INTERIM REPORT
OF THE ACTIVITIES OF THE SKIPJACK SURVEY AND ASSESSMENT PROGRAMME IN THE WATERS OF NEW CALEDONIA
(13 December 1977 - 19 January 1978)

R.E. Kearney
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Skipjack Survey and Assessment Programme
Preliminary Country Report No. 3

South Pacific Commission
Noumea, New Caledonia
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641/78

FOREWORD

Some of the Appendices given in the French version of this report have not been included in the English edition. These Appendices refer to the ship's specifications and cross sectional plan and have been given in the previous country reports Nos. 1 and 2 which were both in English.

INTERIM REPORT OF THE ACTIVITIES OF THE SKIPJACK SURVEY AND ASSESSMENT PROGRAMME IN THE WATERS OF NEW CALEDONIA (13 December 1977 - 19 January 1978)

1. INTRODUCTION

When the survey of New Hebridean waters was temporarily suspended due to the lack of suitable bait, the "Hatsutori Maru" moved to New Caledonia ahead of schedule on 13 December 1977. Unpublished work by ORSTOM, Noumea (Legand, 1960 - Legand, 1971 - Rancurel et al, 1974 - Loubens, 1977 - Veillon, 1974), and previous brief surveys by Japanese vessels (JAMARC 1972 and 1973) indicated that good skipjack and baitfish resources could be found in New Caledonia in the summer months. Furthermore, as the small skipjack fishing vessels based in Noumea were taking excellent catches of skipjack in early December 1977, the prospects for a successful tagging campaign appeared good.

The New Caledonian authorities had offered very generous customs and pilot concessions and hence it was possible for the vessel to commence fishing en route from the New Hebrides, rather than reporting immediately to Noumea. Consequently baiting operations were able to begin on the night of 14 December and tagging commenced on 15 December.

2. VESSEL AND CREW

No major changes were made to the vessel or the crew before or during the New Caledonia survey. Owing to minor accidents and ill health the Fijian crew was reduced to seven members on several occasions, and the team of scientists very temporarily to two.

3. ACTIVITIES AND METHODS

Table 1 summarizes activities during the 37 days of the New Caledonian survey and Figure 1 shows the areas surveyed.

3.1 Tuna Fishing

The techniques previously used and described in Preliminary Country Report No.1 (see Kearney, 1977) were again used in New Caledonia and thus no further description is needed.

There was little information available as to the best fishing areas in New Caledonia and all waters were of equal interest. Therefore, as the direct route from the New Hebrides to New Caledonia leads to the east coast, fishing was commenced on this coast. However, the need to fish for bait daily restricted the radius of coverage and did not allow us to explore all New Caledonian waters. The areas not covered during the first survey will be visited during subsequent campaigns.

TABLE 1 - RESUME OF ACTIVITIES

DATE	GENERAL AREA	ACTIVITY	MOON AGE	BAIT HAUL NO.*	BAIT STATION POSITION	BAIT CARRIED AT COMMENCEMENT OF FISHING+	NO. OF FISH TAGGED
13/12	New Hebrides to New Caledonia	Travel	03	-	-	-	-
14/12	Laugier Bay	Travel	04	-	-	-	-
15/12	North New Caledonia	Fishing	05	1,2	21°22'S 165°52'E	170 bkts.	1,559 SJ 11 YF
16/12	East Coast	Fishing	06	3,4	21°22'S 165°52'E	145 bkts.	535 SJ
17/12	East Coast	Fishing	07	5	21°22'S 165°52'E	153 bkts.	1,249 SJ
18/12	Laugier Bay East Coast	Fishing	08	6	21°22'S 165°52'E	133 bkts.	653 SJ
19/12	East Coast	Fishing	09	7	21°22'S 165°52'E	45 bkts.	105 SJ
20/12	East Coast	Fishing	10	8,9	21°22'S 165°52'E	140 bkts.	922 SJ, 4 YF
21/12	East Coast	Fishing	11	10,11	21°27'S 165°58'E	116 bkts.	284 SJ
22/12	East Coast	Fishing	12	12,13	21°22'S 165°52'E	123 bkts.	844 SJ, 33 YF
23/12	Ouine Bay to Noumea	Fishing/ Travel	13	-	21°59'S 166°45'E	5 bkts.	-
24/12	Noumea	Port	14	-	-	-	-
25/12	Noumea	Port	15	-	-	-	-
26/12	Noumea	Port	16	-	-	-	-
27/12	Noumea to Prony Bay	Port/ Travel	17	-	-	-	-
28/12	West of Noumea	Fishing	18	14,15	22°22'S 166°54'E	40 bkts.	426 SJ
29/12	South New Caledonia	Travel	19	16	22°23'S 166°54'E	4 bkts	-
30/12	Prony Bay	Baiting	20	17	22°19'S 166°49'E	4 bkts.	-
31/12	Noumea	Fishing	21	18,19	22°22'S 166°54'E	42 bkts.	25 SJ
1/1	Noumea	Port	22	-	-	-	-
2/1	South New Caledonia	Travel	23	-	-	-	-
3/1	Port Bouquet - Ouvea	Fishing	24	20,21	21°40'S 166°22'E	297 bkts.	606 SJ
4/1	Ouvea - New Caledonia	Fishing	25	-	-	110 bkts.	235 SJ 1 YF
5/1	East Coast	Fishing	26	22,23	21°22'S 165°51'E	114 bkts.	448 SJ
6/1	Laugier Bay	Baiting	27	24,25	21°22'S 165°51'E	319 bkts.	-

* Bait hauls have been asigned to the day on which bait was used for fishing, i.e. activities from 1800 hours have been assigned to the following day.

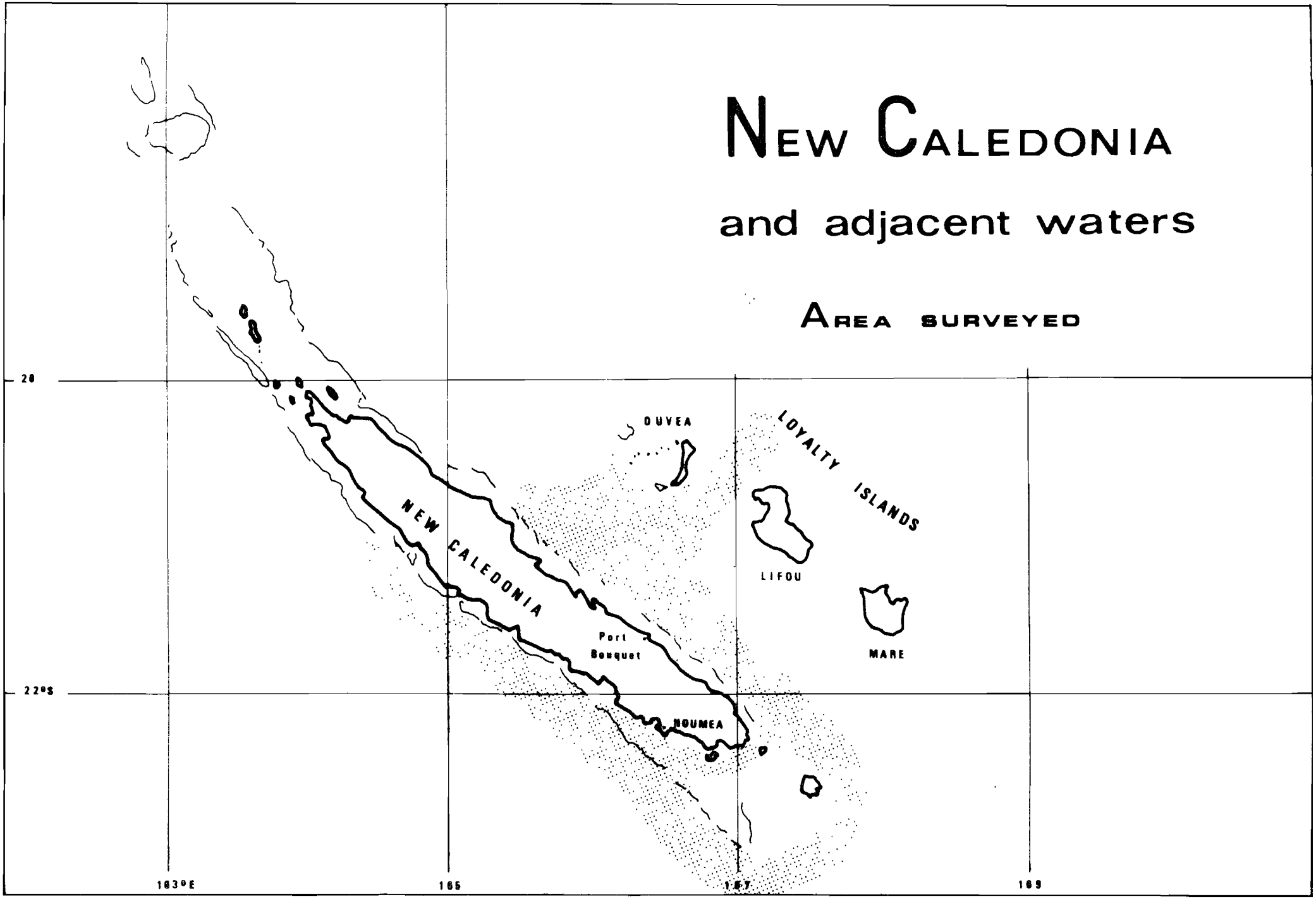
+ The number of buckets has been expressed in each case in terms of standard 1.5 kg wet weight of bait.

TABLE 1 - RESUME OF ACTIVITIES Cont'd

DATE	GENERAL AREA	ACTIVITY	MOON AGE	BAIT HAUL NO.*	BAIT STATION POSITION	BAIT CARRIED AT COMMENCEMENT OF FISHING	NO. OF FISH TAGGED
7/1	East Coast	Repairs/ Fishing	28	-	-	319 bkts.	268 SJ 8 YF
8/1	East Coast	Fishing	29	26	21°40'S 166°21'E	261 bkts.	376 SJ 3 YF
9/1	Port Bouquet	Travel/ Fishing	0	27,28	21°40'S 166°21'E	305 bkts.	71 SJ
10/1	South West coast New Caledonia	Fishing	01	-	-	245 bkts.	224 SJ
11/1	Noumea - Ourai	Fishing	02	29,30	22°12'S 166°18'E	230 bkts.	92 SJ
12/1	Uarai Bay - Boulari Bay	Fishing	03	31	21°49'S 165°46'E	179 bkts.	38 SJ
13/1	Boulari Bay - Bourail - Uarai Bay	Fishing	04	32	22°15'S 166°31'E	163 bkts.	402 SJ
14/1	Uarai Bay - Voh	Fishing	05	33,34	21°49'S 165°45'E	106 bkts.	3 SJ
15/1	Voh - Chasseloup Bay	Fishing	06	35, 36	20°52'S 164°39'E	166 bkts.	847 SJ
16/1	Noumea	Port	07	-	-	-	-
17/1	Noumea - Port Bouquet	Travel	08	-	-	-	-
18/1	Port Bouquet	~~Fishing~~ bait.	09	37,38	21°40'S 166°22'E	320 bkts.	-
19/1	Port Bouquet - New Hebrides	~~Fishing~~ bait. Travel	10	39,40	21°40'S 166°22'E	375 bkts.	-

* Bait hauls have been assigned to the day on which bait was used for fishing, i.e. activities from 1800 hours have been assigned to the following day.

+ The number of buckets has been expressed in each case in terms of standard 1.5 kg wet weight of bait.


NEW CALEDONIA
and adjacent waters
AREA SURVEYED
20
22°S
163°E
165
167
169
OUVEA
LOYALTY ISLANDS
NEW CALEDONIA
LIFOU
MARE
Port Bouquet
NOUMEA

3.2 Baitfishing

During the survey the weather experienced on the north east coast, locally referred to as the "east coast", was more favourable for baitfishing than that encountered on the south "west" coast. Therefore baitfishing was concentrated on the "east" coast. In addition, the "Hatsutori Maru's" net - "bouki-ami" - requires a minimum depth of about 23 metres, making it impossible to fish in the shallow bays which predominate on the west coast and on the northern tip of New Caledonia.

For these reasons, the "Hatsutori Maru" operated 17 days on the east coast, as against only 15, four of which were spent in Noumea, on the west.

The fishing techniques used in New Caledonia were exactly the same as those used during operations in Papua New Guinea, the Solomon Islands, and the New Hebrides. They have previously been described in detail (Kearney 1977, Kearney and Lewis 1978).

3.3 Scientific Procedure

3.3.1 Tuna tagging

All three tagging cradles were in use, except during the few days when there were only two scientists on board.

While the position of the cradles at the bow and amidships proved entirely satisfactory, the position of the stern cradle still leaves much to be desired; the fact that the tagger stands well below the gunwale and the fishermen, and with his back to the sea, makes the tagging operation more difficult. This problem can be alleviated either by raising the cradle, or by turning the tagger around to face the sea, but in the latter case the tagger must work with his left hand.

During this cruise more tagging was done from the stern cradle (41%) than in the bow cradle (38.6%), and naturally more than amidships (20.4%). This increase in the number of fish tagged at the stern was due to an increase in the number of people servicing the stern cradle. Instead of a single assistant we used two; one person to hand the fish one by one to the tagger, the other to release the tagged fish back into the sea, thus relieving the tagger, who stands with his back to the sea, from the necessity of having to do so himself. The assistant normally also helped to hold the fish still during tagging. Immobilising the fish for tagging is a tricky job, since too rough a grip can cause lesions in the muscles, the tendons, fins or spine, most often near the tail.

Unfortunately we still did not have an adequate supply of appropriate tags. The first batch of 4,000 South Pacific Commission tags, received just before leaving the New Hebrides for New Caledonia, was quickly exhausted because of the excellent fishing conditions encountered, and we again had to resort to borrowed Papua New Guinean tags.

3.3.2 Tuna biology

Similar biological data was gathered as during previous campaigns. For the first time, skipjack blood samples were also collected and their analyses should yield much useful information to supplement that obtained from tagging and recapture.

Theoretically, the minimum size of a sample should be 100 specimens from the same school and the same age group (same length), but since schools encountered in New Caledonia were rarely homogeneous, and usually comprised two or more main size groups, a sample of 50 specimens of each size class for each school was regarded as adequate. The blood specimens taken were preserved in a solution of glycerol and sodium citrate.

Two samplings of skipjack blood were made in New Caledonian waters:

Sample A: 105 specimens from two age groups on the east coast, on 8 January 1978.

Sample B: 109 specimens from two age groups on the west coast, on 15 January 1978.

Table 2 summarizes the biological data collected on fish that were not tagged from each school.

3.3.3 Baitfish

Most methods used and types of data collected were as for previous surveys. Experiments on baitfish mortality rates were increased though rapid utilisation of the bait caught somewhat restricted the information that could be recorded.

RESULTS

All data collected was recorded in appropriate logs. A sample sheet of each log type is given in the Appendix.

4. SURVEY RESULTS

Arriving from the New Hebrides, fishing was commenced on the east coast. The vessel then moved to the west coast through the Havannah Pass in the south, returned to the east coast for one week, came back to the west coast via the Isle of Pines, and concluded the campaign on the east coast (see Figure 1). The northern tip of the island was not surveyed but will be covered during future cruises.

TABLE 2 - SUMMARY OF BIOLOGICAL DATA

SPECIES	TOTAL NO. MEASURED	TOTAL NO. WEIGHED	TOTAL NO. EXAMINED FOR SEX	TOTAL NO. OF GONAD EXAMINED	TOTAL NO. EXAMINED FOR STOMACH CONTENT
Skipjack	1,266	483	692	694	275
Yellowfin Tuna	55	26	39	35	22
Dolphin Fish	5	4	5	5	5
Mackerel Tuna	5	-	5	5	5
Rainbow Runner	4	-	4	4	4
Frigate Tuna	4	2	4	4	3
TOTALS All species	1,339	515	721	747	314

TABLE 3 - RESUME OF SIGHTINGS

(SJ = skipjack, YF = yellowfin, FT = frigate tuna, DF = dolphin fish, MT = mackerel tuna, RR = rainbow runner, UNID = unidentified)

DATE	NO OF HOURS SPENT SEARCHING	NO. AND SPECIES OF SCHOOLS	NO. OF SCHOOLS CHUMMED	NO. OF POSITIVE RESPONSES
13/12	12.5	4 SJ,5 UNID	-	-
14/12	2.5	2 UNID	-	-
15/12	13.5	4 SJ,1 SJ+YF,2 UNID	7	5
16/12	12.5	9 SJ	9	5
17/12	13	8 SJ	8	4
18/12	11	5 SJ,4 UNID	9	3
19/12	10	4 SJ,1 SJ+FT	5	2
20/12	4	1 SJ+YF	1	1
21/12	5.5	2 SJ,1 SJ+DF,2 UNID	5	3
22/12	6.5	6 SJ,2 SJ+YF, 1 SJ+YF+FT,4 UNID	12	8
23/12	7	6 SJ,1 UNID	-	-
28/12	5.5	2 SJ,3 UNID	2	2
31/12	6.5	1 SJ,5 UNID	6	1
3/1	12	9 SJ,1 MT,4 UNID	11 14	7
4/1	9.5	1 SJ,1 SJ+YF+RR	2	1 2
5/1	8.5	6 SJ,1 UNID	7	3
7/1	4	1 SJ,1 SJ+YF	2	2
8/1	8	4 SJ,1 SJ+YF	5	2
9/1	7.5	2 SJ,1 YF,1 SJ+YF, 2 UNID	5	1
10/1	12	3 SJ	3	2
11/1	6.5	5 SJ	5	5
12/1	10	3 SJ	3	1
13/1	11	9 SJ,2 YF,1 UNID	12	3
14/1	12	5 SJ,1 YF,1 UNID	6	1
15/1	3.5	4 SJ	4	2
19/1	8	6 UNID	-	-
TOTALS	222.5	103 SJ,4 YF, 6 SJ+YF,48 others	129	64

4.1 Tuna

As local authorities had very generously granted us temporary exemption from entry and customs formalities, we were able to begin fishing before coming to Noumea; we eventually completed these formalities in Noumea on 23 December 1977. All data on the schools sighted is given in Table 3.

Throughout the survey, fishing conditions were better on the east coast than on the west, where we sometimes had difficulty in catching enough baitfish (in Prony Bay and Boulari Bay) and where tuna schools too were less abundant.

A comparison of the fishing conditions on the two coasts is given in the following table.

TABLE 4 - FISHING CONDITIONS IN NEW CALEDONIA

	NO. OF HOURS SPENT SEARCHING	NO. OF SCHOOLS SIGHTED	NO. OF SCHOOLS SIGHTED PER HOUR OF SEARCH	NO. SCHOOLS CHUMMED	% OF POSITIVE RESPONSES
East Coast	148.5	110	0.74	88	53.4
West Coast	67	45	0.67	41	41.4

A surprising number of the schools encountered in New Caledonia were sub-surface, 70% in fact, as against 25% in the Solomon Islands and 3% in Papua New Guinea. All skipjack schools were outside the barrier reef, most were adjacent to the reef and their concentration appeared to decrease with increasing distance seawards. Accordingly very few schools were sighted on 13 December and on 3 and 4 January on our trips between the Loyalty Islands and the mainland.

The size of the schools appeared to be smaller in New Caledonia than in the countries previously surveyed (see Table 5), but it is very difficult to judge the size of a sub-surface school. Often the estimate is biased by the number of birds hovering over it, whereas with surface schools it is the fish which are actually observed. Unfortunately there is not necessarily any relationship between the magnitude of bird concentration and fish abundance.

TABLE 5 - COMPARISON OF SCHOOL SIZE ACCORDING TO AREA (% OF TOTAL)

	New Caledonia	Solomon Islands	Papua New Guinea
Small	60	55	50
Average	30	25	15
Large	10	20	35

Furthermore a larger percentage of the schools seen in New Caledonia seemed to consist of skipjack alone (see Table 6). However, if yellowfin were present with sub-surface skipjack concentrations they would not be visible and if they did not bite for any reason they would completely avoid detection.

TABLE 6 - SCHOOL TYPE ACCORDING TO SPECIES AND AREA (% OF TOTAL)

	New Caledonia	Solomon Islands	Papua New Guinea
SJ only	65%	32%	30%
YF only	3%	20%	45%
SJ + YF + others	6%	15%	8%
SJ + others	1%	3%	0%
YF + others	0%	0%	0%
Unidentified	25%	30%	10%

Schools were, on the whole, more numerous in New Caledonia than had been found in areas previously surveyed by the "Hatsutori Maru" (see Table 7).

TABLE 7 - TUNA SCHOOL FREQUENCY ACCORDING TO AREA

	New Caledonia	Solomon Islands	Papua New Guinea
No. of schools sighted per hour of searching	0.72	0.63	0.45

4.2 Baitfish

The "Hatsutori Maru" was given clearance to fish for bait in all areas without restriction. Forty bait hauls were made on 25 separate days at nine different localities in all areas except the north of the mainland.

As the Japanese surveys in New Caledonia had indicated (JAMARC 1972 and 1973) bait fishing was satisfactory in Laugier Bay and around Port Bouquet, but disappointing in Prony Bay. Good baitfish concentrations were detected in numerous areas not previously surveyed and in general excellent baitfish catches were made throughout this visit (see Tables 8 and 9 and Figure 2).

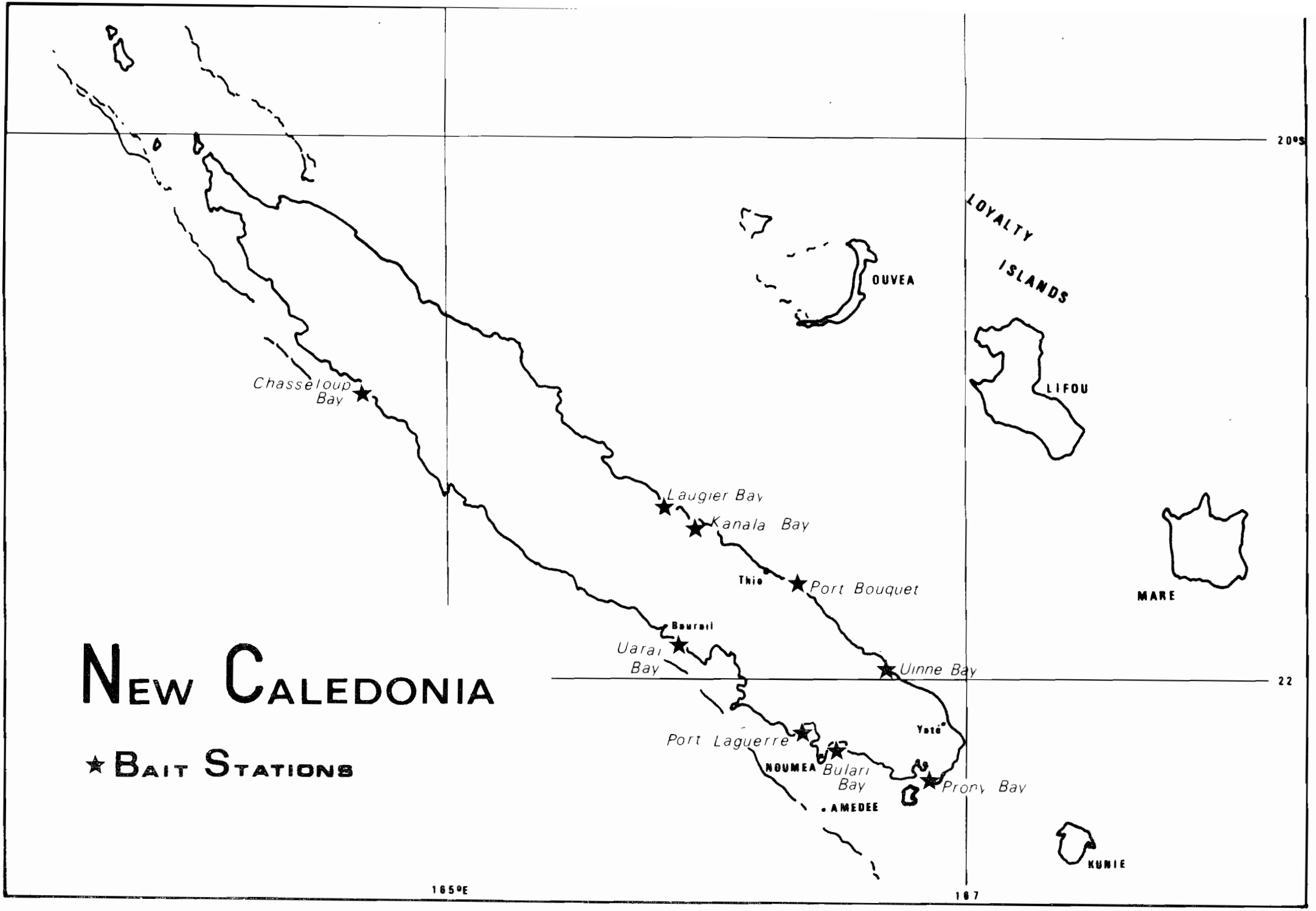
TABLE 9 - BAIT CATCH PER NIGHT FISHING ACCORDING TO AREA

	New Caledonia	Solomon Islands	Papua New Guinea
No. of buckets per night fishing (~~in kg~~)	81	71	96

TABLE 8 - CATCH DETAILS AT EACH BAITFISHING SITE

ANCHORAGE	BAIT CATCH PER HAUL (in buckets)	DOMINANT SPECIES IN ORDER OF NUMERICAL ABUNDANCE	SIZE RANGE (mm)	MEAN(mm)	OTHER COMMON SPECIES
Laugier Bay	72, 98, 71, 74	*Stolephorus heterolobus*	36-67	49.8	*Spratelloides delicatulus*
	128, 133, 45, 67,	*Herklotsichthys punctatus*	42-125	81.6	*Dipterygonotus leucogrammicus*
	73, 75, 48, 78,	*Decapterus maruadsi*	-	-	*Allanetta ovalaua*
	36, 102, 217				*Pranesus pinguis*
Canala Bay	57, 59	*Stolephorus devisi*	36-45	41.8	*Herklotsichthys punctatus*
Prony Bay	24, 16, 5,	*Spratelloides gracilis*	18-39	31.0	
	5, 24, 35	*Stolephorus heterolobus*	57-65	60.6	
Port Bouquet*	161, 136, 71,	*Stolephorus heterolobus*	42-73	61.3	*Dipterygonotus leucogrammicus*
	82, 84, 87,	*Herklotsichthys punctatus*	40-80	64.6	*Lutjanus kasmira*
	233, 76, 32	*Gymnocaesio gymnopterus*	41-89	58.4	Sphyraenidae
		Spratelloides gracilis	24-36	30.8	
		Decapterus maruadsi	72-136	111.8	
		Allanetta ovalaua	44-76	62.4	
		Sardinella clupeoides	81-114	91.9	
Port Laguerre	115, 114	*Stolephorus heterolobus*	66-76	71.0	
		Decapterus maruadsi	80-175	156.6	
Uarai Bay	300, 45, 62	*Stolephorus devisi*	47-58	50.4	
		Herklotsichthys punctatus	39-78	52.6	
Boulari Bay	38	*Stolephorus heterolobus*		53.1	*Decapterus maruadsi*
Chasseloup Bay	22, 135	*Stolephorus heterolobus*	65-74	71.4	*Sardinella sirm*
		Herklotsichthys punctatus	38-82	63.0	*Spratelloides gracilis*
		Stolephorus devisi	43-69	52.9	*Stolephorus bataviensis*
					Spratelloides delicatulus
					Dipterygonotus leucogrammicus
Ouine Bay	0	No haul due to lack of bait			

* Nine hauls were made at this same locality and the dominant species varied from haul to haul.


NEW CALEDONIA
★ BAIT STATIONS
Chasseloup Bay
Laugier Bay
Kanala Bay
Thio
Port Bouquet
Bourail
Uarai Bay
Uinne Bay
Port Laguerre
Yaté
NOUMEA
Bulari Bay
Prony Bay
AMEDEE
OUVEA
LOYALTY ISLANDS
LIFOU
MARE
KUNIE
20°S
22
165°E
167

Even though an average of 151 buckets of baitfish were hauled per day, the number of bays and anchorages suitable for baitfishing from the "Hatsutori Maru", using its existing "bouki-ami" net, is not great. Many areas which could well support good bait resources are too exposed to prevailing winds or currents, or too shallow, to use this net.

5. ASSESSMENT

5.1 Tuna

The large proportion of sub-surface schools and the absence of birds over many schools during our first visit to the east coast impeded school detection; but these difficulties were partly offset by the generally calm condition of the sea on the east coast; it was, however, rougher on the west coast.

5.1.1 Skipjack abundance in the survey area

The apparent abundance of skipjack, as indexed by the catch rate, was high throughout the survey. On the other hand, the occurrence of obvious surface schools was low as most of the fish taken were from sub-surface schools. The lack of surface schools would not effect the operation of any commercial vessels which had previous experience in this area or with fishing sub-surface schools, and in general it can be concluded that the skipjack abundance throughout this survey was more than adequate to sustain good fishing by live bait and pole vessels.

Care must be taken in predicting the overall future of skipjack fisheries development in New Caledonia from the results obtained during this survey, for not only did the survey span a relatively short time period, approximately five weeks, but there is evidence to suggest that the 1977/1978 skipjack season in New Caledonia was an abnormally good one; the catches by the locally registered small skipjack vessels were higher in 1977/1978 than in any other year. On the other hand one must note that the catches by the "Hatsutori Maru" were constantly good over a very large area of New Caledonia's waters, whereas the locally registered vessels operate predominantly in a restricted zone close to Noumea. Therefore, even though one must be careful in extrapolating from the results obtained in this survey to cover all skipjack seasons in New Caledonia, the survey has shown without doubt that the high apparent abundance in this season was over a great area and that the overall biomass of skipjack present was indeed considerable, and that most of these skipjack were vulnerable to live bait fishing techniques.

Great care must be taken when trying to relate the figures for the numbers of skipjack tagged per day to the anticipated catches of a commercial vessel of the same type operating concurrently. The "Hatsutori Maru" carried a total crew of 20 persons on average, including scientists. Normally 10 or less men would be actually poling skipjack at any one time compared to a commercial fishing vessel of the same size, which would have well in excess of 20 men fishing. Furthermore, the fishermen were deliberately poling their skipjack more carefully, and hence slowly, into the tagging cradles. It is probale that the number of fish poled by an

individual fisherman on board the "Hatsutori Maru" would be approximately half of what could be anticipated during commercial operations, and as the number of crew is at least half, our catch rate would represent much less than 25% of that of a comparable commercial vessel in times of good fishing conditions. When biting is slow, however, our catch rate would be comparatively closer to that of a commercial vessel because one of the factors limiting catch would be the slow biting of skipjack, and, this would tend to negate the effects of the extra time taken to pole an individual skipjack into a tagging cradle. Assuming that the catch efficiency of the "Hatsutori Maru" is between one quarter and one sixth of that of a similar size commercial vessel, the total catch of 35 tonnes of skipjack recorded by the "Hatsutori Maru" would represent a commercial catch of between 140 and 210 tonnes on the 23 days actually spent fishing over the 37-day period of the survey.

5.1.2 Skipjack catches of special interest

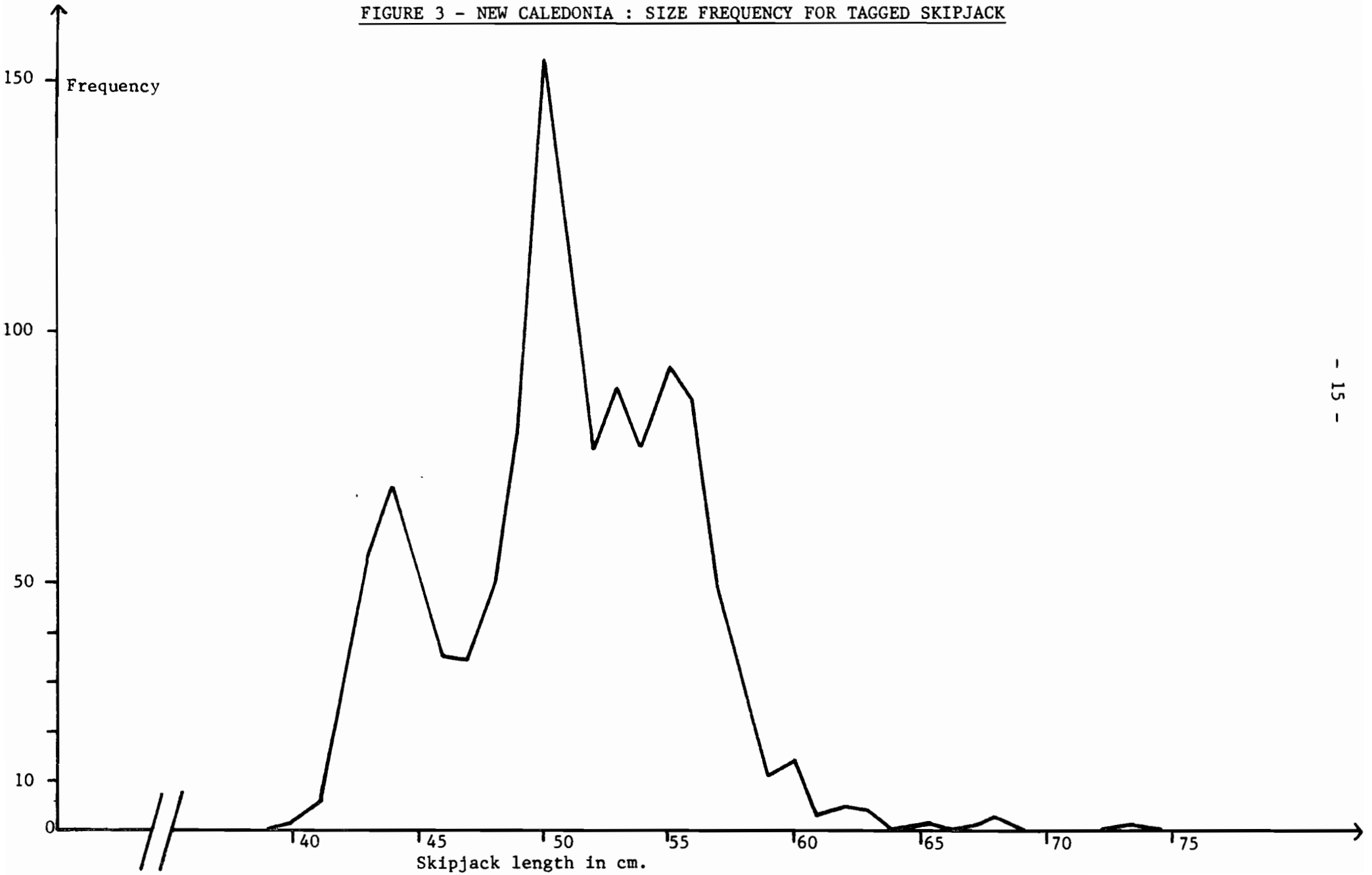
The skipjack schools encountered exhibited a high degree of variability of length frequency distribution. The size range within a school was often great; on two occasions length differences of over 260 mm were recorded from a school. There was a tendency for the degree of length variability within a school to increase with progression southwards; no explanation for this can be given. Skipjack tended to be larger on the east coast than the west coast and on the east coast they tended to be further segregated, with larger fish occurring west of 166°E ($\bar{x}$ = 54.4 cm west of 166°E and 50.0 cm east of this point). Figure 3 shows the distribution of skipjack by size class and from this figure three main classes can be distinguished: (1) around a mean of 44-45 cm found exclusively on the west coast between the southern tip of the mainland and 163°30'E; (2) around a mean of 50-51 cm which was found on the west coast west of 165°30'E and also on the east coast east of 166°30'E - this borderline moved westward between our first and second visit to the east coast; (3) around a mean of 54 cm found exclusively on the east coast west of 166°E (see Figure 1).

There is a suggestion that this size class distribution could be associated with water temperature, with smaller sizes occurring in higher sea surface temperatures, but there is insufficient data to substantiate any hypothesis. It is interesting to note that during our second visit to the east coast, when the smaller fish were taken, the water temperatures were higher in the western zone than during our first visit.

During the survey one skipjack of 73 cm was caught (22 December 1977). This fish weighed 10.1 kg and was the largest caught during the Skipjack Programme to this time.

Not a single floating log was seen during the survey in New Caledonia and hence no log associated schools were detected.

FIGURE 3 - NEW CALEDONIA : SIZE FREQUENCY FOR TAGGED SKIPJACK



5.1.3 Juvenile tuna

Tuna juveniles were found in the stomachs of skipjack only from specimens taken off the east coast around Ouvea. In all 46 juveniles were taken from the stomachs of 26 skipjack. It is interesting that the juveniles were taken in an area where the highest water temperatures were recorded (some 2°C higher than on the west coast), but it is difficult to add any weight to this result.

No juvenile tuna were found in the stomachs of yellowfin tuna, but then few of the latter species were caught.

Positive identification of all tuna juveniles collected is being carried out by scientists of ORSTOM (Noumea).

5.1.4 Yellowfin tuna

Mixed schools of skipjack and yellowfin tuna or pure yellowfin schools were scarce, accounting for 9.7% of the school sightings on the east coast and 6% on the west. Only 60 yellowfin tuna were tagged compared with 10,212 skipjack, that is 0.6% of the total number tagged in New Caledonia, compared with 1.8% in Papua New Guinea and 5.3% in the Solomon Islands. Yellowfin tuna were caught and tagged only on the east coast; the average length of those caught was 60.4 cm, with a size range from 50-79 cm, and weight from 3-9 kg. The largest yellowfin tagged was 73 cm.

As in other countries previously surveyed yellowfin tuna did not bite readily.

5.1.5 Other species

Only a few specimens, listed below, of other common species were caught:

6 Auxis thazard (Frigate tuna)

5 Euthynnus affinis (Mackerel tuna)

4 Elegatis bipinnulatus (Rainbow runner)

5 Coryphaena hippurus (Dolphin fish)

Coryphaena hippurus had not been caught since Papua New Guinea. All catches of incidental species were made by pole and line.

5.2 Baitfish

Based on the results obtained during this survey, the assessment and evaluation of the baitfish resources justify considerable optimism. With only two exceptions, the baitfishing grounds investigated yielded quantities of skipjack bait. In several cases, both the quality and consistency of the available bait were unexpectedly good (Laugier Bay, Port Bouquet, Uarai Bay) (see Table 8).

Stolephorus heterolobus was by far the most abundant baitfish species, and dominated species composition at 5 out of 9 stations and 24 out of 40 hauls. It was generally of ideal size - 61.2 mm on the average.

The study of mortality rates initiated in the Solomon Islands was continued, but the results obtained in New Caledonia were rather inconclusive because the bait caught was used fairly rapidly. Most of the results pertain to Stolephorus heterolobus taken in Laugier Bay. They demonstrate that, on the whole, bait tank No.3 gave better survival rates than tank No.5. Few results were recorded for tank No.4, which is thought to be the best tank.

Stolephorus devisi was dominant in the two hauls made at Uarai Bay (70 and 80%) and made up 10% of the Chasseloup Bay haul. In Canala Bay it was also the dominant species, but its size was disappointingly small (41.8 mm against 50.5 and 52.9 mm in the other localities). Much of the Stolephorus devisi caught around Canala was still in the juvenile stage.

The mortality rate for Stolephorus devisi was higher than for Stolephorus heterolobus - 39% after 12 hours for the former, as against only 20% for the latter. These results bear out those given in the report for Papua New Guinea (Kearney 1977).

Spratelloides gracilis, which is common in the Solomon Islands and Papua New Guinea, dominated hauls only in Prony Bay.

Decapturus maruadsi was observed as an important species for the first time:

- 15% on 5 January 1978 in Laugier Bay;
- 20% and 10% on 7 and 8 January 1978 at Port Bouquet;
- 20% on 10 January 1978 at Port Laguerre.

An unfortunate feature of this species is its serious predatory action on associated baitfish such as anchovies and herrings; it is also often rather too large to be ideal skipjack bait:

- Laugier Bay $\bar{x}$ = 116.0 mm
- Port Bouquet $\bar{x}$ = 111.8 mm
- Port Laguerre $\bar{x}$ = 156.6 mm.

Herklotsichthys punctatus was the second most important of the abundant species, but its proportion rarely exceeded 30% of the total catch. Its mortality rate was low, and therefore it remained a very valuable species.

Gymnocaesio gymnopterus and other fusiliers were recorded as co-dominant species only at Port Bouquet where they made up about 30% of the hauls.

Care must be taken when relating the results of this survey to the year-round abundance and availability of baitfish generally in the waters of New Caledonia. In some Pacific Island countries, most notably Fiji, the occurrence of baitfish fluctuated markedly on a seasonal basis and it is possible that similar fluctuations could occur here. However, unlike Fiji, the New Caledonian baitfish catches were largely dominated by Stolephorus anchovies which have a tendency to be more consistent in their behaviour. Also the very large comparatively uniform baitfish habitat provided by the New Caledonian lagoon and coastal topography could be anticipated to harbour sizeable and reasonably consistent baitfish resources. Furthermore, the season investigated on this occasion corresponded to the known skipjack season in this area and it could reasonably be anticipated that the good baitfish resources detected during this survey could be encountered at least in the summer months, when skipjack fishing in local waters would be most intense.

There were many areas of the New Caledonian coast, particularly to the north, which were not surveyed during this cruise and also many anchorages within the general area surveyed which were not investigated because they were marginally too shallow for the "Hatsutori Maru's" "bouki-ami"net. The general topography of many of these areas suggests they would support considerable baitfish resources, but alternative methods of capture may be required. Considering also that good concentrations of baitfish suitable for beach-seining had previously been observed on numerous occasions by Programme staff, the general potential for developing and sustaining a sizeable fishery, based on exploiting the baitfish resources of New Caledonia, is regarded with considerable optimism.

6. CONCLUSION

Although the skipjack survey and baitfish assessment aspects of the Programme had proceeded most pleasingly during the first two months, poor skipjack fishing conditions in Papua New Guinea and the Solomon Islands and difficulties in obtaining sufficient bait in the New Hebrides had restricted our tag output to well below our expectations. We were, therefore, hopeful of an increased tag output during our visit to New Caledonia. Certainly this hope was realized and the total of 10,272 fish tagged during the five-week period,which included Christmas and the New Year, was most rewarding. The techniques developed and the preparatory training of scientists and crew during the first two months were proven efficient during the very first day in New Caledonian waters, when 1,572 fish were tagged without difficulty. At the completion of the work in New Caledonia the total number of fish released had exceeded the predicted level if our goal of 15,000 in the first cruise period (4 October 1977 to February 1978) was to be achieved.

As with other surveys, the full assessment of the results must await the recovery of tags and subsequent additional data processing; however, from a survey and tag release point of view the New Caledonian campaign was extremely successful. There is no doubt that during the period of this survey the skipjack and baitfish resources available in New Caledonia were more than adequate to support the economic operations of at least a modest number of live bait and pole vessels. Care must of course be taken when projecting these findings beyond the period of the survey.

It has been known for some years that skipjack abundance in this area shows marked seasonality and that the fishing conditions in the southern part of New Caledonia taper off in March. However, it is possible that further surveys to the north could detect concentrations of fish which could prolong this season. Furthermore, when it is considered that a load of bait from New Caledonia was carried to the New Hebrides where it was used to tag skipjack (results to be published in the New Hebridean report), the possibility of basing extended range skipjack fishing operations out of New Caledonia is well worth consideration.

The baitfish surveys confirmed that there are indeed sizeable baitfish resources in New Caledonia and strongly indicated that future surveys, using alternative baitfishing techniques in shallower water, would confirm the presence of further, presently unfished, stocks. Our results suggest that promising though they were, previous baitfish surveys in this area may have indicated lesser baitfish resources than are actually present and available.

During the survey the weather did not prove to be the problem we had anticipated and only one fishing day was actually lost for this reason, even though cyclone "Bob" passed by the area during this period.

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APPENDIX

SAMPLE SHEETS OF DAILY LOGS USED ABOARD "HATSUTORI MARU" DURING NEW HEBRIDES CRUISE

LOCATION: 21°22'S 165°52'E East Coast, New Caledonia Laugier Bay **CHART:** 936 B **DATE:** 15/12/77

DEPTH: 34 m **BOTTOM:** red mud **CLARITY:** 2 ~ 3

LIGHT ON: 2100 **HAULED:** 0130 - 0500

LIGHTS USED: 2000 W-1500 **WNET:** _____ **OTHER:** SST 26.9

1st Haul: T5 = 68 bkts - Total 68 bkts. (71 st. bkts)) Total: 138 bkts(158 kg)
2nd Haul: T4 = 50 bkts.) 145 standard bkts.
T3 = 20 bkts. - Total 70 bkts. (74 st. bkts))

DOMINANT SPP. Haul Nos. 3 and 4

		DOM.	CODE	
Stolephorus heterolobus	80%	D		$\bar{x}(10) = 54.9$ R: 52 ~ 60
Dipterygonotus leucogrammicus	8%	C		$\bar{x}(10) = 58.0$ R: 53 ~ 62
Spratelloides delicatulus	6%	C		$\bar{x}(10) = 36.8$ R: 26 ~ 47

OTHERS:

	CODE		CODE		CODE
Herklotsichthys punctatus		*Spratelloides gracilis*			
Allanetta ovalaua		*Priacanthus* sp.			
Pranesus pinguis		*Bregmaceros* sp.			
Pterocaesio pisang		*Gymnocaesio gymnopterus*			
Aluteridae		Acanthuridae			
Decapterus maruadsi		Chaetodontidae			
Scomberomorus commersoni		Fistularidae			
Caranx sexfasciata		Siganidae			
Leiognathus elongatus		(jelly fish)			
Rastrelliger kanagurta					

NOTES: Just a few difficulties with the wind but easily solved by using leads. Only a few jelly fish this time, relatively good loading conditions as during the previous night. We shall continue with the new light procedure described on page 33.

BIOLOGICAL DATA

SPECIES: S TIME: 1245 hrs DATE: 16 /12 / 77

CAPTURE METHOD: Pole

S.S.T.: 26.5 POSITION: 21°00'S

SCHOOL TYPE: Sub-surface, occasional splasher 165°45'E

No.	LCF	Wt.	Sex	Stage	G.Wt.	GI	Stomach content
1028	550	3.6	F	3	160	96.2	Ch. Tuna Juv. Acan. Sq.
1029	572	4.0	M	-	80	42.7	Ch. Acan. Tuna Juv. Unid.#1, Sq.
30	500	2.8	M	-	66	52.8	Ch. Chaeto. Acan. Unid.#1, Sq.
31	565	4.2	M	-	190	105.3	Ch. Acan. Tuna Juv. Sq.
32	536	3.1	F	3	90	58.4	Acan. Sq.
33	560	3.6	F	3	130	74.0	
34	535	3.2	F	3	125	81.6	
35	536	3.5	M	-	80	51.9	
36	530	3.3	F	3	125	84.0	
37	544	3.2	Und.	-	< 1g	<0.6	
38	561	3.6	F	3	140	79.3	
39	545	3.2	M	-	105	64.9	
40	533	3.1	F	3	90	59.4	
41	575	4.0	M	-	135	71.0	
42	560	3.8	F	3	170	96.8	
43	552	3.6	F	3	125	74.3	
44	566	4.0	M	-	70	38.6	
45	523	2.9	M	-	65	45.4	
	Range 500 ~ 575						
	$\bar{x}$(18) = 546.8						

REMARKS: Third of four schools - 183 tagged plus 67 unmeasured.

RECORDED: JPH **AREA:** East Coast - New Caledonia **DATE:** 16 /12/ 77

Time	Position	Species	Type	Assoc.	Size	CH.	Response	Catch Wt.	Catch No.	Tagged	SST.	
0745	21°17'S 165°57'E	SJ	Sub-surf.	birds	large	+	+ve	650kg	187	156	25.9	bit very well
0850	21°08'S 165°49'E	SJ	"	"	medium	+	-ve	-	-	-	26.1	did not come up
0955	21°03'S 165°43'E	SJ	Sub-surf. occasion.	"	large	+	+ve	550kg	148	119	26.1	very large school spread quickly in large area
1145	21°00'S 165°40'E	SJ	splash Sub-surf.	"	medium	+	-ve	-	-	-	26.5	did not come up
1235	21°00'S 165°45'E	SJ	Sub-surf. splash	"	small	+	+ve	1000kg	260	169	26.7	
1345	21°02'S 165°47'E	SJ	Sub-surf. splash	"	small	+	-ve	-	-	-	26.7	
1425	21°04'S 165°54'E	SJ	Sub-surf.	"	medium	+	+ve	95kg	27	27	26.9	
1515	21°06'S 166°00'E	SJ	Sub-surf.	"	medium	+	-ve	-	-	-	27.1	
1736	21°02'S 165°56'E	SJ	Sub-surf.	"	medium	+	+ve	225kg	60	49	27.0	bit very well and quickly
								=2500kg				

NOTES: Because of very calm conditions, biting was possibly not as good as yesterday. The schools were all sub-surface schools, except for a few splashers. During the afternoon schools were sighted in plankton areas similar to those sighted on the 13th.

SPECIES: S

NUMBER: S 59 D 1

DATE: 16/12/77

TIME: 0955 hrs.

POSITION: 21°03'S 165°43'E

SCHOOL TYPE: Sub-Surf.

TAGGER: JPH stern

Tag No.	LCF.		Tag No.	LCF.		Tag No.	LCF.	
A01674	53		A03251	55.5		3278	Rejected	
75	57		52	55		79	57	
76	53		53	54.5		80	57	
77	53		54	53		81	58	
78	52		55	53.5	shark bite	82	58	
79	49.5		56	53		83	52.5	big shark bite
80	50		57	52		84	56	
81	51		58	54		85	55	
82	55		59	no length	badly tagged		(60)	
83	50		60	59.5		Measured $\bar{x}$ = 544		
84	54.5		61	55				
85	54?	Not clear	62	55		Range = 540-576		
86	54		63	52				
87	55		64	53				
88	52.5		65	65				
89	54		66	55				
90	53		67)		double			
91	53.5		68)	57	tagged			
92	56		69	58				
93	54		70	57				
94	52		71	57				
95	59	badly tagged	72	57.5				
96	57		73	59				
97	49.5		74	57	big shark bite			
98	50		75	52				
99	56		76	56				
1700	55		77	56				

S	D	
5523	14	SJ
145	5	YF
4	-	BE

ACTIVITY: Fishing DATE: 16/12/77

AREA: East Coast, New Caledonia NOON POSITION: 20°59'S 165°40'E

	WIND	SEA	S.S.T.	AIR TEMP.	CLOUD
0900	ENE 10	2	26.1	25.0	25%
1500	E 5	2	26.9	25.8	5%

BAIT CARRIED: 145 bkts/ S. heterolobus USED: 87 bkts.
MORTALITY: 12 bkts.
RUNNING TIME: 1½ hrs to ___ hrs. FISHING TIME. 12½ hours

TAGS	S	SJ	D	S	YF	D	OTHER
	534		1	-		-	

OTHER SIGHTINGS: _____

BIOLOGICAL DATA:	GONAD	STOMACH CONTENTS	BLOOD	OTHER
	60	24	-	
	-	-	-	
	-	-	-	

REMARKS: SPC crew very tired today after strenuous day yesterday and only two hours' sleep last night and very busy day today.

Nine good schools sighted today but biting not as good due to very calm conditions or closer proximity to land.

Eroni Marawa is working for his first day after his injuries.

We returned to Laugier Bay at dusk for baiting (maybe only one pull due to crew conditions). Laugier Bay excellent for our purposes because:

(a) good quality, and quantity of bait;
(b) aids to navigation for night entry:
(c) close to fishing grounds.