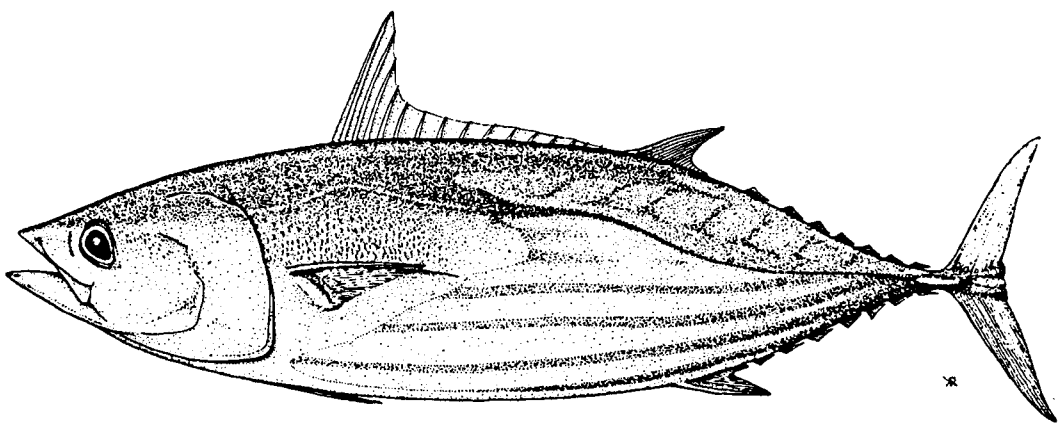
SCTB5

STANDING COMMITTEE ON TUNA AND BILLFISH

17-19 June 1992
Honolulu, Hawaii
United States of America

WORKING PAPER 6

NON-REPORTING AND UNDER-REPORTING OF CATCHES BY WESTERN PACIFIC PURSE SEINERS IN DATA COLLECTED BY COASTAL STATES



Tuna and Billfish Assessment Programme
South Pacific Commission
Noumea, New Caledonia

June 1992

Introduction

The Tuna and Billfish Assessment Programme (TBAP) has compiled daily catch and effort logsheet data from distant-water fishing nations since the early 1980s. The logsheet data in the Regional Tuna Fisheries Database have been provided to the TBAP by SPC member countries, which in turn have collected the data from the fishing nations under the terms of access agreements. Unfortunately, the terms of the agreements have not included provisions allowing for the verification of the logsheet data with data from other sources, such as unloadings. Even a rough estimate of the coverage of the logsheet data has been problematic, due to the lack of reliable estimates of the total catches by the fleets.

Previously, verification of purse seine logsheet data has been approached by comparing the catches reported on logsheets to storage capacity (Anonymous 1991). The comparison of logsheet data with storage capacity assumes, however, that (1) vessels fish until their holds are full, (2) vessels take all catches within the waters of member countries (and thus report all catches on logsheets), and (3) transhipment at sea does not occur. All three assumptions are known to be violated for the Western Pacific purse seine fleet. While estimates of coverage from comparisons of logsheet data with storage capacity are therefore not possible, the magnitude of the differences presented by Anonymous (1991) are so great as to suggest that under-reporting is probably taking place, at least for Korean, Taiwanese and possibly Japanese vessels. In fact, under-reporting by Korean and Taiwanese vessels has been suspected for a number of years based on low catch rates reported by these vessels compared to those reported by American and Japanese purse seiners.

Analysis of the coverage of purse seine catches by logsheet data collected by SPC member countries has recently been made possible with the publication of estimates of annual catches for the fleets operating in the SPC area (South Pacific Commission 1992) and with access to unloading statistics for purse seiners delivering their catches to canneries in Pago Pago, American Samoa, and transhipping at Tinian, Northern Mariana Islands. This information is used below to estimate coverage and to examine non-reporting and under-reporting of catches on logsheets. The rate of non-reporting is defined herein as the proportion of the catch from fishing effort that is not recorded on the logsheets, while the rate of under-reporting is defined as the proportion not recorded on logsheets of the catch from fishing effort recorded on logsheets.

Annual Coverage of Purse Seine Catches

The coverage of purse seine catches by data held collected by member countries can be determined from independent estimates of annual catches. Unfortunately, the annual catch estimates (South Pacific Commission 1992), which are derived from a variety of sources, are poor or incomplete for several distant-water fleets, including those of Indonesia, the Philippines and the Republic of China (Taiwan). Table 1 compares independent estimates of annual catches to catches determined from logsheet data for Japan, Republic of Korea, Taiwan and the United States of America. Although the estimates of annual catches for Taiwan are relatively poor, they have been included to give a rough indication of coverage.

Overall, coverage by logsheet data of the catches by purse seiners from Japan, Korea, Taiwan and the United States combined during 1980—1991 is 45 per cent. However, coverage varies considerably among the fleets.

Coverage for Japanese vessels during 1980—1991 is 67 per cent, with a low of 46 per cent in 1980 and a high of 81 per cent in 1984. Most of the missing 33 per cent might reasonably be explained as catches in international waters, which, under the terms of the access agreements, were not required to be reported on logsheets by the Japanese.

Coverage for American vessels during 1980—1991 is 44 per cent, however it is of interest to consider two periods for this fleet, i.e., before and after the implementation of the multilateral *treaty on fisheries between certain Pacific island states and the United States of America* in June 1988. For the period prior to the treaty, 1980—1987, coverage is 8 per cent, while after the implementation of the treaty coverage has been nearly complete. Access agreements were not entered into by the United States prior to the multilateral treaty due to federal law which did not recognise national jurisdiction for the management of highly migratory species. Those agreements that existed prior to the multilateral treaty were private agreements with American vessel owners.

Coverage of the Korean and Taiwanese fleets are 19 per cent and 23 per cent respectively for 1980—1991. The missing catches, 81 per cent for the Koreans and 77 per cent for the Taiwanese, are much too large to be attributed solely to catches in international waters. Throughout the 1980—1990 period, both fleets had access to major purse seining grounds in the waters of the Federated States of Micronesia and Papua New Guinea, therefore the fleets were not restricted in the areas available for fishing. Since 1990, however, neither fleet has fished in the waters of the Federated States of Micronesia.

While coverage rates in terms of the catch for Korean and Taiwanese vessels are roughly the same, coverage in terms of the number of days fished or searched is greater for Taiwanese vessels than for Korean vessels. Table 2 shows the number of vessels active, the number of vessels covered by logsheet data collected by member countries, and the average annual number of days covered per vessel. While, for most years, data have been received from almost all Taiwanese vessels, the number of Korean vessels covered has consistently been much lower than the number of vessels active. For those Korean vessels for which data have been received, the number of days covered per annum is, on average, lower than the average number of days covered per annum for Taiwanese vessels. Thus, non-reporting would appear to be a greater problem with Korean vessels than with Taiwanese vessels.

Comparison of Catches Recorded on Logsheets to Unloadings

Catches recorded on logsheets are usually estimated by multiplying the number of brails taken to load the fish from each set by a constant representing the average tonnage per brail. While the constants representing the average tonnage per brail vary depending on the species composition and the size of the fish in the brail, the catches recorded on logsheets, the "hailed weights," are less accurate than the catches measured with a scale during unloading.

Data on unloadings by Japanese, Korean and Taiwanese purse seiners in the SPC region have generally been lacking. Unloadings by these fleets have usually taken place on the high seas or at home ports. However, some vessels, mostly Taiwanese, have transhipped at Tinian.

A data processing system for the management of the Tinian transhipment data was installed by the Tuna and Billfish Assessment Programme at the request of the Division of Fish and Wildlife, Saipan, in August 1989. However, the transhipment data have not been entered into the system on

a regular basis. Therefore the only Tinian transhipment data currently available consist of records covering the period from December 1986 to March 1989 that were processed at the time of the installation of the system.

Table 3 compares catches recorded on logsheets to the amount unloaded for Japanese and Taiwanese vessels. While Korean vessels also unloaded at Tinian during 1986—1989, the logsheet data for Korean vessels are too incomplete to be used for meaningful comparisons with transhipment data.

Table 3 shows that catches recorded on logsheets for seven trips by five Japanese vessels appear to over-estimate the catch by about 30 per cent on average. The reason for the discrepancy is unknown, though incomplete unloading is probably a factor. The number of trips examined is small, therefore it should not be concluded that logsheet data for Japanese vessels consistently over-estimate the catch.

The logsheet data reported in Table 3 for 12 trips by seven Taiwanese vessels appear to under-estimate the catch by a large amount, 74 per cent on average. The number of days covered on logsheets compared to the number of days at sea is generally high for Taiwanese vessels, thus the missing catch cannot be attributed to a large amount of unrecorded fishing activity. In the absence of any other explanation, it is reasonable to conclude that the seven Taiwanese vessels under-reported their catches.

American vessels usually unload at Pago Pago or tranship their catch at sea. Several vessels based in Guam also unload their catch at Tinian. Since the implementation of the multilateral treaty in June 1988, the coverage of the fishing activities on logsheets has been nearly complete.

Unloading data for 171 trips by 40 American vessels were examined. The data included only those trips for which unloading occurred at Pago Pago or Tinian and excluded trips for which transhipment was known to have occurred at sea. Only trips for which the difference between the number of days recorded on the logsheet and the duration of the trip (i.e., from the date of departure from port to the date of return to port) was less than or equal to three days were included in order to reduce errors due to unrecorded catches on logsheets.

The resulting estimate of the bias of catches recorded on logsheets for American seiners is small, +1.7 per cent of the amount unloaded. Though the average difference between logsheet catches and unloadings was small, +17 mt per trip, compared to the average amount unloaded, 983 mt per trip, the differences ranged from -870 mt to +589 mt, with a standard deviation of 131 mt. When trips for which gross errors (differences between logsheet catches and unloadings of greater than 200 mt) were excluded, the standard deviation dropped to 43 mt. The bias for the resulting 161 trips by 39 vessels dropped slightly to +1.1 per cent, with an average difference between logsheet catches and unloadings of +11 mt per trip.

Mechanisms of under-reporting

The evidence for under-reporting by Taiwanese vessels raises questions concerning how the catches are under-reported. Is under-reporting of the catch due to sets not being recorded on logsheets? To successful sets being reported as unsuccessful? Or to bias in the catch per set? Table 4 presents

statistics by vessel nationality on the proportion of days recorded on logsheets on which at least one set was made, the proportion of sets in which fish were caught, and the catch per successful set.

Taiwanese vessels report a considerably smaller proportion of days on which sets were made compared to the other fleets. According to the logsheet data, the Taiwanese make sets on only 36 per cent of days fished, compared to 75 per cent for Japanese vessels, 62 per cent for American vessels and 57 per cent for Korean vessels.

In comparing the percentage of successful sets and the catch per successful set, the type of set must be taken into account. A greater proportion of sets made by the Taiwanese are on schools associated with floating objects (i.e. logs, fish aggregating devices or animals), as opposed to free-swimming schools, than the other fleets. On average, sets on schools associated with floating objects are more successful than those on unassociated schools. Therefore only schools associated with floating objects were considered when comparing the percentages of successful sets and the catches per successful set.

The Taiwanese have the highest percentage of successful sets on schools associated with floating objects. Almost every set, 99.7 per cent overall, is successful. The success rates for American and Japanese vessels are also high, while the success rate for Korean vessels is considerably lower than for the other fleets.

While the success rate for Taiwanese vessels is highest, the catch per successful set on floating objects is lowest. The catch per successful set for Taiwanese vessels, 15 mt, is about half that for Japanese vessels, 28 mt.

From the above discussion, it would appear that under-reporting by Taiwanese vessels is due both to sets not being recorded on logsheets and to error in the catch per successful set. The recording of successful sets as unsuccessful does not appear to occur.

A further question that arises is whether all or only some of the Taiwanese vessels under-report. Table 5 presents statistics for individual Taiwanese purse seiners for which data covering at least 500 days fishing, or about two years of fishing effort, are available. The statistics provided include the proportion of days on which sets were made ("set days per days fished"), the average number of sets for days on which at least one set was made ("sets per set day"), the proportion of successful sets, the catch per successful set and the catch per day fished. (The catch per day fished is equal to the product of the four other statistics.) For the 22 Taiwanese vessels, the catch per day fished ranges from 2.25 mt per day to 11.96 mt per day. Even the highest catch per day fished, 11.96 mt per day, is considered to be economically unsustainable for purse seiners of this size, which suggests that all Taiwanese purse seiners listed in Table 5 have under-reported to some degree. The statistics show, however, that the magnitude of under-reporting varies considerably among the vessels, more or less in a continuum from the worst case to the best.

Table 6 presents similar statistics for 10 Korean vessels. Catch per day fished ranges from 5.58 mt per day to 20.89 mt per day, which suggests that only some of the Korean vessels under-reported. Low values of the catch per day fished for Korean vessels are due to a combination of a low rate of successful sets and a low catch per successful set.

In contrast to Taiwanese and Korean purse seiners, catch per day fished for 33 Japanese vessels ranged from 16.61 mt per day to 27.95 mt per day, while for 18 American vessels it ranged from 16.08 mt per day to 33.37 mt per day.

Quantification of the Rates of Non-Reporting and Under-Reporting

Estimates of the rate of under-reporting, P_{under}, can be obtained from the actual annual catch, C_A, the catch recorded on logsheets, C_L, and the rate of non-reporting, P_{non}, from the following relationship:

$$C_L = C_A \cdot (1 - P_{non}) \cdot (1 - P_{under}) \quad (1)$$

Solving Equation (1) for P_{under}, we obtain:

$$P_{under} = 1 - [C_L / C_A] / [1 - P_{non}]. \quad (2)$$

If an independent estimate of the actual number of days fished, D_A, is available, the rate of non-reporting of days fished could be determined from the number of days recorded on logsheets, D_L, and used as a surrogate for P_{non}, the rate of non-reporting of the catch, i.e.:

$$P_{non} \approx 1 - [D_L / D_A] \quad (3)$$

If an independent estimate of the actual number of days fished is unavailable, it can be derived from an independent estimate of the catch per unit effort, CPUE, as follows:

$$D_A = C_A / \text{CPUE} \quad (4)$$

from which we obtain

$$P_{non} \approx 1 - D_L / [C_A / \text{CPUE}]. \quad (5)$$

Substituting (5) into (2) gives P_{under} in terms of CPUE:

$$P_{under} \approx 1 - ([C_L / D_L] \cdot [1 / \text{CPUE}]). \quad (6)$$

Table 7 presents the results of an analysis based on Equations (2) and (3), using the actual number of days fished for Japanese vessels during 1983—1990 (South Pacific Commission 1992). Non-reporting averages 24 per cent, and ranges from 16 to 31 per cent, which is roughly the amount of fishing expected to occur in international waters. Under-reporting is low, averaging 9 per cent and ranging from 1 to 16 per cent.

Reliable estimates of the actual number of days fished or the catch per unit effort are currently unavailable for the purse seine fleets of Korea and Taiwan. Nevertheless, for illustrative purposes, Tables 8 and 9 present estimates of the rates of non-reporting and under-reporting derived from crude estimates of the catch per unit effort. For Korean vessels, annual CPUE was estimated as 70 per cent of the CPUE for American vessels, which are similar in size to Korean vessels, while annual CPUE for Taiwanese vessels was estimated as 70 per cent of the CPUE for Japanese vessels, which are roughly similar in size to Taiwanese vessels. These estimates of CPUE are considered to

be near the upper limit of the possible values. Lower values will result in higher estimates of the rate of non-reporting, therefore the estimated rates of non-reporting may possibly be conservative.

The results in Tables 8 and 9 confirm the finding above that non-reporting is of greater importance for Korean vessels than for Taiwanese vessels. In recent years, non-reporting by Korean vessels may have been ranged from about 58 to 75 per cent, while for Taiwanese vessels it may have been much lower, possibly ranging from about 5 to 31 per cent. A portion of the rate of non-reporting can be attributed to catches in international waters. Yet, for Korean vessels at least, the estimated rates of non-reporting are much greater than would be expected from high seas fishing alone.

Since the overall rates of coverage of the catch are similar for both fleets, 19 per cent and 23 per cent for Korean and Taiwanese vessels respectively, it follows from Equation (1) that if non-reporting is of greater importance for Korean vessels, under-reporting should be of greater importance for Taiwanese vessels. Tables 8 and 9 show that under-reporting for Taiwanese vessels in recent years may have ranged from about 62 to 79 per cent, while for Korean vessels it could have been much lower, possibly ranging from about 18 to 28 per cent. The estimate of under-reporting for Taiwanese vessels roughly agrees with the amount of under-reporting determined from Tinian unloading data.

It should be stressed that the rates of non-reporting and under-reporting in Tables 8 and 9 are only indicative and should be treated with caution. Estimates of non-reporting and under-reporting for Korean and Taiwanese vessels will improve when more accurate information on catch rates or total fishing effort are made available.

Conclusion

The lack of coverage by logsheet data of catches by American purse seiners prior to the implementation of the multilateral treaty in June 1988 was due to the lack of access agreements with SPC member countries. Since June 1988, coverage has been nearly complete. A comparison of catches recorded on logsheets with catches measured during unloading indicates that the logsheet data for American vessels is unbiased and relatively accurate.

Coverage of Japanese catches for 1980—1991 is 67 per cent. Non-reporting, which is probably due to fishing in international waters, accounts for 24 per cent of the missing catch, while a small amount of under-reporting, 9 per cent, accounts for the remainder.

Coverage by logsheet data of Korean and Taiwanese catches for 1980—1991 is similar, 19 and 23 per cent respectively. However, the low coverage of catches by Korean vessels is due primarily to non-reporting, while, for Taiwanese vessels, low coverage is primarily due to under-reporting.

Under-reporting by Taiwanese vessels appears to be due to sets not being recorded on logsheets and to bias in the catch per successful set. All individual Taiwanese vessels examined appeared to have under-reported, although the magnitude of under-reporting varied considerably among vessels. Under-reporting by Korean vessels appears to be due to the reporting of successful sets as unsuccessful and to error in the catch per successful set. Only some of the Korean vessels appear to have under-reported.

References

Anonymous. 1991. Western Pacific tuna fisheries: economic and resource issues relating to tuna fisheries interactions. South Pacific Forum Fisheries Agency, Honiara, Solomon Islands.

South Pacific Commission. 1992. Status of tuna fisheries in the SPC area during 1991, with revised annual catches since 1952. Working Paper 2. Fifth Meeting of the Standing Committee on Tuna and Billfish, 17—18 June 1992, Honolulu, Hawaii. South Pacific Commission, Noumea, New Caledonia.

Table 1. Annual coverage of purse seine catches (mt) in the Regional Tuna Fisheries Database

YEAR	JAPAN			KOREA			TAIWAN			USA			TOTAL		
	TOTAL	RTFD	%	TOTAL	RTFD	%	TOTAL	RTFD	%	TOTAL	RTFD	%	TOTAL	RTFD	%
1980	39,560	18,325	46	500	70	14	0	0	0	11,000	0	0	51,060	18,395	36
1981	59,258	30,108	51	1,600	413	26	0	0	0	35,013	0	0	95,871	30,521	32
1982	100,427	72,225	72	12,000	1,129	9	0	0	0	81,770	0	0	194,197	73,354	38
1983	137,392	90,023	66	16,000	3,627	23	12,000	3,663	31	153,700	618	0	319,092	97,931	31
1984	141,473	114,844	81	13,600	5,368	39	24,000	5,297	22	169,460	16,918	10	348,533	142,427	41
1985	144,200	88,363	61	11,300	4,546	40	28,000	10,473	37	116,700	21,506	18	300,200	124,888	42
1986	149,291	118,576	79	27,700	6,534	24	40,000	11,623	29	130,100	16,059	12	347,091	152,792	44
1987	129,958	101,167	78	60,000	20,858	35	52,000	16,656	32	146,200	13,206	9	388,158	151,887	39
1988	167,172	108,105	65	78,552	21,020	27	76,000	21,284	28	124,600	75,360	60	446,324	225,769	51
1989	139,060	96,182	69	115,754	37,475	32	100,000	22,028	22	139,276	139,276	100	494,090	294,961	60
1990	159,735	101,161	63	173,343	31,546	18	128,000	26,516	21	164,087	164,087	100	625,165	323,310	52
1991	170,315	93,609	55	242,685	11,159	5	176,000	25,599	15	205,884	205,884	100	794,884	336,251	42
TOTAL	1,537,841	1,032,688	67	753,034	143,745	19	636,000	143,139	23	1,477,790	652,914	44	4,404,665	1,972,486	45

NOTES

1. References for the independent estimates of the total annual catches are given in South Pacific Commission (1992).

2. Coverage of American purse seiners by data held in the RTFD is assumed complete for 1989—1990, therefore the coverage rate for 1989—1990 is 100 per cent.

3. Catches determined from logbook data held at SPC may be incomplete for 1991, therefore coverage rates for 1991 may be underestimated.

Table 2. Vessels active compared to vessels covered in the RTFD

	KOREA			TAIWAN		
YEAR	VESSELS ACTIVE	VESSELS COVERED	ANNUAL DAYS PER VESSEL	VESSELS ACTIVE	VESSELS COVERED	ANNUAL DAYS PER VESSEL
1980	2	1	5	–	–	–
1981	3	1	33	–	–	–
1982	10	3	65	–	–	–
1983	11	3	122	3	3	85
1984	12	5	130	6	6	108
1985	11	5	138	7	7	192
1986	13	7	86	10	10	118
1987	20	17	124	13	13	234
1988	23	19	121	19	19	207
1989	30	22	169	25	25	197
1990	..	13	221	35	33	230
1991	37	10	122	44	36	173

1. The numbers of vessels covered and the number of days covered per vessel per annum for 1991 are incomplete.

Table 3. Comparison of catches recorded on logsheets to unloadings at Tinian

VESSEL NATIONALITY	TRIP START	TRIP END	TRIP DURATION	LOGSHEET DAYS	TINIAN ARRIVAL	LOGSHEET CATCH	AMOUNT UNLOADED	DIFFERENCE
JAPAN	25.10.88	15.11.88	22	22	16.11.88	395	359	35
JAPAN	15.03.89	30.03.89	16	15	31.03.89	275	179	95
JAPAN	15.03.89	28.03.89	14	14	29.03.89	265	253	11
JAPAN	21.12.88	30.12.88	10	10	30.12.88	90	66	23
JAPAN	18.02.89	25.03.89	36	30	27.03.89	475	269	205
JAPAN	07.01.89	22.02.89	47	43	23.02.89	302	179	122
JAPAN	16.12.88	19.01.89	35	35	20.01.89	680	610	69
TAIWAN	01.06.87	06.08.87	67	60	07.08.87	41	571	-530
TAIWAN	01.06.87	22.08.87	83	83	23.08.87	79	640	-561
TAIWAN	09.03.88	31.05.88	84	84	01.06.88	225	571	-346
TAIWAN	01.12.86	31.12.86	31	31	03.01.87	520	612	-92
TAIWAN	20.03.87	05.05.87	47	47	06.05.87	75	500	-425
TAIWAN	18.05.87	10.09.87	116	114	16.09.87	110	720	-610
TAIWAN	17.03.88	28.05.88	73	73	29.05.88	50	720	-670
TAIWAN	01.06.87	10.09.87	102	102	16.09.87	50	700	-650
TAIWAN	01.03.88	19.05.88	80	80	20.05.88	75	571	-496
TAIWAN	20.01.87	08.03.87	48	48	10.03.87	150	122	27
TAIWAN	07.04.87	22.05.87	46	45	24.05.87	170	600	-430
TAIWAN	19.04.87	14.05.87	26	26	15.05.87	200	400	-200

Table 4. Days with sets, successful set rate and catch per successful set, by vessel nationality

VESSEL NATIONALITY	DAYS WITH SETS (%)	LOG SETS (%)	SUCCESSFUL LOG SETS (%)	CATCH PER SUCCESSFUL LOG SET (mt)
JAPAN	75.1	61.7	92.1	28.1
KOREA	56.9	57.4	76.1	25.9
TAIWAN	36.0	87.9	99.7	15.0
UNITED STATES	62.3	22.7	92.2	40.2

Table 5. Catch (mt) per day fished for individual Taiwanese purse seiners

VESSEL	SET DAYS PER DAY FISHED	SETS PER SET DAY	SUCCESSFUL SET RATE	CATCH PER SUCCESSFUL SET	CATCH PER DAY
1	0.44	1.23	0.99	22.33	11.96
2	0.42	1.03	0.99	26.71	11.44
3	0.41	1.06	1.00	25.29	10.99
4	0.36	1.27	0.89	20.06	8.16
5	0.37	1.01	0.86	24.67	7.93
6	0.39	1.14	0.95	18.01	7.61
7	0.28	1.00	0.97	24.97	6.78
8	0.24	1.11	0.97	23.18	5.99
9	0.31	1.00	0.96	16.64	4.95
10	0.30	1.32	0.96	12.63	4.80
11	0.46	1.09	1.00	9.17	4.60
12	0.17	2.72	0.77	12.63	4.50
13	0.32	1.32	0.99	10.24	4.28
14	0.26	1.25	0.94	13.60	4.15
15	0.35	1.14	1.00	9.52	3.80
16	0.25	1.20	0.99	12.53	3.72
17	0.22	1.12	0.98	15.01	3.62
18	0.38	1.13	1.00	8.26	3.55
19	0.53	1.05	1.00	5.91	3.29
20	0.58	1.03	1.00	5.46	3.26
21	0.48	1.10	1.00	5.68	3.00
22	0.18	1.36	0.95	9.66	2.25

Table 6. Catch (mt) per day fished for individual Korean purse seiners

VESSEL	SET DAYS PER DAY FISHED	SETS PER SET DAY	SUCCESSFUL SET RATE	CATCH PER SUCCESSFUL SET	CATCH PER DAY
1	0.67	1.46	0.53	40.30	20.89
2	0.53	1.15	0.74	46.27	20.87
3	0.55	1.16	0.70	39.80	17.77
4	0.65	1.29	0.57	36.62	17.50
5	0.57	1.11	0.78	32.79	16.18
6	0.65	1.00	0.65	29.63	12.52
7	0.46	1.00	0.85	23.52	9.20
8	0.61	1.00	0.75	20.03	9.16
9	0.56	1.02	0.59	17.31	5.83
10	0.63	1.00	0.33	26.82	5.58

Table 7. Rates of non-reporting and under-reporting of the catch by Japanese purse seiners

YEAR	ANNUAL CATCH	DAYS FISHED	DAYS COVERED	NON-REPORTING	UNDER-REPORTING
1983	137,392	6,579	4,872	26	12
1984	141,473	7,268	6,107	16	3
1985	144,200	7,210	5,132	29	14
1986	149,291	6,343	5,155	19	2
1987	129,958	6,473	5,111	21	1
1988	167,172	7,110	5,500	23	16
1989	139,060	7,207	5,354	26	7
1990	159,735	6,689	4,595	31	15

Table 8. Rates of non-reporting and under-reporting of the catch by Korean purse seiners

YEAR	ANNUAL CATCH	CPUE	DAYS FISHED	DAYS COVERED	NON-REPORTING	UNDER-REPORTING
1982	12,000	13.3	902	177	80	52
1983	16,000	14.4	1,110	309	72	19
1984	13,600	11.4	1,192	621	48	24
1985	11,300	11.6	972	631	35	38
1986	27,700	18.5	1,501	477	68	26
1987	60,000	16.6	3,615	1,531	58	18
1988	78,552	12.5	6,269	1,790	71	6
1989	115,754	14.8	7,837	3,156	60	20
1990	173,343	18.0	9,636	2,431	75	28

1. Korean CPUE (mt/day) is assumed to be equal to 70 per cent of the CPUE for American vessels.

Table 9. Rates of non-reporting and under-reporting of the catch by Taiwanese purse seiners

YEAR	ANNUAL CATCH	CPUE	DAYS FISHED	DAYS COVERED	NON-REPORTING	UNDER-REPORTING
1984	24,000	13.6	1,767	528	70	26
1985	28,000	13.4	2,083	1,074	48	27
1986	40,000	16.5	2,432	1,204	50	41
1987	52,000	14.0	3,714	3,114	16	62
1988	76,000	16.5	4,600	4,008	13	68
1989	100,000	13.9	7,179	4,926	31	65
1990	128,000	17.2	7,464	7,121	5	79

1. Taiwanese CPUE (mt/day) is assumed to be equal to 70 per cent of the CPUE for Japanese vessels.

ADDENDUM TO WORKING PAPER 6

Table 10. Effect of CPUE (mt per day) on rates (%) of non-reporting and under-reporting of the catch by Korean (1982-1990) and Taiwanese (1984-1990) purse seiners

	KOREAN PURSE SEINERS			TAIWANESE PURSE SEINERS		
CPUE	ACTUAL DAYS	NON-REPORTING	UNDER-REPORTING	ACTUAL DAYS	NON-REPORTING	UNDER-REPORTING
10.0	50,825	78	–	44,800	51	48
12.5	40,660	73	5	35,840	39	59
15.0	33,883	67	21	29,867	26	65
17.5	29,043	62	32	25,600	14	70
20.0	25,412	56	41	22,400	2	74
22.5	22,589	51	47	19,911	–	75
25.0	20,330	45	52	17,920	–	75
27.5	18,482	40	57	16,291	–	75
30.0	16,942	34	60	14,933	–	75
32.5	15,638	29	63	13,785	–	75
35.0	14,521	23	66	12,800	–	75