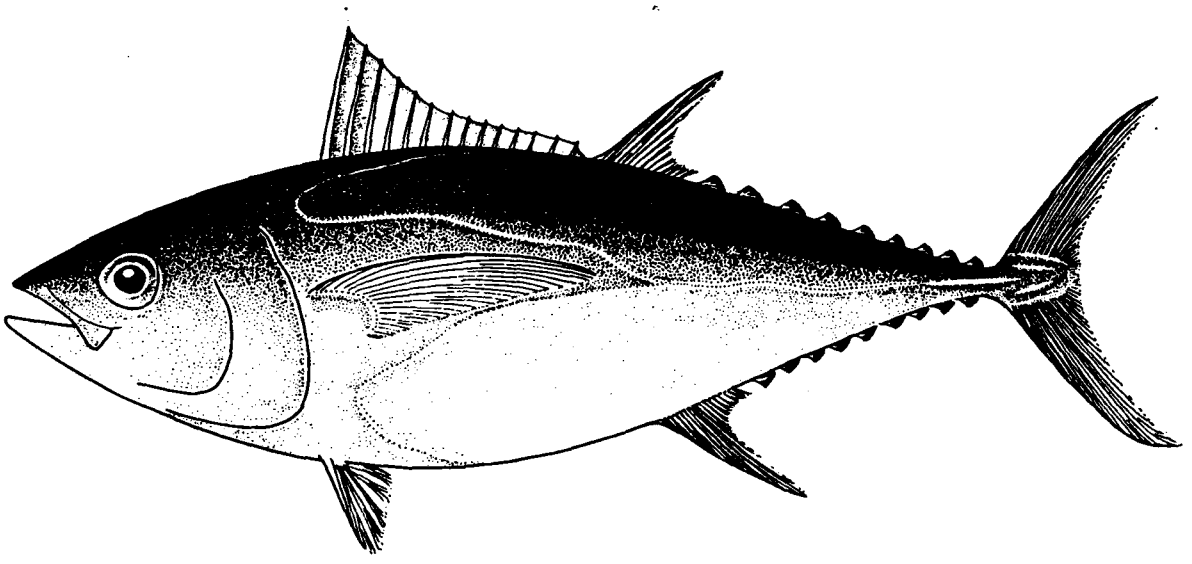
TENTH MEETING OF THE STANDING COMMITTEE ON TUNA AND BILLFISH

16th-18th June 1997
Nadi, Fiji

INFORMATION PAPER 6

BIGEYE CATCH ESTIMATES IN THE WESTERN AND CENTRAL PACIFIC OCEAN, WITH IMPLICATIONS FOR PORT SAMPLING PROGRAMMES



Oceanic Fisheries Programme
South Pacific Commission
Noumea, New Caledonia

June 1997

1. INTRODUCTION

"Bigeye tuna (Thunnus obesus) occur in the western and central Pacific from approximately 45^0 N to 45^0 S, and are captured by a variety of gears, including longline (as adults), purse seine and pole-and-line. They are however primarily taken by longline gear, for which they are a major target species. Smaller but still substantial amounts are taken by the purse seine fishery, particularly in sets on logs or other floating objects. Such catches, typically of juvenile bigeye, are not normally recorded as such, but are usually combined with the yellowfin catch in logsheet records and landing statistics." (Hampton et al., 1996).

The compilation of annual bigeye catch estimates by gear type since 1988 was the subject of, *inter alia*, a recent OFP paper (Hampton et al., 1996). The purpose of this internal report is two-fold. Firstly, this report reviews the estimates provided in Hampton et al. (1996) and extends the estimates to cover all years since 1980. Secondly, a timely review of the port sampling data that is fundamental to the estimation of purse seine bigeye catch is included in the section dealing with purse seine estimates.

The area for which estimates have been determined cover the Western and Central Pacific (WCPO), that is, the area west of 150^0 W, and including eastern Indonesia and the Philippines (Figure 1).

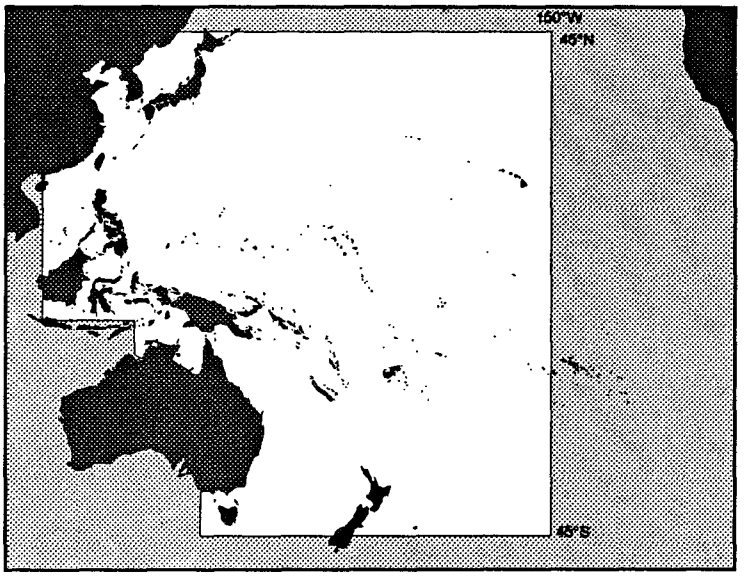


Figure 1. Area used in estimation of bigeye tuna catch.

2. ESTIMATES OF BIGEYE CATCH BY GEAR

Catch estimates are provided for longline and purse seine gear, based mainly on data held in the Regional Tuna Fisheries Database (RTFD), and the multi-gear Philippines and eastern Indonesian fisheries.

2.1 Longline

Longline estimates were based on the best information available, including Lawson (1996) and aggregated data made available to the OFP by the Fisheries Agency of Japan, the National Fisheries Research and Development Agency of Korea and the National Taiwan University and the Council of

Agriculture (Executive Yuan) of Taiwan. Estimates for the Hawaiian longline fishery were obtained from Boggs and Ito (1993) for 1980-1990 data, Curran et al. (1996) for 1991-1994 data, and Bigelow (pers. comm.) for 1995 data. Catches listed under "Other" in Table 1 are mainly from fleets based in various Pacific Island countries. These estimates exclude catches in the Philippines and Indonesia, which are provided in separate sections (see below).

The estimates of bigeye longline catch presented in Hampton et al. (1996) for the years 1988–1995 have been further updated due to the receipt of new data and information during the past few months.

The bigeye catch data for the Japanese and Korean distant-water longline fleets are provided to the OFP in numbers only and, as such, it has been necessary to apply an estimate of bigeye average weight in order to produce estimates of bigeye catch by weight. Since the previous estimates of bigeye catch for these fleets were presented in Hampton et al. (1996), the method of determining bigeye average weight estimates has been further refined; that is, estimated bigeye average weight by fleet has been determined for **each month** from logsheet data available to the OFP and applied to bigeye catch (by number) to produce estimates of bigeye catch by weight; this has been done only for years where adequate logsheet data are available to the OFP (i.e. since 1980). It is worth noting that the bigeye catch by weight estimates are only as reliable as the average weight data used in the estimation process, and as such, may be an area of further review in the future.

Table 1. Estimated bigeye catch (t.) from longline vessels operating in western and central Pacific tuna fisheries (excluding Indonesia and Philippines).

Year	Japan	Korea	Taiwan	PRC	Hawaii	Other	Total
1970	21,570	0	1,673	0	250	0	23,493
1971	22,360	0	1,429	0	250	0	24,039
1972	30,311	0	1,704	0	250	0	32,265
1973	21,243	0	1,653	0	250	16	23,161
1974	24,173	0	1,496	0	250	0	25,919
1975	22,789	15,203	901	0	250	0	39,143
1976	27,048	14,889	801	0	250	25	43,013
1977	30,544	13,874	1,073	0	250	34	45,775
1978	26,066	7,543	1,000	0	250	36	34,894
1979	29,148	12,029	1,241	0	250	86	42,754
1980	33,755	10,740	1,468	0	300	98	46,361
1981	27,974	6,381	943	0	380	25	35,704
1982	32,501	7,020	468	0	420	42	40,452
1983	30,640	4,462	295	0	490	52	35,939
1984	35,628	6,428	475	0	600	94	43,226
1985	39,108	9,149	298	0	700	76	49,331
1986	31,979	6,137	181	0	800	31	39,127
1987	40,824	11,760	220	0	816	113	53,734
1988	35,872	11,491	186	0	1,500	68	49,118
1989	37,353	11,564	347	0	1,600	69	50,933
1990	40,184	14,077	3,899	0	1,700	116	59,976
1991	32,113	6,360	2,379	380	1,680	223	43,135
1992	32,501	13,060	5,076	1,226	1,597	538	53,999
1993	30,667	10,647	3,396	3,131	2,161	720	50,721
1994	27,904	13,754	4,870	7,764	1,886	918	57,096
1995	23,330	12,625	3,627	4,890	2,300	1,102	47,875

2.2 *Purse seine*

Few estimates of catches of bigeye (mainly juvenile) by purse seine fleets are available from the literature; the species are not separated from yellowfin of similar size in the catch, and are not readily distinguishable to the untrained eye.

Some Japanese and US vessels report bigeye catches on purse seine logsheets submitted to the OFP. Table A1 (Appendix) shows the proportion of bigeye catch (by weight) to the combined catch of yellowfin and bigeye reported by vessels, which reported at least one set with bigeye catch during that year. However, problems, such as a likely preference to only report bigeye catches when they are substantial, and include bigeye as part of the yellowfin catch when the bigeye component is small, mean that this information is most probably not as reliable as using species composition data collected by port samplers.

Thus, the methodology used here to estimate bigeye catch by purse seine vessels is based on the assumption that part of the logsheet-reported yellowfin catch contains some component of bigeye, and this component can be determined by appropriate species composition sampling by port samplers during the unloading process.

A port sampling programme dedicated to species and size composition data collection from the US purse seine fleet has been in operation in Pago Pago since 1988. Species and size composition data, collected from Korean and Taiwanese vessels by port samplers operating in regional ports, have only been available since the ban on high seas transhippment was established in 1993.

Sampling programmes in Japan have provided estimates of bigeye catch for the Japanese purse seine fleet (see Hampton et al., 1996).

A breakdown of the port sampling data that is available to the OFP for use in determining bigeye catch estimates is provided in Table 2.

Table 2. A summary of yellowfin/bigeye species composition data held at SPC, collected from purse seine vessels by port samplers. Values in "Unassoc." and "Assoc." represent the percentage of bigeye expected in the purse seine logsheet-reported catch of yellowfin, by set type, based on the species composition data collected by port samplers.

	KOREA			TAIWAN			US		
Year	Trips sampled	Unassoc. %	Assoc. %	Trips sampled	Unassoc. %	Assoc. %	Trips sampled	Unassoc. %	Assoc. %
1988	0	–	–	0	–	–	97	3.04	8.88
1989	0	–	–	0	–	–	261	0.48	16.02
1990	0	–	–	0	–	–	315	0.34	11.62
1991	0	–	–	0	–	–	282	1.01	10.12
1992	0	–	–	0	–	–	331	0.66	13.92
1993	5	0.00	25.20	11	0.99	7.62	292	0.91	12.94
1994	93	0.23	4.79	12	7.35	6.19	328	0.44	11.59
1995	26	0.00	3.05	12	0.00	15.38	266	0.98	16.30
1996	68	0.00	0.00	3	0.00	0.00	282	...	...

The coverage of species composition data collected from Korean and Taiwanese vessels warrants closer examination (see Tables A2 and A3 in the Appendix). Unlike the sampling of US purse seine vessels, which has been operating over nearly 10 years and, primarily at one port (Pago Pago), the unloadings from Korean and Taiwanese purse seine vessels have been spread over 14 ports in the region during the past 4 years. This has presented several problems in implementing port sampling during this time; two problems, in particular, are noted:

- These fleets typically unload at ports, which (1) are in proximity to the area fished, and (2) are located in member countries that are engaged in bilateral agreement with the particular fleet. In the past few years, there have been several cases where major transhippment activities have shifted from port to port around the region, and as such, there has been subsequent delays due to various logistical problems in establishing port sampling activities. For example, when the fishing agreement with FSM was not renewed in early 1995, some Korean vessels began transhippment activities out of Kavieng, Papua New Guinea (PNG). Some effort was made by the PNG National Fisheries Authority (NFA), with assistance from SPC, to establish port sampling at this port. Unfortunately, these vessels then shifted general transhippment activities to other PNG ports, namely Wewak, and then Manus. There were further delays in establishing port sampling activities at these ports, which meant that port sampling coverage was zero in the early stages for each port.
- Observers active on Taiwanese purse seine vessels have reported the practice of transferring the catch between wells at sea, or high grading, in order to take advantage of different freezing and storage capabilities onboard and facilitate the unloading process on return to port. Unfortunately, this causes a problem for the port sampler, as it becomes difficult to establish the set type of the sampled fish at time of unloading. (The port sampler is required to review the vessel's well loading sequence and daily logsheet to determine the set type of the sampled fish). The inability of port samplers to adequately identify the set type of the catch unloaded from Taiwanese purse seine vessels is the reason given for the low coverage of species composition data available for this fleet.

This review did not, therefore, consider the available sampling data collected from the Korean and Taiwanese purse seine vessels in the bigeye catch estimation due to the low coverage in comparison to the data collected from US purse seine vessels.

Hampton et al. (1996) applied species composition data, by set type, collected from US purse seine vessels during port sampling activities to determine estimates for the major purse seine fleets fishing in the WCPO.

Several assumptions were made when determining these estimates:

1. For each year, the species composition of bigeye compared to yellowfin taken in unassociated (school) sets made by other fleets is similar to that of US purse seine vessels, based on the NMFS port sampling data (Table 3).
2. For each year, the species composition of bigeye compared to yellowfin taken in associated (log and FAD) sets made by other fleets is similar to that of log sets made by US purse seine vessels, based on the NMFS port sampling data (Table 3).
3. For each year, the size composition of bigeye taken in unassociated sets made by other fleets is similar to that of US purse seine vessels, based on the NMFS port sampling data.
4. For each year, the size composition of bigeye taken in associated (log and FAD) sets made by other fleets is similar to that of log sets made by US purse seine vessels, based on the NMFS port sampling data.

Since species composition data was not collected for years prior to 1988, an estimate of 0.64 percent, for school sets, and 12.70 percent, for log sets, was derived from Table 3 (i.e. calculating the average for years 1989–1994).

Given these assumptions, a percentage of the logsheet-reported yellowfin catch was allocated to bigeye for year, flag and school type strata. The raising factors used to expand the catches of yellowfin reported on logsheets to the total regional estimates of yellowfin catch (Lawson, 1996) were then used to expand the bigeye catches apportioned from the reported yellowfin catches.

Table 3. Percentage of bigeye (by weight) expected in the purse seine logsheet-reported catch of yellowfin, based on NMFS port sampling data (data for 1988–1995 derived from information provided by A. Coan, pers. comm.).

Year	% BET	
	SCHOOL	LOG
1980	*0.64*	*12.70*
1981	*0.64*	*12.70*
1982	*0.64*	*12.70*
1983	*0.64*	*12.70*
1984	*0.64*	*12.70*
1985	*0.64*	*12.70*
1986	*0.64*	*12.70*
1987	*0.64*	*12.70*
1988	3.04	8.88
1989	0.48	16.02
1990	0.34	11.62
1991	1.01	10.12
1992	0.66	13.92
1993	0.91	12.94
1994	0.44	11.59
1995	0.98	16.30

Thus, the estimation of purse seine bigeye catch for the years 1980–1995 is presented in Table 4.

Table 4. Estimated purse seine catch (t.) of bigeye and the percentage of bigeye in the combined yellowfin-bigeye purse seine catch in the WCPO.

Year	JAPAN		KOREA		TAIWAN		US		OTHER		TOTAL	
	BET	%	BET	%	BET	%	BET	%	BET	%	BET	%
1980	1,026	10.9	6	8.7			73	6.7	34	7.5	1,139	10.4
1981	2,648	12.3	51	8.7			1,087	6.7	101	7.5	3,887	9.8
1982	3,024	10.5	213	10.4			1,533	6.7	105	5.5	4,875	8.7
1983	2,820	10.8	96	12.1	265	12.3	4,745	8.7	373	13.5	8,299	9.6
1984	2,944	9.5	52	12.6	410	10.7	4,258	9.3	575	12.4	8,239	9.6
1985	3,431	9.9	155	9.6	487	10.9	1,696	7.0	602	8.7	6,371	8.9
1986	3,779	9.5	164	6.8	694	12.4	2,483	7.5	649	11.3	7,769	9.0
1987	3,385	8.4	1,412	8.1	915	12.6	4,035	6.3	1,677	12.7	11,424	8.1
1988	2,125	8.3	1,077	7.0	780	8.5	1,510	6.0	927	8.8	6,418	7.5
1989	3,914	11.7	2,046	12.8	2,268	14.2	2,374	5.1	2,536	16.0	13,139	9.0
1990	1,502	7.1	2,084	9.0	2,546	11.0	1,448	2.5	2,531	11.2	10,111	6.4
1991	2,434	5.4	2,604	7.4	3,175	9.0	1,301	3.2	1,769	10.0	11,284	5.8
1992	2,956	6.3	4,621	9.1	4,331	8.6	3,092	6.8	2,872	12.6	17,872	7.7
1993	3,116	5.7	2,586	4.2	2,733	4.5	3,503	6.6	2,583	10.8	14,521	5.9
1994	2,132	5.8	2,277	5.1	1,758	3.9	1,142	1.8	1,642	9.0	8,951	4.2
1995	2,688	6.9	2,829	9.5	1,309	4.4	2,382	6.5	3,250	13.0	12,458	6.9

2.3 *Philippines and Indonesia*

Bigeye catches in Philippine (Table 5) and Indonesian (Table 6) waters for years 1980–1995 have been estimated using the methodology described in Hampton et al. (1996).

Table 5. Estimated catch (t.) of bigeye by gear in the Philippines.

Year	Bagnet	Gillnet	Handline	LL	PS	Ringnet	Seine net	UncL	Total
1980	65	230	2,761	0	1,246	0	7	43	4,353
1981	51	266	2,821	92	1,455	364	1	95	5,143
1982	12	139	2,557	163	1,635	133	5	106	4,749
1983	32	126	3,086	0	2,078	0	14	366	5,701
1984	75	216	2,666	110	2,299	0	8	65	5,440
1985	133	204	3,053	156	1,675	484	68	133	5,907
1986	35	214	3,112	207	1,267	492	1	82	5,411
1987	42	216	2,271	325	1,517	292	9	87	4,758
1988	0	0	0	0	0	0	0	5,706	5,706
1989	0	0	0	0	0	0	0	6,215	6,215
1990	69	81	236	18	2,157	819	0	4,687	8,069
1991	1	2	1,967	22	2,398	298	0	4,548	9,236
1992	12	176	2,080	105	1,211	272	112	181	4,147
1993	65	114	2,271	90	445	157	0	294	3,435
1994	54	425	3,248	121	944	773	0	294	5,859
1995	5	166	3,026	114	1,864	105	0	278	5,558

Table 6. Estimated catch (t.) of bigeye by gear in Indonesia.

Year	PL	Handline	LL	PS	UNCL	Total
1980	0	0	0	0	1,755	1,755
1981	0	0	0	0	2,189	2,189
1982	96	0	310	143	1,834	2,384
1983	0	0	0	0	2,020	2,020
1984	228	0	144	211	2,039	2,622
1985	234	0	212	211	2,267	2,924
1986	228	0	210	165	2,787	3,390
1987	232	0	0	168	2,843	3,244
1988	244	0	0	177	2,985	3,406
1989	471	234	441	252	3,135	4,532
1990	443	275	474	267	3,229	4,687
1991	547	330	521	250	3,446	5,094
1992	532	412	537	220	3,677	5,378
1993	559	433	537	460	3,861	5,849
1994	583	529	396	490	3,765	5,763
1995	0	0	0	0	5,913	5,913

3. ESTIMATED BIGEYE CATCH FOR THE WCPO

Table 7 and Figure 3 show the estimated bigeye catch by gear for the WCPO.

Table 8. Estimated catch (t.) of bigeye in the western and central Pacific Ocean, west of 150°W.

Year	Longline	Purse seine	Philippines	Indonesia	Total
1980	46,361	1,139	4,353	1,755	53,609
1981	35,704	3,887	5,143	2,189	46,923
1982	40,452	4,875	4,749	2,384	52,460
1983	35,939	8,299	5,701	2,020	51,960
1984	43,226	8,239	5,440	2,622	59,527
1985	49,331	6,371	5,907	2,924	64,533
1986	39,127	7,769	5,411	3,390	55,697
1987	53,734	11,424	4,758	3,244	73,160
1988	49,118	6,418	5,706	3,406	64,648
1989	50,933	13,139	6,215	4,532	74,819
1990	59,976	10,111	8,069	4,687	82,843
1991	43,135	11,284	9,236	5,094	68,748
1992	53,999	17,872	4,147	5,378	81,396
1993	50,721	14,521	3,435	5,849	74,527
1994	57,096	8,951	5,859	5,763	77,669
1995	47,875	12,458	5,558	5,913	71,804

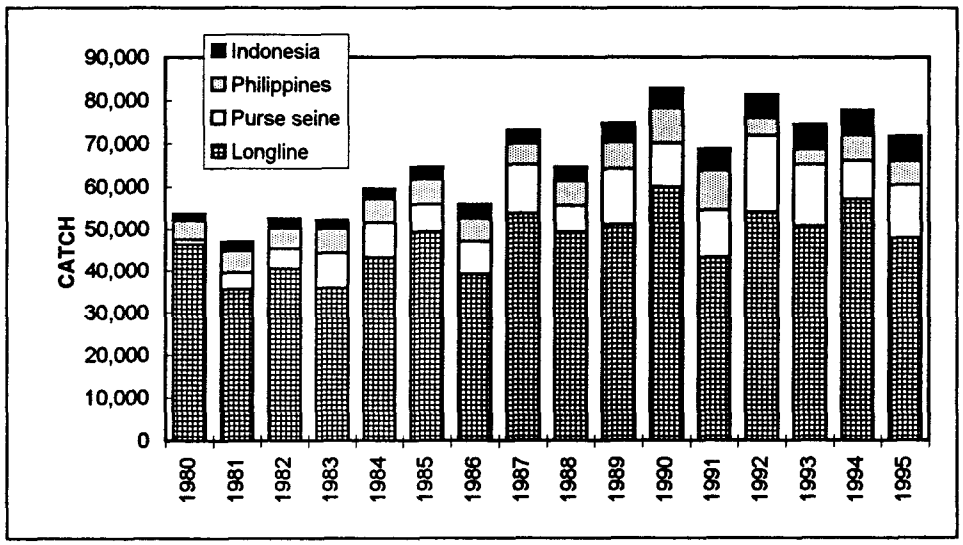


Figure 3. Estimated catch of bigeye in the western and central Pacific Ocean, west of 150°W.

4. FUTURE WORK

Future work on producing bigeye estimates will probably include the following:

- As estimated average weight is critical in the process of determining the estimate of longline-caught bigeye for the distant-water Japanese and Korean fleets, average weight data may be further reviewed in the future;
- Efforts will be made to increase the coverage of port sampling of Korean and Taiwanese purse seine vessels in order to obtain appropriate species composition information to estimate the proportion of bigeye in the yellowfin catch. Specifically, the ports of Chuuk (FSM), Manus and Wewak (PNG), Tarawa (Kiribati) and Honiara (Solomon Islands) have been identified as the primary ports where future transhippment activities for these fleets may occur. Every effort should, therefore, be made to monitor the movements of these fleets (with review of bilateral licensing agreements) to ensure that these ports have the necessary resources to conduct port sampling. The OFP will also continue to liaise with member countries to ensure that resources for port sampling is in place in other ports, if and when the need arises;
- It was noted that increasing the port sampling coverage for the Taiwanese purse-seine fleet may have problems due to the practice of transferring the catch between wells at sea, which in turn, causes a problem for port samplers in determining the set type of the sampled catch during unloading. It is noted that the OFP, in collaboration with member countries, will need to review the port sampling protocol to cater for this problem;
- Any available information regarding estimates of the bigeye catch by Japanese purse-seine vessels, determined by scientists from the Japan Fisheries Agency, would be a valuable addition to the overall purse-seine bigeye estimate;
- Efforts will continue to obtain information that might improve the bigeye estimates for the Philippines and Indonesia.

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APPENDIX

Table A1. Proportion of bigeye catch (by weight) to yellowfin+bigeye in purse seine sets for vessels that reported at least one set with bigeye catch in that year. (Source: logsheet data. Shaded area indicates low coverage of logsheet data.)

Year	Japan Associated %	Japan Unassociated %	USA Associated %	USA Unassociated %
1979	3.9	0.0	0.0	0.0
1980	7.7	0.0	0.0	0.0
1981	4.1	0.0	0.0	0.0
1982	4.5	0.9	0.0	0.0
1983	7.9	1.2	0.0	0.0
1984	2.8	0.8	24.9	0.0
1985	3.6	0.0	0.0	0.0
1986	4.4	0.7	0.0	0.0
1987	3.7	0.6	0.0	0.0
1988	2.0	0.5	0.0	0.0
1989	5.1	0.0	15.6	0.1
1990	9.9	0.1	7.6	0.3
1991	7.8	0.1	7.4	0.1
1992	9.6	0.3	7.6	0.4
1993	3.9	0.4	5.2	0.2
1994	2.5	0.2	6.0	0.1
1995	3.2	0.2	5.5	0.8
1996	8.8	0.3	14.4	1.1

Table A2. Coverage of species composition sampling conducted during the unloading of Korean purse seine vessel in ports of Pacific island countries, 1993–1996. Legend: "Trips" - Number of vessels trips with return to port marked on catch logsheets submitted to the OFP; "Sampled" - Number of unloadings sampled for species composition.

Country	Port	1993			1994			1995			1996		
		Trips	Sampled	%	Trips	Sampled	%	Trips	Sampled	%	Trips	Sampled	%
FSM	CHUUK	49	5	10	124	50	40	36	12	33	14	11	79
	KOSRAE	50	0	0	5	0	0	...	...	..	...	...	..
	POHNPEI	1	0	0	...	...	..	...	...	..	...	...	..
	YAP	...	...	..	...	...	..	...	...	..	...	...	..
	TOTAL	100	5	5	129	50	39	36	12	33	14	11	79
GUAM	APRA	40	0	0	33	0	0	40	0	0	35	0	0
KIRIBATI	TARAWA	8	0	0	54	5	9	0	0	..	15	0	0
N. MARIANAS	TINIAN	...	...	..	...	...	..	...	...	..	...	...	..
PNG	KAVIENG	...	...	..	...	...	..	46	6	13	8	0	0
	MANUS	...	...	..	...	...	..	11	0	0	65	53	82
	RABAUL	...	...	..	...	...	..	1	0	0	4	0	0
	WEWAK	...	...	..	...	...	..	14	0	0	24	2	8
	TOTAL	...	...	..	...	...	..	72	6	8	101	55	54
SOLOMON Is.	HONIARA	10	0	0	65	38	58	45	8	18	45	0	0
	NORO	...	...	..	...	...	..	1	0	0	...	...	..
	TULAGI	1	0	0	...	...	..	...	...	..	...	...	..
	TOTAL	11	0	0	65	38	58	46	8	18	45	0	0
GRAND TOTAL		159	5	3	281	93	33	194	26	13	210	66	31

Table A3. Coverage of species composition sampling conducted during the unloading of Taiwanese purse seine vessel in ports of Pacific island countries, 1993–1996. Legend: "Trips" - Number of vessels trips with return to port marked on catch logsheets submitted to the OFP; "Sampled" - Number of unloadings sampled for species composition.

Country	Port	1993			1994			1995			1996		
		Trips	Sampled	%	Trips	Sampled	%	Trips	Sampled	%	Trips	Sampled	%
FSM	CHUUK	149	11	7	285	10	4	154	12	8	6	0	0
	KOSRAE	...	...	..	...	...	..	...	...	..	...	...	..
	POHNPEI	...	...	..	2	0	0	...	...	..	...	...	..
	YAP	...	...	..	...	...	..	...	...	..	3	0	0
	TOTAL	149	11	7	287	10	4	154	12	8	9	0	0
GUAM	APRA	38	0	0	47	0	0	51	0	0	12	0	0
KIRIBATI	TARAWA	...	...	..	...	...	..	...	...	..	...	...	..
N. MARIANAS	TINIAN	7	0	0	14	0	0	4	0	0	...	...	..
PNG	KAVIENG	...	...	..	...	...	..	4	0	0	10	0	0
	MANUS	...	...	..	...	...	..	...	...	..	...	...	..
	RABAUL	...	...	..	...	...	..	1	0	0	1	0	0
	WEWAK	...	...	..	...	...	..	16	0	0	63	3	5
	TOTAL	...	...	..	...	...	..	21	0	0	74	3	4
SOLOMON Is.	HONIARA	1	0	0	2	2	100	...	...	..	3	0	0
	NORO	...	...	..	...	...	..	...	...	..	...	...	..
	TULAGI	2	0	0	...	...	..	...	...	..	...	...	..
	TOTAL	3	0	0	2	2	100	...	...	..	3	0	0
GRAND TOTAL		197	11	7	350	12	3	230	12	5	98	3	3