell within a two-hour interval (i.e. within plus or minus one hour) from the set time recorded by the observer. When the interval about the observer's set time was increased from two hours to four hours or to eight hours, the percentage of sets matched increased to 30.8 per cent and 39.3 per cent respectively. There are thus discrepancies between set times recorded by observers and on logsheets for a large proportion of the observer data.

For the 20 sets sampled by observers with set times which matched exactly with logsheet data, there were 12 sets for which the retained catch of target species recorded by the observer was the same as that recorded on the logsheet. For the remaining 8 sets, the difference was minor, less than 10 per cent of the catch recorded on the logsheet. Hence, it would appear that for these sets, the observer obtained both the set time and the retained catch of target species from the captain or crew.

Figure 1 shows the distribution of the ratio of logsheet to observer estimates of the retained catch of target species, for sets for which the logsheet set time was within one hour of the observer set time, and for which the observer estimate was greater than zero. For 35 sets out of a total of 106, the ratio ranged from 0.95 to 1.05, i.e. the observer and logsheet estimates were identical or almost identical. For 18 sets, the ratio ranged from 1.05 to 1.15, i.e. the logsheet estimates were slightly larger than the observer estimates. There were 13 sets for which the observer estimate was greater than zero and the logsheet estimate was zero, and

there were 9 sets for which the logsheet estimate was twice as great, or more, than the observer's estimate. Hence, it appears that in about half the cases, the observer and logsheet estimates are relatively close, while in about one third of the cases, there were large differences in the estimates. From a visual inspection, it did not appear that the frequency of large differences was related to vessel nationality.

Incidence of species and species groups

Table 4 gives the incidence of species and species groups in purse-seine sets sampled by observers. In many cases, the observer was unable to identify the species, and recorded only the species group. This occurred most notably for sharks; 'unidentified sharks' was the third species or species group most frequently observed, after skipjack and yellowfin.

Estimates of fishing effort

The estimation of purse-seine bycatch was restricted to the American, Japanese, Korean and Taiwanese fleets due to the small number of sets sampled for the other fleets. Table 5 presents estimates of the total number of sets, for the four major fleets, determined from estimates of the retained catch of target species based on landings and/or logsheet data, and estimates of the proportion caught by set type and the average retained catch of target species per set, determined from logsheet data held at SPC. The four major fleets accounted for about 87 per cent of the retained catch of target species in the purse-seine fishery during 1996.

Preliminary estimates of purse-seine bycatch

Preliminary estimates of bycatch for the four major fleets were derived in order to identify the important bycatch species and to examine the sample sizes that may be required for reliable estimates.

Certain species were combined with their species group in the analysis; these include sharks, oceanic triggerfishes, mackerel and trevallies. The observer data for all years were used to estimate the average catches per set.

Table 6 presents estimates of catches by species, together with standard errors and coefficients of variation. Table 7 presents catch estimates by species and by fleet, with standard errors, coefficients of variation, and an estimate of the sample sizes necessary for a coefficient of variation equal to 10 per cent.

Only species for which the appropriate unit of catch is weight, rather than number of individuals, have been examined in Tables 6 and 7. Results for species for which the appropriate unit of catch is numbers of individuals are presented in Table 8.

Target species were defined as bigeye, skipjack and yellowfin, while bycatch species were defined as all other species.

The following points are of interest:

- The overall discard rate for target species was low, 3.5 per cent, and the overall bycatch rate was less than 1 per cent. Discards and bycatch together are equal to only 4.2 per cent of the total catch.

- The rate of discarding target species from unassociated sets was 1.2 per cent of the total catch, while the rate of discarding target species from associated sets was 5.7 per cent.

- The bycatch rates for unassociated sets was 0.5 per cent of the total catch, while the bycatch rate for associated sets was 0.9 per cent.

- The only coefficient of variation less than 10 per cent in Table 6 is for skipjack, for which the coefficient of variation was 7.5 per cent. If an estimate with a coefficient of variation of 10 per cent, and hence an approximate 95 per cent confidence interval of plus or minus 20 per cent, is considered reliable, then skipjack is the only species for which the catch estimate can be considered reliable.

- Nevertheless, Table 6 gives a rough indication of the relative importance of the bycatch species. No species other than the target species (skipjack, yellowfin and bigeye) accounted for more than 1 per cent of the catch. The most important bycatch

species were the shark species group and rainbow runner. No other species or species group accounted for more than 1,000 mt. Species which accounted for between 100 mt and 1,000 mt included *Decapturus sp.*, frigate tuna, oceanic triggerfish, mackerel, black marlin, mahi mahi and blue marlin.

- Excluding skipjack, the coefficient of variation for the total catch by species in Table 6 ranges from 12.6 per cent to 100 per cent. It was shown that, under the assumptions discussed above, the coefficient of variation of the catch estimate is equivalent to the coefficient of variation of the estimate of the average catch per set. The estimate of the average catch per set for each species and fleet (Table 7) can be unreliable due to a high level of variability in the catch per set and/or to a small sample size.

- Table 7 presents estimates of the number of sets that must be sampled to achieve a coefficient of variation of 10 per cent. When the coefficient of variation is large, the estimate of the number of sets required is also large, sometimes in excess of the estimate of the total annual number of sets made (Table 5). The implication is that for certain species, i.e. those for which the average catch per set is almost negligible, a reliable estimate of the average catch per set may only be obtained through total enumeration.

- For species for which the average catch per set is non-negligible, the estimate of the number of sets listed in Table 7 is a rough indication of the amount of sampling necessary to obtain reliable estimates of the catch per set. For example, for Japanese purse seiners fishing on associated schools, a reliable estimate of the catch of rainbow runner may require sampling of about 987 sets, or 28 per cent of the total number of associated sets during 1996. For the American fleet fishing associated schools, estimates for rainbow runner may require sampling of about 1,089 sets or 39 per cent of the total. The level of sampling would thus appear to depend on the species, the fleet, and the reliability required.

Comparison of estimates of the retained catch of target species based on observer data to those based on landings and logsheet data

Table 9 presents a comparison of estimates of the retained catch of target species based on observer data to those based on landings and/or logsheet data. The estimates for skipjack based on landings and/or logsheets are considered reliable. The estimates for yellowfin based on landings and/or logsheets slightly overestimate actual catches. The estimates for bigeye based on landings and/or logsheets seriously underestimate actual catches.

The estimate of the annual catch of bigeye by the four major fleets based on observer data is twice as great as the estimate based on landings. The average catch per set based on observer data is 4.2 times greater than the average catch per set based on logsheet data. The logsheet data are known to seriously underestimate catches of bigeye; hence the estimates based on observer data are probably more accurate.

The estimates of the annual catch of skipjack are similar; the estimate based on observer data is equal to 87 per cent of the estimate based on landings and/or logsheets. The estimates of average catch per set are also relatively close.

In contrast, the estimate of the annual catch of yellowfin based on observer data is 2.4 times greater than the estimate based on landings and/or logsheets. The average catch per set based on observer data is 2.4 times greater than the estimate based on landings and/or logsheets.

The differences in the estimates of the yellowfin catch and catch per set may be due in part to the different time periods covered by the observer data (i.e. 1994–1996) and the landings and logsheet data (i.e. 1996). For example, oceanographic conditions may have been responsible for the drop in yellowfin catch rates that was experienced by the fishery during 1996. The differences may also be due to the small sample size for the Japanese, Korean and Taiwanese fleets, and possibly to systematic biases in either the observer data or the landings and logsheet data.

Discards of target species

Table 10 presents estimates of annual discards of target species, based on observer data, for the four major purse-seine fleets. The total amount of discards of target species, based on an estimate of fishing effort for 1996, is estimated at 24,089 mt. Skipjack accounted for 73 per cent of discards of target species, while yellowfin and bigeye accounted for 22 and 5 per cent respectively. Associated sets accounted for 84 per cent of discards of target species, while unassociated sets accounted for 16 per cent.

PRELIMINARY RESULTS FOR LONGLINE

Incidence of species and species groups

Table 11 gives the incidence of species and species groups in longline sets sampled by observers. A total of 54 species or species groups were observed, and 26 species were found in more than 10 per cent of sets.

Estimates of fishing effort

The estimation of longline bycatch was restricted to fleets for which there were at least 20 sets sampled. Data for the Japanese fleet was further stratified into two areas: the SPC statistical area between 15°N and 10°S, and the SPC area south of 10°S. The Taiwanese fleet was stratified into the offshore fleet and the distant-water fleet. In each case, the species composition differs considerably among the strata. The fleets examined accounted for about 77 per cent of the retained catch of target species in the SPC statistical area during 1996.

Table 12 presents estimates of the total number of hooks, determined from independent estimates of the retained catch of target species and estimates of the average catch rate for retained catches of target species. The catch rate was estimated from observer data, except for the Japanese fleets and the Taiwanese distant-water fleet, for which the catch rate was determined from catch and effort data, stratified by time-area, provided by the fishing nation.

Preliminary estimates of longline bycatch

Table 13 presents estimates of catches by species, together with standard errors and coefficients of variation, for the longline fleets listed in Table 12. Table 14 presents catch estimates by species and by fleet, with standard errors, coefficients of variation, and an estimate of the sample sizes necessary for a coefficient of variation equal to 10 per cent.

Only species for which the appropriate unit of catch is weight, rather than number of individuals, have been examined in Tables 13 and 14. Results for species for which the appropriate unit of catch is numbers of individuals are presented in Table 15. The weights of most fish sampled were assigned either by applying weight-length relationships to lengths measured by observers, or by using average weights.

For convenience, target species were defined as albacore, bigeye and yellowfin, for all fleets, while bycatch was defined as all other species. However, several bycatch species have commercial value, and certain vessels have targeted billfish or sharks. Estimates of discards do not include fish for which the condition code assigned by the observer was ‘alive and healthy’.

The following points are of interest:

- The overall discard rate for target species was relatively low, 3.8 per cent of the total catch, while the overall bycatch rate was high, 42 per cent. Sharks accounted for 23 per cent of the total catch.

- The coefficients of variation in Table 13 were less than 10 per cent for fifteen species. The total number of sets sampled was about half the number of purse-seine sets sampled; however, it would appear that longline catch rates are much less variable than for purse seine. The implication is that, in general, sample sizes necessary for reliable estimates of bycatch will be smaller for longline than for purse seine.

- The most important bycatch species was blue shark, followed by blue marlin, swordfish, striped marlin, wahoo, sailfish, black marlin, escolars, silky shark, thresher shark and oceanic white-tip shark. Eighteen

other species or species groups accounted for catches between 100 and 1,000 mt.

- Table 14 presents estimates of the number of sets that must be sampled to achieve a coefficient of variation of 10 per cent. The coefficients of variation for individual fleets are much greater than for all fleets combined. For example, for the Taiwanese offshore fleet, which was the most heavily sampled, only bigeye and yellowfin had a coefficient of variation of less than 10 per cent. It is estimated that in order to obtain improved estimates of the two most important bycatch species, blue shark and blue marlin, only a relatively small amount of sampling would be required, while for relatively rare bycatch species, such as hammerhead sharks, 4,571 thousand hooks, about 36 per cent of total effort during 1996, would need to be sampled.

Comparison of estimates of the retained catch of target species based on observer data to those based on landings and logsheet data

Table 16 presents a comparison of estimates of the retained catch of target species based on observer data to those based on landings and/or logsheet data.

The estimates of the annual retained catch of albacore based on observer data is 84 per cent of the estimate based on landings and/or logsheets, while the estimates of the annual retained catch of bigeye are almost identical. The estimates of the annual retained catch of yellowfin based on observer data is 76 per cent of the estimate based on landings and/or logsheets. As for purse seine, the differences may be due to the different time periods covered by the observer data, and the landings and logsheet data.

Discards of target species

Table 17 presents estimates of annual discards of target species (albacore, bigeye and yellowfin), based on observer data, for certain longline fleets in the SPC statistical area. The total amount of discards of target species is estimated at 5,160 mt per annum. Yellowfin accounted for 69 per cent of discards of target species, while albacore and bigeye accounted for 17 and 14 per cent respectively.

CONCLUSION

This study has identified important bycatch species in purse-seine and longline fisheries in the central and western Pacific, and has examined the reliability of estimates of annual bycatch based on catch rates determined from observer data collected over several years. The question arises whether the available observer data are representative of the fisheries and, hence, whether they will result in unbiased catch estimates. It was shown that large discrepancies exist between estimates of purse-seine catches of yellowfin based on observer data and estimates based on landings and logsheet data. In order to fully examine the accuracy of catch estimates determined from observer data, the effects of various factors, such as year, quarter and area, on the variation in average catch rates will need to be explored.

Table 1. Purse-seine observer data held at SPC, summarised by year, observer programme and fishing nation. Observer programme codes: MMAOB = Micronesian Maritime Authority, NR = Nauru Department of Fisheries and Marine Resources, PNGOB = Papua New Guinea National Fisheries Authority, SPOB = South Pacific Commission, USMLT = US multilateral treaty. Fishing nation codes: FM = Federated States of Micronesia, JP = Japan, KI = Kiribati, KR = Korea, PG = Papua New Guinea, PH = Philippines, TW = Taiwan, US = United States of America, VU = Vanuatu.

YEAR	PROGRAM	FLAG	VESSELS	TRIPS	DAYS	SETS		
						UNASS	ASSOC	TOTAL
1994	USMLT	US	3	3	108	98	13	111
1995	MMAOB	FM	1	1	31	16	15	31
		JP	2	2	40	6	30	36
		KI	1	1	28	0	16	16
		PG	2	2	53	11	18	29
		TW	2	2	38	8	17	25
		VU	1	1	13	7	1	8
		TOT	9	9	203	48	97	145
	SPOB	JP	1	1	24	2	23	25
		TW	1	1	45	1	39	40
		TOT	2	2	69	3	62	65
	USMLT	US	12	12	298	209	26	235
	TOTAL		23	23	570	260	185	445
1996	NR	JP	1	1	22	1	14	15
	PNGOB	KR	3	3	45	20	25	45
		PG	1	1	19	8	6	14
		TW	5	5	150	96	47	143
			9	9	214	124	78	202
	SPOB	KR	5	5	65	24	30	54
		PH	3	3	28	1	25	26
		TW	1	2	68	28	42	70
		VU	1	1	16	6	9	15
		TOT	10	11	177	59	106	165
	USMLT	US	23	25	667	267	311	578
	TOTAL		43	46	1,080	451	509	960
GRAND TOTAL			69	72	1,758	809	707	1,516

Table 2. Longline observer data held at SPC. See Table 1 for observer programme codes. Fishing nation codes: CN = China, FJ = Fiji, FM = Federated States of Micronesia, JP = Japan, KR = Korea, NC = New Caledonia, PF = French Polynesia, PG = Papua New Guinea, TO = Tonga, TW = Taiwan, US = United States of America. LO = between 10°N and 10°S. HI = south of 10°S. OS = offshore. DW = distant-water.

YEAR	PROGRAM	FLEET	VESSELS	TRIPS	DAYS	SETS
1992	MMAOB	KR	1	1	11	8
	SPOB	NC	1	1	4	4
	TOTAL		2	2	15	12
1993	MMAOB	CN	2	2	18	18
		JP LO	2	2	27	25
		KR	1	1	6	6
		TW OS	4	4	34	34
		TOT	9	9	85	83
	SPOB	PF	1	1	3	2
	TOTAL		10	10	88	85
1994	MMAOB	CN	4	4	28	28
		FM	1	1	7	5
		JP LO	3	3	46	39
		TW OS	12	12	93	92
		TOT	20	20	174	164
	SPOB	FJ	1	1	5	4
	TOTAL		21	21	179	168
1995	MIMRA	CN	5	6	50	50
	MMAOB	CN	3	4	19	29
		FM	1	1	2	1
		JP LO	4	4	53	43
		TW OS	4	4	28	26
		US	2	2	26	22
		TOT	14	15	128	121
	SPOB	CK	1	1	6	6
		CN	3	3	26	26
		FJ	2	3	29	26
		FM	1	1	3	2
		JP HI	1	1	12	11
		TO	1	1	18	17
		TW OS	5	5	46	46
		US	1	1	5	5
		TOT	15	16	145	139
	TOTAL		34	37	323	310
1996	MMAOB	FM	1	1	7	6
	SPOB	CK	1	1	1	1
		JP HI	2	2	34	31
		NC	5	8	62	57
		PG	1	1	9	9
		TW DW	1	1	83	74
		TO	1	1	3	3
		TOT	11	14	192	175
	TOTAL		12	15	199	181
1997	SPOB	TW DW	1	1	31	29
GRAND TOTAL			79	85	804	785

Table 3. Ranking of purse-seine observers by the average number of species recorded for associated sets, with the observer programme, the number of trips and the number of sets sampled. See Table 1 for observer programme codes.

RANK	PROG	TRIPS	SETS	AVG
1	USMLT	1	5	7.4
2	SPOB	4	70	7.1
3	USMLT	1	1	7.0
4	MMAOB	2	13	6.9
5	MMAOB	2	23	6.3
6	USMLT	2	10	6.1
7	USMLT	2	15	6.1
8	USMLT	1	15	5.9
9	USMLT	1	14	5.6
10	USMLT	1	9	5.4
11	USMLT	1	14	5.4
12	USMLT	1	7	5.1
13	MMAOB	2	25	5.1
14	USMLT	1	11	5.0
15	SPOB	1	5	4.8
16	USMLT	1	29	4.7
17	MMAOB	1	17	4.6
18	USMLT	1	5	4.6
19	USMLT	1	22	4.5
20	MMAOB	2	21	4.5
21	USMLT	1	2	4.5
22	USMLT	1	4	4.5
23	USMLT	1	3	4.3
24	PNGOB	2	4	4.3
25	PNGOB	1	19	4.3
26	USMLT	1	22	4.1
27	USMLT	1	17	4.1
28	NR	2	48	3.9
29	PNGOB	1	2	3.5
30	PNGOB	1	6	3.5
31	SPOB	2	48	3.5
32	PNGOB	1	14	3.4
33	SPOB	2	33	3.3
34	USMLT	1	6	3.2
35	USMLT	1	15	3.1
36	PNGOB	1	14	3.0
37	USMLT	1	1	3.0
38	SPOB	5	12	2.8
39	PNGOB	1	10	2.7
40	USMLT	1	3	2.3
41	PNGOB	1	10	2.2
42	USMLT	1	6	2.2
43	USMLT	1	20	2.1
44	USMLT	1	2	2.0
45	USMLT	1	13	1.8
46	USMLT	1	22	1.6
47	USMLT	2	16	1.6
48	PNGOB	1	9	1.4

Table 4. Incidence (number of sets and percentage of sets) of species and species groups observed in purse-seine sets

NO	CODE	SPECIES OR SPECIES GROUP	SETS	%
1	SKJ	Skipjack	1,366	83.55
2	YFT	Yellowfin	890	54.43
3	SHK	Sharks (unidentified)	575	35.17
4	RRU	Rainbow Runner	345	21.10
5	BET	Bigeye	305	18.65
6	TRI	Oceanic (pelagic) triggerfishes	215	13.15
7	BAR	Barracudas	118	7.22
8	WAH	Wahoo	118	7.22
9	BLZ	Blue Marlin	97	5.93
10	DOL	Mahi Mahi, Dolphinfish, Dorado	92	5.63
11	BLM	Black Marlin	91	5.57
12	MAX	Mackerel (unident, prob Decapterus)	76	4.65
13	MAN	Manta rays	29	1.77
14	UNS	Fish (unidentified)	25	1.53
15	DPT	Decapturus sp.	24	1.47
16	BLT	Bullet tuna	17	1.04
17	FRI	Frigate tuna	17	1.04
18	BUP	Pacific rudderfish	14	0.86
19	PLS	Pelagic sting-ray	14	0.86
20	SFA	Sailfish (Indo-Pacific)	10	0.61
21	TRE	Trevallies (unidentified - Jacks)	10	0.61
22	SWO	Swordfish	5	0.31
23	DLP	Dolphins/porpoises	2	0.12
24	MAM	Marine (aquatic) mammal	2	0.12
25	MLS	Striped Marlin	2	0.12
26	ALB	Albacore	1	0.06
27	CXS	Bigeye trevally	1	0.06
28	KAW	Kawakawa	1	0.06
29	KYC	Drummer (blue chub)	1	0.06
30	LEO	Olive Ridley turtle	1	0.06
31	MOX	Ocean sunfish	1	0.06
32	PSK	Crocodile shark	1	0.06
33	RHN	Whale shark	1	0.06
34	SQU	Squids	1	0.06

Table 5. Estimates of the total number of sets, by set type, during 1996, for the four major purse-seine fleets, determined from the catch of target species (metric tonnes) and the average catch rate (metric tonnes per set) for target species. See Table 1 for fishing nation codes.

FISHING NATION	CATCH	UNASSOCIATED SETS			ASSOCIATED SETS			TOTAL NUMBER OF SETS
		PROP	CATCH RATE	NUMBER OF SETS	PROP	CATCH RATE	NUMBER OF SETS	
JP	159,125	0.291	20.8	2,254	0.709	33.8	3,485	5,740
KR	142,957	0.540	24.3	3,228	0.460	33.2	2,178	5,407
TW	178,971	0.487	25.8	3,406	0.513	29.8	3,172	6,578
US	126,090	0.330	16.8	2,558	0.670	33.9	2,762	5,321
TOTAL	607,143	0.416	22.0	11,446	0.584	30.6	11,597	23,046

Table 6. Preliminary estimates of annual catches (metric tonnes) by the American, Japanese, Korean and Taiwanese purse-seine fleets in the SPC statistical area, determined from catch rates estimated from observer data collected during 1994–1996 and estimates of fishing effort for 1996. Standard errors and coefficients of variation of the catch estimates, and the percentage of the total catch, are also given. Totals are given for discards of target species, and the retained and discarded catch of bycatch species. See Table 4 for species codes.

SPECIES CODE	UNASSOCIATED SETS				ASSOCIATED SETS				TOTAL			
	CATCH	SE	CV	%	CATCH	SE	CV	%	CATCH	SE	CV	%
BAR	9	7	0.772	0.00	50	22	0.449	0.01	59	23	0.397	0.01
BET	2,727	2,045	0.750	0.80	19,800	4,971	0.251	5.58	22,528	5,375	0.239	3.23
BLM	100	41	0.419	0.03	145	49	0.338	0.04	245	64	0.263	0.04
BLT	0	-	-	0.00	72	31	0.431	0.02	72	31	0.431	0.01
BLZ	70	28	0.405	0.02	99	28	0.286	0.03	170	40	0.237	0.02
BUP	0	-	-	0.00	17	15	0.936	0.00	17	15	0.936	0.00
DOL	1	0	0.673	0.00	183	111	0.607	0.05	184	111	0.603	0.03
DPT	198	150	0.760	0.06	325	130	0.400	0.09	523	199	0.380	0.08
FRI	433	433	1.000	0.13	2	0	0.429	0.00	436	433	0.995	0.06
MAN	6	1	0.311	0.00	5	4	0.694	0.00	11	4	0.378	0.00
MAX	0	-	-	0.00	284	85	0.302	0.08	284	85	0.302	0.04
MOX	0	-	-	0.00	4	4	1.000	0.00	4	4	1.000	0.00
PLS	5	5	0.855	0.00	1	0	0.363	0.00	7	5	0.711	0.00
RHN	0	-	-	0.00	9	9	1.000	0.00	9	9	1.000	0.00
RRU	44	26	0.605	0.01	1,118	224	0.201	0.32	1,162	226	0.195	0.17
SFA	4	2	0.504	0.00	2	2	0.973	0.00	7	3	0.476	0.00
SHK	781	353	0.452	0.23	548	71	0.131	0.15	1,330	360	0.271	0.19
SKJ	236,148	29,085	0.123	68.93	228,048	19,415	0.085	64.32	464,196	34,970	0.075	66.59
SWO	0	0	1.000	0.00	2	1	0.595	0.00	3	1	0.511	0.00
TRE	0	-	-	0.00	2	1	0.384	0.00	2	1	0.384	0.00
TRI	32	12	0.399	0.01	296	39	0.133	0.08	328	41	0.126	0.05
UNS	12	10	0.812	0.00	15	4	0.291	0.00	27	10	0.394	0.00
WAH	1	1	0.673	0.00	25	7	0.283	0.01	27	7	0.269	0.00
YFT	102,016	38,216	0.375	29.78	103,472	15,541	0.150	29.19	205,488	41,256	0.201	29.48
TOTAL	342,595	48,073	0.140	100.00	354,536	25,363	0.072	100.00	697,132	54,353	0.078	100.00
DISCARDS	3,965	821	0.207	1.16	20,123	3,166	0.157	5.68	24,089	3,270	0.136	3.46
BYCATCH	1,703	582	0.342	0.50	3,215	314	0.098	0.91	4,918	662	0.135	0.71

Table 7. Preliminary estimates of purse-seine catches (metric tonnes), by species, fishing nation and set type, in the SPC statistical area, determined from catch rates estimated from observer data collected during 1994–1996 and estimates of fishing effort for 1996. The average catch per set, standard error and coefficient of variation of the catch estimate, the number of sets that must be sampled to achieve a coefficient of variation of 10 per cent, and the percentage of the total catch, are also shown. See Table 1 for fishing nation codes and Table 4 for species codes.

FISHING NATION	SPECIES CODE	UNASSOCIATED SETS					ASSOCIATED SETS					ALL SETS			
		CPS	CATCH	SE	CV	CV=10%	CPS	CATCH	SE	CV	CV=10%	CATCH	SE	CV	%
JP	BAR	0.004	8	7	0.875	689	0.004	12	3	0.285	543	20	8	0.398	0.01
	BET	0.021	47	37	0.791	563	0.125	417	260	0.624	2,608	464	263	0.566	0.34
	BLM	0.017	37	37	1.000	900	0.013	45	16	0.348	812	82	40	0.492	0.06
	BLT	0.000	-	-	-	-	0.016	52	28	0.544	1,980	52	28	0.544	0.04
	BLZ	0.004	10	10	1.000	900	0.018	60	26	0.440	1,299	69	28	0.404	0.05
	DOL	0.000	-	-	-	-	0.049	162	111	0.685	3,140	162	111	0.685	0.12
	DPT	0.089	198	151	0.760	520	0.096	323	130	0.404	1,093	521	199	0.383	0.38
	MAN	0.000	-	-	-	-	0.001	3	3	1.000	6,700	3	3	1.000	0.00
	MAX	0.000	-	-	-	-	0.025	85	41	0.478	1,533	85	41	0.478	0.06
	MOX	0.000	-	-	-	-	0.001	5	5	1.000	6,700	5	5	1.000	0.00
	RRU	0.017	37	26	0.707	450	0.143	479	184	0.384	987	516	186	0.360	0.38
	SHK	0.107	238	221	0.932	781	0.085	285	64	0.226	342	522	231	0.441	0.38
	SKJ	12.056	26,858	24,567	0.915	753	14.328	47,896	14,074	0.294	578	74,754	28,313	0.379	55.05
	TRE	0.000	-	-	-	-	0.001	3	1	0.395	1,046	3	1	0.395	0.00
	TRI	0.006	14	9	0.665	397	0.017	58	10	0.170	192	72	13	0.187	0.05
	WAH	0.000	1	1	1.000	900	0.001	5	2	0.428	1,228	6	2	0.394	0.00
	YFT	19.222	42,822	36,736	0.858	662	4.676	15,630	5,082	0.325	708	58,452	37,086	0.634	43.05
	TOT		70,269	44,194	0.629			65,519	14,968	0.228		135,788	46,660	0.344	100.00
	DIS		296	199	0.672			1,115	228	0.205		1,411	303	0.215	1.04
	BYC		543	272	0.501			1,576	266	0.169		2,119	381	0.180	1.56

FISHING NATION	SPECIES CODE	UNASSOCIATED SETS					ASSOCIATED SETS					ALL SETS			
		CPS	CATCH	SE	CV	CV=10%	CPS	CATCH	SE	CV	CV=10%	CATCH	SE	CV	%
KR	BAR	0.000	0	0	1.000	4,400	0.000	1	0	0.497	1,356	1	0	0.447	0.00
	BET	0.000	-	-	-	-	1.423	2,819	969	0.344	649	2,819	969	0.344	1.52
	BLM	0.004	12	12	1.000	4,400	0.024	47	43	0.918	4,631	59	45	0.757	0.03
	BLZ	0.002	7	6	0.874	3,363	0.001	2	2	1.000	5,500	9	6	0.734	0.00
	DOL	0.000	-	-	-	-	0.002	4	3	0.897	4,420	4	3	0.897	0.00
	FRI	0.136	434	434	1.000	4,400	0.000	0	0	1.000	5,500	434	434	1.000	0.23
	MAX	0.000	-	-	-	-	0.001	2	2	0.799	3,511	2	2	0.799	0.00
	PLS	0.002	6	5	0.881	3,415	0.000	-	-	-	-	6	5	0.881	0.00
	RRU	0.000	-	-	-	-	0.118	233	74	0.317	552	233	74	0.317	0.13
	SHK	0.074	236	143	0.605	1,611	0.039	77	20	0.255	356	313	144	0.461	0.17
	SKJ	20.718	65,917	12,371	0.188	154	33.843	67,036	11,084	0.165	150	132,953	16,610	0.125	71.83
	TRI	0.000	0	0	1.000	4,400	0.030	60	17	0.286	450	60	17	0.286	0.03
	UNS	0.000	-	-	-	-	0.008	15	5	0.295	480	15	5	0.295	0.01
	WAH	0.000	-	-	-	-	0.000	1	1	1.000	5,500	1	1	1.000	0.00
	YFT	8.134	25,879	9,387	0.363	578	11.257	22,298	4,485	0.201	222	48,177	10,403	0.216	26.03
	TOT		92,492	15,536	0.168			92,595	11,996	0.130		185,086	19,629	0.106	100.00
	DIS		647	200	0.308			7,970	2,825	0.354		8,617	2,832	0.329	4.66
	BYC		696	457	0.657			442	90	0.203		1,137	466	0.410	0.61

Table 7 continued

FISHING NATION	SPECIES CODE	UNASSOCIATED SETS					ASSOCIATED SETS					ALL SETS			
		CPS	CATCH	SE	CV	CV=10%	CPS	CATCH	SE	CV	CV=10%	CATCH	SE	CV	%
TW	BAR	0.000	1	0	0.553	4,062	0.011	34	22	0.648	6,083	35	22	0.636	0.02
	BET	0.729	2,463	2,043	0.830	9,152	2.602	8,009	4,738	0.592	5,074	10,472	5,160	0.493	5.44
	BLM	0.010	32	15	0.452	2,722	0.012	37	16	0.438	2,784	69	22	0.315	0.04
	BLT	0.000	-	-	-	-	0.007	20	13	0.640	5,933	20	13	0.640	0.01
	BLZ	0.011	39	26	0.675	6,054	0.010	32	11	0.328	1,560	71	28	0.397	0.04
	BUP	0.000	-	-	-	-	0.005	16	16	0.968	13,588	16	16	0.968	0.01
	DOL	0.000	1	1	0.939	11,729	0.001	4	1	0.339	1,664	4	1	0.326	0.00
	DPT	0.000	-	-	-	-	0.001	3	2	0.508	3,736	3	2	0.508	0.00
	FRI	0.000	-	-	-	-	0.001	2	1	0.454	2,984	2	1	0.454	0.00
	MAN	0.001	3	2	0.539	3,866	0.001	3	3	1.000	14,500	6	4	0.578	0.00
	MAX	0.000	-	-	-	-	0.062	192	76	0.393	2,238	192	76	0.393	0.10
	PLS	0.000	0	0	1.000	13,300	0.000	1	0	0.416	2,508	1	0	0.384	0.00
	RHN	0.000	-	-	-	-	0.003	10	10	1.000	14,500	10	10	1.000	0.01
	RRU	0.001	4	4	0.977	12,698	0.098	301	104	0.346	1,734	305	104	0.341	0.16
	SFA	0.001	3	2	0.704	6,599	0.001	3	3	1.000	14,500	5	3	0.610	0.00
	SHK	0.001	5	2	0.500	3,330	0.023	72	22	0.307	1,369	77	22	0.290	0.04
	SKJ	20.343	68,710	8,607	0.125	208	15.288	47,053	6,056	0.129	240	115,763	10,524	0.091	60.12
	SWO	0.000	1	1	1.000	13,300	0.000	1	1	1.000	14,500	2	1	0.714	0.00
	TRI	0.005	18	9	0.510	3,454	0.054	167	34	0.203	600	185	35	0.190	0.10
	WAH	0.000	0	0	1.000	13,300	0.005	14	7	0.486	3,431	14	7	0.476	0.01
	YFT	5.285	17,849	4,383	0.246	801	15.415	47,441	13,909	0.293	1,246	65,290	14,583	0.223	33.91
	TOT		89,128	9,872	0.111			103,416	15,893	0.154		192,544	18,710	0.097	100.00
	DIS		635	227	0.357			2,170	444	0.205		2,805	499	0.178	1.46
	BYC		106	32	0.299			914	140	0.153		1,020	144	0.141	0.53

FISHING NATION	SPECIES CODE	UNASSOCIATED SETS					ASSOCIATED SETS					ALL SETS			
		CPS	CATCH	SE	CV	CV=10%	CPS	CATCH	SE	CV	CV=10%	CATCH	SE	CV	%
US	BAR	0.000	0	0	0.386	8,556	0.001	3	1	0.270	2,553	3	1	0.246	0.00
	BET	0.088	218	83	0.379	8,242	3.435	8,556	1,122	0.131	601	8,774	1,125	0.128	4.78
	BLM	0.007	18	4	0.237	3,235	0.007	16	6	0.347	4,208	35	7	0.206	0.02
	BLZ	0.006	15	3	0.215	2,658	0.002	6	2	0.390	5,328	21	4	0.190	0.01
	BUP	0.000	-	-	-	-	0.000	1	0	0.465	7,577	1	0	0.465	0.00
	DOL	0.000	0	0	0.783	35,175	0.005	14	3	0.206	1,483	14	3	0.201	0.01
	MAN	0.001	3	1	0.320	5,873	0.000	0	0	1.000	35,000	3	1	0.309	0.00
	MAX	0.000	-	-	-	-	0.002	5	1	0.261	2,388	5	1	0.261	0.00
	RRU	0.001	2	1	0.437	10,967	0.042	105	18	0.176	1,089	107	18	0.173	0.06
	SFA	0.001	2	1	0.715	29,339	0.000	0	0	1.000	35,000	2	1	0.692	0.00
	SHK	0.122	303	236	0.777	34,617	0.046	115	12	0.101	355	419	236	0.564	0.23
	SKJ	30.096	74,663	3,912	0.052	157	26.522	66,063	4,399	0.067	155	140,727	5,887	0.042	76.60
	SWO	0.000	-	-	-	-	0.001	1	1	0.701	17,184	1	1	0.701	0.00
	TRI	0.000	1	0	0.654	24,524	0.005	11	2	0.153	817	12	2	0.149	0.01
	UNS	0.005	12	10	0.812	37,853	0.000	0	0	1.000	35,000	12	10	0.807	0.01
	WAH	0.000	0	0	0.599	20,588	0.002	6	1	0.171	1,023	6	1	0.166	0.00
	YFT	6.234	15,466	1,918	0.124	882	7.268	18,104	1,465	0.081	229	33,570	2,413	0.072	18.27
	TOT		90,707	4,364	0.048			93,007	4,770	0.051		183,713	6,465	0.035	100.00
	DIS		2,388	737	0.309			8,868	1,340	0.151		11,256	1,529	0.136	6.13
	BYC		359	236	0.657			283	23	0.081		642	237	0.369	0.35

Table 8. Preliminary estimates of catches (number of individuals) by the American, Japanese, Korean and Taiwanese purse-seine fleets in the SPC statistical area, determined from catch rates estimated from observer data collected during 1994–1996 and estimates of fishing effort for 1996. Standard errors and coefficients of variation of the catch estimates are also given. See Table 4 for species codes.

SPECIES CODE	UNASSOCIATED SETS			ASSOCIATED SETS			TOTAL		
	CATCH	SE	CV	CATCH	SE	CV	CATCH	SE	CV
DLP	25	25	1.000	0	-	-	25	25	1.000
MAM	50	50	1.000	0	-	-	50	50	1.000

Table 9. Comparison of estimates of annual retained catches (metric tonnes) of target species, and average catch per set (metric tonnes), for purse seiners, based on landings and logsheet data, to those based on observer data. See Table 1 for fishing nation codes.

LANDINGS AND LOGSHEET DATA								
	BIGEYE		SKIPJACK		YELLOWFIN		TOTAL	
FISHING NATION	CATCH	CATCH PER SET	CATCH	CATCH PER SET	CATCH	CATCH PER SET	CATCH	CATCH PER SET
JP	1,940	0.123	131,127	25.276	26,055	4.684	159,122	30.083
KR	0	0.000	120,083	24.435	22,872	4.262	142,955	28.697
TW	359	0.004	161,581	25.214	17,388	3.518	179,328	28.736
US	9,074	0.684	100,944	20.621	16,069	7.654	126,087	28.959
TOTAL	11,373	0.567	513,735	24.145	82,384	4.900	607,492	29.126

OBSERVER DATA								
	BIGEYE		SKIPJACK		YELLOWFIN		TOTAL	
FISHING NATION	CATCH	CATCH PER SET	CATCH	CATCH PER SET	CATCH	CATCH PER SET	CATCH	CATCH PER SET
JP	307	0.092	74,133	13.394	57,821	15.337	132,261	28.823
KR	2,574	1.300	126,335	25.495	46,422	9.127	175,331	35.922
TW	10,426	2.148	113,597	18.008	64,699	12.490	188,722	32.646
US	8,023	3.071	132,498	26.942	31,293	6.315	171,814	36.328
TOTAL	21,330	2.363	446,563	22.011	200,235	11.567	668,128	33.696

Table 10. Estimates of annual discards (metric tonnes) of target species by purse seiners, determined from discard rates estimated from observer data collected during 1994–1996 and estimates of fishing effort for 1996. Standard errors and coefficients of variation of the discards estimates are also given. See Table 1 for fishing nation codes and Table 4 for species codes.

FISHING	SPECIES	UNASSOCIATED SETS			ASSOCIATED SETS			ALL SETS		
NATION	CODE	DISCARDS	SE	CV	DISCARDS	SE	CV	DISCARDS	SE	CV
JP	SKJ	125	84	0.671	498	102	0.204	623	132	0.211
	YFT	124	82	0.661	508	132	0.261	632	156	0.246
	BET	47	37	0.791	109	23	0.210	156	44	0.280
	TOT	296	199	0.672	1,115	228	0.205	1,411	303	0.215
KR	SKJ	618	191	0.308	5,999	2,123	0.354	6,618	2,132	0.322
	YFT	29	29	1.000	1,726	583	0.338	1,755	583	0.332
	BET	0	-	-	245	183	0.747	245	183	0.747
	TOT	647	200	0.308	7,970	2,825	0.354	8,617	2,832	0.329
TW	SKJ	605	224	0.369	1,561	331	0.212	2,166	400	0.185
	YFT	30	16	0.550	563	129	0.229	593	130	0.219
	BET	0	-	-	46	30	0.647	46	30	0.647
	TOT	635	227	0.357	2,170	444	0.205	2,805	499	0.178
US	SKJ	1,617	419	0.259	6,611	1,033	0.156	8,228	1,115	0.136
	YFT	743	591	0.796	1,534	393	0.256	2,277	710	0.312
	BET	27	20	0.736	724	344	0.476	751	345	0.459
	TOT	2,388	737	0.309	8,868	1,340	0.151	11,256	1,529	0.136
TOTAL	SKJ	2,966	519	0.175	14,669	2,387	0.163	17,634	2,442	0.138
	YFT	926	598	0.646	4,331	727	0.168	5,256	941	0.179
	BET	74	42	0.569	1,124	392	0.349	1,198	394	0.329
	TOT	3,965	821	0.207	20,124	3,166	0.157	24,089	3,271	0.136

Table 11. Incidence (number of sets and percentage of sets) of species and species groups observed in longline sets

NO	CODE	SPECIES OR SPECIES GROUP	SETS	%
1	YFT	Yellowfin	677	86.46
2	BET	Bigeye	588	75.10
3	BSH	Blue shark	481	61.43
4	WAH	Wahoo	313	39.97
5	BLZ	Blue Marlin	307	39.21
6	SWO	Swordfish	305	38.95
7	LEC	Escolar	288	36.78
8	ALB	Albacore	274	34.99
9	OCS	Oceanic white-tip shark	240	30.65
10	BAR	Barracudas	217	27.71
11	DOL	Mahi Mahi, Dolphinfish, Dorado	216	27.59
12	SKJ	Skipjack	202	25.80
13	UNS	Fish (unidentified)	202	25.80
14	FAL	Silky shark	194	24.78
15	SHK	Sharks (unidentified)	179	22.86
16	MLS	Striped Marlin	172	21.97
17	SSP	Short-billed spearfish	170	21.71
18	PLS	Pelagic sting-ray	168	21.46
19	ALI	Lancetfishes	166	21.20
20	SFA	Sailfish (Indo-Pacfic)	162	20.69
21	THR	Thresher sharks	130	16.60
22	OIL	Oilfish	126	16.09
23	GEP	Snake mackerels and escolars	112	14.30
24	LAG	Moonfish (Opah)	100	12.77
25	BRZ	Pomfrets and ocean breams	97	12.39
26	BLM	Black Marlin	85	10.86
27	SMA	Short finned Mako shark	70	8.94
28	PSK	Crocodile shark	54	6.90
29	AML	Grey reef shark	51	6.51
30	BIL	Marlins, sailfishes, spearfishes (uniden	49	6.26
31	TUN	Tuna (unidentified)	48	6.13
32	MAK	Mako sharks	32	4.09
33	TRP	Dealfish (Trachipterus spp.)	27	3.45
34	MOX	Ocean sunfish	24	3.07
35	TTX	Marine turtle	24	3.07
36	SPN	Hammerhead sharks	19	2.43
37	TIG	Tiger shark	16	2.04
38	ALS	Silver-tip shark	13	1.66
39	DOT	Dogtooth tuna	11	1.40
40	BTH	Bigeye thresher shark	9	1.15
41	PTH	Pelagic thresher shark	9	1.15
42	TRB	White-tip reef shark	7	0.89
43	RRU	Rainbow Runner	6	0.77
44	BLR	Blacktip reef shark	3	0.38
45	BIZ	Unidentified Bird	2	0.26
46	TRE	Trevallies (unidentified - Jacks)	2	0.26
47	BUP	Pacific rudderfish	1	0.13
48	CCL	Blacktip shark	1	0.13
49	FLY	Flying fishes	1	0.13
50	LEO	Olive Ridley turtle	1	0.13
51	LMA	Long finned Mako shark	1	0.13
52	MAM	Marine (aquatic) mammal	1	0.13
53	MAX	Mackerel (unidentified)	1	0.13
54	TUG	Green turtle	1	0.13

Table 12. Estimates of the total number of longline hooks (thousands), per annum, for certain longline fleets, determined from the total catch of target species (metric tonnes) and the average catch rate (kilograms per 100 hooks) for target species. See Table 2 for fishing nation codes.

FISHING FLEET	CATCH	CATCH RATE	NUMBER OF HOOKS
CN	5,366	46.1	11,644
FJ	2,185	46.6	4,690
JP LO	32,365	53.6	60,392
JP HI	14,985	53.5	27,996
NC	1,100	34.8	3,164
TO	571	53.9	1,059
TW OS	5,970	47.2	12,636
TW DW	22,819	41.9	54,467
US	316	34.0	928
TOTAL	85,677	48.4	176,976

Table 13. Preliminary estimates of catches (metric tonnes) by certain longline fleets in the SPC statistical area, determined catch rates estimated from observer data collected during 1992–1997 and estimates of annual fishing effort. Standard errors and coefficients of variation of the catch estimates, and the percentage of the total catch, are also given. Totals are given for the retained catch of target species, discards of target species, the retained and discarded catch of bycatch species, and the retained and discarded catch of sharks. See Table 11 for species codes.

SPECIES CODE	TOTAL			
	CATCH	SE	CV	%
ALB	24,396	2,372	0.097	17.98
ALI	360	32	0.091	0.27
ALS	112	37	0.330	0.08
AML	467	94	0.202	0.34
BAR	277	21	0.076	0.20
BET	23,626	1,589	0.067	17.41
BIL	775	121	0.157	0.57
BLM	1,700	206	0.122	1.25
BLR	8	6	0.803	0.01
BLZ	6,587	508	0.077	4.85
BRZ	298	59	0.199	0.22
BSH	23,705	971	0.041	17.47
BTH	60	22	0.373	0.04
BUP	9	9	1.000	0.01
CCL	5	5	1.000	0.00
DOL	461	38	0.083	0.34
DOT	4	1	0.400	0.00
FAL	1,468	187	0.128	1.08
GEP	202	22	0.111	0.15
LAG	631	82	0.131	0.47
LEC	1,497	118	0.079	1.10
LMA	7	7	1.000	0.01
MAK	111	20	0.181	0.08
MLS	2,856	265	0.093	2.10
MOX	15	4	0.259	0.01
OCS	1,007	83	0.082	0.74
OIL	457	47	0.103	0.34
PLS	415	48	0.116	0.31
PSK	90	17	0.191	0.07
PTH	93	36	0.387	0.07
RRU	2	0	0.440	0.00
SFA	1,795	222	0.124	1.32
SHK	1,916	166	0.087	1.41
SKJ	488	49	0.102	0.36
SMA	736	123	0.167	0.54
SPN	125	31	0.249	0.09
SSP	864	159	0.184	0.64
SWO	2,935	273	0.093	2.16
THR	1,334	197	0.148	0.98
TIG	284	93	0.329	0.21
TRB	44	19	0.435	0.03
TRE	1	1	0.707	0.00
TRP	35	9	0.255	
TUN	869	249	0.287	0.64
UNS	320	27	0.086	0.24
WAH	2,201	128	0.058	1.62
YFT	30,016	1,629	0.054	22.12
TOTAL	135,689	3,543	0.026	100.00
TARGET	78,039	3,288	0.042	57.51
DISCARDS	5,160	508	0.099	3.80
BYCATCH	57,650	1,320	0.023	42.49
SHARKS	31,282	1,040	0.033	23.05

Table 14. Preliminary estimates of longline catches (metric tonnes) in the SPC statistical area, determined catch rates estimated from observer data collected during 1992–1997 and estimates of annual fishing effort. The average catch per 100 hooks (kilograms and numbers of fish), the average weight (kilograms), the standard error and coefficient of variation of the catch estimate, the number of hooks (thousands) that must be sampled to achieve a coefficient of variation of 10 per cent, and the percentage of the total catch, are also shown. See Table 2 for fishing nation codes and Table 11 for species codes.

FISHING NATION	SPECIES CODE	CPUE KG	CPUE NO	AVG WT	CATCH	SE	CV	CV=10%	%
CN	ALB	0.039	0.002	17.5	4	3	0.707	7,555	0.04
	ALI	0.054	0.018	3.0	6	2	0.351	1,858	0.06
	ALS	0.075	0.002	30.0	9	6	0.743	8,344	0.09
	AML	1.218	0.032	38.0	142	44	0.308	1,430	1.40
	BAR	0.030	0.005	6.0	3	1	0.404	2,461	0.03
	BET	32.598	0.543	60.0	3,796	1,054	0.278	1,163	37.40
	BIL	1.398	0.013	108.0	163	54	0.333	1,669	1.61
	BLM	1.264	0.011	118.0	147	45	0.305	1,402	1.45
	BLZ	8.530	0.105	81.0	993	160	0.161	392	9.78
	BRZ	0.027	0.003	8.0	3	2	0.500	3,768	0.03
	BSH	4.297	0.114	37.7	500	86	0.171	442	4.93
	BTH	0.208	0.005	40.0	24	15	0.635	6,095	0.24
	DOL	0.274	0.030	9.0	32	8	0.251	948	0.32
	FAL	2.534	0.147	17.2	295	65	0.219	723	2.91
	GEP	0.016	0.004	3.6	2	1	0.539	4,388	0.02
	LEC	0.215	0.032	6.8	25	7	0.289	1,258	0.25
	MLS	0.684	0.010	66.0	80	26	0.323	1,578	0.79
	MOX	0.040	0.005	8.0	5	2	0.483	3,523	0.05
	OCS	2.081	0.100	20.7	242	44	0.180	490	2.38
	OIL	0.098	0.006	17.0	11	5	0.405	2,476	0.11
	PLS	0.245	0.061	4.0	28	10	0.348	1,826	0.28
	PSK	0.033	0.005	7.0	4	2	0.525	4,161	0.04
	PTH	0.288	0.007	40.0	33	26	0.781	9,205	0.33
	RRU	0.004	0.001	3.0	1	0	0.709	7,593	0.01
	SFA	0.765	0.017	44.0	89	23	0.253	968	0.88
	SHK	2.536	0.065	39.0	295	70	0.239	859	2.91
	SKJ	0.215	0.051	4.2	25	10	0.394	2,342	0.25
	SPN	0.069	0.002	40.0	8	6	0.712	7,654	0.08
	SSP	0.054	0.004	13.0	6	3	0.496	3,714	0.06
	SWO	3.385	0.084	40.1	394	68	0.172	449	3.88
	THR	1.649	0.037	45.0	192	72	0.377	2,151	1.89
	TRB	0.044	0.001	30.0	5	5	1.000	15,100	0.05
	TRE	0.008	0.001	10.0	1	1	1.000	15,100	0.01
	TUN	0.092	0.002	50.0	11	8	0.719	7,803	0.11
	UNS	0.205	0.041	5.0	24	8	0.350	1,847	0.24
	WAH	0.085	0.007	11.4	10	3	0.352	1,871	0.10
	YFT	21.821	0.647	33.7	2,541	226	0.089	119	25.03
	TOT				10,151	1,106	0.109		100.00
	DIS				214	46	0.215		2.11
	BYC				3,810	287	0.075		37.53
	SHK				1,750	171	0.098		17.24

Table 14 continued

FISHING NATION	SPECIES CODE	CPUE KG	CPUE NO	AVG WT	CATCH	SE	CV	CV=10%	%
FJ	ALB	25.803	1.727	14.9	1,210	102	0.084	21	30.24
	ALI	0.495	0.167	3.0	23	5	0.226	153	0.57
	AML	1.068	0.028	38.0	50	20	0.397	473	1.25
	BAR	0.739	0.123	6.0	35	8	0.223	149	0.87
	BET	10.701	0.436	24.5	502	45	0.090	24	12.55
	BLM	0.964	0.008	118.0	45	19	0.416	518	1.12
	BLZ	1.963	0.025	80.1	92	27	0.297	264	2.30
	BRZ	0.275	0.033	8.3	13	4	0.329	325	0.32
	BSH	12.643	0.253	49.9	593	117	0.197	116	14.82
	DOL	2.627	0.292	9.0	123	21	0.170	86	3.07
	FAL	0.315	0.015	21.5	15	8	0.527	832	0.37
	GEP	0.036	0.009	4.0	2	1	0.422	534	0.05
	LAG	1.802	0.063	28.7	85	20	0.239	171	2.12
	LEC	0.962	0.137	7.0	45	13	0.283	239	1.12
	MAK	0.700	0.017	40.0	33	14	0.417	521	0.82
	MLS	0.493	0.007	66.0	23	15	0.632	1,197	0.57
	MOX	0.073	0.009	8.0	3	2	0.571	976	0.07
	OCS	1.006	0.048	21.0	47	13	0.276	229	1.17
	OIL	0.660	0.037	17.6	31	6	0.189	106	0.77
	PLS	0.079	0.020	4.0	4	1	0.303	275	0.10
	SFA	1.496	0.034	43.4	70	19	0.276	228	1.75
	SHK	0.368	0.009	39.0	17	7	0.429	551	0.42
	SKJ	0.161	0.038	4.2	8	3	0.367	403	0.20
	SMA	0.357	0.008	43.0	17	7	0.422	533	0.42
	SSP	1.297	0.100	12.9	61	15	0.254	193	1.52
	SWO	3.204	0.032	99.9	150	45	0.302	273	3.75
	THR	0.196	0.004	45.0	9	9	1.000	3,000	0.22
	TUN	0.109	0.002	50.0	5	5	1.000	3,000	0.12
	UNS	0.215	0.043	5.0	10	3	0.284	242	0.25
	WAH	3.307	0.274	12.1	155	24	0.156	72	3.87
	YFT	11.192	0.543	20.6	525	82	0.157	73	13.12
	TOT				4,001	199	0.050		100.00
	DIS				114	22	0.198		2.85
	BYC				1,764	156	0.089		44.09
	SHK				781	130	0.167		19.52

Table 14 continued

FISHING NATION	SPECIES CODE	CPUE KG	CPUE NO	AVG WT	CATCH	SE	CV	CV=10%	%
JP LO	ALB	0.019	0.001	24.5	12	8	0.737	5,805	0.03
	ALI	0.180	0.060	3.0	109	21	0.193	398	0.29
	ALS	0.104	0.003	30.0	63	28	0.448	2,150	0.17
	AML	0.094	0.002	38.0	57	26	0.455	2,216	0.15
	BAR	0.065	0.011	6.0	39	9	0.238	606	0.10
	BET	23.121	0.456	50.7	13,963	1,136	0.081	70	37.44
	BIL	0.041	0.000	108.0	25	25	1.000	10,700	0.07
	BLM	1.194	0.010	118.0	721	144	0.200	427	1.93
	BLZ	3.309	0.041	80.8	1,999	339	0.169	307	5.36
	BRZ	0.439	0.055	8.0	265	59	0.223	530	0.71
	BSH	2.661	0.055	48.3	1,607	288	0.179	343	4.31
	DOL	0.101	0.011	9.0	61	17	0.283	855	0.16
	DOT	0.005	0.002	3.0	3	2	0.605	3,911	0.01
	FAL	0.140	0.007	19.8	84	72	0.855	7,830	0.23
	GEP	0.073	0.018	4.0	44	11	0.239	611	0.12
	LAG	0.395	0.014	28.0	239	65	0.274	805	0.64
	LEC	0.416	0.059	7.0	251	50	0.197	416	0.67
	MAK	0.015	0.000	40.0	9	9	1.000	10,700	0.02
	MLS	0.369	0.006	66.0	223	68	0.304	988	0.60
	MOX	0.003	0.000	8.0	2	2	1.000	10,700	0.01
	OCS	0.196	0.009	21.0	118	37	0.313	1,047	0.32
	OIL	0.133	0.008	17.0	80	23	0.288	885	0.21
	PLS	0.589	0.147	4.0	356	47	0.133	188	0.95
	PSK	0.096	0.014	7.0	58	15	0.262	736	0.16
	SFA	0.258	0.006	44.0	156	45	0.288	890	0.42
	SHK	0.528	0.014	39.0	319	73	0.228	555	0.86
	SKJ	0.221	0.038	5.8	134	32	0.236	596	0.36
	SSP	0.064	0.005	13.0	38	13	0.339	1,231	0.10
	SWO	1.073	0.026	41.0	648	134	0.207	459	1.74
	THR	1.297	0.029	45.0	784	177	0.225	543	2.10
	TIG	0.091	0.001	80.0	55	55	1.000	10,700	0.15
	TRB	0.011	0.000	30.0	7	7	1.000	10,700	0.02
	TUN	0.456	0.009	50.0	276	158	0.572	3,506	0.74
	UNS	0.126	0.025	5.0	76	12	0.156	259	0.20
	WAH	0.624	0.052	12.0	377	65	0.172	315	1.01
	YFT	23.249	0.749	31.0	14,041	1,311	0.093	93	37.65
	TOT				37,297	1,828	0.049		100.00
	DIS				3,132	472	0.151		8.40
	BYC				9,281	732	0.079		24.88
	SHK				3,105	376	0.121		8.33

Table 14 continued

FISHING NATION	SPECIES CODE	CPUE KG	CPUE NO	AVG WT	CATCH	SE	CV	CV=10%	%
JP HI	ALB	30.749	1.632	18.8	8,609	960	0.112	52	22.99
	ALI	0.682	0.227	3.0	191	24	0.128	68	0.51
	ALS	0.022	0.001	30.0	6	6	1.000	4,200	0.02
	BAR	0.214	0.036	6.0	60	10	0.174	127	0.16
	BET	1.566	0.039	40.4	438	84	0.191	153	1.17
	BLM	0.814	0.008	107.3	228	76	0.334	467	0.61
	BLZ	2.399	0.028	85.1	672	160	0.238	237	1.79
	BSH	54.924	0.889	61.8	15,377	759	0.049	10	41.07
	BTH	0.122	0.003	40.0	34	16	0.482	974	0.09
	DOL	0.288	0.032	9.0	81	18	0.218	198	0.22
	FAL	1.333	0.030	44.7	373	133	0.356	531	1.00
	GEP	0.473	0.118	4.0	132	19	0.147	90	0.35
	LAG	0.229	0.009	24.9	64	28	0.441	815	0.17
	MLS	6.417	0.098	65.6	1,797	242	0.135	76	4.80
	OCS	0.517	0.025	21.0	145	32	0.218	200	0.39
	PLS	0.012	0.003	4.0	3	2	0.482	974	0.01
	PSK	0.031	0.003	9.8	9	6	0.684	1,963	0.02
	PTH	0.188	0.005	40.0	53	24	0.453	860	0.14
	SFA	0.302	0.008	36.4	85	28	0.331	459	0.23
	SHK	0.310	0.008	39.0	87	35	0.404	686	0.23
	SKJ	0.566	0.083	6.8	158	28	0.179	135	0.42
	SMA	1.403	0.033	42.7	393	79	0.201	170	1.05
	SPN	0.358	0.009	40.0	100	30	0.298	372	0.27
	SSP	0.670	0.053	12.7	188	43	0.230	221	0.50
	SWO	1.924	0.030	65.1	539	152	0.281	332	1.44
	THR	0.202	0.004	45.0	57	22	0.383	614	0.15
	TIG	0.764	0.010	80.0	214	76	0.354	527	0.57
	TRP	0.011	0.002	5.0	3	2	0.563	1,332	0.01
	TUN	1.800	0.036	50.0	504	192	0.382	612	1.35
	UNS	0.547	0.109	5.0	153	22	0.145	88	0.41
	WAH	2.199	0.174	12.6	616	79	0.128	69	1.65
	YFT	21.702	0.723	30.0	6,076	583	0.096	38	16.23
	TOT				37,442	1,429	0.038		100.00
	DIS				720	107	0.150		1.92
	BYC				22,319	816	0.037		59.61
	SHK				16,632	750	0.045		44.42

Table 14 continued

FISHING NATION	SPECIES CODE	CPUE KG	CPUE NO	AVG WT	CATCH	SE	CV	CV=10%	%
NC	ALB	16.069	1.012	15.9	509	62	0.121	89	19.78
	ALI	0.564	0.188	3.0	18	4	0.206	258	0.70
	BAR	0.788	0.131	6.0	25	5	0.198	239	0.97
	BET	3.525	0.096	36.6	112	28	0.250	382	4.35
	BIL	0.148	0.001	108.0	5	5	1.000	6,100	0.19
	BLM	0.225	0.002	105.1	7	5	0.712	3,089	0.27
	BLZ	3.061	0.038	81.0	97	32	0.332	670	3.77
	BSH	14.830	0.204	72.8	469	66	0.140	119	18.23
	DOL	1.462	0.162	9.0	46	7	0.157	151	1.79
	FAL	3.426	0.089	38.7	108	22	0.202	249	4.20
	GEP	0.025	0.006	4.0	1	0	0.521	1,655	0.04
	LAG	4.599	0.161	28.6	146	28	0.192	225	5.67
	LEC	2.106	0.301	7.0	67	17	0.261	416	2.60
	MAK	0.137	0.003	40.0	4	3	0.740	3,342	0.16
	MLS	5.999	0.088	68.3	190	32	0.166	168	7.38
	OCS	1.142	0.054	21.0	36	6	0.166	168	1.40
	OIL	0.056	0.003	17.0	2	1	0.568	1,970	0.08
	SFA	0.887	0.018	48.1	28	8	0.293	525	1.09
	SHK	0.050	0.001	39.0	2	2	1.000	6,100	0.08
	SKJ	0.468	0.072	6.5	15	3	0.203	252	0.58
	SMA	2.121	0.049	43.0	67	13	0.200	244	2.60
	SPN	0.087	0.002	40.0	3	2	0.702	3,007	0.12
	SSP	0.842	0.064	13.2	27	6	0.229	319	1.05
	SWO	1.142	0.014	81.9	36	15	0.427	1,111	1.40
	THR	0.058	0.001	45.0	2	2	1.000	6,100	0.08
	TIG	0.197	0.002	80.0	6	4	0.711	3,086	0.23
	TUN	1.053	0.021	50.0	33	11	0.345	725	1.28
	UNS	0.130	0.026	5.0	4	1	0.323	637	0.16
	WAH	0.498	0.041	12.0	16	3	0.208	262	0.62
	YFT	15.579	0.566	27.5	493	65	0.132	107	19.16
	TOT				2,573	132	0.052		100.00
	DIS				71	15	0.212		2.76
	BYC				1,460	98	0.068		56.74
	SHK				691	73	0.106		26.86

Table 14 continued

FISHING NATION	SPECIES CODE	CPUE KG	CPUE NO	AVG WT	CATCH	SE	CV	CV=10%	%
TO	ALB	46.658	3.385	13.8	494	47	0.096	18	49.15
	BET	3.117	0.090	34.5	33	13	0.383	293	3.28
	BIL	0.466	0.004	108.0	5	5	1.000	2,000	0.50
	BSH	10.824	0.168	64.4	115	23	0.203	82	11.44
	DOL	0.599	0.067	9.0	6	3	0.536	574	0.60
	LAG	2.392	0.085	28.0	25	6	0.249	123	2.49
	LEC	4.949	0.707	7.0	52	7	0.136	37	5.17
	MAK	5.216	0.130	40.0	55	10	0.187	70	5.47
	MLS	4.481	0.068	66.0	47	11	0.236	111	4.68
	OCS	1.004	0.048	21.0	11	4	0.332	220	1.09
	OIL	0.543	0.032	17.0	6	3	0.508	516	0.60
	SHK	0.712	0.018	39.0	8	4	0.584	683	0.80
	SKJ	0.051	0.007	7.0	1	1	1.000	2,000	0.10
	SSP	1.030	0.079	13.0	11	4	0.367	269	1.09
	SWO	0.481	0.009	51.9	5	4	0.784	1,229	0.50
	THR	0.547	0.012	45.0	6	4	0.705	993	0.60
	TRE	0.090	0.009	10.0	1	1	1.000	2,000	0.10
	UNS	0.320	0.064	5.0	3	1	0.433	374	0.30
	WAH	0.237	0.020	12.0	3	1	0.560	627	0.30
	YFT	11.117	0.525	21.2	118	55	0.468	437	11.74
	TOT				1,005	80	0.080		100.00
	DIS				59	17	0.295		5.87
	BYC				360	27	0.076		35.82
	SHK				193	23	0.123		19.20

Table 14 continued

FISHING NATION	SPECIES CODE	CPUE KG	CPUE NO	AVG WT	CATCH	SE	CV	CV=10%	%
TW OS	ALB	0.014	0.001	14.0	2	1	0.713	10,052	0.01
	ALI	0.085	0.028	3.0	11	2	0.223	983	0.08
	ALS	0.274	0.009	30.0	35	22	0.648	8,324	0.24
	AML	1.730	0.045	38.9	219	77	0.353	2,460	1.53
	BAR	0.233	0.039	6.0	29	4	0.144	410	0.20
	BET	31.682	0.527	60.1	4,003	332	0.083	135	27.89
	BIL	4.574	0.042	108.0	578	106	0.184	667	4.03
	BLM	2.749	0.023	121.5	347	77	0.221	968	2.42
	BLR	0.065	0.003	20.0	8	7	0.840	13,966	0.06
	BLZ	9.428	0.117	80.7	1,191	127	0.106	224	8.30
	BRZ	0.096	0.012	7.8	12	3	0.223	982	0.08
	BSH	15.140	0.374	40.5	1,913	235	0.123	297	13.33
	BTH	0.018	0.000	40.0	2	2	1.000	19,800	0.01
	CCL	0.040	0.001	30.0	5	5	1.000	19,800	0.03
	DOL	0.602	0.067	9.0	76	15	0.194	748	0.53
	DOT	0.011	0.004	3.2	1	1	0.576	6,569	0.01
	FAL	2.956	0.180	16.5	374	69	0.186	685	2.61
	GEP	0.163	0.041	4.0	21	4	0.179	631	0.15
	LEC	0.413	0.059	7.0	52	8	0.161	512	0.36
	MAK	0.054	0.001	40.0	7	4	0.579	6,631	0.05
	MLS	1.871	0.028	66.0	236	36	0.153	460	1.64
	MOX	0.021	0.003	8.0	3	1	0.409	3,310	0.02
	OCS	1.551	0.074	21.1	196	26	0.133	351	1.37
	OIL	0.630	0.037	17.0	80	19	0.233	1,078	0.56
	PLS	0.183	0.045	4.0	23	4	0.164	529	0.16
	PSK	0.153	0.022	6.9	19	5	0.254	1,274	0.13
	SFA	1.427	0.032	44.2	180	28	0.153	464	1.25
	SHK	9.281	0.238	39.0	1,173	127	0.108	232	8.17
	SKJ	0.354	0.055	6.5	45	12	0.257	1,311	0.31
	SPN	0.115	0.003	40.0	15	7	0.481	4,571	0.10
	SSP	0.113	0.007	15.2	14	5	0.349	2,409	0.10
	SWO	6.138	0.135	45.6	776	78	0.101	200	5.41
	THR	1.961	0.044	45.0	248	43	0.175	608	1.73
	TIG	0.041	0.001	80.0	5	5	1.000	19,800	0.03
	TRB	0.256	0.009	30.0	32	17	0.534	5,640	0.22
	TUN	0.321	0.006	50.0	41	14	0.338	2,267	0.29
	UNS	0.221	0.044	5.0	28	5	0.182	653	0.20
	WAH	0.452	0.038	12.0	57	9	0.158	493	0.40
	YFT	18.170	0.524	34.7	2,296	210	0.091	165	16.00
	TOT				14,353	531	0.037		100.00
	DIS				275	40	0.145		1.92
	BYC				8,051	480	0.060		56.09
	SHK				4,239	356	0.084		29.53

Table 14 continued

FISHING NATION	SPECIES CODE	CPUE KG	CPUE NO	AVG WT	CATCH	SE	CV	CV=10%	%
TW DW	ALB	24.877	1.858	13.4	13,550	2,166	0.160	260	48.37
	BAR	0.156	0.026	6.0	85	12	0.143	208	0.30
	BET	1.042	0.040	26.0	568	71	0.125	160	2.03
	BLM	0.082	0.001	118.0	45	32	0.704	5,049	0.16
	BLZ	2.814	0.035	81.0	1,533	274	0.179	325	5.47
	BSH	5.619	0.156	36.0	3,060	451	0.147	221	10.92
	BUP	0.018	0.004	5.0	10	10	1.000	10,200	0.04
	DOL	0.050	0.006	9.0	27	8	0.292	872	0.10
	FAL	0.389	0.012	31.6	212	52	0.245	613	0.76
	GEP	0.001	0.000	4.0	1	1	1.000	10,200	0.00
	LAG	0.135	0.005	28.0	74	24	0.324	1,069	0.26
	LEC	1.844	0.263	7.0	1,004	105	0.105	111	3.58
	LMA	0.014	0.000	40.0	8	8	1.000	10,200	0.03
	MLS	0.465	0.007	63.5	253	62	0.246	619	0.90
	MOX	0.003	0.000	8.0	2	2	1.000	10,200	0.01
	OCS	0.377	0.018	21.0	205	42	0.202	417	0.73
	OIL	0.447	0.026	17.0	244	36	0.147	221	0.87
	PTH	0.013	0.000	40.0	7	7	1.000	10,200	0.02
	RRU	0.002	0.001	3.0	1	1	0.704	5,055	0.00
	SFA	2.155	0.049	44.0	1,174	212	0.181	333	4.19
	SHK	0.014	0.000	39.0	7	7	1.000	10,200	0.02
	SKJ	0.190	0.045	4.2	104	20	0.196	390	0.37
	SMA	0.477	0.011	43.0	260	93	0.358	1,304	0.93
	SSP	0.952	0.073	13.0	519	152	0.293	873	1.85
	SWO	0.520	0.007	79.7	283	138	0.487	2,416	1.01
	TRP	0.060	0.012	5.0	33	9	0.274	767	0.12
	UNS	0.038	0.008	5.0	21	5	0.246	615	0.07
	WAH	1.769	0.149	11.9	964	73	0.076	59	3.44
	YFT	6.910	0.286	24.1	3,764	695	0.185	347	13.44
	TOT				28,015	2,362	0.084		100.00
	DIS				563	138	0.246		2.01
	BYC				10,134	1,005	0.099		36.17
	SHK				3,752	509	0.136		13.39

Table 14 continued

FISHING NATION	SPECIES CODE	CPUE KG	CPUE NO	AVG WT	CATCH	SE	CV	CV=10%	%
US	ALB	0.776	0.046	16.8	7	4	0.492	653	0.82
	ALI	0.315	0.105	3.0	3	1	0.240	155	0.35
	BAR	0.083	0.014	6.0	1	0	0.454	557	0.12
	BET	22.780	0.406	56.2	211	28	0.132	46	24.85
	BLM	17.209	0.146	118.0	160	84	0.523	739	18.85
	BLZ	1.226	0.015	81.0	11	4	0.348	327	1.30
	BRZ	0.532	0.067	8.0	5	1	0.243	159	0.59
	BSH	7.679	0.156	49.4	71	18	0.252	171	8.36
	DOL	0.950	0.106	9.0	9	5	0.579	905	1.06
	FAL	0.705	0.042	17.0	7	2	0.323	282	0.82
	MAK	0.344	0.009	40.0	3	2	0.504	684	0.35
	MLS	0.781	0.012	66.0	7	5	0.719	1,397	0.82
	MOX	0.112	0.014	8.0	1	0	0.356	342	0.12
	OCS	0.782	0.037	21.0	7	3	0.382	394	0.82
	OIL	0.501	0.029	17.0	5	3	0.635	1,089	0.59
	PLS	0.094	0.023	4.0	1	0	0.375	379	0.12
	SFA	1.402	0.032	44.0	13	6	0.484	632	1.53
	SHK	0.907	0.023	39.0	8	5	0.577	900	0.94
	SSP	0.109	0.008	13.0	1	1	1.000	2,700	0.12
	SWO	11.285	0.167	67.8	105	41	0.395	421	12.37
	THR	4.018	0.089	45.0	37	11	0.295	235	4.36
	TIG	0.505	0.006	80.0	5	3	0.555	830	0.59
	UNS	0.160	0.032	5.0	1	1	0.470	595	0.12
	WAH	0.553	0.046	12.0	5	1	0.226	138	0.59
	YFT	17.566	0.449	39.2	163	59	0.361	352	19.20
	TOT				849	116	0.137		100.00
	DIS				8	3	0.364		0.94
	BYC				467	133	0.285		55.01
	SHK				134	25	0.186		15.78

Table 15. Preliminary estimates of catches (number of individuals) by certain longline fleets in the SPC statistical area, determined catch rates estimated from observer data collected during 1992–1997 and estimates of annual fishing effort. Standard errors and coefficients of variation of the catch estimates are also given. See Table 11 for species codes.

SPECIES CODE	TOTAL		
	CATCH	SE	CV
BIZ	282	200	0.71
LEO	106	106	1.00
MAM	47	47	1.00
TTX	2,493	595	0.24
TUG	102	102	1.00

Table 16. Comparison of estimates of annual retained catches (metric tonnes) of target species, and average catch rate (kilograms per 100 hooks), for longliners, based on landings and logsheet data, to those based on observer data. See Table 2 for fishing nation codes.

FISHING NATION	LANDINGS & LOGSHEETS							
	ALBACORE		BIGEYE		YELLOWFIN		TOTAL	
	CATCH	CPUE	CATCH	CPUE	CATCH	CPUE	CATCH	CPUE
CN	8	0.068	2,802	11.843	2,556	11.010	5,366	22.921
FJ	911	29.168	401	4.830	873	8.305	2,185	42.303
JP LO	915	1.515	14,084	23.321	17,366	28.755	32,365	53.591
JP HI	5,616	20.061	2,094	7.479	7,275	25.985	14,985	53.525
NC	187	36.020	190	2.627	723	24.472	1,100	63.119
TO	494	...	30	...	47	...	571	...
TW OS	0	0.274	2,263	15.065	3,707	14.157	5,970	29.496
TW DW	19,809	37.312	992	0.346	2,018	2.635	22,819	40.293
US	13	0.000	109	16.457	194	20.239	316	36.696
TOTAL	27,954	31.713	22,965	18.113	34,759	23.108	85,677	45.853

FISHING NATION	OBSERVER DATA							
	ALBACORE		BIGEYE		YELLOWFIN		TOTAL	
	CATCH	CPUE	CATCH	CPUE	CATCH	CPUE	CATCH	CPUE
CN	2	0.018	3,701	31.790	2,423	20.808	6,126	52.616
FJ	1,173	25.028	448	9.554	480	10.255	2,101	44.837
JP LO	11	0.019	13,540	22.420	11,335	18.770	24,886	41.209
JP HI	8,305	29.666	438	1.566	5,658	20.212	14,401	51.444
NC	475	15.006	108	3.432	458	14.472	1,041	32.910
TO	452	42.733	28	2.683	108	10.213	588	55.629
TW OS	1	0.014	3,900	30.875	2,121	16.794	6,022	47.683
TW DW	13,056	23.972	544	0.999	3,716	6.823	17,316	31.794
US	7	0.776	207	22.394	158	17.063	372	40.233
TOTAL	23,482	26.197	22,914	24.100	26,457	17.155	72,853	42.586

Table 17. Estimates of annual discards (metric tonnes) of target species, by certain longliner fleets in the SPC statistical area, determined from discard rates estimated from observer data collected during 1992–1997 and estimates of fishing effort for 1996. Standard errors and coefficients of variation of the discards estimates are also given. See Table 2 for fishing nation codes and Table 11 for species codes.

FISHING NATION	SPECIES CODE	DISCARDS	SE	CV
CN	ALB	2	2	1.000
	BET	94	34	0.366
	YFT	117	28	0.240
	TOT	214	46	0.215
FJ	ALB	23	7	0.299
	BET	49	14	0.295
	YFT	41	14	0.347
	TOT	114	22	0.198
JP LO	ALB	-	-	-
	BET	426	107	0.252
	YFT	2,706	443	0.164
	TOT	3,132	472	0.151
JP HI	ALB	303	52	0.173
	BET	-	-	-
	YFT	417	85	0.205
	TOT	720	107	0.150
NC	ALB	33	9	0.269
	BET	2	2	1.000
	YFT	35	8	0.245
	TOT	71	15	0.212
TO	ALB	42	17	0.412
	BET	5	5	1.000
	YFT	11	6	0.574
	TOT	59	17	0.294
TW OS	ALB	-	-	-
	BET	102	21	0.214
	YFT	173	32	0.186
	TOT	275	40	0.145
TW DW	ALB	493	137	0.279
	BET	23	11	0.494
	YFT	47	18	0.389
	TOT	563	138	0.246
US	ALB	-	-	-
	BET	3	1	0.388
	YFT	4	2	0.571
	TOT	8	3	0.364
TOTAL	ALB	898	148	0.166
	BET	706	116	0.165
	YFT	3,555	454	0.128
	TOT	5,160	508	0.099

Figure 1. Distribution of the ratio of logsheet to observer estimates of the retained catch of target species by purse seiners, for 106 sets for which matches of set times were within one hour and for which the observer's estimate was greater than zero