WP 4

SOUTH PACIFIC ALBACORE OBSERVER PROGRAMME 1988/89

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1. Background

1.1 South Pacific albacore fisheries

Albacore (*Thunnus alalunga*) have been exploited in the South Pacific by Asian longliners since 1952, first by the Japanese and subsequently by Koreans and Taiwanese. As the longline fishery developed, catch rates fell and targeted albacore fishing by Japanese longliners declined. Catches have fluctuated between 25,000 t and 50,000 t since 1960, with production model estimates indicating an MSY for the longline fishery of 35,000 t, assuming a minor surface fishery of up to 2,000 t.

A small troll fishery for albacore has operated for some years in coastal waters off the west coast of New Zealand, usually recording catches of 3,000-4,000 t annually. Exploratory troll fishing in 1985/86 and 1986/87 suggested that a viable surface fishery

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could be developed in the offshore waters of the sub-tropical convergence zone (STCZ) (35-40°S, 170-130°W) during December - April. Preliminary indications were that this fishery could support a catch of about 10,000 t without substantially reducing longline catches.

Since these surveys, the surface fishery has developed rapidly. During 1987/88, 44 U.S., Canadian and Fijian troll vessels caught about 4,000 t of albacore in the STCZ. In addition, 7 Taiwanese gill netters caught 1,100 t, and an unknown number of Japanese gill netters also fished. During the 1988/89 season, 54 troll vessels from the U.S., Canada, New Zealand and French Polynesia caught about 5,000 t of albacore in the STCZ, while a similar amount was caught by some 200 trollers in inshore waters off the west coast of New Zealand, resulting in a total troll catch of about 10,000 t.

Gill-net fishing in the South Pacific also expanded dramatically in 1988/89. Prior to the exploratory Taiwanese fishing in 1987/88, the only known gill-net activity in the South Pacific has been that of a Japanese fleet of 30-50 vessels, which has fished since 1985 mainly in the Tasman Sea. The exact number of gill netters that fished in the South Pacific in 1988/89 is not known with certainty, however reports suggest that at least 100 Taiwanese, 30 Japanese and 2 South Korean vessels fished. (The Japanese fleet fished mainly in the Tasman Sea, however some vessels transferred to the STCZ east of New Zealand later in the season). Based on limited catch rate information, the combined gill-net catch for the 1988/89 season is estimated to be between 30,000 and 60,000 t.

This rapid increase in catch, particularly by the gill-net fishery, has caused much concern throughout the South Pacific, particularly by Pacific Island countries involved in troll and longline fishing, or in the processing/transhipping of albacore catches. As a consequence of this concern, an informal consultation, sponsored by the Forum Fisheries Agency (FFA), the South Pacific Commission (SPC) and the Food and Agriculture Organisation of the United Nations (FAO), took place in Suva, Fiji on 3-4 November 1988. The consultation noted the paucity of information available on the surface fishery for albacore, and in particular on the likely level of interaction among the troll, gill-net and longline fisheries. As a consequence, it strongly endorsed a proposal for data collection during the 1988/89 season consisting of detailed fishery monitoring, aerial reconnaissance and placement of observers on board commercial troll vessels.

1.2 Observerprogramme

In line with the recommendations of the November 1988 consultation, an observer programme was mounted for the 1988/89 season. The programme was coordinated by SPC and the New Zealand Ministry of Agriculture and Fisheries (MAF). Funding for the first observer cruise was provided by the United Nations Development Programme (UNDP), while the second cruise was undertaken voluntarily by Mr Sharples without

funding. A third cruise by a second observer, funded by the FAO/UNDP Regional Fisheries Support Programme and NZ MAF, had to be aborted because of an unexpected finish to the season.

Programme objectives and sampling protocols were developed jointly by scientists from the SPC's Tuna and Billfish Assessment Programme, the NZ MAF Pelagic Research Group in Wellington, and the U.S. National Marine Fisheries Service (NMFS) Southwest Fisheries Center in Hawaii. Observer recruitment, briefing/debriefing, and liaison was carried out by the Pelagic Research Group in Wellington.

1.3 Other data collected during the 1988/89 season

Various other data were collected from the fisheries during 1988/89, including longline log book and catch length-frequency data in Pago Pago (NMFS), troll catch landings and length-frequency data in Pago Pago (NMFS), Papeete (EVAAM), Levuka (Pacific Fishing Co. and SPC) and New Zealand (MAF), and gill-net transhipment and length-frequency data in Noumea (SPC) and Wellington (MAF). Tagged albacore were also released by MAF and U.S. troll fishermen contracted to NMFS. These data will undergo independent analysis in due course.

2. Objectives of the observer programme

The general objective of the observer programme was to document the fishing activities of troll and drift gill-net vessels along the STCZ in the South Pacific Ocean. The principal activities of the observer were to collect albacore size composition data, estimate by-catch composition in the surface fisheries fisheries, estimate the occurrence of net damaged albacore, ranked by severity, and to generally gather information on drift gill-net fishing in the South Pacific. The specific daily activities of the observer were:

i To record the daily catch of albacore and troll by-catch onboard host vessels.

ii To routinely record length, weight and girth of albacore; recording also the presence of gill-net marks and ranking their severity.

iii To observe gill-net hauling operations on distant-water vessels, recording the approximate number of albacore and other species caught and numbers of fish dropping out during hauling of the net, and to document characteristics of vessels and gill-net gear in the vicinity of trolling operations, if possible with photographic records.

iv To record observations on the behaviour of albacore schools and collect oceanographic data where feasible, and to carefully record recapture details of any tagged fish.

3. OperationalSummary

The observer was offered berths aboard albacore troll vessels from New Zealand and the U.S. on an opportunistic basis. The programme began upon departure from Nelson, New Zealand aboard the M.F.V. *DanielSolander* on 26 December, 1988 and finished on 30 April, 1989 with his arrival in Pago Pago, American Samoa aboard the F.V. *Barbara H*. The observer was away from the fishing grounds for 40 days in mid-season from 11 February to 22 March 1989. The programme can therefore be considered to comprise of an early-season cruise (M.F.V.'s *DanielSolander* and *Solander II*) and a late season cruise (F.V. *Barbara H*), hereafter referred to as Cruise 1 and Cruise 2, respectively.Apart from the mid-season break in the observer programme, good coverage of the season was possible since work began on one of the first boats to start fishing and finished the season on one of the last boats to leave the fishing grounds. A total of 108 days were spent at sea, 71 of which were spent fishing. The area of activity coincided with the areas of troll and drift gill-net operations, ranging from approximately 36°20'S to 39°00'S and from 168°10'W to 136°10'W. Plots of the cruise tracks, along with positions of gill-net vessel sightings, are shown in Figure 1.

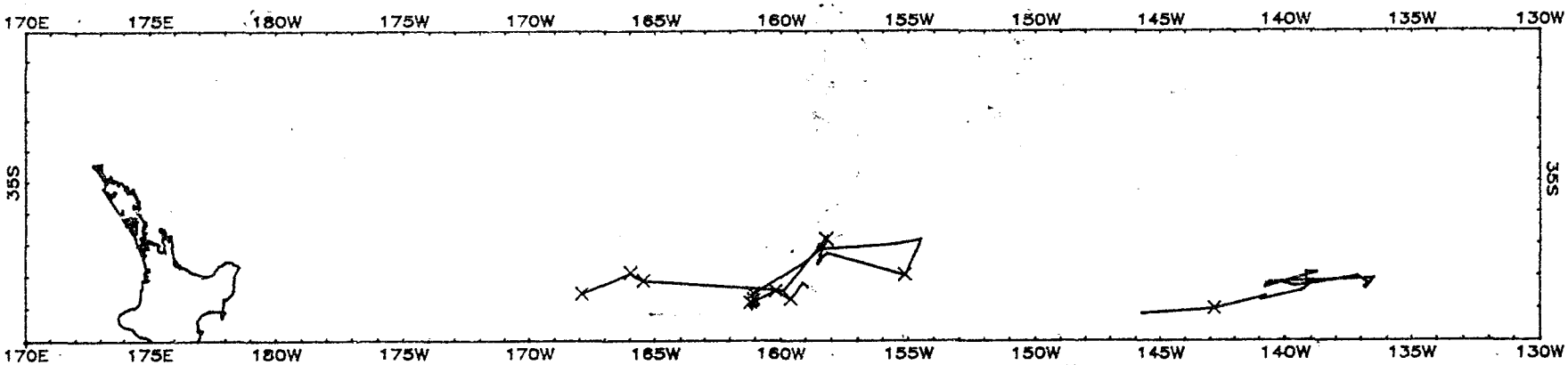
3.1 Vessels sampled and visited at sea

Due to initial uncertainty by the troll boat skippers as to the role of an observer onboard their vessels, the opportunity to collect data was limited to relatively few vessels. The vessels that were visited or from which data were collected were as follows:

M.F.V. *DanielSolander**	26 Dec - 16 Jan and 19 Jan - 10 Feb
F.V. *Nightwind*	A visit on 11 Jan
M.F.V. *Solander II**	16 Jan - 19 Jan
F.V. *Royal Dawn*	A visit on 10 Feb
F.V. *BaldEagle*	For transit to Pago Pago 10 Feb - 20 Feb
F.V. *Barbara H**	11 Mar - 30 Apr

* albacore sampling on these vessels only.

Figure 1. Cruise tracks of the 1988/89 South Pacific albacore observer programme. Cruise 1 is the more westerly of the two.



3.2 Troll vessel characteristics and fishing strategies

M.F.V. *Daniel Solander*: Radio Call Sign ZMCH

Length	53.6 metres
Breadth	8.5 metres
Gross Tonnage	345
Freezer Hold Capacity	300 tonnes
Owner	Solander Fisheries
Master	John Bennett
Crew No.	10
Nationality	N.Z.

Originally built as a Japanese longliner, the Daniel Solander was bought by Solander Fisheries (NZ) and used for trolling and handlining southern bluefin tuna (Thunnus maccoyii). It was converted for the South Pacific offshore albacore fishery in late 1988 with the addition of an adjustable stern platform that could be lowered from the main deck level to any height above the water thus enabling fish to be landed easily in any weather. Up to 22 lines were fished with 4 to 5 from the stern, 6 to 7 from each of the two outriggers, and 3 to 4 from the starboard HIAB deck crane located on the bow. Fish on the HIAB lines were hauled through the starboard sea-door. Once landed, all fish had their pectoral fins removed and most were spiked to minimise damage on deck before being blast frozen. Measurements were made after fin removal and spiking.

The *Daniel Solander*'s main fishing strategy along the STCZ was to search for temperature fronts using a sea surface temperature recorder. Satellite seas surface temperature charts were also available on a regular basis. After locating a front the vessel then would hunt in the vicinity of the front for sub-surface fish schools using a depth sounder. The *Daniel Solander* did not have sonar. If fish were present and weather permitted, the vessel would circle while fishing. A second strategy was to circle logs or sunfish (*Molamola*) it encountered, which usually resulted in the capture a few fish. The vessel would also circle stray buoys it encountered. If a school of fish was found in an otherwise quiet fishing period, the *Daniel Solander* would release its own buoy to mark the spot and begin circling.

M.F.V. *Solander II*: Radio Call Sign ZMFH

Length	34.0 metres
Breadth	5.8 metres
Gross tonnage	79
Freezer Hold Capacity	64 tonnes
Owner	Solander Fisheries
Master	Carl Fry
Crew No.	8
Nationality	N.Z.

Originallybuiltin Japan as a combination salmon gill-net and squid-jig vessel, the *Solander II* has regularly been used for squid jigging and albacore trolling in New Zealand domestic fisheries. More recently it has been used in the development of longlining for southern bluefin tuna in winter months. The *Solander II* was equipped for the offshore albacore fishery with two outriggers. It pulled up to 19 lines, with 4 to 5 from the stern and 6 to 7 from each outrigger.

All fish were pulled by hand. Fish had pectoral fins removed but were not spiked when landed. Fish were blast frozen and were periodically transhipped, after freezing, to the *DanielSolander*'s larger freezer hold.

The fishing strategy was the same as onboard the *Daniel Solander*, with the exceptionthatthe *Solander II* was equipped with sonar. Sonar enabled the *Solander II* to stay circling on a school of fish once it was located and increased the effective search radius of the vessel.

F.V. *Barbara H*: Radio Call Sign WYU9637

Length	23.7 metres
Breadth	7.4 metres
Gross tonnage	?
Freezer Hold Capacity	84 tonnes
Owner	Art Haworth
Master	David Haworth
Crew No.	4
Nationality	U.S.A.

Designed and built as an albacore troll-boat, the *Barbara H* has been modified as a swordfish gill-net boat for the North Pacific fishery. The *Barbara H* did not carry gill-net gear in the South Pacific and fished only by trolling, using up to 15 lines with up to 3 from the stern and 5 to 6 from each outrigger. Hydraulic salmon gurdies were used to haul outrigger lines with one man working each side. The stern lines were pulled by hand. Fish were frozen whole under a brine spray.

The fishing strategy was to search for temperature fronts and to use a combination of depth sounder and sonar to hunt for and stay with fish schools. During the period the observer was onboard the *Barbara H*, the satellite sea surface temperature charts, which were available to the vessel earlier in the season, could not be received in the area fished late in the season (observer cruise 2).

3.3 Sampling procedures for length, girth, and weight

Generally an attempt was made to measure all fish caught. However, this was not feasible when fishing was busy. In these circumstances four periods during the day were chosen to collect lengths, girths, and weights of at least 25 randomly chosen fish. Lengths of a further 25 albacore were subsequently taken. All fish sampled after 7 January were graded for net marks.

Fork length was measured from the tip of the snout with the mouth closed to the end of the median caudal fin ray and rounded down to nearest whole centimetre. The fork length of albacore measured during Cruise 1 ranged from 42 cm to 103 cm. However, after the first few days all fish smaller than about 55 cm were released. Fish this small were rare, and usually fewer than 2 per day were caught. Occasionally these small albacore were damaged during hauling and would be kept for the galley. These damaged fish were measured and included in the sample. Albacore caught during Cruise 2 were larger, and hence all fish landed were kept.

Girth measurements were made by passing a plastic measuring tape around the fish beneath the pectoral fins perpendicular to the long axis at a point just posterior to the tip of the pelvic fins when folded flush with the body. This was the only measure possible during Cruise 1 (*Daniel Solander* and *Solander II*), where pectoral fins were removed after fish were landed. During Cruise 2 (*Barbara H*), where pectoral fins were not removed, the tape was passed over one pectoral fin folded flush against the body and under the other. This proved to be an easier method of measuring girth with the pectoral fins intact, and gave identical results to the method used on Cruise 1. Girth measurements were rounded down to the nearest 0.5 cm.

Albacore were weighed during Cruise 1 with a 15 kg hand held beam balance suspended from an overhang. Weight was recorded to the nearest 0.1 kg. Albacore were

not weighed during Cruise 2.

3.4 Scoring of gill-net damage

Prior to 7 January, over 2,000 albacore were examined and measured, however gill-net damage scores were not kept. This pre-scoring period was used to ensure that the damage codes developed did not include damage that might have resulted from capture by trolling or damage incurred after landing. The pre-scoring period was prior to encountering the gill-net fleet.

Codes were developed to describe types of gill-net damage that were later verified by pushing unmarked fish of different sizes through a piece of gill-net recovered at sea from a stray buoy. In this experiment, unmarked fish were dropped head first through the suspended net segment. Those large enough to be forced through the mesh all bore the characteristic longitudinal stripes of net marked fish, either on the trunk or the head depending on fish size.

Gill-net mesh size obviously determines the size class(es) of tuna that are captured. The piece of gill-net recovered had a 20 cm stretch diagonal mesh, which was found to tightly encircle an albacore with a girth of 46-49 cm at a position just posterior to the gills. This girth is equivalent to a fork length of 65-75 cm, which coincides with the larger of two size classes sampled from gill-net vessels transhipping in Noumea during January - February (see section 4.2).

3.5 Gill-net damage codes

Early in the trip a scale of gill-net damage codes was established. Initially "0" to "3", the final scale was expanded to "4", with "0" representing undamaged fish. Albacore with damage types "1" and "4" were at first all categorised under "1", indicating minor damage to fish (7-19 January only). It became apparent by 20 January that there was minor damage found in larger fish (type "4") that was distinct from the minor damage seen in small fish (type "1"), hence the introduction of the new category. For ease of data presentation, it is assumed that all albacore 68 cm and larger coded "1" during the period 7-19 January should actually be coded "4". This is in agreement with the size of fish having minor damage of the two types observed after 19 January. Descriptions of the gill-net damage categories are as follows:

Category 0: Fish without gill-net damage.

Category 1: By far the majority of fish were scored with this grade. Usually the fish had multiple lateral stripes that appeared as slight skin discoloration spaced 5-10 mm apart. These stripes were continuous along the thickest part of the body, starting anywhere

from just forward of the gill operculae to just forward of the largest girth measurement and running to the corresponding girth measurement at the posterior part of the fish.

Category 2: Similar to category "1", these fish also had a patch where skin and scales had been scraped away, leaving a raw area in the region of greatest girth. Typically this raw area was 2.5-5.0 cm wide and 5.0-10.0 cm in length and located 1.0-2.5 cm below the first dorsal fin on both sides of the fish. Accompanying damage to the second dorsal, anal, and caudal fins was common. Occasionally, damage to the first dorsal and pectoral fins was also observed. A few category "2" fish had the scraped portion located dorsally across the first dorsal fin groove. This damage generally seemed a little more severe than typical type "2" damage. A few fish lacked the raw patches described above but the fish were scored as category "2" because of type "1" damage plus bad fin damage. Several fish recorded as type "1" appeared as if they may have had the more serious type "2" damage earlier but had now healed, being evident only as a slight discolouration of the skin.

Category 3: This was reserved for badly lacerated or bleeding fish caused by the mesh cutting into the flesh. Albacore with this type of damage were not caught by trolling.

Category 4: Prior to 20 January fish with this damage type were scored as "1". Category "4" was recognised as a distinct damage type only after the frequency of fish larger than 68 cm fork length increased. Albacore with this damage type typically bore the longitudinal stripes and skin discoloration of type "1" fish. However, due to the large girth of these fish preventing them going further into the mesh, the marks were restricted to the head and gill operculae. Type "4" marks began well forward of the operculae, usually stopping abruptly at or just beyond the operculae but anterior to the pectoral fins. This type of damage was consistent with a fish swimming into a net until the mesh tightened around its head. Lateral banding appeared to result from large fish having been caught, struggled enough for the mesh to slip fractionally, then swimming into the mesh again. All previous damage categories appeared to result from fish passing through the mesh.

4. Results and observations

4.1 Albacore catch, effort, and CPUE

Albacore catch and effort data were collected early in the season aboard the *Daniel Solander* from 27 December 1988 to 9 February 1989 (Cruise 1) and at the end of the season aboard the *Barbara H* from 22 March to 17 April 1989 (Cruise 2). The only trolling by-catch on either vessel was skipjack tuna (*Katsuwonis pelamis*) which comprised a very small fraction of the total catch by number. Catch and effort are summarised in Table 1.

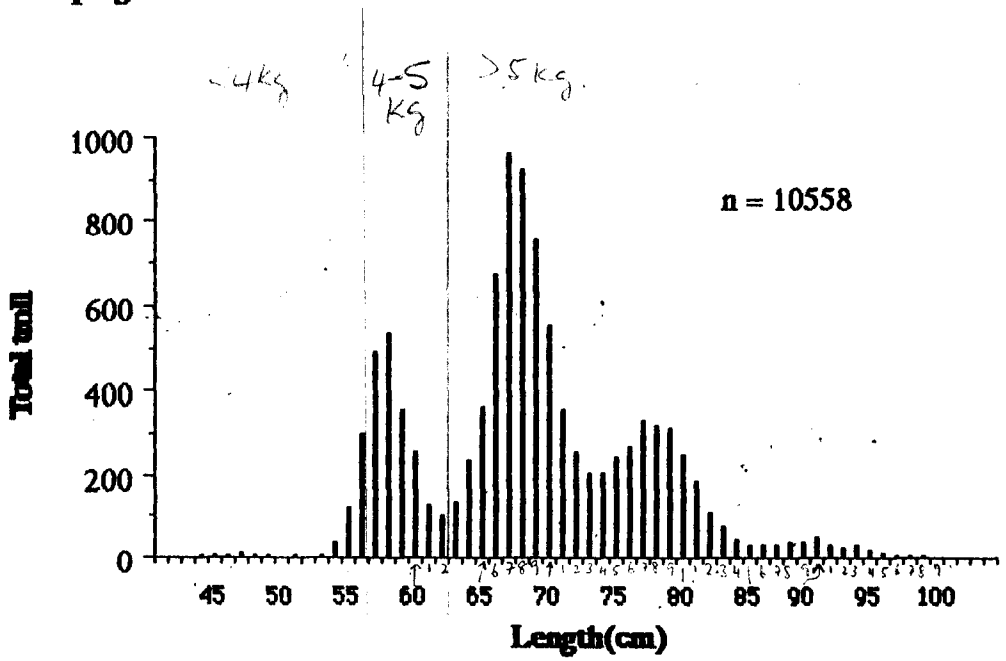
Table 1. Catch and effort statistics collected onboard albacore troll vessels.

		Cruise 1	Cruise 2
Vessel		*DanielSolander*	*Barbara H.*
Datessampled		27 Dec - 9 Feb	22 Mar - 17 Apr
Areassampled		40°56'-36°20'S 176°27'E-158°57'W	39°00'-37°54'S 145°53-136°06'W
Daily sea surface temperature	av.	17.7	18.5
	min.	15.7	17.5
	max.	19.0	19.5
Days fished		44	25
Hours fished per day	av.	15.3	12.0
	s.d.	1.2	2.0
Number of jigs fished	av.	20.9	10.4
	s.d.	1.6	3.0
No. of albacore landed per day	av.	215.0	107.0
	s.d.	247.1	106.9
No. of albacore per 100 hook hrs	av.	67.51	76.10
	s.d.	82.78	76.60

4.2 Lengthcomposition

The overall length composition of albacore measured during both cruises is shown in Figure 2. Three modes are apparent in the data: 57-58 cm, 67-68 cm and 77-78 cm. These modes are the result of discrete spawnings, the periodicity of which is unclear at this time. Previous data suggest some variation in the positioning of modes, which could imply year-to-year variation in growth rate or time of spawning (or differences in sampling times). For example, clear modes in the 1987/88 U.S. troll catch were found at 62 and 72 cm (Majors and Coan 1989), which correspond to the troughs in Figure 2. This is in agreement with the sampling carried out in Papeete, where the two dominant modes (corresponding to the first two modes in Figure 2) are 2-3 cm smaller than in the previous year (Yen *et al.* 1989).

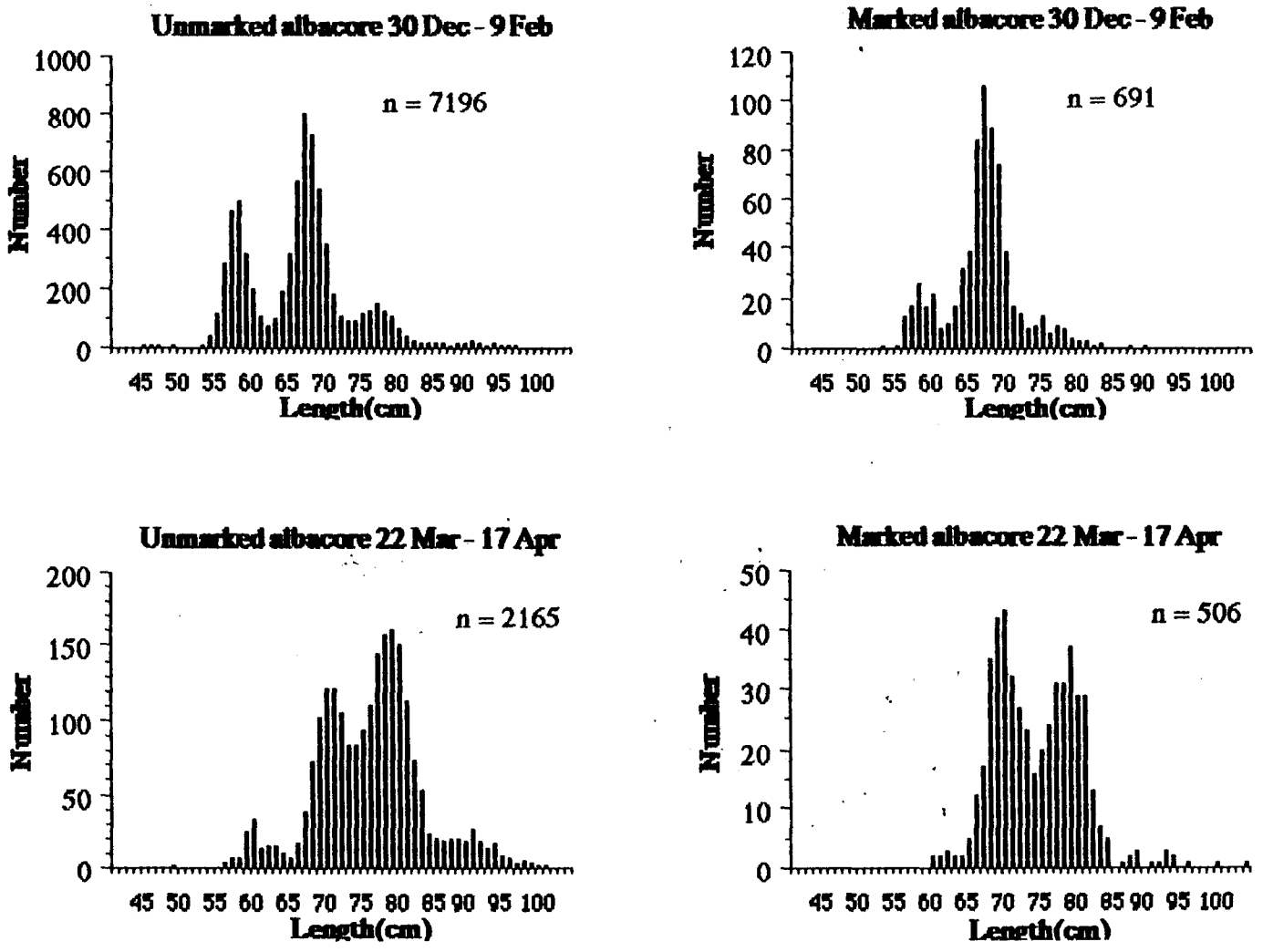
Figure 2. Length-frequency distribution of all albacore sampled during the observer programme.



Length frequencies broken down by cruise and by the presence or absence of external marks produced by entanglement and escapement from gill nets are shown in Figure 3. There is little difference in the positioning of modes for the unmarked and marked albacore measured during each cruise. The modes show a progression of 1-3 cm from the first to the second cruise, which is probably due to growth (although geographic differences could also be present). The Cruise 2 length frequency agrees well with that

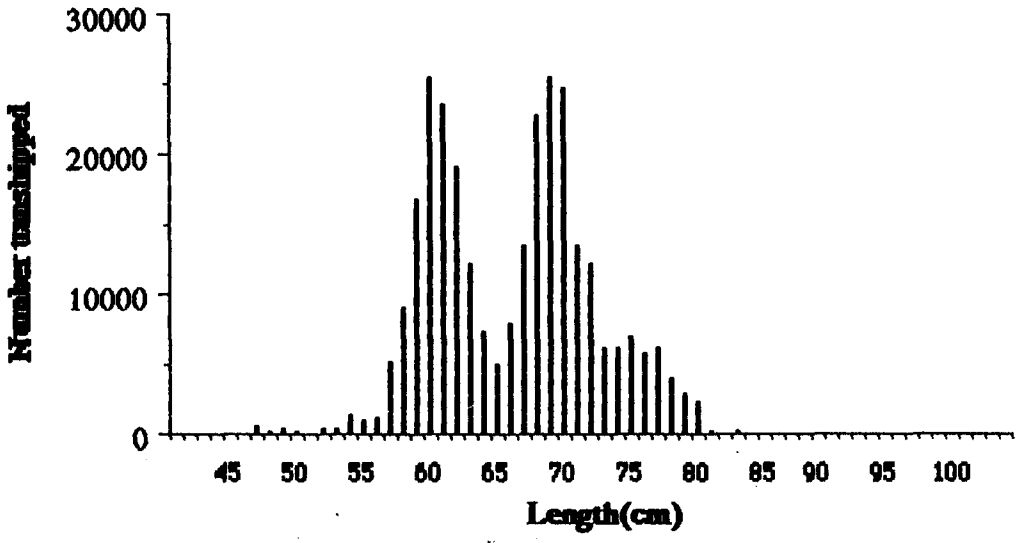
presented by Yen *et al.* (1989) for the same period. There are, however, some differences in the size compositions of unmarked and marked fish. The first and third modes appear to be somewhat under-represented in the marked length frequencies, possibly indicating size selection effects of gill nets. This is discussed further in later sections.

Figure 3. Length-frequency distributions of unmarked and gill-net marked albacore sampled during Cruise 1 (30 Dec - 9 Feb) and Cruise 2 (22 Mar - 17 Apr).



The size composition of albacore sampled from Japanese gill netters transhipping in Noumea is shown in Figure 4. These fish were caught exclusively in the Tasman Sea during December - January. The two prominent modes in these data are 2-3 cm larger than the corresponding modes in the data from the first observer cruise, indicating slight geographical variation in modal structure.

Figure 4. Length-frequency distribution of albacore sampled from Japanese gill-net vessels transhipping in Noumea, 12 Jan - 8 Feb.



4.3 Incidence of gill-net-marked albacore

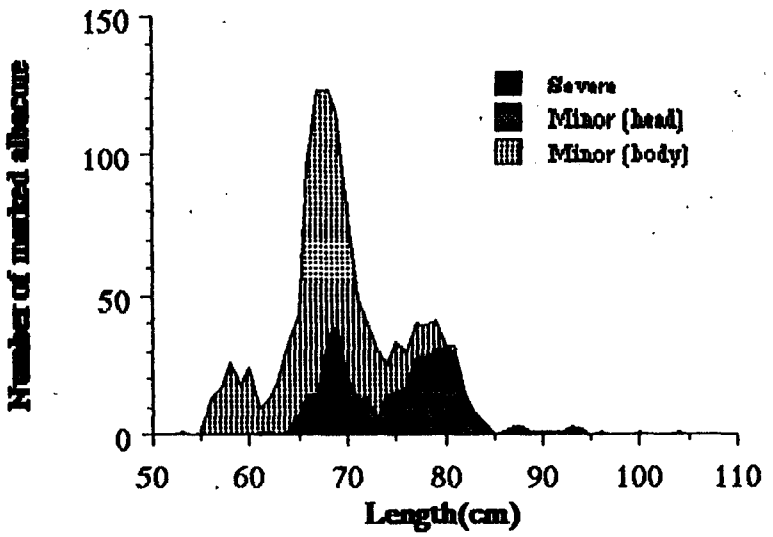
A record of the occurrence of gill-net-marked albacore was kept from 7 January. During the first cruise, 12.4% of albacore sampled were marked by previous encounter(s) with gill nets. The percentage of marked albacore increased to 19.0% during the second cruise. Claims of a higher incidence of marked fish (claims of 40-50% were common, with some reports as high as 90% incidence of marked albacore) when the observer was not on the grounds (the middle of the season) were reported but could not be verified. The impression from interviews with some troll boat captains was that the reported period of increased incidence of net damage coincided with a period when troll and gill-net boats were fishing adjacent to each other. Gill-net marks were classified as being minor (head), minor (body) or severe. Most marks were minor during the first cruise, whereas a larger number of severe marks was observed during the second cruise (Table 1).

Table 1. Numbers of unmarked and marked albacore recorded during the observer programme (beginning 7 January 1989). Parentheses contain percentages of each category within cruises.

	Cruise 1		Cruise 2		Total	
Unmarked	4878	(87.6)	2163	(81.0)	7041	(85.5)
Minor (head)	107	(1.9)	204	(7.6)	311	(3.8)
Minor (body)	496	(8.9)	297	(11.1)	793	(9.6)
Severe	88	(1.6)	5	(0.2)	93	(1.1)
Total marked	691	(12.4)	506	(19.0)	1197	(14.5)
Grand total	5569		2669		8238	

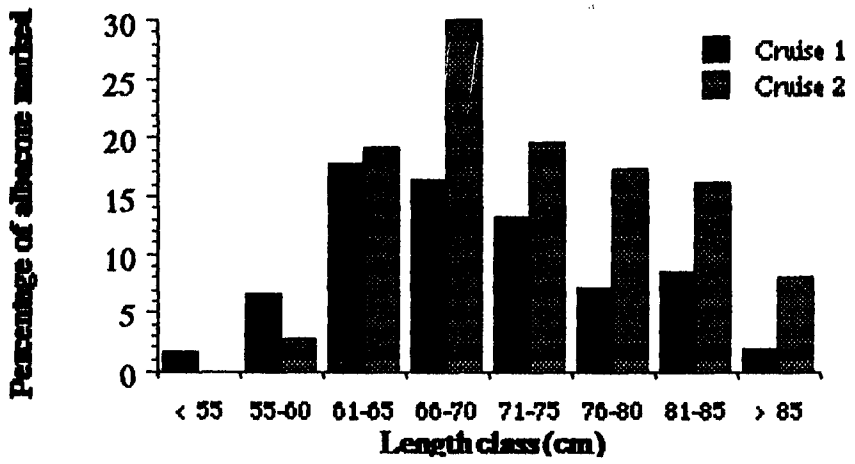
The category of gill net damage was related to fish size, with minor damage to the head tending to be found in albacore larger than 68 cm while minor damage to the body was found mainly in albacore smaller than 75 cm (Figure 5). Severe damage was found mostly in albacore of 63-71 cm, which have a body size that tightly fits the standard 18-20 cm gill-net stretched mesh.

Figure 5. Length-frequency distribution of gill-net marked albacore, classified by type of damage.



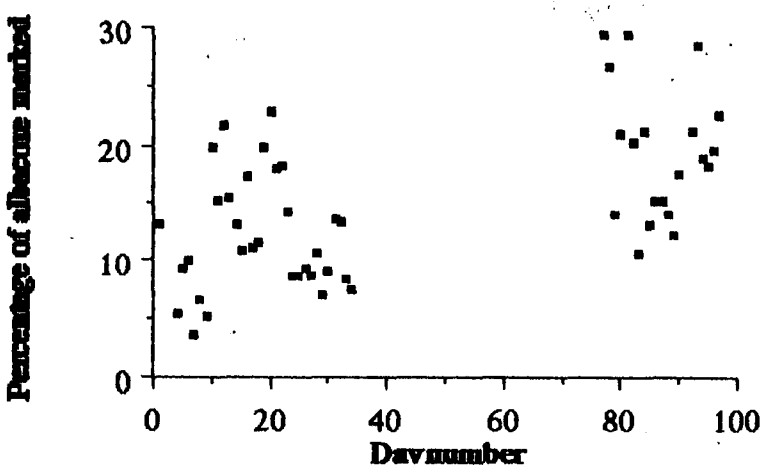
Relatively few albacore less than 60 cm were observed to be marked (Figure 6). During Cruise 1, occurrence of marked albacore (of all damage types) was highest for the 61-65 cm size class and fell for progressively larger size classes. A similar pattern was observed on the second cruise, although the most marked size class in this case was 66-70 cm.

Figure 6. Percentage of gill-net marked albacore sampled, by 5 cm length classes.



The percentage of albacore with gill net marks varied substantially from day to day. For days where at least 10 albacore were caught, the percentage ranged from less than 5% to about 30% (Figure 7).

Figure 7. Percentage of gill-net marked albacore caught on days where ten or more albacore were sampled. Day 1 is 7 January.



4.4 Albacore condition

Length-weight and length-girth measurements of marked and unmarked albacore were taken to test for negative effects of gill net encounter on albacore condition. These relationships for unmarked albacore sampled are shown in Figures 8 and 9, respectively.

Figure 8. Length-weight observations of sampled albacore.

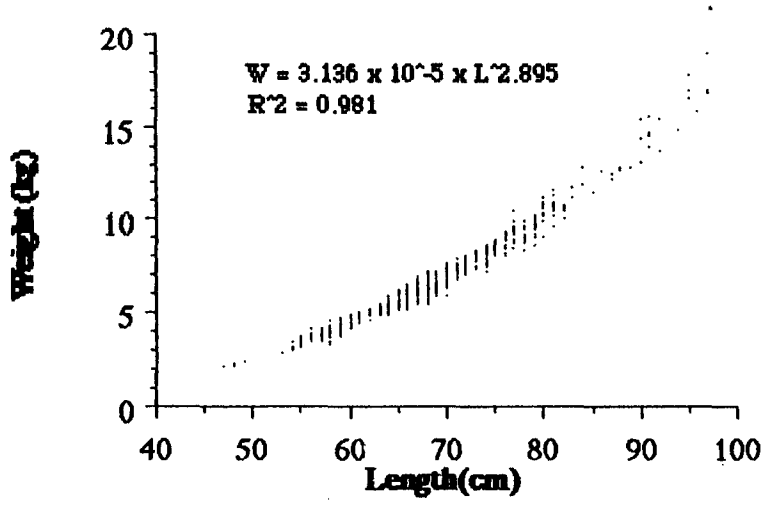
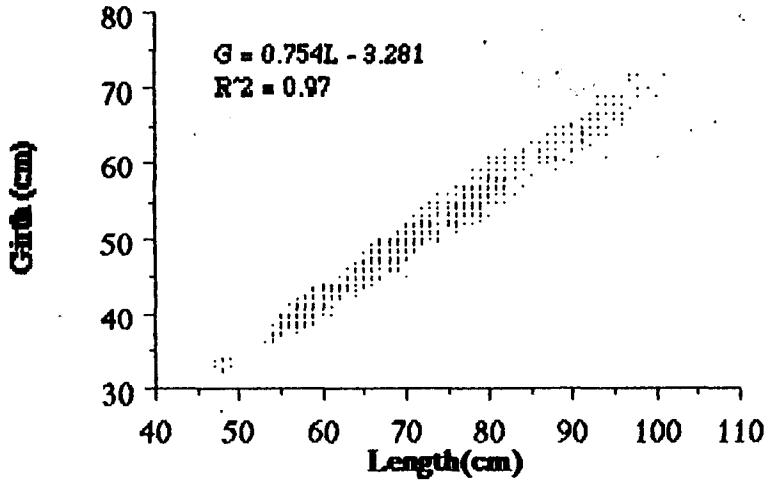


Figure 9. Length-girth observations of sampled albacore.



The residuals, relative to the fitted curves, of the marked albacore provide a measure of the reduction in condition attributable to the trauma of gill net encounter and the physical injury subsequently inflicted. The residuals of both predicted weight and predicted girth indicate that the condition of marked albacore was significantly lower than that of unmarked albacore for both cruises (Table 2).

Table2. Condition comparisons of unmarked and gill-net-marked albacore based on length-weight and length-girth measurements. No length-weight measurements were taken on cruise 2.

	Cruise 1			Cruise 2		
Length-weight		(P=0.0005)				
	n	Mean residual	s.d.			
Unmarked	1104	-0.001	0.046			
Marked	164	-0.013	0.045			
Length-girth		(P=0.0014)			(P=0.0016)	
	n	Mean residual	s.d.	n	Mean residual	s.d.
Unmarked	1104	-0.314	1.056	1586	0.262	1.160
Marked	164	-0.580	1.056	398	0.069	1.230

There was also a significant difference in condition, as indicated by the length-girth relationship, between cruise 1 (155°-168°W) and cruise 2 (137°-146°W), with albacore caught during cruise 2 being of significantly higher condition (Table 3).

Table3. Condition comparisons between cruises of unmarked albacore based on length-girth measurements.

	n	(P=0.0001) Mean residual	s.d.
Cruise 1	1104	-0.314	1.058
Cruise 2	1586	0.262	1.160

4.5 Gill-net vessel sightings

Reports during the 1987/88 albacore season suggested that gill-net vessels compete directly with troll fishermen for fishing space and interfere with troll vessel activities. Such direct interaction was not observed on either of the observer cruises. Troll vessel captainscommentedthat gill-net vessels seemed to be keeping away more this year, and suggested that they may be endeavouring to keep a low profile in order to avoid criticisms of interfering with trolling.

Despite a lack of direct interaction, gill-net vessels were sighted sporadically by the observer while onboard the *DanielSolander* and other troll vessels, and were regularly reported by other troll vessels. Gill-net vessels were usually seen while travelling to new fishing areas or while searching for fish rather than while fishing. When possible, these were approached in order to identify the vessel name and registration numbers.

There were two periods when gill-net vessels were seen in concentrations. During the period 1-4 January, while the *DanielSolander* was travelling east from New Zealand to join the the troll fleet at 158°W, eight gill-net vessels were seen between 38°00'S and 38°37'S from 166°00'W to 159°30'W. Nets that were seen ran from ESE to WNW. To avoid entanglement on one occasion, one net had to be skirted by the *DanielSolander* for elevenmiles.

During this same period the *Solander II* and *Day Star*, while steaming on a southerly but parallel course, reported encountering up to 17 gill-net vessels and nets, making night-time steaming very difficult. The *Day Star* inadvertently crossed one net entangling the vessel by its propeller.

The second concentration was encountered on 27 January by the *DanielSolander* while fishing at 38°20'S 161°05'W. Here, we successfully fished a small area with up to 7 gill-net vessels in the vicinity. During the next day several troll vessels joined the *DanielSolander* while the gill-net vessels moved further south. The *Karen Kristie*, fishing at 39°S, 161°W, reported seeing the lights of 30 gill-net vessels on 29 January.

When not fishing in concentrations, gill-net vessels were usually seen in pairs. Identification could be obtained from only eight gill-net vessels and one carrier vessel on the grounds. Difficulty in identification was due to both distance and poor legibility of vessel markings. All vessels for which a home port could be established were from Taiwan. Only five vessels were sighted during Cruise 2, and only one was close enough to identify.

Comments from various troll boat captains suggested that most of the gill-net vessel activityencounteredby the troll fleet this season was during the period that the observer was off of the grounds (February 10 - March 22). More details of gill-net vessel sightings are provided in Appendixes 1 and 2.

4.6 Marine mammal sightings

Marine mammals were not observed in the main area of troll fishing and were only encountered twice in the same areas as gill-net vessels. Several sightings of marine mammals were made while the observer was aboard the *Daniel Solander* travelling towards the albacore fishing grounds. The easternmost sighting was at approximately 38°S between 155-156°W while onboard the *Solander II*. About 50 small dark dolphins were also sighted on the same day to the east of the gill-net vessel *No. 1 Fuh Kuo* (out of Kaoshung). All other sightings of marine mammals were prior to 7 January and to the west of 159°W.

5. Major conclusions

The major conclusions drawn for the analyses of data collected during the 1988/89 observer programme are as follows:

(i) Catch rates of albacore on vessels used during the observer programme were somewhat lower than overall catch rates by the troll fleet last season. Analysis of log book data for the troll fleet is required to confirm this observation. There was little evidence that catch rates declined when in the vicinity of gill-net vessels, however the data are limited in this respect.

(ii) The size composition of albacore sampled during the observer programme showed a slightly different pattern to those of previous seasons, with the modal sizes of the two most prominent size groups being several cm smaller this season. Slight differences in the positions of the modes were also apparent from data collected from Japanese gill-net vessels fishing in the Tasman Sea. A comprehensive analysis of South Pacific albacore length-frequency data from all sources is required to provide information on growth, spawning frequency and population structure.

(iii) The analysis of gill-net-marked albacore provides some information on the size selectivity of gill nets. There were few net-marked fish less than 60 cm fork length, despite substantial numbers of these fish being caught by trolling. Length-frequency data collected from Japanese gill-net vessels working in the Tasman Sea suggest that few fish less than about 58 cm are caught in gill nets. This would suggest that escapement of small albacore from gill nets is high, and occurs with little physical damage to the fish (they probably pass fairly easily through the meshes). The highest incidence of net-marked albacore was observed in albacore of 60-75 cm, which also coincides with the size range of most of the albacore caught by gill net.

This would suggest that gill nets of the mesh size used in the South Pacific are most effective for albacore of this size. Substantial numbers still manage to escape, but are marked by the net, sometimes severely, in the process. On the other hand, albacore larger than about 70 cm are less frequently caught by gill net. The marks observed on fish of this size suggest that they are too large to fully enter the mesh, and are often able to escape before becoming entangled.

(iv) Escapement from gill nets appears to have a statistically significant effect on the condition of albacore, as measured by the relationships between length and weight, and length and girth. This indicates that albacore are traumatised by gill-net encounter, and loss of condition results. While the real effect observed was not particularly striking, the sample of marked albacore observed is biased in that each fish had recovered to the extent that it was able to resume feeding.

(v) The incidence of gill-net-marked albacore in troll catches, while not as high on the observer vessels as reported by fishermen, are nevertheless indicative of a high exploitation rate by the gill net fleet on albacore in the STCZ. Because the observer vessels did not generally fish in the immediate vicinity of gill netters, it is possible that the incidence of marked albacore observed in the troll catches is approximately indicative of their incidence in the population as a whole in this area. It might be possible to use the incidence of marked albacore in the troll catch as a crude tagging experiment, however the rate of escapement from gill nets (analogous to release numbers) and drop-out mortality (analogous to tagging mortality) would need to be known in addition to details of the gill-net and troll catches. If escapement is in fact low, simple (and somewhat crude) calculations indicate that the exploitation rate by the gill-net fleet could be approaching 50%. If escapement is high, lower exploitation rates are obtained.

References

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Yen, S., J. Chabanne, and L. Wrobel. (1989). La peche des germons en Polynesie Francaise. 2nd South Pacific Albacore Research Workshop, 14-16 June, Suva, Fiji. Working Paper.

Appendix 1
Miscellaneous Observations and Reports

(i) Gill-netsetting

On January 4 the Daniel Solander encountered a drift gill-net which we followed for 11 miles before reaching the end (we've no knowledge of how far the net extended in the opposite direction) which a gill-net vessel had just set. The net was set downwind towards the N.W., orange buoys (about 54 litres in size) were spaced approximately 200 metres apart with small white headline floats (about 0.5 litre in size) approximately every 2 metres. A separately buoyed radio beacon was attached to about every 20th buoy. The net was certainly at the surface and made a distinct navigation barrier. Although it was daylight at the time no lights or radar reflectors could be seen on any of the buoys.

(ii) Refueling of gill-net vessels

The following information was obtained from the purser rescued from the stricken tanker *Delima120* which sank empty after refueling several gill-net vessels in the South Pacific. The observer interviewed him in Pago Pago. He reported that his company had contracts to refuel most of the Taiwanese gill-net vessels in the South Pacific. He said there were 130 Taiwanese gill-net vessels in the South Pacific. He was upset that after refueling a group of these vessels the *Delima120* had been denied assistance at sea by these same vessels. The request had been made separately to 16 separate gill-net vessels that he said were close enough to give assistance and that despite notifying them that they were without steerage and rolling in very heavy seas, the vessels denied assistance. The crew of 16 was taken off by the U.S. troll boat F.V. Royal Dawn. The *Delima120* sank within a few days.

The following addresses were obtained from the purser of the tanker *Delima120*:

Golden Key Petroleum Pty Ltd (Only South Pacific)
10, Anson Road #02-38
InternationaPlaza
Singapore 0410
Directors: Mr. Albert Oon, Mr. Raymond Low, Mr. Seo Sang Il (Korean)
Telephone: 223-0010 or 223-0014
Telex No: 24458 Goldky
Fax No: 223-064

The parent company of Golden Key Petroleum Pty Ltd is:
King State Oil
Los Angeles, California
Cable: KINGOIL, L.A.

(iii) Reports by Troll Vessel Captains

F.V. *Pursuit* (Kyle van der Pool)

31 Jan. The vessel ran over a net in the fog and dark. He almost circled on the net thinking it was a bite when it caught on his jigs. Fortunately he realised in time and proceeded on his way. This was at 38°12'S 160°06'W. 8 miles further North at about 38°04'S 160°06'W he came across a gill-net vessel setting a net. It was proving difficult to get around the net, however the gill netter stopped setting, then recommenced 1/4-1/2 of mile further on. *Pursuit* was able to slip through the gap. *Persuit* was within 30 metres of stern of this vessel but the name was too obscured to be legible despite the close proximity. The net was being set NE to SW.

F.V. *Pacific Warwind*

27 Jan. Reported picking up a bundle of net that contained the remains of 1 porpoise, 2 sharks and 6 albacore. The position was 37°47'S 155°W.

M.F.V. *Solander II* (Carl Fry)

10 Feb. Spotted 2 gill-net vessels south of him at 1900 hr. His position 38°15'S 158°55'W. At 2005 hr the gill-net vessels started setting in a WSW direction.

F.V. *Mercator* (Don)

27 Jan. Sighted *Champion No. 1.* (CT6-0816) near 38°31'S 161°14'W. Took some video footage of it hauling and observed crew trying to gaff fish which had fallen from the net.

F.V. *Robin Ann* (Lonny)

3-7 Jan. Fishing at about 36°-37°S 158°W. Reported large numbers of net-marked fish.

27 Jan. Saw 3 gill-net vessels at about 36°15'S 163°31'W. These vessels began setting their nets that night.

10 Feb. Left the rest of the fleet at 38°05'S 158°52'W and heard reports that several gill-net vessels moved into that area almost immediately.

He also mentioned a time when he was fishing in fog with another boat on radar that he presumed to be fishing with him. The fog lifted momentarily and there was a gill-net vessel about 1/2 mile away laying his net. He could not recall the date.

F.V. *Karen Kristie*

29 Jan. Reports seeing the lights of 30 gill-net vessels at about 39°S 161°W. These were just to the south of the *Robin Ann*, *Judy S* and a few other troll vessels.

F.V. *Judy S* (Dave)

28 Jan. Ran over 2 gill-nets running parallel 1-2 miles apart at 38°30'S 161°28'W. He did not see these nets until they were on them, but fortunately did not become entangled.

Appendix 2
Drift Gill-net Vessel Sightings

Vessel Sighted		Vessel		Observer Vessel
Date	Time	Activity	Name	Position
30-12-88	1130	steaming	?	38°30'S, 167°55'W
01-01-89	1400	transhipping	Yung Pang	38°00'S, 166°02'W
01-01-89	1400	transhipping	Chiu - Fu	38°00'S, 166°02'W
03-01-89	1000	hauling	Yung Pang	38°18'S, 165°06'W
04-01-89	1610	steaming	?	38°37'S, 159°38'W
04-01-89	1610	steaming	?	38°37'S, 159°38'W
04-01-89	1840	setting	?	38°24'S, 160°08'W
04-01-89	1840	setting	Jin Hong Shinn	38°24'S, 160°08'W
16-01-89	1010	hauling	No.1 Fuh Kuo	37°57'S, 155°06'W
16-01-89	1010	hauling	?	37°57'S, 155°06'W
27-01-89	1430	none	Champion No.1	38°25'S, 161°10'W
27-01-89	1430	?	?	38°25'S, 161°10'W
27-01-89	1430	?	?	38°25'S, 161°10'W
27-01-89	1430	?	?	38°25'S, 161°10'W
27-01-89	1430	?	?	38°25'S, 161°10'W
27-01-89	1430	?	?	38°25'S, 161°10'W
27-01-89	1430	?	?	38°25'S, 161°10'W
27-01-89	1430	?	?	38°25'S, 161°10'W
27-01-89	1430	?	?	38°25'S, 161°10'W
30-01-89	1500	steaming	?	38°47'S, 161°05'W
30-01-89	1730	none	?	38°45'S, 161°03'W
30-01-89	1730	none	?	38°45'S, 161°03'W
04-02-89	0720	hauling	?	38°49'S, 161°19'W
04-02-89	1615	?	?	38°16'S, 159°55'W
04-02-89	1615	?	?	38°16'S, 159°55'W
05-02-89	0645	hauling	Der Fu No.6	38°49'S, 161°14'W
06-02-89	1930	transhipping	?	38°46'S, 159°39'W
23-03-89	1130	hauling	?	39°01'S, 142°49'W
23-03-89	1130	steaming	?	39°01'S, 142°49'W
23-03-89	1635	setting	?	38°54'S, 142°30'W
27-03-89	0745	hauling	San Yu No.11	38°58'S, 141°28'W
27-03-89	1115	steaming	?	38°53'S, 141°18'W

Appendix 3
Observer's Itinerary

22 Dec Observer arrived Wellington for final briefing and gearing up ready for departure Boxing Day 26 December.

26 Dec Flew to Nelson to board *Daniel Solander*. Vessel departed 1300 h bound for fishing grounds and looking for fish along the way. Encountered mixed fishing success and several gill-net vessels during this portion of the trip as did the *Solander II* travelling a similar route.

5 Jan Reached the bulk of the troll-fishing fleet at about 1800 hr. Position: 36°52'S, 158° 12'W. Continued to fish with them.

11 Jan Visited the *Nightwind* for the morning for general discussion with Stan Davis, president of Western Fishboat Owners Association (WFOA).

12 Jan The *DanielSolander* with the *Solander II* broke from the fleet after fishing slowed up and headed generally eastwards searching for fish with little success. Travelled as far east as 154°W.

16 Jan Boarded *Solander II* to travel with them as we travelled west to rejoin the fleet.

19 Jan Rejoined the *DanielSolander*.

10 Feb Visited the *Royal Dawn* in the morning for discussion with Brent Bixler. In the evening transhipped from *Daniel Solander* to *Bald Eagle* for passage to Pago Pago. Ran into a storm on the way north which claimed 2 other vessels and hindered our progress by at least 2 days.

20 Feb Arrived in port Pago Pago. Spent week visiting the Captains of jig boats as they arrived in Pago Pago and visiting the canneries Starkist and Samoa Packing to obtain catch data and discuss attitudes towards gill-net vessels.

27 Feb Flew to Suva to deliver data to SPC scientist and to attend the Second Consultation on South Pacific Albacore.

1 Mar (28 February lost due to crossing of dateline). Helped prepare data for presentation at meeting.

2 Mar Attended Second Consultation on South Pacific Albacore.

3 Mar Flew to Apia on route to Pago Pago to rejoin fishing fleet. Air Pacific mislaid baggage resulting in a one week while baggage was recovered and a new boat could be identified to carry him back to the grounds.

10 Mar Flew Apia to Pago Pago to join *Barbara H*.

11 Mar Sailed on *Barbara H* at 1300 hr bound for fishing grounds.

22 Mar Started fishing 39° 10'S, 145° 45'W.

24 Mar Caught up with remaining fleet 38° 45'S 140° 38'W. Continued fishing with them.

18 Apr With other two remaining vessels, left fishing grounds to head to Pago Pago. 1988/89 South Pacific albacore fishing season now over.

30 Apr Arrived Pago Pago.
31 Apr Visited Department of Marine and Wildlife Resources of American Samoa.
1 May Flew from Pago Pago to Auckland (2 May 1989).
8-15 May Wellington for debriefing.
16 May Observer returned home to Christchurch.

Summary of Observer's Daily Catch Log
1988/89 South Pacific Surface Albacore Fishery

Vessel: Daniel Solander

Date	latitude deg.	min.		longitude deg.	min.		hours fished	no. jigs	albacore caught	SST	albacore per 100 hook hours
Dec 27	40	56	S	176	27	E	11.5	19	3	17.9	1.37
Dec 29	40	19	S	174	45	W	13.5	19	5	17.3	1.95
Dec 30	39	20	S	170	10	W	15.5	19	23	16.6	7.81
Dec 31	37	56	S	166	0	W	15.0	19	332	16.8	116.49
Jan 01	37	56	S	166	0	W	14.5	19	197	16.7	71.51
Jan 02	38	1	S	165	47	W	16.2	19	164	16.7	53.28
Jan 03	38	10	S	165	28	W	12.5	19	45	16.4	18.95
Jan 04	39	20	S	160	51	W	12.5	19	0	15.7	0.00
Jan 05	37	33	S	158	18	W	14.3	19	131	16.7	48.21
Jan 06	36	51	S	158	12	W	15.5	19	1461	16.6	496.10
Jan 07	36	51	S	158	13	W	14.5	19	589	17.6	213.79
Jan 08	37	2	S	158	20	W	15.8	19	238	17.0	79.28
Jan 09	37	0	S	158	23	W	14.0	22	608	17.1	197.40
Jan 10	37	0	S	158	32	W	16.5	21	626	17.5	180.66
Jan 11	37	7	S	158	35	W	16.0	21	471	17.4	140.18
Jan 12	37	9	S	158	23	W	16.5	21	301	17.6	86.87
Jan 13	37	7	S	156	35	W	16.0	21	33	17.3	9.82
Jan 14	36	20	S	154	0	W	16.8	22	31	17.2	8.39
Jan 15	36	55	S	154	38	W	16.5	22	182	17.4	50.14
Jan 16	37	37	S	154	40	W	16.0	22	77	17.1	21.88
Jan 17	37	0	S	157	54	W	15.0	22	84	18.3	25.45
Jan 18	37	36	S	158	29	W	17.5	22	202	17.7	52.47
Jan 19	37	41	S	158	36	W	16.5	22	100	17.9	27.55
Jan 20	37	18	S	158	24	W	16.8	19	235	18.1	73.62
Jan 21	37	26	S	158	27	W	16.8	22	166	18.0	44.91
Jan 22	37	29	S	158	28	W	16.1	22	177	18.1	49.97
Jan 23	36	36	S	158	9	W	15.0	22	80	18.0	24.24
Jan 24	36	55	S	158	14	W	15.5	22	49	17.9	14.37
Jan 25	37	26	S	158	48	W	16.5	22	177	17.9	48.76
Jan 26	37	35	S	159	0	W	15.5	22	89	17.9	26.10
Jan 27	37	37	S	160	54	W	16.0	22	389	17.9	110.51
Jan 28	38	36	S	161	8	W	16.5	22	158	17.7	43.53
Jan 29	38	41	S	161	5	W	15.7	22	173	17.9	50.09
Jan 30	38	42	S	161	7	W	13.8	22	116	17.8	38.21
Jan 31	38	53	S	161	0	W	15.7	22	228	18.1	66.01
Feb 01	38	56	S	160	58	W	15.2	22	170	18.6	50.84
Feb 02	39	1	S	160	59	W	15.2	22	321	19.0	95.99
Feb 03	38	55	S	161	13	W	15.3	22	93	18.8	27.63
Feb 04	39	2	S	161	9	W	15.3	22	169	18.8	50.21
Feb 05	38	51	S	161	8	W	15.1	23	65	18.9	18.72
Feb 06	38	28	S	160	23	W	15.0	23	66	19.0	19.13
Feb 07	38	23	S	159	22	W	15.6	16	155	18.8	62.10
Feb 08	38	16	S	159	5	W	14.9	22	270	18.8	82.37
Feb 09	38	19	S	158	57	W	15.0	22	210	18.7	63.64
minimum							11.5	16	0	15.7	0.00
maximum							17.5	23	1461	19.0	496.10
Mean							15.3	20.9	215.0	17.7	67.51
Std. Dev.							1.2	1.6	247.1	0.8	82.78
n							44	44	44	44	44

Summary of Observer's Daily Catch Log
1988/89 South Pacific Surface Albacore Fishery

Vessel: Barbara H

Date	latitude deg.	min.		longitude deg.	min.		hours fished	no. jigs	albacore caught	SST	albacore per 100 hook hours
Mar 22	39	0	S	145	53	W	12.7	8	3	18.6	2.95
Mar 23	38	49	S	142	19	W	13.3	8	5	18.5	4.70
Mar 24	38	42	S	140	42	W	13.5	15	156	19.5	77.04
Mar 25	38	44	S	140	45	W	12.8	15	71	19.1	36.98
Mar 26	38	45	S	140	57	W	13.3	10	21	19.0	15.79
Mar 27	38	29	S	139	26	W	12.5	15	189	18.5	100.80
Mar 28	38	13	S	138	57	W	13.0	11	27	18.4	18.88
Mar 29	38	20	S	139	9	W	12.8	13	83	18.7	49.88
Mar 30	37	54	S	139	12	W	13.0	12	37	18.8	23.72
Mar 31	37	55	S	138	46	W	12.2	9	61	18.6	55.56
Apr 01	37	55	S	138	49	W	13.0	11	45	18.7	31.47
Apr 02	38	22	S	140	42	W	13.0	13	216	18.7	127.81
Apr 03	38	26	S	140	48	W	12.8	13	380	18.5	228.37
Apr 04	38	27	S	140	42	W	12.8	13	141	18.6	84.74
Apr 05	38	12	S	140	36	W	12.3	10	97	18.6	78.86
Apr 06	38	10	S	140	34	W	12.1	10	241	18.4	199.17
Apr 08	38	13	S	140	15	W	12.0	10	33	18.3	27.50
Apr 09	38	20	S	139	37	W	12.0	10	42	17.5	35.00
Apr 10	38	3	S	137	36	W	12.8	8	147	18.3	143.55
Apr 11	38	14	S	136	45	W	12.4	10	344	18.4	277.42
Apr 12	38	21	S	136	49	W	12.3	10	112	18.4	91.06
Apr 13	38	24	S	136	49	W	12.3	10	216	18.3	175.61
Apr 14	38	30	S	136	32	W	4.6	6	1	18.3	3.62
Apr 15	38	19	S	136	31	W	7.0	2	0	17.9	0.00
Apr 17	37	54	S	136	6	W	9.7	7	8	17.5	11.78
minimum							4.6	2	0	17.5	0.00
maximum							13.5	15	380	19.5	277.42
Mean							12.0	10.4	107.0	18.5	76.1
Std. Dev.							2.0	3.0	106.9	0.4	76.6
n							25	25	25	25	25