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Contents

A joint venture purse-seine vessel in set. Note the circling skiff and speedboat near the vessel and the large (over 100-t) school of skipjack outside the net.

Introduction

In the early and mid 1970s purse-seine surveys of New Zealand's skipjack (*Katsuwonus pelamis* Linnaeus, 1758) resource established that there were good prospects for a commercial fishery (Hinds 1974, Eggleston 1976). This led to the formation of a joint venture between two companies—one New Zealand and one American—in which several large American purse-seine vessels were to further investigate the commercial prospects for skipjack fishing. At the same time interest was raised in the local industry, and two small New Zealand seiners also began to seek skipjack. Since then there has been a rapidly developing summer fishery for skipjack in which landings have risen from 5000 t in 1975–76 (1976 season) to about 9000 t in each of the last four seasons.

Each season the Ministry of Agriculture and Fisheries (MAF) has monitored catch-per-effort of the commercial fleet fishing skipjack and related this to environmental parameters, skipjack biology, and fluctuations in size of the skipjack resource. The results of observations on earlier seasons are presented in Clement (1976, 1978); Habib (1976, 1978a, 1978b); Vooren (1976); Eggleston and Paul (1978); Richardson (1978); and Habib, Clement, and Fisher (1980a, 1980b, 1980c).

This publication contains information on the 1981 purse-seine skipjack fishery in New Zealand. The season began on 31 October 1980 and ended on 13 May 1981. The fishery is discussed in terms of the areas shown in Fig. 1.

Materials and methods

Vessels

These were *Adriatic Sea* (formerly *Apollo*, 1558 gross tonnes, 79 m overall length, 2000 t carrying capacity); *Voyager* (1472 t, 73 m, 1600 t); *Tifaimoana* (1435 t, 72 m, 1470 t); *Captain M. J. Souza* (1172 t, 67 m, 1150 t); *Captain Frank Medina* (1093 t, 68 m, 1150 t); *Montana* (1070 t, 68 m, 1150 t); *Frontier* (as for *Captain M. J. Souza*); *Pacific Princess* (991 t, 67 m, 980 t); *Island Princess* (1274 t, 69 m, 1350 t); *Cindy Ann* (1049 t, 68 m, 1010 t); *Western Pacific* (U.S.) (894 t, 60 m, 980 t); *White Star* (837 t, 53 m, 862 t); *Finisterre* (1063 t, 62 m, 1150 t); *Western Pacific* (N.Z.) (544 t, 36 m, 350 t); *Western Ranger* (as for *Western Pacific* (N.Z.)); *Janet D* (498 t, 35 m, 330 t); *Marine Countess* (135 t, 27 m, 130 t); *San Benito* (248 t, 33 m, 120 t); and *Lindberg* (159 t, 23 m, 90 t).

The first four vessels fished under charter to the New Zealand Pelagic Fisheries Development Company (1976) Limited (NZPFDC) with *Finisterre*, the company-owned vessel. *Captain Frank Medina*, *Montana*, *Frontier*, and *Pacific Princess* fished under charter to J. Wattie Canneries Limited, and *Island Princess*, *Cindy Ann*, *Western Pacific* (U.S.), and *White Star* were under charter to Jaybel Nichimo Limited. In this publication these vessels constitute the chartered purse seiners.

Tifaimoana, *Captain M. J. Souza*, *Captain Frank Medina*, *Montana*, *Pacific Princess*, *Cindy Ann*, *Western Pacific* (U.S.), and *Finisterre* joined the New Zealand fishery from the eastern Pacific Ocean. *Adriatic Sea*, *Voyager*, *Frontier*, *Island Princess*, and *White Star* joined the fishery from the western Pacific tuna grounds north and east of Papua New Guinea.

Western Pacific (N.Z.) and *Western Ranger* were operated by Nelson Fisheries Limited, *Janet D* and *Marine Countess* by J. Wattie Canneries Limited, and *San Benito* and *Lindberg* by Sanford Limited. All these vessels except the first two joined the fishery from other New Zealand pelagic fisheries. *Western Pacific* (N.Z.) joined the fishery from the western Pacific grounds mentioned above, and *Western Ranger*, which was launched in February, joined the fishery on her maiden voyage.

Fishing gear and auxiliary equipment

The purse-seine nets ranged from 640 to 1682 m (2100 to 5518 ft) in length and 64 to 263 m (210 to 863 ft) in depth.

Most vessels used a motorised skiff (dory) during fishing. The exceptions were the Norwegian-style seiners *Janet D* and *Marine Countess*, which used

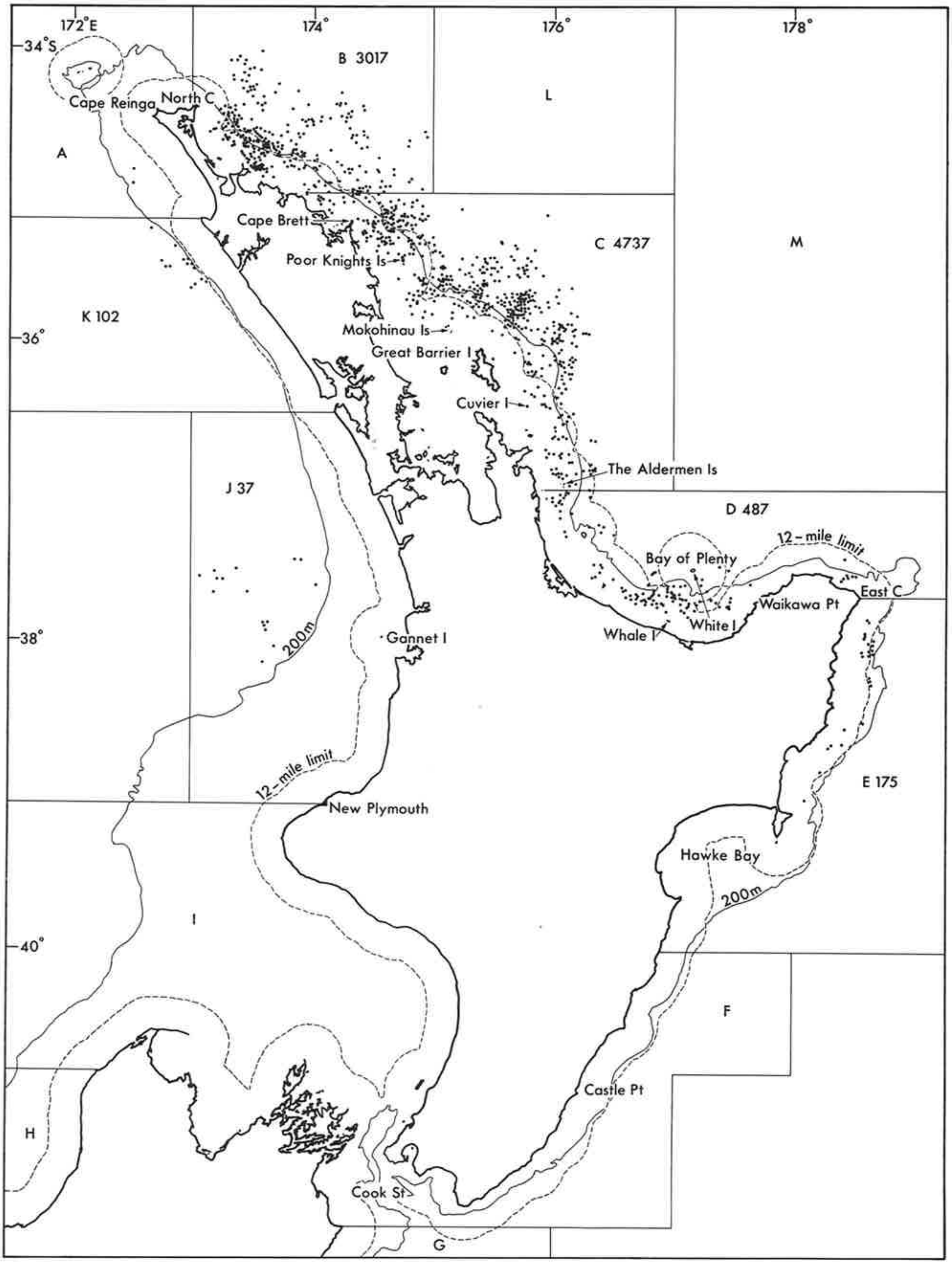


Fig. 1: Set positions and quantities (t) of skipjack caught by area in the 1981 purse-seine skipjack fishery in New Zealand.

Dahn buoys during net setting. Skiffs ranged in size from 7 to 12 m in length, 3.5 to 6 m in width, and 7 to 30 t in weight.

Many vessels were equipped with satellite navigation, sonar, and weather facsimile machines, and all had radar, depth sounders, and sophisticated radio equipment.

Nine vessels carried helicopters for fish finding and directing net setting, and most carried speedboats for herding the skipjack schools during fishing.

Fish storage aboard the vessels was in refrigerated brine.

Observer programme

As in previous seasons, the Fisheries Divisions of MAF placed observers aboard the purse-seine vessels to record:

1. Vessel activity, subdivided into time and place searching, travelling, at anchor or in port carrying out repairs or survey requirements, discharging fish, taking stores, sheltering from poor weather, or taking time off.
2. Vessel fishing activity, with location, date, time, depth, size, and success of sets.
3. Weather and sea conditions.
4. Location and size of surface schools of skipjack and other pelagic fishes.
5. Lengths of skipjack and other species in the catches.
6. Reproductive state and stomach contents of skipjack and other species in the catches.

Fork lengths were measured to the whole centimetre below the actual length in randomly selected samples of 40 to 600 fish from all catches while observers were aboard the vessels.

On some vessels, samples of 12 to 162 skipjack were measured and weighed for growth studies, and on one vessel skipjack gills and alimentary tracts were collected for joint parasite studies between MAF and the University of Queensland.

For studies on reproduction and feeding, 5 to 30 fish were dissected from occasional catches. The developmental stage of the gonads was judged by use of criteria described by Orange (1961) and Raju (1964). Gonads which were larger than rudimentary, thread-like structures were preserved in formalin and later weighed and dissected ashore. All stomachs which contained food were also preserved in formalin and later examined ashore. The contents were removed from the stomachs, lightly blotted to remove excess liquid, and then weighed to the nearest 0.1 g. A record was also kept of all empty stomachs.

On eight vessels, observers marked randomly selected samples of skipjack before placing them in the brine tanks. The storage position of each fish was noted. In addition, some of these fish were measured. This was part of a joint exercise between MAF and the South Pacific Commission (SPC) to test recovery rates of marked fish on the vessels at the time of off-loading and at the canneries during processing. The length measurements were taken as a test of the accuracy of such measurements being recorded at the time of recovery of marked fish.

Coverage of the skipjack fishery by the observer programme is shown in Table 1, which also contains data on earlier seasons for comparison. For vessels with no observers, log books were issued and the crews requested to complete the log forms.

Skipjack sightings programme

Ministry of Agriculture and Fisheries logs were kept by observers and pilots aboard "spotter" aircraft flying in support of the skipjack fishery. This applied mainly to the three fixed-wing, shore-based aircraft. Occasionally, observers were also on vessel-based helicopters during fish-spotting flights.

Sightings of numbers and sizes of schools were recorded with the date, time of day, locality, and weather and sea state. The behaviour and likely "catchability" of the fish were also often noted. Schools of skipjack were located and identified and school sizes estimated by use of criteria outlined by Bell (1976). These tasks were carried out by spotters with specialised training and considerable experience gained over several years of assisting pelagic fishing vessels (for discussion of these requirements see Squire 1972). Most observations were made from commercial fish-spotting flights, supplemented by observations from wider-ranging MAF aerial surveys. Skipjack sightings data were also collected by the observers aboard the vessels and used to supplement those gathered from aircraft. Information from vessels and

TABLE 1: Coverage of the purse-seine skipjack fishery by Ministry of Agriculture and Fisheries observer programme, 1976 to 1981

	Vessels					
Year	No. in fishery	No. with observers	No. of observers	Observer-days	Season-days	% of season-days observed
1976	5	5	17	225	486	46.3
1977	11	9	17	292	797	36.6
1978	10	9	11	471	806	58.4
1979	12	10	13	634	1 042	60.8
1980	15	12	16	862	1 192	72.3
1981	19	16	22	873	2 084	41.9

aircraft is used in this publication to describe the distribution, abundance, and seasonality of skipjack in New Zealand waters.

Sightings effort

The distribution of sightings effort by aircraft and purse-seine vessels is recorded in Fig. 2. No attempt was made to measure the effort, as MAF had little control over the way it was applied. Much of the effort was non-systematic and poorly spent. For example, a day's effort in an area was often represented by the movements of 3 fixed-wing aircraft, 6 or 7 helicopters, and 8 to 12 vessels. Search patterns were haphazard, and on most occasions the fish could have been located and their quantities estimated with a small fraction of the sightings effort. On other days, effort in an area was represented by a single rapid pass by an aircraft or a vessel, as part of more wide-ranging surveys and other activities, such as travelling to fishing grounds in other areas and travelling to and from ports and airports. Many other area-time combinations of sightings effort by aircraft and vessels occurred during the season. Because of the variable nature of the sightings effort and the dubious quality of much of it,

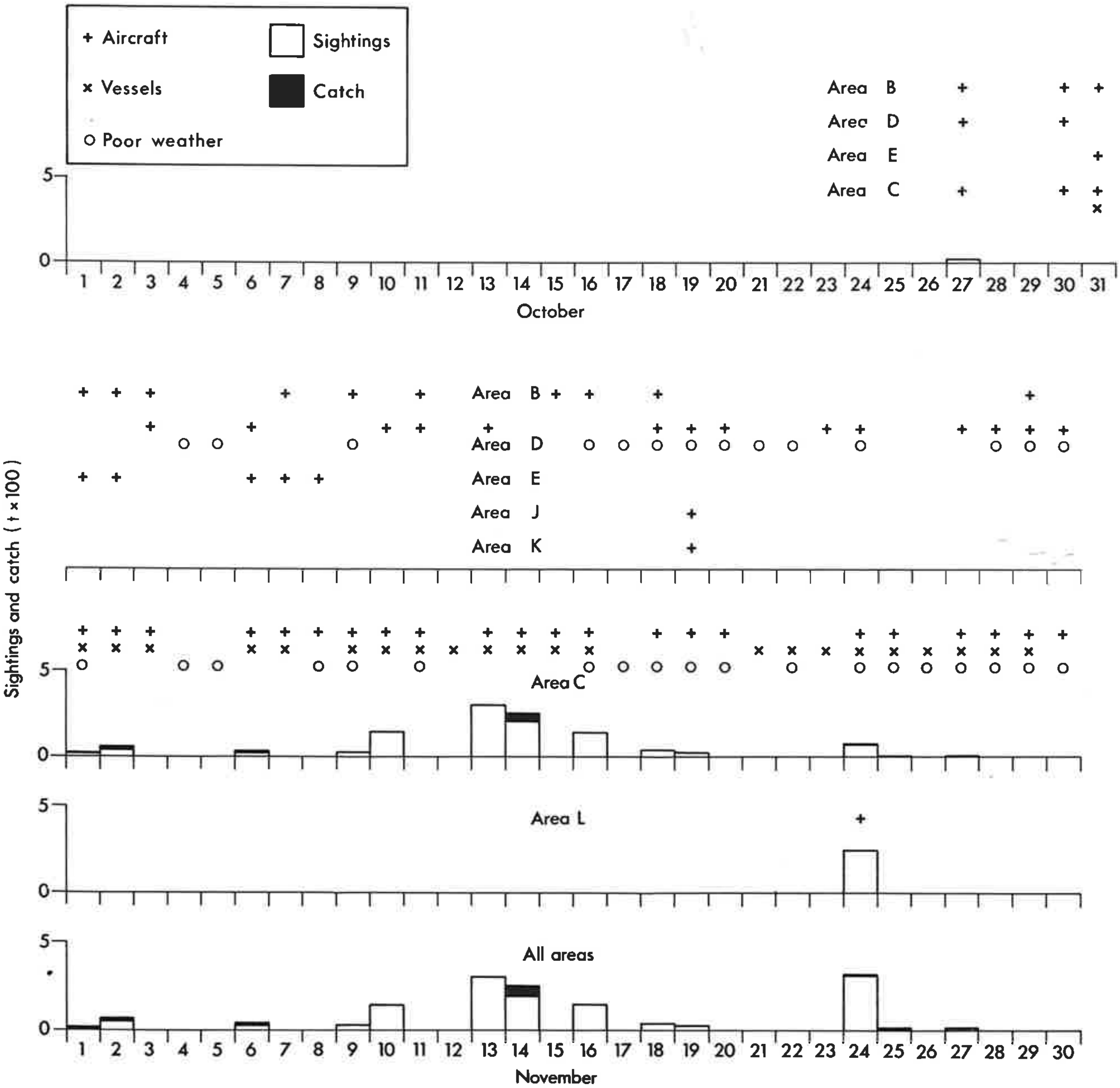


Fig. 2 (above and following pages): Daily sightings of skipjack and catch by area and for all areas combined during the 1981 season in New Zealand. Daily sightings effort from aircraft and purse-seine vessels and periods of poor weather are also indicated.

we decided not to measure it, but simply to note where and when it was applied.

Skipjack sightings

These are usually discussed in terms of two measures of abundance, apparent and real.

Apparent abundance is defined by Marr (1951) as ". . . abundance as affected by availability, or the absolute number of fish accessible to a fishery." In this publication apparent abundance refers to the quantity of fish which was seen at the surface each day and which was accessible to the purse-seine fleet each day. The daily estimate was chosen because during each day it was usually possible to eliminate multiple sightings of schools and so derive good estimates of the quantity of fish present at the surface. In past seasons, fish were present in greater quantities. They were also evident at the surface for longer periods during the day. Multiple sightings could then be eliminated only by analysing the data by half-day.

It should be appreciated that in adding together estimates of apparent abundance, fish which were quantified on one day probably often contributed to subsequent day totals. Therefore, the total of all daily measures of apparent abundance does not represent the quantity which could have been taken in the fishery and is to some extent an overestimate.

However, other factors caused the daily measures of apparent abundance to be underestimated. These were the cursory nature of much sightings effort, the inadequate sightings effort in all areas at some time during the season, and the movement of schools through the different depths of the sea during the day, which would have resulted in some proportion of the skipjack resource passing through the New Zealand region unsighted.

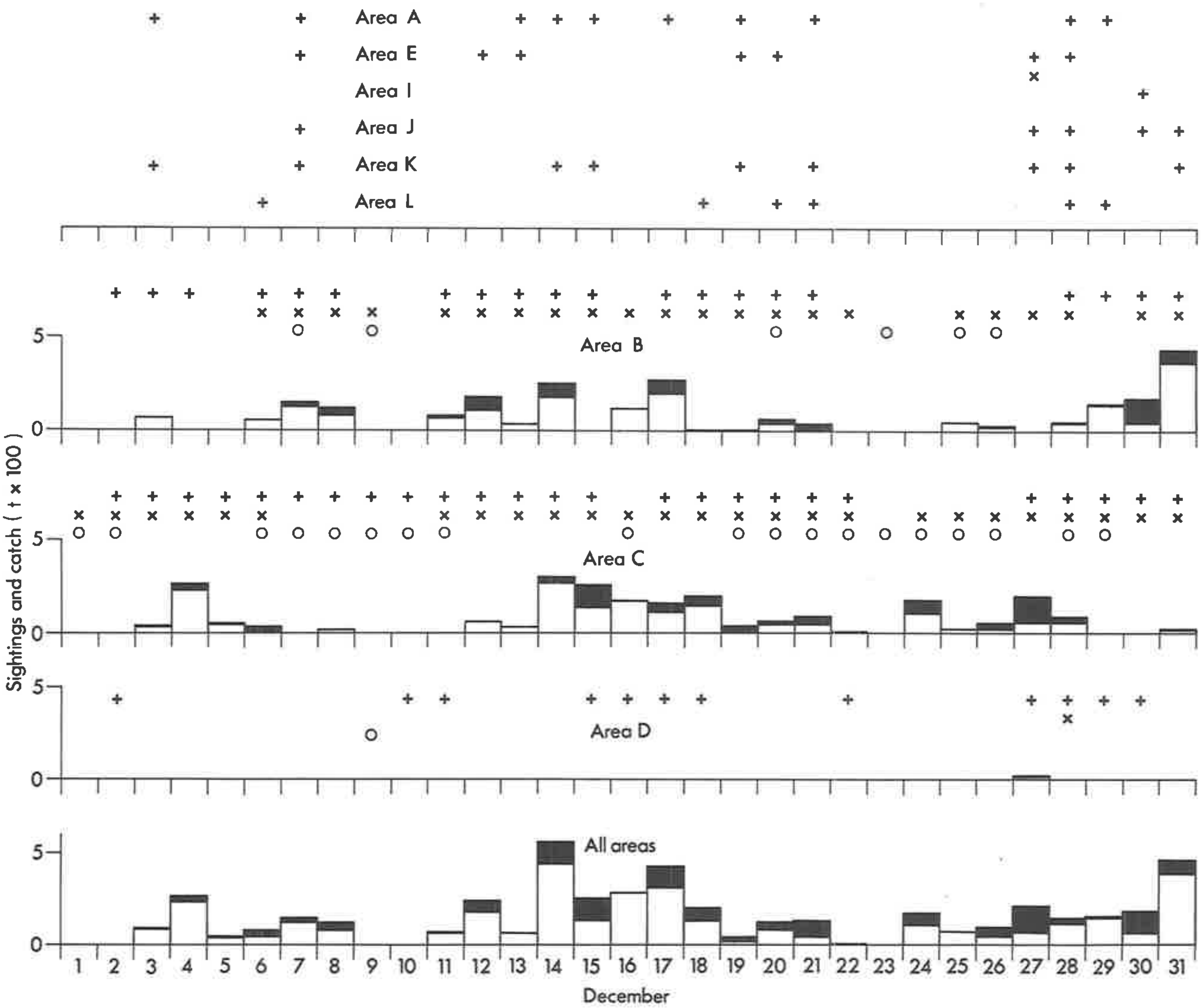
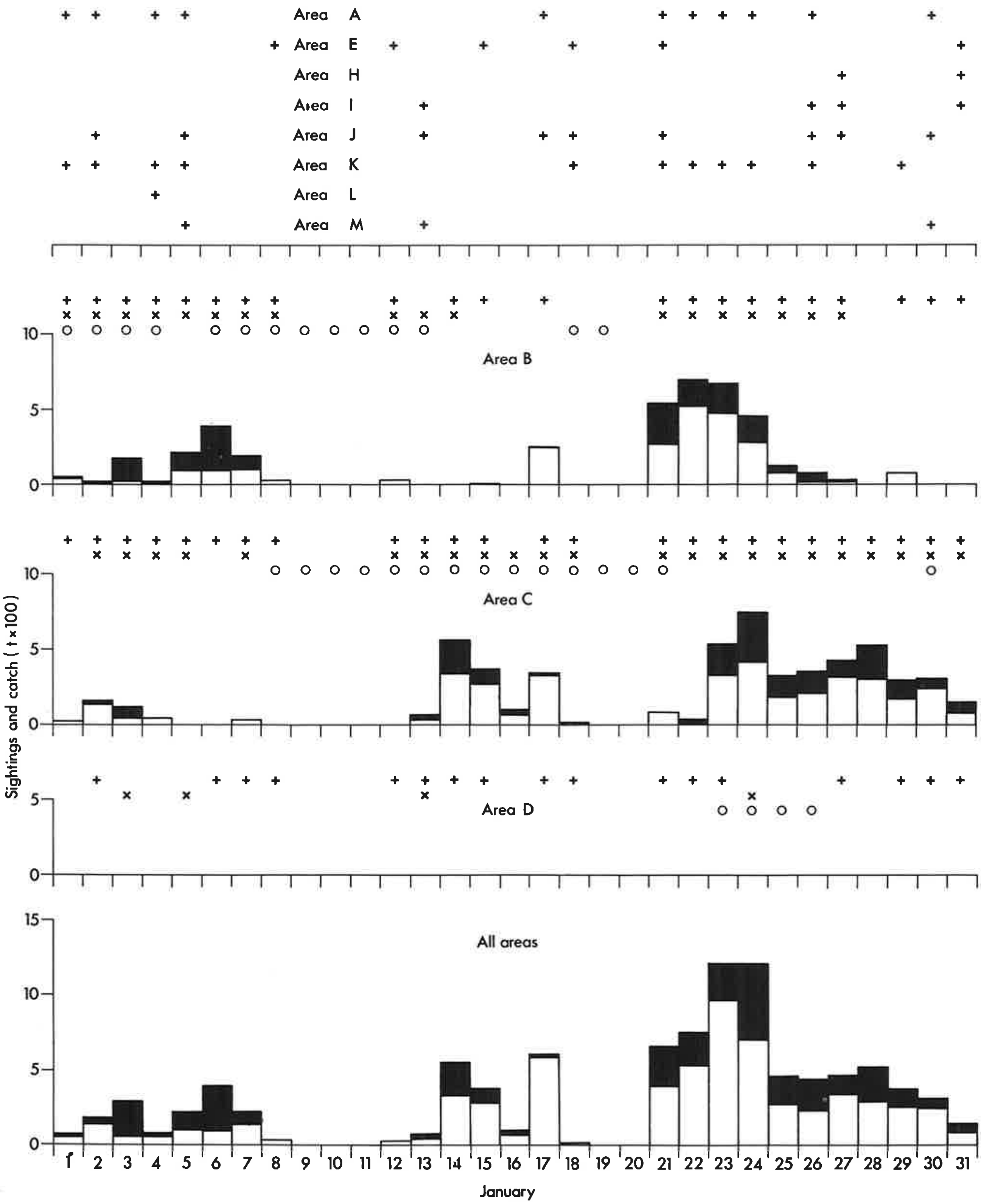


Fig. 2—*continued.*



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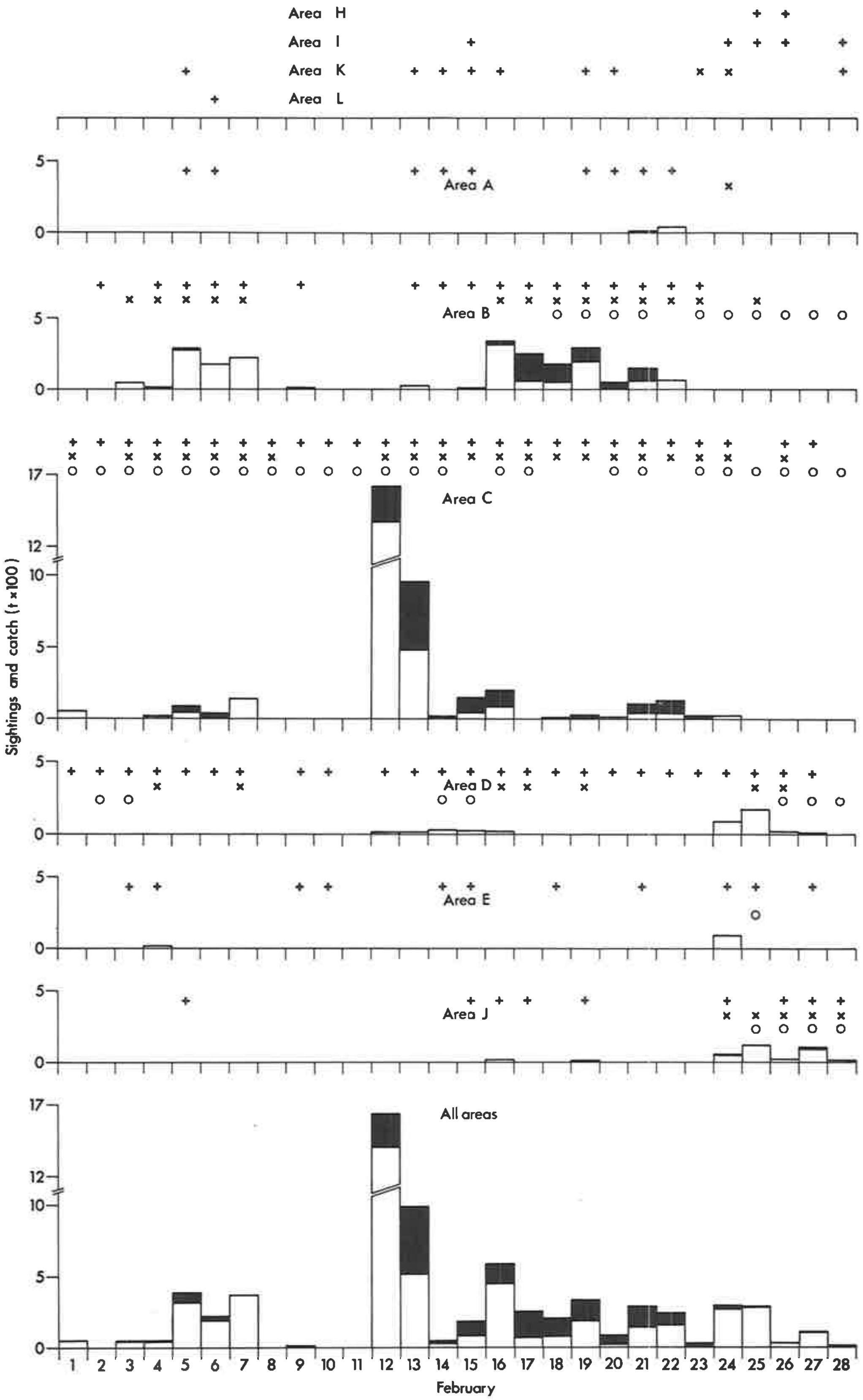

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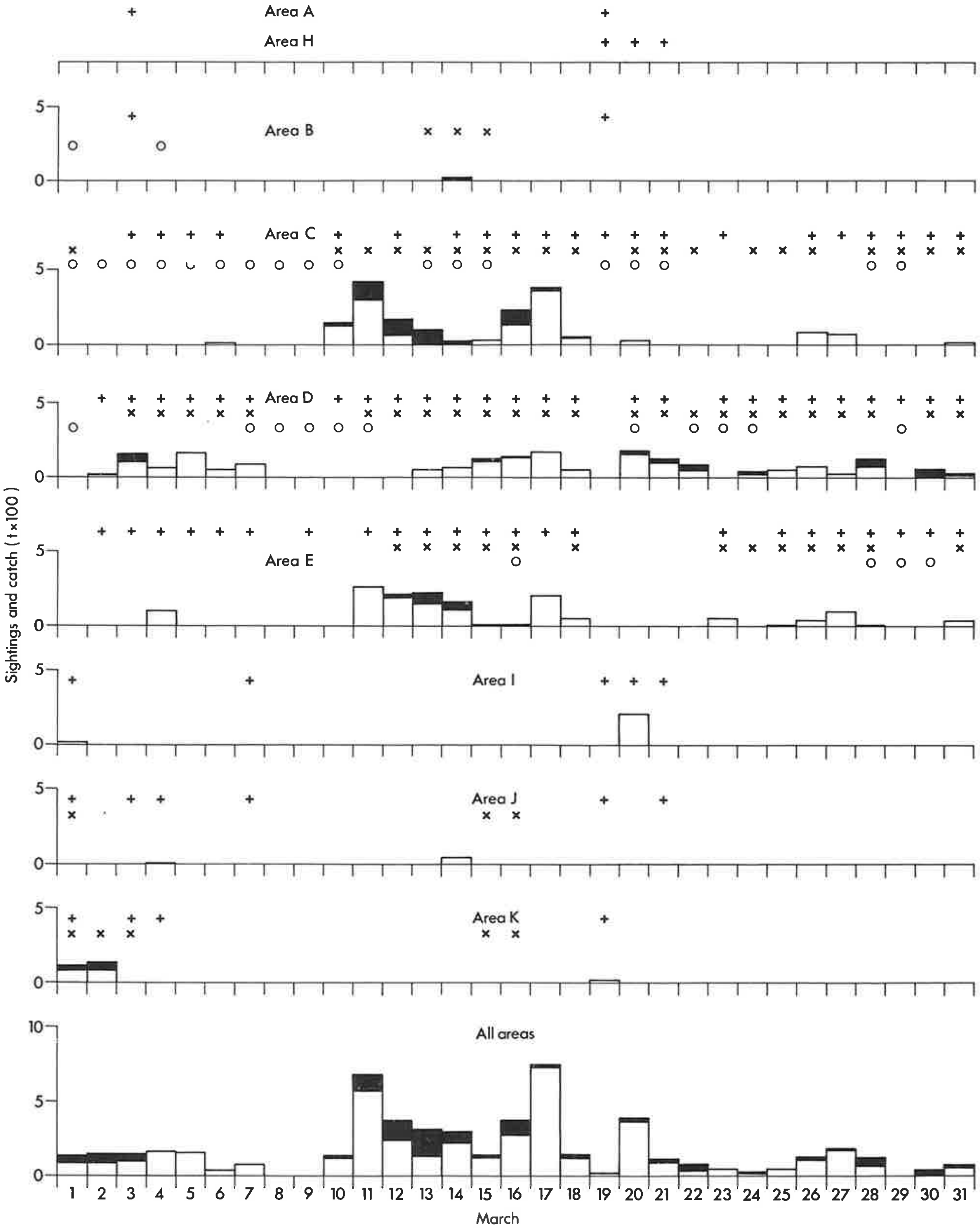

Fig. 2—*continued.*

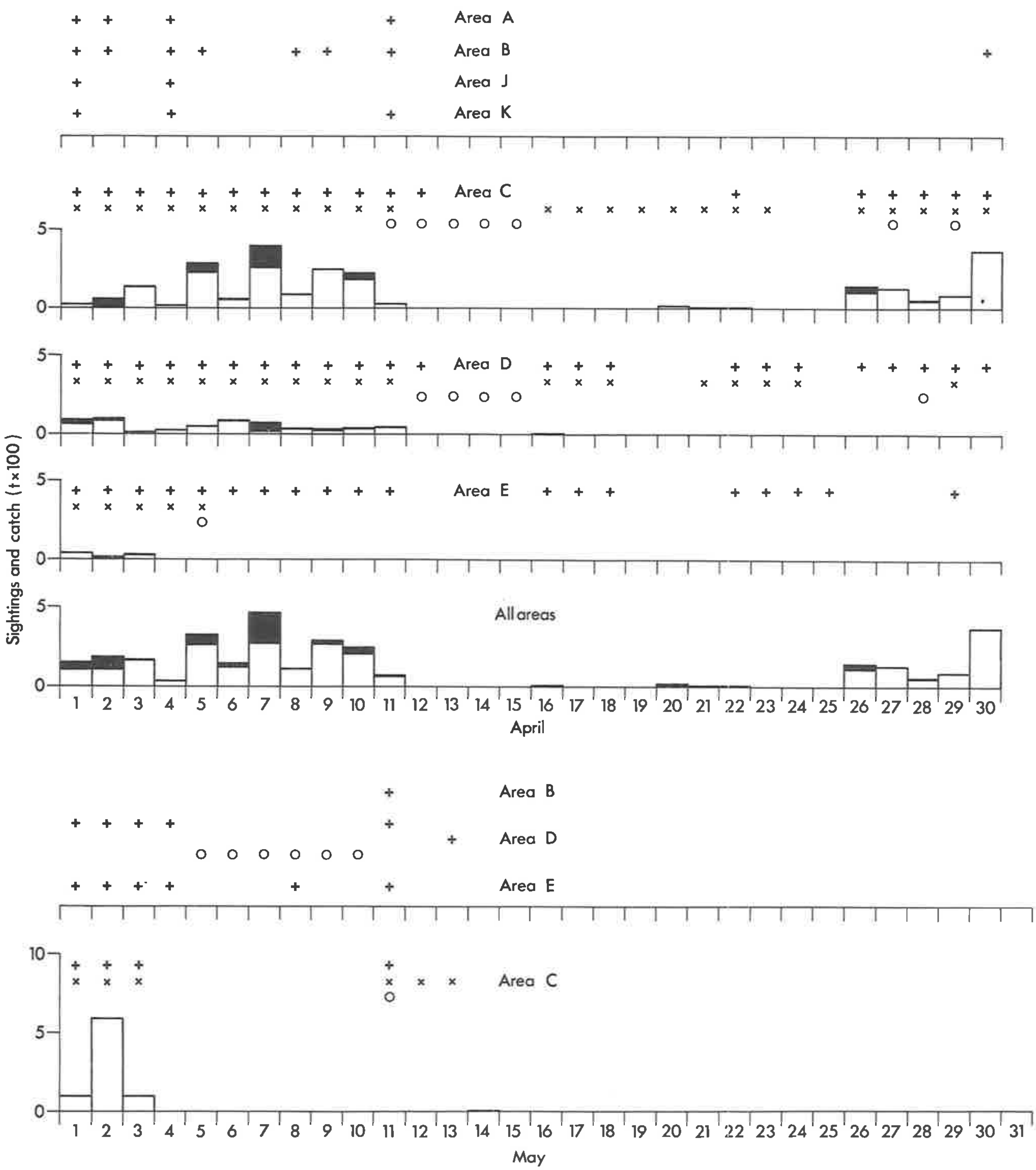

Fig. 2—*continued.*

Of considerable significance with respect to inadequate sightings effort are periods of poor weather (indicated in Fig. 2). Such weather restricts the operations of both vessels and aircraft and thus reduces the quantities of fish recorded. This is particularly critical when the periods of poor weather are long and coincide with the usual peak periods of sightings (January to March). The effects of poor weather on the 1981 fishery will be discussed later in this publication.

Real abundance refers to estimates of the absolute quantity of skipjack which pass through New Zealand waters. This measure depends on the acceptance of the concept of a "body" of skipjack, which refers to a close-knit group of schools of skipjack moving through the New Zealand area as a unit. In seasons when such a phenomenon was observed, a measure of real abundance could be gained for each body by addition of the largest sighting of each body to the quantity of fish caught from it before the largest sighting. By summing estimates obtained in this way for all bodies seen, and adding the isolated fish which probably did not contribute to any of the main bodies, it was possible to derive a measure of real abundance of fish for those seasons (see, for example, page 21 in Habib, Clement, and Fisher 1980c). The measures were considered to be largely free of multiple sightings, as they were based on sightings effort which recorded schools only once.

No clear bodies of fish were sighted during the 1981 season; instead, the fish were scattered over large areas in loose aggregations of schools. Therefore, no estimate of real abundance was made.

Hydrology

Sea surface temperatures were available from two sources: observers recorded temperatures from the purse-seine vessels during every set by use of insulated water bottles and hand-held thermometers; and, as in previous seasons (Eggleston and Paul 1978, Habib, Clement, and Fisher 1980a, 1980b, 1980c), MAF received sea surface temperature charts for the New Zealand region from the National Oceanic and Atmospheric Administration of the United States Department of Commerce. The manner in which the satellites measured the temperature and the limitations on these data are discussed in Eggleston and Paul (1978).

Tagging

In August 1981, SPC made available to us all the skipjack tagging data with some New Zealand content which had been collected by the SPC Skipjack Survey and Assessment Programme. Some of the data are presented in Habib, Clement, and Fisher (1980b, 1980c); the rest are in this publication.

In conjunction with a survey of New Zealand's albacore (*Thunnus alalunga*) resource in early 1981 by the Japanese research organisation Jamarc (Japan Marine Fishery Resource Research Center), MAF carried out a skipjack tagging programme on the skipjack grounds to the west and south of New Plymouth.

Definitions of effort

In the following analyses a **season-day** is defined as any day that a purse seiner spent in activity related to the skipjack fishery. This includes days searching and fishing, travelling, in port, at anchor or at sea drifting, and days off.

Days fished are days on which a net was set or there was searching activity with the aim of setting.

A **set** is defined as any time a net was released into the water to entrap a skipjack school and then retrieved; and sets were **successful** if at least 1 t of skipjack was caught, even if this represented only part of a school.

Results and discussion

Distribution and apparent abundance of skipjack

Surface schools of skipjack were seen in New Zealand waters from 27 October 1980 to 14 May 1981. Daily estimates of quantities seen were derived for each area investigated throughout the season and these were totalled to yield overall daily estimates for all areas (Fig. 2).

Season's sightings, north-east North Island (areas B and C)

The first skipjack were sighted near the edge of the continental shelf (the 200-m depth contour) off Cape Brett on 27 October by a commercial fish-spotting aircraft surveying between the Bay of Plenty and North Cape. Over the next 6 months sightings effort by aircraft and vessels along this coastline was fairly consistent. Generally, quantities sighted were small and scattered over a wide area. In November fish were found between Cape Brett and Mokohinau Islands and the largest day's sighting was 300 t. In December they were between North Cape and Cuvier Island (to 500 t per day), in January between North Cape and The Aldermen Islands (to 750 t), in February between North Cape and Great Barrier Island (to 1600 t), in March between Mokohinau Islands and The Aldermen Islands (to 420 t), and in April between Poor Knights Islands and The Aldermen Islands (to 380 t). In early May, some 600 t of skipjack was seen east of Cuvier Island. Fish in areas B and C supported most of the commercial fishing operations during the season.

Off-shore sightings (area L)

An off-shore aerial survey on 24 November located 16 schools of skipjack at 33°41' S, 176°31' E. There was about 240 t of fish in these schools, which were in the area where skipjack were sighted in January 1979 (see Fig. 1 and section on off-shore sightings, north-east Northland in Habib, Clement, and Fisher 1980b).

TABLE 2: Quantities of fish seen and caught by month in the 1981 purse-seine skipjack fishery in New Zealand

Month	Quantity sighted (t)	Quantity caught (t)	% caught of quantity sighted
Oct	28	0	0
Nov	1 315	99	7.5
Dec	4 637	1 350	29.2
Jan	9 770	3 524	36.1
Feb	6 684	1 908	28.6
Mar	5 419	1 114	20.4
Apr	2 935	560	19.1
May	798	0	0
Oct-May	31 586	8 555	27.1

Season's sightings, Bay of Plenty (area D)

Skipjack were first seen in this area near Waikawa Point on 27 December. The sighting was small (15 t) and proved to be prophetic of quantities to be seen in the area during the rest of the season. In addition, fish were seen in this area on very few days, except for March, despite regular sightings effort. The largest quantity sighted was 170 t on 25 February in the area between Whale Island and White Island.

Season's sightings, East Cape to Hawke Bay (area E)

Skipjack schools were found in this area intermittently between 4 February and 3 April. Sightings effort, also intermittent, was spread over most of the season. Quantities seen were mainly small, the largest daily sighting being 216 t.

Season's sightings, west coasts of North and South Islands (areas H, I, J, K, and A)

Despite fairly regular sightings effort off these coasts throughout the season, sightings of skipjack were infrequent and small. The first fish were seen on 5 January (a few scattered individuals), the next in mid and late February, and there were a few scattered sightings in March. The largest quantity sighted was about 200 t on 20 March north-west of Westport.

Sightings by time of day

The 1981 skipjack sightings data were analysed on a daily basis, and so no distinction was made between morning and afternoon-evening sightings, as has been done in previous seasons.

Fluctuations in apparent abundance

Quantities of skipjack sighted in 1981 were small and scattered over wide areas, and so there were no clear fluctuations in apparent abundance of the kind seen in past seasons, when large bodies of fish were observed to pass through New Zealand waters.

Apparent abundance and catch

A summary of the data in Fig. 2 (see Table 2) shows that of the skipjack sighted, about one-quarter were caught. This indicates that the small resource was under considerable pressure from fishing, at least compared with that in the 1980 season, when 11%-14% of the fish seen were caught.

We reiterate that the sightings listed in Table 2 were measures of **apparent abundance**, which probably included some multiple quantification of skipjack schools from day to day, and even month to month. Therefore the totals do not necessarily represent quantities of fish which could have been taken in the purse-seine fishery, but simply indicate quantities which were seen at the surface each day accumulated to give monthly and season totals.

Sightings and the 12-mile limit

Early in the season, skipjack sightings were mostly in off-shore waters outside the 12-mile territorial sea. As the season progressed the proportion of the resource found off shore decreased and the sightings in shore increased. This trend reversed late in the season (Table 3). A similar distribution of the resource with time was found in the 1976 and 1979 seasons. Possible reasons for the seasonal differences in the distribution of the resource in relation to the 12-mile limit are discussed later in this publication.

Skipjack schools

There were 1964 schools seen during the 1981 season. On average, 11 schools were seen per day of sightings effort, and the mean size of school was about 16 t. As discussed above, there was probably some multiple quantification of these schools.

Sightings, 1976 to 1981 seasons

Fewer skipjack were seen at the surface during 1981 than in any of the previous seasons (Table 4). As in 1979 and 1980 there were long spells of poor weather which curtailed or restricted the effectiveness of sightings effort. The quantity of skipjack sighted was undoubtedly affected by the occurrence of poor weather at times and in areas which caused the greatest disruption to sightings effort and fishing. However, the lack of any large bodies of fish, and the absence of fish in areas such as the west coast and Bay of Plenty for much of the season, probably indicate that fewer skipjack passed through New Zealand waters in 1981

TABLE 3: Monthly skipjack sightings* in relation to the 12-mile limit in the 1981 purse-seine skipjack fishery in New Zealand

	Inside 12 miles		Outside 12 miles		
Month	Quantity (t)	% of total	Quantity (t)	% of total	Total (t)
Oct	28	100	0	0	28
Nov	210	16	1 105	84	1 315
Dec	1 403	30	3 234	70	4 637
Jan	5 204	53	4 566	47	9 770
Feb	3 691	55	2 993	45	6 684
Mar	3 733	69	1 686	31	5 419
Apr	2 423	83	512	17	2 935
May	116	15	682	85	798
Oct-May	16 808	53	14 778	47	31 586

* Computed by totalling maximum daily sightings.

TABLE 4: Monthly skipjack sightings in New Zealand, 1976 to 1981, computed for 1976 to 1980 by totalling maximum half-day sightings and for 1981 by totalling daily sightings (data for 1976 and 1977 from Clement (1978), for 1978, 1979, and 1980 from Habib, Clement, and Fisher (1980a, 1980b, 1980c))

		Quantity sighted (t)									
Season	Period	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
1976	7 Oct-	3 337	1 112	9 455	13 905	17 798	10 012	- †	-	-	55 619
	27 Mar	(6%)*	(2%)	(17%)	(25%)	(32%)	(18%)				
1977	21 Nov-	-	0	1 190	12 697	9 126	15 871	793	-	-	39 677
	14 Apr			(3%)	(32%)	(23%)	(40%)	(2%)			
1978	25 Dec-		-	1 225	25 286	11 779	29 674	342	258	-	68 564
	31 May			(1.7%)	(37%)	(17.2%)	(43.3%)	(0.5%)	(0.3%)		
1979	20 Nov-	-	819	240	9 409	11 967	10 339	119	65	-	32 958
	27 May		(2.4%)	(0.7%)	(28.6%)	(36.3%)	(31.4%)	(0.4%)	(0.2%)		
1980	13 Nov-	-	937	1 150	13 219	7 525	9 460	62	215	142	32 710
	17 Jun		(2.9%)	(3.5%)	(40.4%)	(23%)	(29%)	(0.2%)	(0.6%)	(0.4%)	
1981	28 Oct-	28	1 315	4 637	9 770	6 684	5 419	2 935	798	-	31 586
	15 May	(0.1%)	(4.2%)	(14.7%)	(30.9%)	(21.2%)	(17.1%)	(9.3%)	(2.5%)		

* Percentage of season's total.
† No sightings effort.

TABLE 5: Vessel activity by month in the 1981 purse-seine skipjack fishery in New Zealand

Month	Searching and fishing No. of days	Searching and fishing % of total	Travelling No. of days	Travelling % of total	Bad weather No. of days	Bad weather % of total	Repairs or survey No. of days	Repairs or survey % of total	Discharging or stores No. of days	Discharging or stores % of total	Time off No. of days	Time off % of total	Total season-days
Oct	1.0	100.0											1.0
Nov	24.0	31.6	15.5	20.4	16.5	21.7	6.5	8.6	9.0	11.8	4.5	5.9	76.0
Dec	167.5	46.3	16.5	4.6	42.0	11.6	68.5	18.9	11.0	3.0	56.5	15.6	362.0
Jan	311.0	56.1	33.5	6.0	138.5	25.0	34.0	6.1	25.0	4.5	12.0	2.2	554.0
Feb	193.5	38.5	52.0	10.4	129.0	25.7	74.5	14.8	38.0	7.6	15.0	3.0	502.0
Mar	173.5	43.1	18.5	4.6	111.5	27.7	62.0	15.4	22.5	5.6	15.0	3.7	403.0
Apr	68.0	40.2	6.5	3.8	17.0	10.1	41.0	24.3	28.5	16.9	8.0	4.7	169.0
May	7.0	41.2	2.0	11.8	6.0	35.3	1.5	8.8	0.5	2.9	0	0	17.0
	945.5	45.4	144.5	6.9	460.5	22.1	288.0	13.8	134.5	6.5	111.0	5.3	2 084.0

than in previous seasons. As in the past, most fish were seen from January to March.

Catch, effort, and catch per unit of effort

During the season, which began in October and finished in May, the fleet worked 2084 season-days, divided among various activities (Table 5). This was the greatest number of season-days worked so far in this fishery; it exceeded by almost 75% the previous greatest number of the 1980 season. Time spent or lost on all activities was also considerably more than in past seasons. Of particular note is the high number of days lost to poor weather (460.5, 22.1% of season-days), which was proportionately comparable with the 26% of season-days of the weather-affected 1980 season and considerably more than in earlier seasons, when 6% to 18% of the days were affected by weather. Periods of poor weather were frequent and often long, particularly in the area east and north of Great Barrier Island (see area C data in Fig. 2). For example, there were 24 weather-affected days in that area in February (that is, at the height of the season). There is little doubt that such weather seriously affected quantities of fish sighted and caught during the season.

During the 945.5 days fished, 8555 t of skipjack was caught. As in 1980, the peak months for fishing were January and February (Table 6).

The rise and fall of catch and effort resulted partly from fluctuations in the number of vessels in the fishery (1 in October, 5 in November, 17 in December, 18 in January, 19 in February, 15 in March, 6 in April, and 2 in May) and partly from variation in the availability, size, and catchability of the skipjack resource. The largest quantities were seen between January and March, with only small sightings in the other months.

Catch and effort by area

There was seining in six areas on the New Zealand coast (see Fig. 1). However, most seining and other vessel activities occurred in areas B and C (Table 7). Over half the season's catch (4737 t) was taken in area C with about three-fifths of the fishing days and half the sets; area B yielded about one-third of the season's catch (3017 t) with about one-quarter of the fishing days and one-third of the sets (Table 8). Fishing occurred in area C throughout the season with peak catches in January and February.

TABLE 6: Catch, effort, and catch per unit of effort by month in the 1981 purse-seine skipjack fishery in New Zealand

	Catch		Effort								Catch/effort			
	Catch		Season-days		Days searching and fishing		Sets		Successful sets					
Month	Quantity (t)	% of total	No.	% of total	No.	% of total	No.	% of total	No.	% of total	Catch per season-day (t)	Catch per day searching and fishing (t)	Catch per set (t)	Catch per successful set (t)
Oct	0	0	1.0	0.1	1.0	0.1	0	0	0	0	0	0	0	0
Nov	99	1.2	76.0	3.6	24.0	2.5	15	1.6	6	1.0	1.3	4.1	6.6	16.5
Dec	1 350	15.8	362.0	17.4	167.5	17.7	163	17.0	119	20.7	3.7	8.1	8.3	11.3
Jan	3 524	41.2	554.0	26.6	311.0	32.9	371	38.6	249	43.4	6.4	11.3	9.5	14.2
Feb	1 908	22.3	502.0	24.1	193.5	20.5	153	15.9	82	14.3	3.8	9.9	12.5	23.3
Mar	1 114	13.0	403.0	19.3	173.5	18.4	188	19.6	84	14.6	2.8	6.4	5.9	13.3
Apr	560	6.5	169.0	8.1	68.0	7.2	65	6.8	34	5.9	3.3	8.2	8.6	16.5
May	0	0	17.0	0.8	7.0	0.7	5	0.5	0	0	0	0	0	0
	8 555		2 084.0		945.5		960		574		4.1	9.0	8.9	14.9

TABLE 7: Vessel activity by area in the 1981 purse-seine skipjack fishery in New Zealand

Area	Searching and fishing No. of days	Searching and fishing % of total	Travelling No. of days	Travelling % of total	Bad weather No. of days	Bad weather % of total	Repairs or survey No. of days	Repairs or survey % of total	Discharging or stores No. of days	Discharging or stores % of total	Time off No. of days	Time off % of total	Total season-days
A	1.0	40.0	1.5	60.0	0	0	0	0	0	0	0	0	2.5
B	239.0	74.1	12.0	3.7	62.5	19.4	3.5	1.1	0.5	0.2	5.0	1.6	322.5
C	552.5	42.9	79.0	6.1	339.5	26.4	217.5	16.9	38.5	3.0	60.5	4.7	1 287.5
D	92.0	30.3	33.5	11.0	43.0	14.1	34.5	11.3	63.0	20.7	38.0	12.5	304.0
E	35.0	29.4	9.0	7.6	7.0	5.9	32.5	27.3	28.5	23.9	7.0	5.9	119.0
J	15.0	62.5	0	0	8.5	35.4	0	0	0	0	0.5	2.1	24.0
K	11.0	95.7	0.5	4.3	0	0	0	0	0	0	0	0	11.5
	0	0	9.0	69.2	0	0	0	0	4.0	30.8	0	0	13.0*
	945.5	45.4	144.5	6.9	460.5	22.1	288.0	13.8	134.5	6.5	111.0	5.3	2 084.0

* Outside New Zealand — days spent travelling to and from, and discharging at, the cannery in American Samoa.

TABLE 8: Catch, effort, and catch per unit of effort by area in the 1981 purse-seine skipjack fishery in New Zealand

Area	Catch Quantity (t)	Catch % of total	Effort: Season-days No.	Season-days % of total	Days searching and fishing No.	Days searching and fishing % of total	Sets No.	Sets % of total	Successful sets No.	Successful sets % of total	Catch/effort: Catch per season-day (t)	Catch per day searching and fishing (t)	Catch per set (t)	Catch per successful set (t)
A	0	0	2.5	0.1	1.0	0.1	1	0.1	0	0	0	0	0	0
B	3 017	35.3	322.5	15.5	239.0	25.3	290	30.2	208	36.2	9.4	12.6	10.4	14.5
C	4 737	55.4	1 287.5	61.8	552.5	58.4	509	53.0	295	51.4	3.7	8.6	9.3	16.1
D	487	5.7	304.0	14.6	92.0	9.7	104	10.8	46	8.0	1.6	5.3	4.7	10.6
E	175	2.0	119.0	5.7	35.0	3.7	26	2.7	13	2.3	1.5	5.0	6.7	13.5
F	-*	-												
G	-	-												
H	-	-												
I	-	-												
J	37	0.4	24.0	1.2	15.0	1.6	15	1.6	5	0.9	1.5	2.5	2.5	7.4
K	102	1.2	11.5	0.5	11.0	1.2	15	1.6	7	1.2	8.9	9.2	6.8	14.5
			13.0†	0.6										
	8 555		2 084.0		945.5		960		574		4.1	9.0	8.9	14.9

* No fishing.

† Outside New Zealand—days spent travelling to and from, and discharging fish at, the cannery in American Samoa.

TABLE 9: Catch, sets, and set success by bottom depth in the 1981 purse-seine skipjack fishery in New Zealand

Depth (m)	Catch Quantity (t)	Catch % of total	Sets No.	Sets % of total	Catch per set (t)	Successful sets No.	Successful sets % of total	Catch per successful set (t)
0-99	539	6.3	90	9.4	6.0	49	8.5	11.0
100-199	2 740	32.0	319	33.2	8.6	174	30.3	15.7
200-299	2 478	29.0	212	22.1	11.7	123	21.4	20.1
300-399	1 178	13.8	137	14.3	8.6	83	14.5	14.2
400-499	467	5.5	53	5.5	8.8	34	5.9	13.7
500-599	356	4.2	35	3.6	10.2	26	4.5	13.7
600-699	112	1.3	16	1.7	7.0	11	1.9	10.2
700-799	86	1.0	11	1.1	7.8	10	1.7	8.6
800-899	26	0.3	7	0.7	3.7	3	0.5	8.7
900-999	17	0.2	6	0.6	2.8	2	0.3	8.5
>1000	557	6.5	74	7.7	7.5	59	10.3	9.4
	8 555		960		8.9	574		14.9

Catches in other areas were small compared with those in areas B and C, and compared with catches in those areas in past seasons. For example, area J (west coast North Island) produced a catch of 1127 t in 1977 (14.9% of the season's catch), 2613 t in 1978 (27.4%), 557 t in 1979 (6.2%), and 1670 t in 1980 (18.7%). In 1981 a mere 37 t was caught, 0.4% of the season's catch. However, there was little fishing in the west (Table 8).

Catch and effort by depth

Skipjack were caught where bottom depths were between 38 and 2440 m. However, fishing was concentrated along the edge of the continental shelf in depths of 100 to 399 m (Table 9). There, three-quarters of the season's catch was taken with about the same proportion of the season's sets and at the highest catch rates (per set, per successful set).

Catch and effort by time of day

Sets were made between 0743 and 2105 hours. Over half the fish were taken in the afternoon with about the same proportion of the sets and at catch rates per set close to the season's mean and per successful set below the mean (Table 10). About one-quarter of the fish were caught in the morning, and the remainder in the evening.

Catch and effort by moon phase

The best fishing occurred during the first quarter and full moon periods when three-fifths of the season's catch was taken (Table 11). The remainder of the catch was taken during the other moon phases.

Catch and effort by sea surface salinity

Skipjack were caught in areas where sea surface salinities ranged from 34.9 to 36.19 parts per thousand (Table 12). Over three-quarters of the monitored catch was taken in water of 35.4 to 35.8 parts per thousand salinity with about the same proportion of the monitored sets. The best catch rates (per successful set) were in salinities of 35.5 to 35.6 parts per thousand.

Catch and effort by sea surface temperature

Skipjack were caught in areas where surface water temperatures ranged from 16.6° to 24.5°C (Table 13). Almost three-fifths of the catch came from water of 19° to 21.9°C, which we have in past seasons (1979 and 1980) designated as "skipjack water". However, a significant catch, considerably greater than in past seasons (Table 14), was also taken in warmer water. The skipjack water and warmer water were present within the range of skipjack on the New Zealand coast for more time during 1981 than was cooler water. As a result most of the fishing occurred in those waters.

TABLE 10: Catch, sets, and set success by time of day in the 1981 purse-seine skipjack fishery in New Zealand

	Catch		Sets			Successful sets		Catch per
Time of day	Quantity (t)	% of total	No.	% of total	Catch per set (t)	No.	% of total	successful set (t)
0000–0559	0	0	0	0	0	0	0	0
0600–1159	2 263	26.5	271	28.2	8.4	147	25.6	15.4
1200–1759	4 654	54.4	537	55.9	8.7	337	58.7	13.8
1800–2359	1 638	19.1	152	15.8	10.8	90	15.7	18.2
	8 555		960		8.9	574		14.9

TABLE 11: Catch, sets, and set success by moon phase in the 1981 purse-seine skipjack fishery in New Zealand

	Catch		Sets			Successful sets		Catch per
Moon phase	Quantity (t)	% of total	No.	% of total	Catch per set (t)	No.	% of total	successful set (t)
New moon	1 637	19.1	184	19.2	8.9	104	18.1	15.7
First quarter	2 449	28.6	239	24.9	10.2	137	23.9	17.9
Full moon	2 773	32.4	278	28.9	10.0	163	28.4	17.0
Last quarter	1 696	19.8	259	27.0	6.5	170	29.6	10.0
	8 555		960		8.9	574		14.9

TABLE 12: Catch and successful sets by sea surface salinity in the 1981 purse-seine skipjack fishery in New Zealand

Salinity (parts per thousand)	Catch Quantity (t)	Catch % of total	Successful sets No.	Successful sets % of total	Catch per successful set (t)
34.9-34.99	12	0.3	2	1.0	6.0
35.0-35.09	20	0.6	3	1.5	6.7
35.1-35.19	30	0.9	3	1.5	10.0
35.2-35.29	132	3.8	8	4.0	16.5
35.3-35.39	230	6.6	18	9.0	12.8
35.4-35.49	367	10.6	23	11.5	16.0
35.5-35.59	1 272	36.6	46	23.0	27.7
35.6-35.69	595	17.1	41	20.5	14.5
35.7-35.79	465	13.4	35	17.5	13.3
35.8-35.89	155	4.5	11	5.5	14.1
35.9-35.99	142	4.1	7	3.5	20.3
36.0-36.09	31	0.9	2	1.0	15.5
36.1-36.19	24	0.7	1	0.5	24.0
	3 475*		200†		17.4

* Monitored catch 41% of total catch.
† Water samples were not taken from 374 successful sets.

TABLE 13: Catch, sets, set success, and fishing effort (searching and fishing) by sea surface temperature in the 1981 purse-seine skipjack fishery in New Zealand (temperatures from shipboard records)

Water temp. range (°C)	Catch Quantity (t)	Catch % of total	Sets No.	Sets % of total	Catch per set (t)	Successful sets No.	Successful sets % of total	Catch per successful set (t)
16.0-16.9	29	0.3	8	0.8	3.6	3	0.5	9.7
17.0-17.9	235	2.7	29	3.0	8.1	18	3.1	13.1
18.0-18.9	526	6.1	63	6.6	8.3	48	8.4	11.0
19.0-19.9	562	6.6	71	7.4	7.9	46	8.0	12.2
20.0-20.9	1 375	16.1	140	14.6	9.8	101	17.6	13.6
21.0-21.9	3 006	35.1	348	36.3	8.6	196	34.1	15.3
22.0-22.9	2 463	28.8	253	26.4	9.7	139	24.2	17.7
23.0-23.9	333	3.9	44	4.6	7.6	21	3.7	15.9
24.0-24.9	26	0.3	4	0.4	6.5	2	0.3	13.0
	8 555		960		8.9	574		14.9

Fishing effort expended during the fortnightly periods

Water temp. range (°C)	2/11-15/11	16/11-29/11	30/11-13/12	14/12-27/12	28/12-10/1	11/1-24/1	25/1-7/2	8/2-21/2	22/2-7/3	8/3-21/3	22/3-4/4	5/4-18/4	19/4-2/5
16.0-16.9	✓	✓											
17.0-17.9	✓		✓	✓	✓					✓	✓		
18.0-18.9			✓	✓	✓					✓	✓		
19.0-19.9			✓	✓	✓	✓			✓	✓	✓		✓
20.0-20.9				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
21.0-21.9					✓	✓	✓	✓	✓	✓	✓	✓	✓
22.0-22.9					✓	✓	✓	✓	✓	✓	✓	✓	✓
23.0-23.9					✓	✓	✓	✓	✓	✓	✓		
24.0-24.9							✓	✓					

TABLE 14: Catch, sets, and catch per set by sea surface temperature in the 1978, 1979, and 1980 purse-seine skipjack fisheries in New Zealand (data from Habib, Clement, and Fisher 1980a, 1980b, 1980c)

Water temp. range (°C)	1977–78 Catch Quantity (t)	% of total	Sets No.	% of total	Catch per set (t)	1978–79 Catch Quantity (t)	% of total	Sets No.	% of total	Catch per set (t)	1979–80 Catch Quantity (t)	% of total	Sets No.	% of total	Catch per set (t)
15.0–15.9											12	0.1	2	0.3	6.0
16.0–16.9											83	1.0	14	2.3	5.9
17.0–17.9	238	2.5	25	3.6	9.5	44	0.5	6	0.9	7.3	18	0.2	5	0.8	3.6
18.0–18.9	563	5.9	33	4.7	17.1	5	0.1	1	0.1	5.0	44	0.5	18	3.0	2.4
19.0–19.9	2 258	23.7	145	20.6	15.6	170	1.9	11	1.6	15.5	2 349	26.9	144	23.8	16.3
20.0–20.9	3 559	37.4	229	32.5	15.5	3 393	37.8	267	40.0	12.7	2 825	32.4	215	35.6	13.1
21.0–21.9	2 281	23.9	202	28.7	11.3	4 557	50.8	317	47.5	14.4	2 601	29.8	125	20.7	20.8
22.0–22.9	567	5.9	60	8.5	9.4	806	9.0	65	9.7	12.4	689	7.9	76	12.6	9.1
23.0–23.9	53	0.6	8	1.1	6.6						105	1.2	5	0.8	21.0
24.0–24.9	7	0.1	2	0.3	3.5										
	9 526		704		13.5	8 975		667		13.5	8 726		604		14.4

Sea surface temperature measurements from satellites in relation to the skipjack fishery

Weekly satellite sea surface temperature charts for the New Zealand region for 21 October 1980 to 30 June 1981 are presented (Fig. 3). The charts cover the 1981 skipjack season and some time before and after the season.

Skipjack water first appeared on the coast in mid November as a 19°C tongue extending down the east Northland coast to Great Barrier Island. This tongue dissipated over the next month and gave way to colder water. Another tongue appeared in the east in late December and extended south to the Bay of Plenty, and by mid February to Cook Strait. Over the next 3 months cycles of warming and cooling occurred, with skipjack water extending south to various localities between the Bay of Plenty and Castle Point. Water cooled in the east from late June, though skipjack water was still present off the Northland coast.

In the west the water was slower in warming, which has also been typical of other seasons. The warm water first appeared off the west coast in late December near Cape Reinga. The water slowly warmed southward to be off Gannet Island in early February, and in Cook Strait by late February. Cycles of warming and cooling followed over the next 6 weeks in the area between Cook Strait and Gannet Island. These were followed during the second half of April by a marked southward warming reaching as far south as Greymouth. After that, the water slowly cooled in the west, with skipjack water being limited to a small area near Cape Reinga by late June.

Some of the sea surface temperature charts from satellites (Fig. 3, charts for the weeks ending 11 November, 23 December, 13 January, 3 February, 17 March, 21 April, 26 May, and 23 June) suggest that there was some mass "movement" of a tongue of warm water south to and north from New Zealand during the season. Eggleston and Paul (1978) described a similar feature in 1977 and suggested that such a movement may have been more apparent than real, resulting from a progressive southward warming (and by implication a northward cooling late in the season) rather than a movement of surface water. We suggest that there was progressive warming and cooling and also water movement. Supporting arguments for water movement were presented in some detail by Habib, Clement, and Fisher (1980c).

Given the high correlation between the distribution of skipjack and skipjack water, the satellite data are

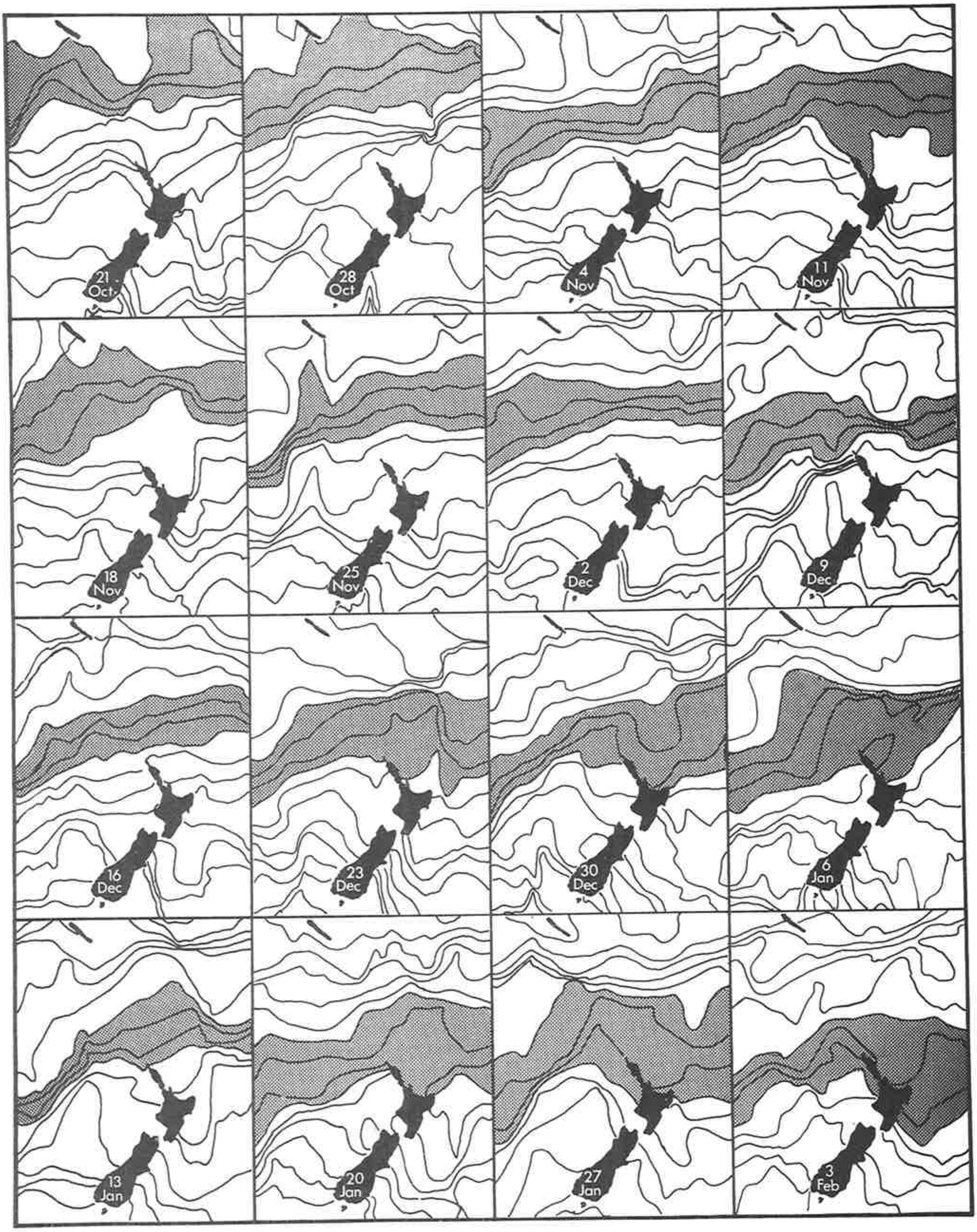

Fig. 3 (above and following pages): Weekly sea surface temperature charts for the New Zealand region, from satellite measurements, for the 1981 skipjack season. Water of 19° to 22 °C ("skipjack water") is shaded; isotherms are at 1 °C intervals.

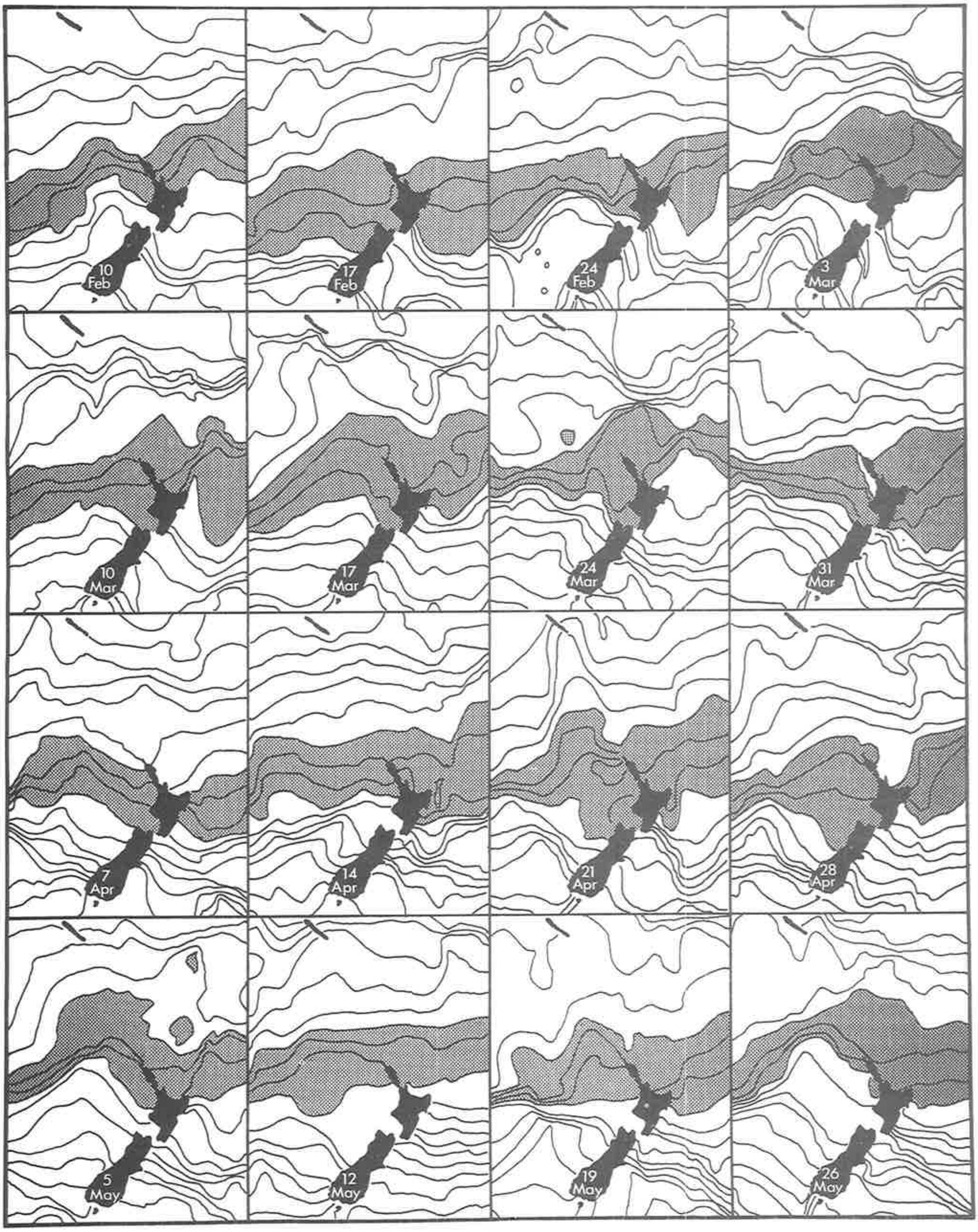

Fig. 3—*continued*.

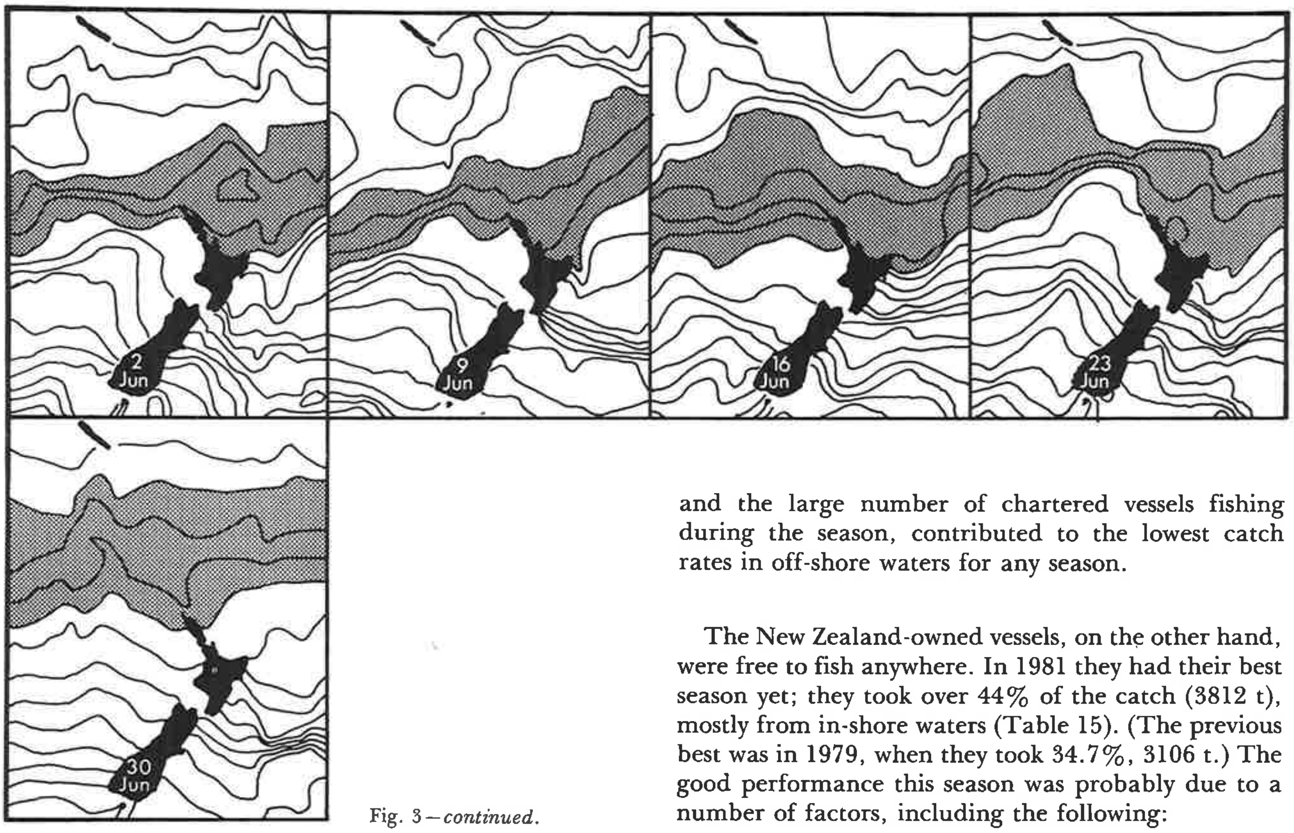

Fig. 3—*continued.*

useful in leading to a broad understanding of skipjack distribution in New Zealand in summer. If they were available closer to the time that the satellites recorded the data, they would also have some predictive value.

Purse-seine fishing, the 12-mile limit, and sea surface temperatures

Three-fifths of the season's catch (5156 t) was taken outside the 12-mile limit and the remainder (3399 t) inside (Table 15). Although much of the fishing was along the 200-m depth contour, which was close to the 12-mile limit, there was also considerable fishing in off-shore waters (see set positions, Fig. 1). Much of the off-shore fishing was probably on skipjack which were migrating towards the coast.

As in the 1978 to 1980 seasons, the large chartered vessels were restricted to fishing outside 12 miles. They did not perform well in that area because the overall quantity of skipjack sighted during the season was less than in past seasons, less than half the skipjack sighted was in off-shore waters (Table 3), and schools found there were generally small and scattered over a wide area. In addition, the long periods of poor weather impeded fishing in off-shore waters. These factors, and the large number of chartered vessels fishing during the season, contributed to the lowest catch rates in off-shore waters for any season.

The New Zealand-owned vessels, on the other hand, were free to fish anywhere. In 1981 they had their best season yet; they took over 44% of the catch (3812 t), mostly from in-shore waters (Table 15). (The previous best was in 1979, when they took 34.7%, 3106 t.) The good performance this season was probably due to a number of factors, including the following:

1. Good quantities of fish surfaced inside the 12-mile limit and school sizes were generally suitable for the New Zealand vessels.
2. Schools inside the limit were generally concentrated in smaller areas.
3. There were more local vessels, which fished a longer season compared with other years, and thus more effort was used.
4. The skills of local vessel operators continued to improve.
5. There was better weather for seining on the in-shore grounds than off shore.

We also examined the sea surface temperature and set position data from the seiners in relation to the 12-mile limit. We were seeking to refine our knowledge of the relationships between these factors with a view to suggesting an explanation for the year-to-year changes in distribution of the major part of the skipjack resource in relation to the 12-mile limit. (1976, 1979, and 1981 were years in which most of the skipjack resource surfaced inside the limit; in 1977, 1978, and 1980 most surfaced outside the limit.) No clear pattern emerged. Surface temperatures were similar in shore and off shore in November, January, and March and differed in other months (Fig. 4). Generally, the analyses supported earlier statements that most of the fishing occurred in skipjack water or warmer.

TABLE 15: Catch and set data for catches made inside the 12-mile limit by chartered (ICh) and locally owned (INZ) purse-seine vessels and outside the limit by chartered (OCh) and local (ONZ) vessels in the 1976 to 1981 purse-seine skipjack fisheries in New Zealand (data for all seasons from MAF files)

		Catch		Sets			Successful sets		Catch per successful set (t)
Season	Vessel	Quantity (t)	% of total	No.	% of total	Catch per set (t)	No.	% of total	
1976	ICh	3 558	75.5	190	62.5	18.7	118	65.6	30.2
	INZ	201	4.3	50	16.4	4.0	26	14.4	7.7
	OCh	942	20.0	62	20.4	15.2	35	19.4	26.9
	ONZ	14	0.3	2	0.7	7.0	1	0.6	14.0
		4 715		304		15.5	180		26.2
1977	ICh	767	10.2	119	19.5	6.4	58	18.4	13.2
	INZ	792	10.5	146	24.0	5.4	80	25.4	9.9
	OCh	5 184	68.7	287	47.1	18.1	141	44.8	36.8
	ONZ	798	10.6	57	9.4	14.0	36	11.4	22.2
		7 541		609		12.4	315		23.9
1978	ICh	1 101	11.6	43	6.1	25.6	25	8.4	44.0
	INZ	981	10.3	137	19.5	7.2	54	18.2	18.2
	OCh	5 519	57.9	349	49.6	15.8	143	48.3	38.6
	ONZ	1 925	20.2	175	24.9	11.0	74	25.0	26.0
		9 526		704		13.5	296		32.2
1979	ICh	549	6.1	23	3.4	23.9	13	4.6	42.2
	INZ	2 150	24.0	173	25.9	12.4	63	22.4	34.1
	OCh	5 320	59.3	319	47.8	16.7	146	52.0	36.4
	ONZ	956	10.7	152	22.8	6.3	59	21.0	16.2
		8 975		667		13.5	281		21.9
1980	ICh	0	0	0	0	0	0	0	0
	INZ	900	10.1	166	26.6	5.4	78	26.4	11.5
	OCh	6 803	76.2	355	56.8	19.2	171	58.0	39.8
	ONZ	1 228	13.7	104	16.6	11.8	46	15.6	26.7
		8 931		625		14.3	295		30.3
1981	ICh	223	2.6	10	1.0	22.3	9	1.6	24.8
	INZ	3 176	37.1	372	38.8	8.5	206	35.9	15.4
	OCh	4 520	52.8	489	50.9	9.2	307	53.5	14.7
	ONZ	636	7.4	89	9.3	7.1	52	9.1	12.2
		8 555		960		8.9	574		14.9

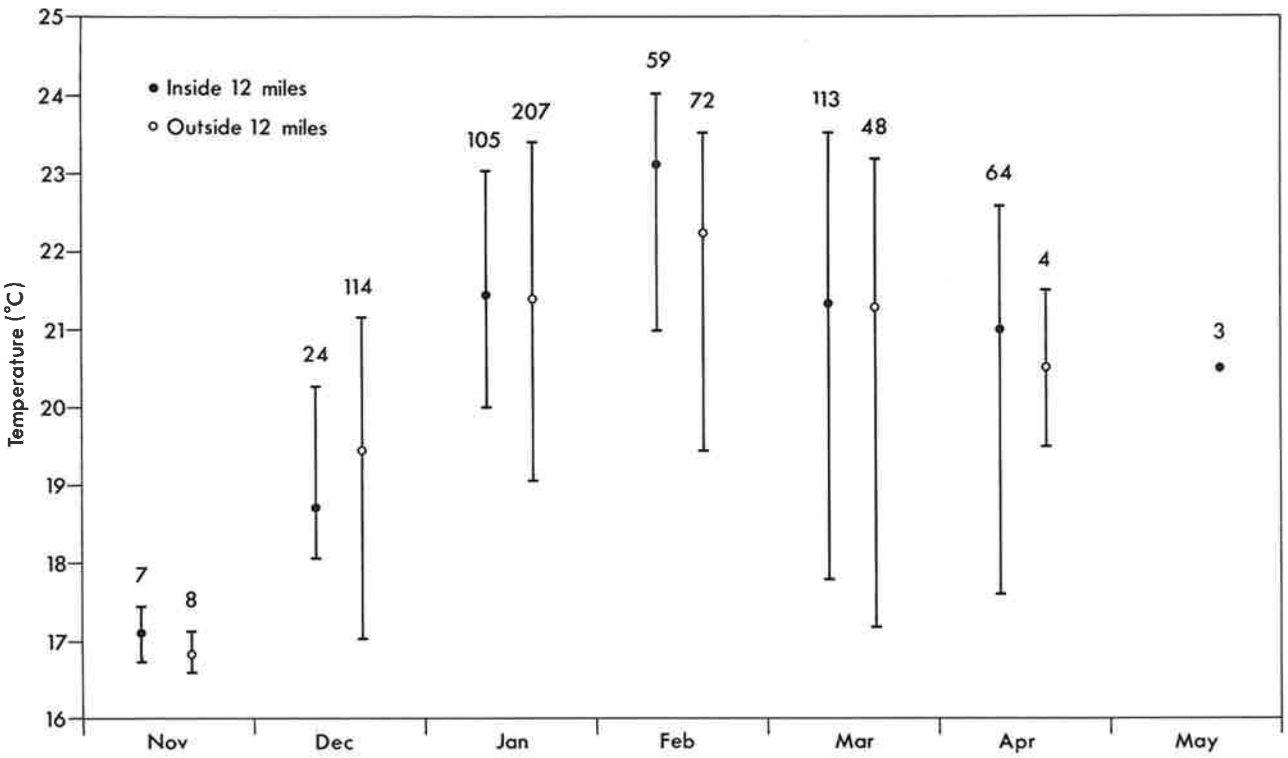

Fig. 4: Range of sea surface temperatures by month in relation to the 12-mile limit. The means of the ranges inside and outside 12 miles are indicated, as are the number of temperature recordings made.

Biology

Length-frequency distributions

During 1981, 37 662 skipjack were measured (0.88% of the estimated total number of fish caught during the season). Catches sampled by area were 93 in B, 107 in C, 28 in D, 1 in E, 5 in J, and 3 in K. All length measurements were grouped by 2-week intervals by area to provide a record of the length composition of the catches throughout the season (Fig. 5). These data also show the changes in the location of the fishery during the season.

Catches made in early November off Great Barrier Island (area C) contained large, 50- to 67-cm fish (2.6 to 6.9 kg in weight). By early December in this area the large fish had been replaced in the catches by smaller fish (47 to 50 cm, 2.1 to 2.6 kg), and in late December by even smaller fish (38 to 45 cm, 1.0 to 1.8 kg). Over the next 4 months most of the catches in this area were of small fish. Over this period there was progression of the mode in the length-frequency distributions from about 42 to 48 cm. This increase in modal lengths may have reflected growth of the fish and would correspond to an increase in weight of about 800 g. This is similar to modal progression observed in purse-seine catches of small skipjack in New Zealand in 1976 (Vooren 1976). Vooren measured a 3.5-cm increase in modal length over a 2-month period and suggested that this probably reflected growth which could correspond to an increase in body weight of skipjack of 400 to 500 g.

Late in the season large fish were again predominant in the catches in area C.

Fish of the size which made up the bulk of area C catches also predominated in catches in area B (east Northland). Fishing began there in December and most fish were 38 to 46 cm (1.0 to 1.9 kg) (mode 41 cm, 1.3 kg). Over the next 10 weeks the modes in the length-frequency distributions increased to 46 cm, which possibly indicated growth similar to that suggested for the small fish in area C catches. As in area C, the small fish were replaced in the catches by large fish late in the season.

From mid to late season small fish also predominated in catches in areas D (Bay of Plenty) and E (East Cape to Hawke Bay). Larger fish (mode 49 to 50 cm, 2.4 to 2.6 kg) were found in west coast (areas J and K) catches during the same period.

Large fish were present in early and late season catches, and early season sea surface temperatures were generally low for skipjack (see Fig. 5 and Table 13). This correlation between large fish and low water temperatures has also been observed in past seasons and appears to be a regular feature of the New Zealand fishery.

Fish in the 1981 catches were predominantly of the same size as in 1974, 1976, and 1979 catches (see Fig. 14 in Habib, Clement, and Fisher 1980a and Table 13 in Habib, Clement, and Fisher 1980b). In the other seasons, fish were generally larger (Habib, Clement, and Fisher 1980a, 1980c).

Possible reasons for year-to-year variability in the major size classes of skipjack were advanced by Habib, Clement, and Fisher (1980a). Another possibility is that New Zealand skipjack are derived from different spawning stocks or source areas from year to year.

The estimated numbers of fish at different lengths in the 1981 catches are presented in Table 16. These estimates were obtained by converting the number of fish of each length to weight of fish at each length by use of a previously determined length-weight relationship (see Fig. 6 and Table 4 in Habib 1978a). These weights were scaled up by the weights of the catches to yield total weights of fish at each length, which were then converted back to total numbers at each length.

Length-weight relationship and growth

Because there has been little modal progression in the length-frequency distributions during the past three seasons, we decided to investigate the possibility that New Zealand skipjack might be growing in weight rather than length. This hypothesis resulted from three quite separate observations: firstly, while collecting length-frequency data in past seasons, observers have occasionally noted that certain samples contained fish which were similar in length to other samples of fish, but that some fish were noticeably larger in girth; secondly, in the early years of the New Zealand skipjack fishery, processors reported having difficulty canning New Zealand skipjack because of their unusually high oil content compared with skipjack from other parts of the Pacific; thirdly, Japanese fishermen on various research vessels operating in New Zealand in recent years have expressed a liking for

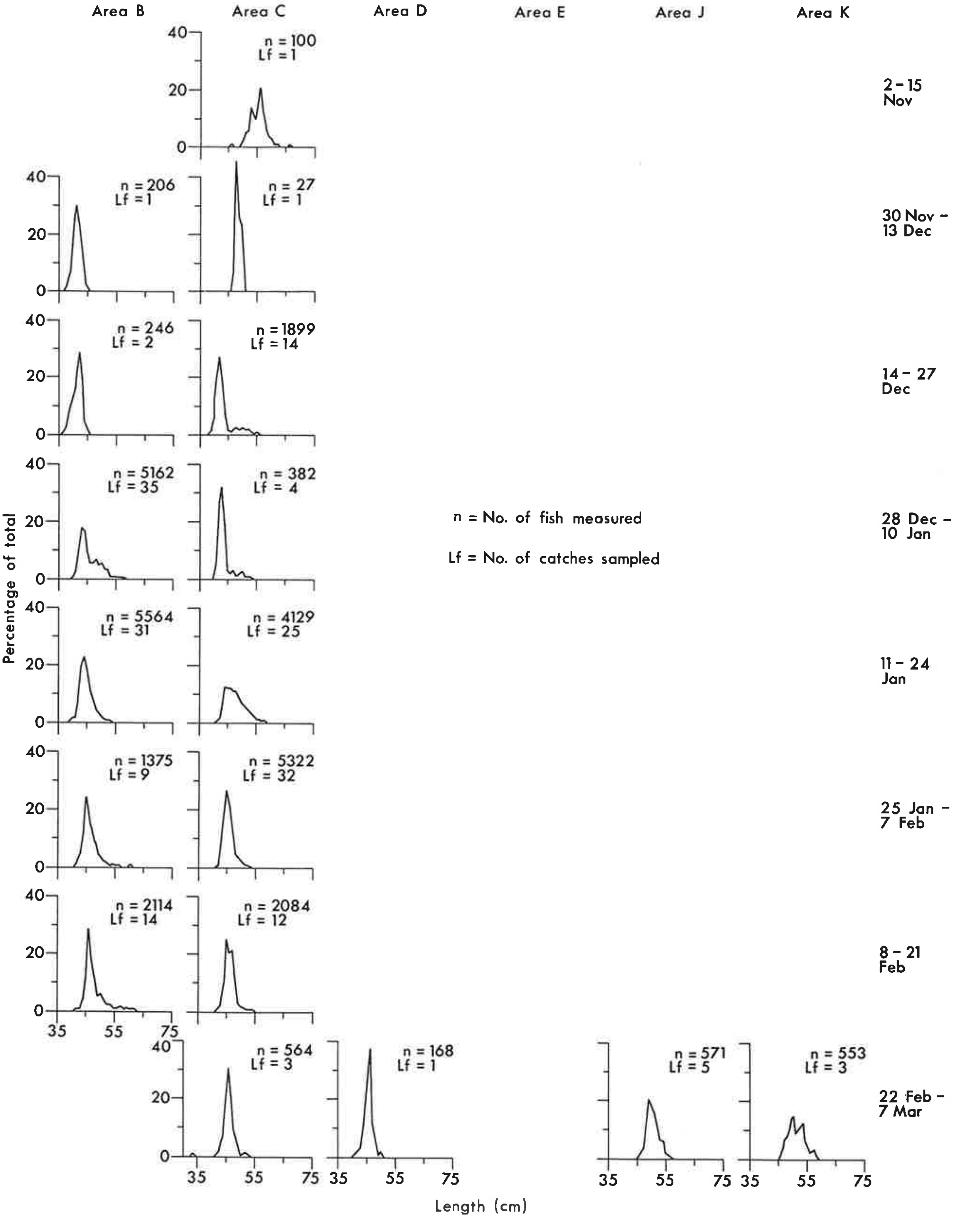

Fig. 5 (above and right): Length-frequency distributions by area by 2-week intervals in the 1981 purse-seine skipjack fishery in New Zealand.

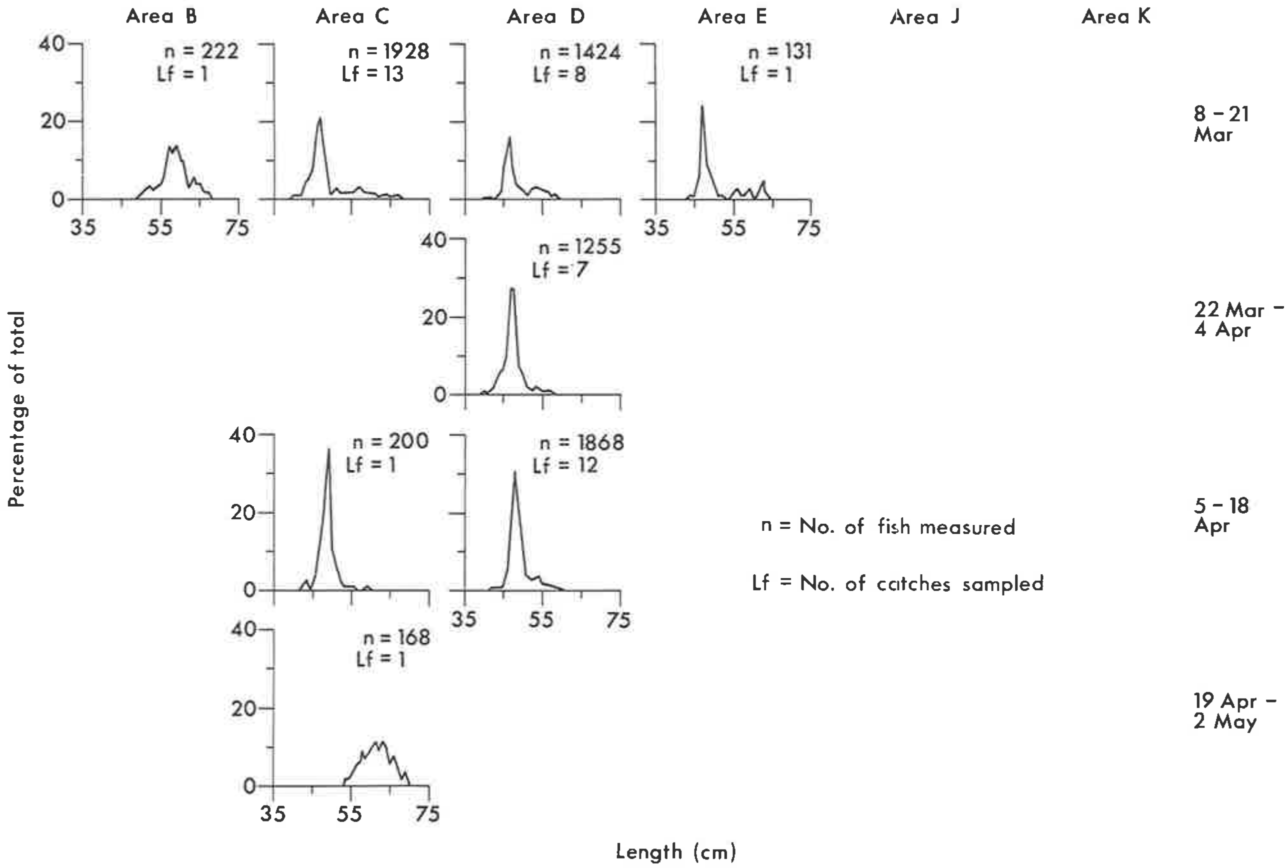

TABLE 16: Estimated number of skipjack of different lengths in the 1981 purse-seine catch in New Zealand

Length (cm)	Est. No. in season's catch	% of est. total No.	Length (cm)	Est. No. in season's catch	% of est. total No.
32	240	-*	52	77 620	1.8
33	260	-	53	59 100	1.4
34	880	-	54	39 060	0.9
35	70	-	55	28 090	0.7
36	590	-	56	27 220	0.6
37	390	-	57	22 460	0.5
38	4 400	0.1	58	16 160	0.4
39	23 850	0.6	59	14 020	0.3
40	75 700	1.8	60	11 880	0.3
41	182 950	4.3	61	7 860	0.2
42	289 510	6.8	62	7 710	0.2
43	356 780	8.4	63	5 460	0.1
44	467 200	11.0	64	4 670	0.1
45	583 840	13.7	65	2 880	-
46	564 650	13.3	66	2 110	-
47	523 310	12.3	67	1 580	-
48	399 520	9.4	68	910	-
49	207 000	4.9	69	740	-
50	152 880	3.6	70	30	-
51	94 200	2.2		4 257 780	

* Less than 0.1% of total.

TABLE 17: Length-weight relationships and sampling data for samples of skipjack collected from the 1981 purse-seine catches in New Zealand

Date	Position	Area	Temp. (°C)	No. in sample	Length (mm) Min.	Mean	Max.	Weight (g) Min.	Mean	Max.	Equation coefficients*	Goodness of fit †
8.12.80	34°33' S, 173°12' E	B	18.1	53	390	419	445	1225	1490	1725	− 8.87 + 2.68	70.9
14.12.80	34°49' S, 174°14' E	B	18.9	13	404	423	443	1420	1563	1690	− 1.90 + 1.53	65.2
21.1.81	34°30' S, 173°22' E	B	21.3	49	421	465	591	1250	2187	4800	− 12.70 + 3.32	93.7
22.1.81	34°51' S, 173°32' E	B	21.9	50	435	466	529	1700	2090	3200	− 11.60 + 3.14	91.1
22.1.81	34°26' S, 173°22' E	B	21.5	37	438	474	613	1600	2301	4750	− 11.60 + 3.14	95.2
23.1.81	34°51' S, 173°34' E	B	21.5	49	421	455	550	1600	1939	3500	− 9.44 + 2.78	86.5
23.1.81	34°38' S, 173°34' E	B	21.3	53	441	473	553	1750	2311	3750	− 11.10 + 3.05	90.8
24.1.81	34°52' S, 173°35' E	B	21.5	49	434	456	578	1700	1961	5000	− 13.10 + 3.38	89.0
24.1.81	34°52' S, 173°30' E	B	22.0	47	438	462	522	1600	2030	3600	− 12.00 + 3.19	86.2
24.1.81	34°51' S, 173°30' E	B	22.5	44	435	470	544	1700	2102	3200	− 8.72 + 2.66	83.0
18.2.81	34°32' S, 173°11' E	B	22.0	12	453	488	519	2100	2646	3050	− 10.30 + 2.94	91.1
21.2.81	34°40' S, 173°20' E	B	21.5	49	370	601	700	1100	5045	7500	− 11.20 + 3.08	98.2
21.2.81	34°41' S, 173°37' E	B	20.9	53	504	579	651	2850	4573	6950	− 13.70 + 3.47	97.4
15.12.80	35°35' S, 175°07' E	C	18.7	5	-‡	-	-	-	-	-	-	-
17.12.80	35°36' S, 175°10' E	C	18.9	44	398	422	444	1200	1575	1900	− 10.00 + 2.88	68.9
17.12.80	35°33' S, 175°19' E	C	19.4	56	407	426	451	1400	1598	1920	− 6.97 + 2.37	69.8
24.12.80	35°10' S, 174°47' E	C	19.0	44	430	508	587	1650	2995	4650	− 12.40 + 3.28	95.1
14.1.81	35°40' S, 175°43' E	C	21.2	104	429	496	580	1550	2511	4150	− 12.70 + 3.30	97.4
15.1.81	35°42' S, 175°48' E	C	21.2	96	442	500	608	1400	2490	5000	− 17.10 + 4.01	90.2
17.1.81	36°17' S, 176°06' E	C	21.2	48	475	511	552	2450	2930	3950	− 9.55 + 2.81	87.2
24.1.81	35°31' S, 175°25' E	C	22.5	127	430	460	500	1400	1817	2550	− 13.00 + 3.35	81.7
25.1.81	35°09' S, 174°42' E	C	21.7	39	437	457	488	1600	1914	2500	− 11.90 + 3.18	75.2
26.1.81	35°08' S, 174°38' E	C	21.7	136	424	457	548	1600	2065	3600	− 11.20 + 3.07	93.7
27.1.81	35°09' S, 174°33' E	C	22.2	33	433	470	549	1650	2226	3500	− 10.40 + 2.95	90.9
28.1.81	35°22' S, 175°43' E	C	21.7	41	427	451	479	1600	1874	2250	− 7.03 + 2.38	73.5
13.2.81	36°08' S, 176°10' E	C	22.5	43	446	472	525	1900	2269	3200	− 9.18 + 2.75	87.2
13.2.81	36°07' S, 176°01' E	C	22.3	162	404	466	540	1280	1881	3150	− 12.70 + 3.29	78.7
15.2.81	36°15' S, 175°51' E	C	21.8	41	468	536	623	2200	3483	5500	− 12.20 + 3.24	96.3
25.2.81	37°53' S, 173°36' E	J	21.2	61	465	511	540	2350	3003	3600	− 8.92 + 2.71	85.3
27.2.81	37°36' S, 173°07' E	J	21.4	43	461	496	531	2100	2727	3450	− 11.70 + 3.16	89.8
				1681	370	478	700	1100	2345	7500	− 12.94 + 3.35	93.6

* Equation: $\log_e W = \log_e A + B \log_e L$.
† Square of correlation coefficient.
‡ Not calculated; sample too small.

New Zealand skipjack as a sashimi dish (fresh, raw) because of the high oil content of the flesh.

Observers on the seiners were instructed to collect precise skipjack length-weight data. It was hoped that sufficient samples could be obtained to enable testing for changes in the length-weight relationship over the time that skipjack were present in the New Zealand fishery.

Linear regression equations were fitted to the logarithms of weight and length (Table 17). Generally, the data were insufficient for testing the above hypothesis; several samples were too small and/or too imprecise to be useful. However, there was sufficient variation in the more reliable data (see Table 17, length-weight relationships for 14, 15, 17 January, 21 February) to indicate that further, more systematic sampling might be worth while.

A length-weight relationship was also calculated for all samples combined (Table 17). The curve fitted the data closely (Fig. 6) and was similar to curves derived by Vooren (1976) and Habib (1978a) for New Zealand skipjack. The weights predicted for given lengths by the equation are given in Table 18.

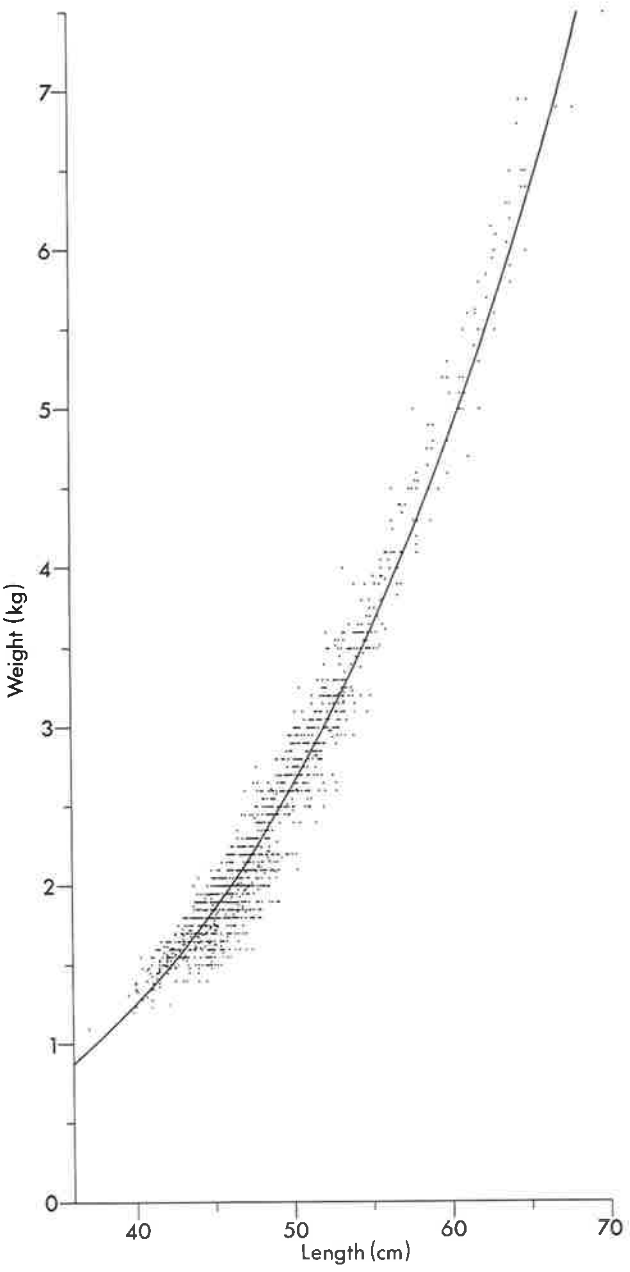

Fig. 6: Length-weight relationship of skipjack caught in the 1981 purse-seine fishery in New Zealand.

TABLE 18: Expected weights for given lengths of skipjack caught during the 1981 skipjack season in New Zealand

Length (cm)	Weight (g)	Length (cm)	Weight (g)
30.0	474	53.0	3 185
30.5	501	53.5	3 287
31.0	529	54.0	3 391
31.5	558	54.5	3 497
32.0	588	55.0	3 606
32.5	619	55.5	3 717
33.0	652	56.0	3 830
33.5	686	56.5	3 946
34.0	720	57.0	4 064
34.5	757	57.5	4 184
35.0	794	58.0	4 307
35.5	833	58.5	4 433
36.0	872	59.0	4 561
36.5	914	59.5	4 692
37.0	956	60.0	4 825
37.5	1 000	60.5	4 961
38.0	1 046	61.0	5 100
38.5	1 092	61.5	5 241
39.0	1 141	62.0	5 385
39.5	1 190	62.5	5 532
40.0	1 241	63.0	5 681
40.5	1 294	63.5	5 834
41.0	1 348	64.0	5 989
41.5	1 404	64.5	6 147
42.0	1 462	65.0	6 308
42.5	1 521	65.5	6 472
43.0	1 582	66.0	6 639
43.5	1 644	66.5	6 809
44.0	1 708	67.0	6 982
44.5	1 774	67.5	7 158
45.0	1 842	68.0	7 337
45.5	1 911	68.5	7 519
46.0	1 982	69.0	7 704
46.5	2 055	69.5	7 893
47.0	2 130	70.0	8 084
47.5	2 207	70.5	8 279
48.0	2 286	71.0	8 477
48.5	2 367	71.5	8 679
49.0	2 449	72.0	8 884
49.5	2 534	72.5	9 092
50.0	2 621	73.0	9 304
50.5	2 709	73.5	9 519
51.0	2 800	74.0	9 737
51.5	2 893	74.5	9 959
52.0	2 998	75.0	10 185
52.5	3 086		

Marked fish experiment

By August 1981 many of the marked fish placed in the brine tanks on the purse seiners had been recovered. Further recoveries are expected, and the data are being analysed by SPC.

Food and feeding

Stomachs were examined from 908 skipjack during the season. The fish in the samples ranged from 38 to 72 cm, but most were close to 45 cm (see Table 16). Samples came from all areas in the fishery and were collected throughout the day. Over two-thirds of the stomachs were empty. Those with food contained predominantly the planktonic euphausiid *Nyctiphanes australis* (92.4% of all food). Other food recorded was fish (6.1%, including pilchard *Sardinops neopilchardus* and saury *Scomberesox saurus*) and liquid remains (1.5%).

Few skipjack contained much food. Eighty-nine percent of stomachs with food were less than one-quarter full, 7% between a quarter and half full, and 4% over half full (Fig. 7). The fullness curves in this figure are based on an observation that in all stomach samples collected in New Zealand in the last six seasons, the maximum recorded weight of food in any fish was 5.3% of the body weight. We believe, then, that 5.5% of the body weight is a fair estimate of the maximum (full) stomach capacity of skipjack of

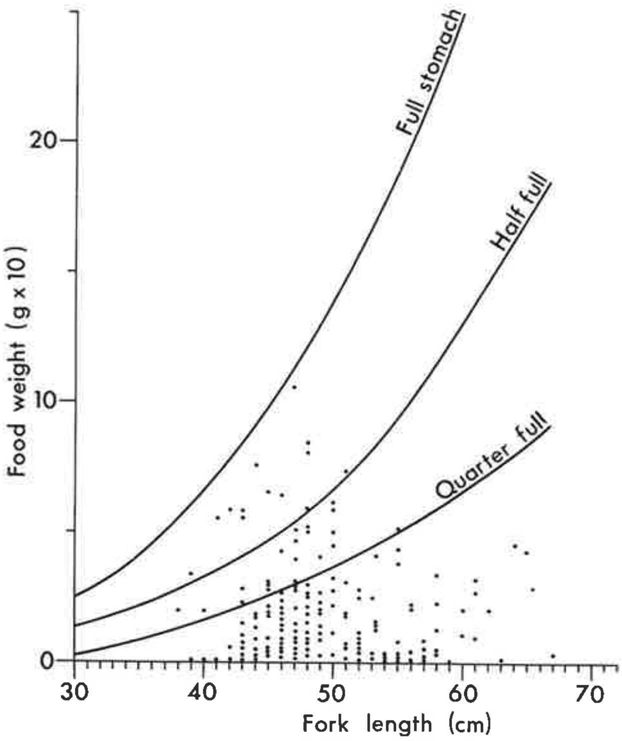

Fig. 7: Stomach fullness plotted against body length of skipjack caught in the 1981 purse-seine fishery in New Zealand.

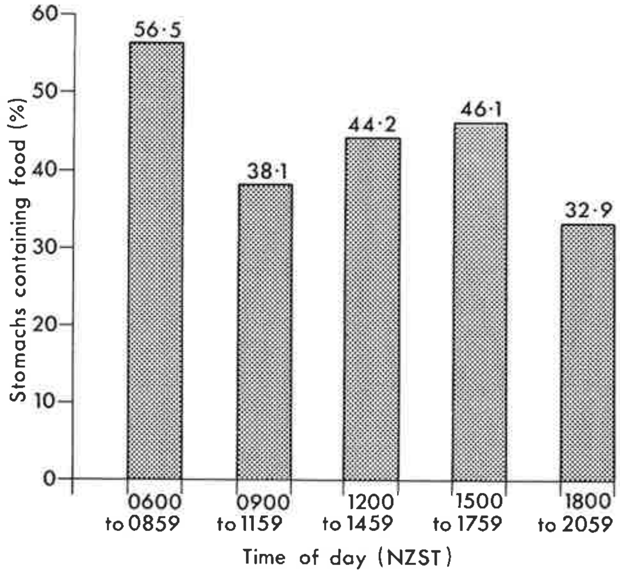

Fig. 8: Diurnal feeding rhythm of skipjack caught in the 1981 purse-seine fishery in New Zealand.

lengths from 38 to 67 cm which are taken in the purse-seine fishery in New Zealand. The other curves are half and one-quarter of those values.

The curves have lower values than those shown in Habib (1978a), which were derived from a maximum stomach capacity of 7% observed by Magnuson (1969) in feeding studies on captive skipjack. The curves give a scale of reference to the scatter of food weights in the samples and indicate the approximate level of feeding.

All feeding data were analysed in the examination of diurnal variation in stomach contents. The proportions of stomachs containing food were calculated for five time periods through the day (Fig. 8). There was an early morning peak in feeding, followed by a late morning low, a rise through to the late afternoon, and another low in the evening. This was in marked contrast to the results obtained in 1980 (see Fig. 19 in Habib, Clement, and Fisher 1980c) and provides yet another example of the variable nature of skipjack.

Gonad condition

Gonads were examined in the fish dissected for stomach analyses: 461 were female, 447 male. Four hundred and sixty-nine gonads (245 female, 224 male) were weighed and dissected in the laboratory. The female gonads ranged in weight from 1 to 43 g. All ova in these gonads were less than 0.15 mm in diameter, which has been classed as "immature" in various classifications (see Raju 1964). The male gonads ranged in weight from 0.5 to 12.5 g and showed no signs of development (Fig. 9).

The skipjack from which gonads were dissected ranged from 38 to 72 cm. Most were about 45 cm, the length at which this species usually undergoes first spawning (see section on reproduction in Forsbergh 1980). As there were no signs that these fish had spawned, they were probably soon to spawn in other parts of their range.

Skipjack population identification

The use of electrophoretic methods for detecting geographical variations in blood samples is widespread in the study of animal populations. In the last decade several population structures, based on electrophoretic analyses, have been proposed for Pacific Ocean skipjack (Fujino 1970, 1972, 1976, Sharp 1978). More recently SPC, through its Skipjack Survey and Assessment Programme, has sought to clarify skipjack population structuring by simultaneously collecting blood samples and tagging skipjack from selected schools. Additional blood genetics data, including data from the eastern Pacific and New Zealand, have subsequently been included in their analyses and the findings are presented (South Pacific Commission 1980, 1981a, 1981b).

The SPC workers found no evidence of genetically isolated skipjack subgroups separated by stable geographical boundaries. Further, they found no reason to propose any permanent barriers to the interaction of fisheries between neighbouring regions. However, they could not use the blood genetics data to define the exact geographical extent of those regions. They did find evidence that skipjack follow some form of population structuring across the Pacific, and they suggested that this could have resulted from an isolation-by-distance phenomenon. (Reproducing fish in any one region mingle with reproducing fish in neighbouring regions, and the degree of mingling between any two regions decreases with increasing distance between them.)

With regard to New Zealand, no clear evidence emerged from the analyses of blood samples to indicate whether the skipjack stocks which form the basis for the New Zealand summer fishery interact with stocks in other fisheries. However, analyses of SPC skipjack tagging data show that interactions between the New Zealand skipjack stocks and stocks in other fisheries are wide ranging (see following section). Therefore, to be consistent with the observed population structuring across the Pacific (see Fig. 2 in South Pacific Commission 1980), and the isolation-by-distance concept, it is likely that **most** interactions between the New Zealand skipjack fishery and other fisheries are in a north-south (latitudinal) direction. This is also consistent with the north-south warming and cooling in the sea which governs the seasonal nature of the New Zealand skipjack fishery.

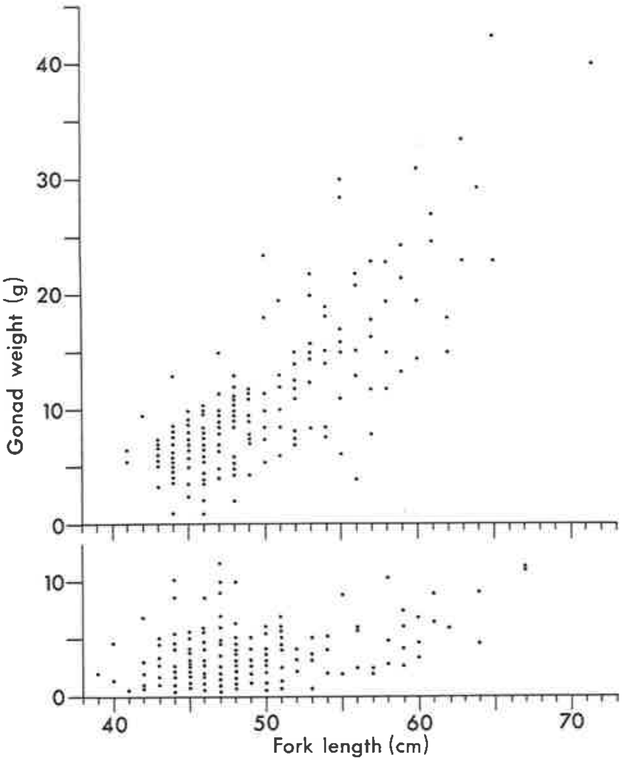

Fig. 9: Gonad weights plotted against body lengths for female (upper) and male (lower) skipjack caught in the 1981 purse-seine fishery in New Zealand.

Skipjack parasites

A large number of samples of skipjack viscera (gills, alimentary tracts, and gonads) were collected from purse-seined fish during the 1980 season. Further samples were collected in 1981. All samples were sent to the University of Queensland as part of a joint study on the parasites of New Zealand skipjack. The data are also being used in a wider central and western Pacific study of skipjack parasite fauna in relation to population structure.

Preliminary results indicate that skipjack from tropical areas have similar parasites, which makes it difficult to separate fish from different areas according to their parasites. Skipjack from New Zealand have a predominantly temperate-water parasite fauna, with reduced numbers of tropical parasites. It has not been possible so far to match the parasite mix in New Zealand skipjack with that in skipjack from any of a number of tropical areas sampled (see Lester 1981). Analyses of the data are continuing.

Skipjack tagging and migrations

In 1974 the SPC Expert Committee on Tropical Skipjack recommended that a regional survey and tagging programme be instituted in the central and

TABLE 19: International data for skipjack released or recaptured in New Zealand waters in 1978 to 1981 (data from SPC Skipjack Survey and Assessment Programme)

Release data				Recapture data				
Date	Position	Country	Fish length (cm)	Date	Position	Country	Fish length (cm)	Distance (km)
29.5.78	14°05' S, 177°58' W	Wallis	51.0 (M)*	11.4.79	36°00' S, 176°00' E	New Zealand	56.0 (J)†	2 509
6.4.79	35°14' S, 151°05' E	Australia	46.0 (M)	30.1.80‡ to 1.2.80	37°20' S, 176°20' E to 37°36' S, 177°28' E	New Zealand	50.5 (K)	2 317§
9.4.79	34°58' S, 151°05' E	Australia	46.0 (M)	30.1.80 to 1.2.80	37°20' S, 176°20' E to 37°36' S, 177°28' E	New Zealand	50.5 (K)	2 324
23.3.80	35°31' S, 174°50' E	New Zealand	54.0 (M)	18.3.81	35°10' S, 151°00' E	Australia	(U)	2 155
2.3.79	35°26' S, 174°53' E	New Zealand	50.0 (M)	2.12.79	18°29' S, 160°07' E	New Caledonia	62.5 (W)	2 378
6.3.79	35°53' S, 175°34' E	New Zealand	44.5 (M)	22.12.80	18°39' S, 160°34' E	New Caledonia	54.2 (W)	2 415
8.3.79	37°41' S, 177°26' E	New Zealand	58.0 (M)	8.1.80	18°43' S, 165°15' E	New Caledonia	68.2 (W)	2 417
14.3.79	37°41' S, 176°51' E	New Zealand	59.5 (B)	9.2.80	17°49' S, 160°43' E	New Caledonia	73.5 (W)	2 709
14.3.79	37°41' S, 176°51' E	New Zealand	59.5 (B)	17.2.80	17°34' S, 158°35' E	New Caledonia	69.5 (W)	2 857
13.3.79	37°38' S, 176°33' E	New Zealand	52.0 (M)	18.3.80	16°21' S, 164°31' E	Vanuatu	71.0 (W)	2 643
22.2.79	35°36' S, 175°15' E	New Zealand	52.0 (M)	1.1.80	18°40' S, 178°20' E	Fiji	58.0 (W)	1 906
22.2.79	35°20' S, 174°48' E	New Zealand	45.0 (M)	2.1.80	18°50' S, 178°20' E	Fiji	51.0 (B)	1 866
22.2.79	35°20' S, 174°48' E	New Zealand	44.0 (M)	24.2.80	18°15' S, 178°30' E	Fiji	(U)	1 933
22.2.79	35°20' S, 174°48' E	New Zealand	44.0 (M)	13.2.81	18°16' S, 177°59' E	Fiji	55.0 (E)	1 922
27.2.79	35°16' S, 174°41' E	New Zealand	46.0 (M)	13.7.81	15°50' S, 179°10' E	Fiji	(U)	2 205
2.3.79	35°24' S, 174°54' E	New Zealand	44.0 (M)	15.10.79	18°40' S, 178°20' E	Fiji	(U)	1 890
2.3.79	35°24' S, 174°54' E	New Zealand	45.0 (M)	5.2.80	16°52' S, 179°12' E	Fiji	49.3 (B)	2 103
2.3.79	35°24' S, 174°54' E	New Zealand	44.0 (M)	1.3.80 to 31.3.80	16°00' S, 177°00' E to 19°00' S, 179°00' E	Fiji	(U)	2 030
2.3.79	35°27' S, 174°52' E	New Zealand	46.0 (M)	15.3.80	17°00' S, 179°50' W	Fiji	(U)	2 116
2.3.79	35°24' S, 174°54' E	New Zealand	45.0 (M)	8.4.80	16°00' S, 179°00' E	Fiji	51.0 (B)	2 194
2.3.79	35°24' S, 174°54' E	New Zealand	45.0 (M)	12.8.80	16°05' S, 179°00' E	Fiji	66.0 (B)	2 185
3.3.79	35°32' S, 174°49' E	New Zealand	46.0 (M)	15.3.80	17°00' S, 179°50' W	Fiji	(U)	2 126
3.3.79	35°32' S, 174°49' E	New Zealand	45.0 (M)	4.2.81	17°25' S, 179°29' W	Fiji	52.0 (E)	2 090
5.3.79	35°37' S, 175°11' E	New Zealand	47.0 (M)	1.11.79 to 30.11.79	16°00' S, 177°00' E to 19°00' S, 179°00' W	Fiji	(U)	2 048
6.3.79	35°51' S, 175°30' E	New Zealand	45.0 (M)	1.11.79 to 30.11.79	16°00' S, 177°00' E to 19°00' S, 179°00' W	Fiji	(U)	2 068
6.3.79	35°46' S, 175°28' E	New Zealand	46.5 (M)	2.1.80	18°50' S, 178°20' E	Fiji	50.0 (B)	1 903
6.3.79	35°53' S, 175°34' E	New Zealand	45.0 (M)	22.2.80	16°41' S, 179°52' W	Fiji	51.0 (E)	2 181
6.3.79	35°51' S, 175°30' E	New Zealand	45.0 (M)	1.3.80 to 31.3.80	16°00' S, 177°00' E to 19°00' S, 179°00' W	Fiji	(U)	2 068
20.3.79	35°47' S, 175°20' E	New Zealand	46.0 (M)	17.3.80	17°20' S, 179°55' W	Fiji	51.0 (B)	2 103
20.3.79	35°47' S, 175°20' E	New Zealand	47.0 (M)	5.2.81	16°00' S, 179°50' E	Fiji	59.0 (W)	2 243

22.3.79	37°50' S, 174°11' E	New Zealand	45.0 (M)	15.7.80	18°30' S, 177°50' E	Fiji	(U)	2 177
23.3.80	35°31' S, 174°50' E	New Zealand	48.5 (M)	20.1.81	17°10' S, 179°10' E to 17°10' S, 180°00'	Fiji	55.0 (E)	2 092
23.3.80	35°31' S, 174°50' E	New Zealand	41.0 (M)	27.1.81	18°13' S, 179°50' E	Fiji	53.5 (W)	1 984
23.3.80	35°31' S, 174°50' E	New Zealand	55.0 (M)	8.2.81	16°50' S, 178°45' W	Fiji	62.0 (B)	2 171
23.3.80	35°31' S, 174°50' E	New Zealand	55.0 (M)	25.2.81	16°02' S, 178°04' E	Fiji	58.0 (B)	2 189
23.3.80	35°31' S, 174°50' E	New Zealand	48.0 (M)	13.6.81	15°46' S, 179°55' W	Fiji	(U)	2 256
23.3.80	35°31' S, 174°50' E	New Zealand	55.0 (M)	13.6.81	15°46' S, 179°55' W	Fiji	(U)	2 256
23.3.80	35°31' S, 174°50' E	New Zealand	55.0 (M)	30.3.81	12°34' S, 179°55' E	Tuvalu	62.0 (W)	2 601
2.3.79	35°24' S, 174°54' E	New Zealand	47.0 (M)	20.2.80	21°04' S, 175°22' W	Tonga	52.5 (E)	1 854
22.2.79	35°20' S, 174°48' E	New Zealand	45.0 (M)	27.12.79	14°10' S, 171°50' W	Western Samoa	51.0 (E)	2 705
2.3.79	35°27' S, 174°52' E	New Zealand	48.0 (M)	29.12.79	13°48' S, 171°46' W	Western Samoa	52.0 (E)	2 752
20.3.79	35°47' S, 175°20' E	New Zealand	45.0 (M)	9.1.80	14°04' S, 171°26' W	Western Samoa	52.0 (E)	2 750
23.3.80	35°31' S, 174°50' E	New Zealand	49.0 (M)	21.2.81	13°40' S, 171°40' W	Western Samoa	54.5 (E)	2 778
6.3.79	35°51' S, 175°30' E	New Zealand	46.5 (M)	4.11.80	9°23' S, 171°13' W	Tokelau	67.9 (E)	3 233
2.3.79	35°26' S, 174°53' E	New Zealand	46.0 (M)	14.5.80	17°20' S, 149°40' W	French Polynesia	57.0 (E)	4 029
3.3.79	35°31' S, 174°50' E	New Zealand	47.0 (M)	13.10.80	16°55' S, 149°55' W	French Polynesia	65.0 (E)	4 044
6.3.79	35°51' S, 175°30' E	New Zealand	46.0 (M)	28.1.80	17°35' S, 149°10' W	French Polynesia	(U)	4 019
6.3.79	35°51' S, 175°30' E	New Zealand	45.0 (M)	2.2.80	18°10' S, 149°50' W	French Polynesia	49.6 (W)	3 924
23.3.80	35°31' S, 174°50' E	New Zealand	62.0 (M)	10.2.81	17°00' S, 149°33' W	French Polynesia	65.0 (E)	4 069
14.3.79	37°38' S, 176°32' E	New Zealand	52.0 (M)	1.2.81 to 28.2.81	4°23' N, 179°30' E	International	(U)	4 679

* Release length credibility: M, measured; B, estimated from biological data.

† Recapture length credibility: B, measured by local joint ventures; E, measurements from unreliable sources; J, estimated from weight; K, estimated from other sources (string, etc.); U, unknown; W, measured length verified by weight.

‡ Where ranges of dates and positions are given, exact data are not available.

§ Distance is mid point between the two recapture positions.

western Pacific. This recommendation was endorsed at the SPC Seventh Technical Meeting on Fisheries, where it was also recommended that SPC make every possible effort to obtain funding for the programme. This occupied most of the time of the programme co-ordinator through to mid 1977, and the programme became operational in August 1977. From that time to August 1980, the Skipjack Survey and Assessment Programme made 45 individual country visits in the central and western Pacific and tagged 139 961 skipjack and a small number of other tunas, collected biological data on the tunas, and gathered information on the baitfish resources (see Kearney 1978, 1979a, 1980, 1981). Over 6000 of the tagged skipjack were recaptured.

The programme visited New Zealand in February-March 1979 and in March 1980. During the first visit 11 614 skipjack and 3 albacore tuna were tagged (see Kearney and Hallier 1979); on the second visit 1111 skipjack were tagged (see Kearney 1981).

Many of the fish tagged in New Zealand in 1979 were recaptured shortly afterwards along the north-east coast of the North Island in the purse-seine fishery. The most reliable of these recapture data are in the Appendix to this publication. More were recovered in the New Zealand fishery in 1980. A number of fish which were tagged in New Zealand in 1979 and 1980 were recaptured elsewhere, and fish which were tagged in other parts of the Pacific have been recaptured in New Zealand. Data on such releases and recoveries can be found in Figs. 6–8 and Table 14 in Habib, Clement, and Fisher (1980b), Tables 13 and 14 in Habib, Clement, and Fisher (1980c), and Table 19 in this publication.

Only one fish tagged in New Zealand in 1980 was recaptured soon after in New Zealand. It was tagged on 23 March near Poor Knights Islands (35°31' S, 174°50' E) and its length was 54.5 cm. It was recaptured on 7 June in the Bay of Plenty (37°22' S, 176°12' E) and its length was 55 cm. The straight-line distance between release and recapture points was 239 km and the time at liberty was 76 days.

Recapture data tabulated so far are up to July 1981. Further recoveries of tagged fish are expected. The data show that New Zealand shares its skipjack resource with many of its Pacific neighbours (see also Fig. 6 in South Pacific Commission 1981a). The degree of sharing, or the extent of interaction between the New Zealand fishery and those in neighbouring countries, is a problem at present being addressed by the SPC skipjack programme. A report on this, and on other matters pertinent to New Zealand which arise from the programme's activities in New Zealand and other parts of the Pacific, is expected in early 1982.

Other skipjack tagging

Data on skipjack tagged by one of us (G. Habib) in New Zealand waters in 1981 are presented in Table 20. The fish were tagged in a similar manner to those in the SPC programme, which followed the method outlined in Kearney, Lewis, and Smith (1972) and Kearney (1974). Although these data have no immediate relationship with the purse-seine skipjack fishery, we believe it is useful to present them in this publication, as some of the tagged fish might have been taken in purse-seine catches in 1981 or could be taken by the seiners in coming seasons. So far none of these tagged fish has been returned.

International management

The SPC international tagging data show that there is a sharing of skipjack among many nations in the Pacific. However, the degree and nature of the sharing have yet to be determined. Nevertheless, as there is some resource sharing, and as most of the Pacific nations are developing or seeking to develop their skipjack fisheries (Kearney 1979b, 1979c), some measure of harmony between individual country developments or development plans seems desirable. To this end the South Pacific Forum Fisheries Agency (FFA) convened a meeting of Pacific nation representatives in May 1981 to:

"Provide a forum for parties to consult together on matters of common concern in the field of fisheries; Promote intra-regional co-ordination and co-operation in the following fields:

TABLE 20: Data for skipjack tagged on *Kaio Maru No. 52 in New Zealand waters, February 1981**

Date	General area	Position	Time fishing (NZST)	No. tagged	Length (cm)
22.2.81	North Taranaki Bight	38°24' S, 173°26' E	0730–0740	3	53–54
22.2.81	North Taranaki Bight	38°24' S, 173°26' E	0828–0905	52	54.5†
22.2.81	North Taranaki Bight	38°27' S, 173°26' E	1144–1157	67	54.6†
22.2.81	North Taranaki Bight	38°29' S, 173°26' E	1241–1425	174	53.9†
26.2.81	North-west South Island	39°57' S, 171°40' E	1312–1325	99	47.9†

* Activities of this vessel in New Zealand waters in 1981 are described in Ichikawa (1981).
† Mean length of skipjack taken in fishing operations at that position at that time; tagged fish were not measured.

harmonisation of policies with respect to fisheries management;

co-operation in respect of relations with distant water fishing countries;

co-operation in surveillance and enforcement;

co-operation in respect of access to the 200 mile zones of other parties."

The outcome was the definition of a Regional Fisheries Research and Development Programme (RRDP) (see Forum Fisheries Agency 1981a). The agency convened a further meeting in August-September 1981 to discuss the implementation of the RRDP and, in particular, a project for harmonising fisheries in the Pacific (see Forum Fisheries Agency 1981b).

The fisheries under discussion in both meetings were mainly those for the tunas and billfishes, with the fisheries for skipjack being the dominant issue.

The agency therefore is addressing many of the issues of international fisheries management and will no doubt continue to do so. If the organisation is to function effectively, it needs support from its members (one of which is New Zealand), from its observer state members (for example, Federated States of Micronesia), from other fisheries research and management organisations (for example, SPC), and from the distant water fishing nations which have fishing fleets in the central and western Pacific (for example, Japan). Such support should lead to sound and rational exploitation of the Pacific skipjack resource.

New Zealand was a very active supporter of FFA at the above meetings. Its representatives contributed useful information and comments to the discussions, which were often based on New Zealand's experiences in developing and managing its own tuna fisheries. New Zealand obviously must support any initiatives which might lead to the rational development of the Pacific skipjack resource.

Summary

The 1980–81 (1981) purse-seine fishery for skipjack was pursued by 19 vessels, which ranged from 23 to 79 m overall length and 135 to 1558 t gross weight.

Observations were made from aircraft and purse-seine vessels of surface schools of skipjack during the season. Skipjack migrated into New Zealand waters in October and were present in purse-seinable quantities intermittently until May. Although there was sightings effort over a wide area off both the North and South Islands, the effort was most concentrated off the north-east North Island, where most of the fishing was done. As in past seasons, most fish were seen from January to March. Except for early and late in the season, over half the fish were seen inside the 12-mile limit. Fewer fish were seen in 1981 than in earlier seasons. The season's sighting, obtained by totalling the best daily measures of apparent abundance, was 31 586 t. No estimate of real abundance was made because such estimates depend on "bodies" of skipjack being present, and none were seen.

The purse-seine fleet worked 2084 season-days: 945.5 were spent searching and fishing, 144.5 travelling, and 134.5 discharging fish or taking on stores. There were 460.5 days lost through weather and 288 through repairs or survey, and 111 days were taken off.

During the 945.5 days fished 8555 t of skipjack was caught: 99 t in November, 1350 t in December, 3524 t in January, 1908 t in February, 1114 t in March, and 560 t in April. All measures of effort peaked in January. Catch rates that month were 6.4 t per season-day, 11.3 t per day fished, 9.5 t per set, and 14.2 t per successful set.

There was seining in six areas on the New Zealand coast. Over half the season's catch (4737 t) was taken east and north of Great Barrier Island (area C) in January and February with about half of the season's effort. Most of the remainder of the season's catch was taken off east Northland (area B) during the 239 days fished there. The best catch rates of the season were in that area. Small catches were also made in the Bay of Plenty (area D), off the east coast south of East Cape (area E), and in the west (areas J and K).

Fishing was conducted in depths of 38 to 2440 m. Most success was in depths of 100 to 399 m; that is, above the continental shelf edge.

Over half the fish were caught in the afternoon with about the same proportion of sets and at catch rates per set close to the season's mean. Fewer fish were caught in the morning and still fewer in the evening.

The best phases of the moon for fishing were first quarter and full moon, when three-fifths of the season's catch was taken.

Fishing took place where sea surface salinities ranged from 34.9 to 36.19 parts per thousand. Over three-quarters of the monitored catch was taken in water of 35.4 to 35.8 parts per thousand salinity at the best catch rates.

There was fishing where sea surface temperatures ranged from 16.6° to 24.5°C. Almost three-fifths of the catch came from 19° to 21.9°C water ("skipjack water"). A significant catch was also taken in warmer water.

Three-fifths of the season's catch was taken outside the 12-mile limit and the remainder inside. As in past seasons, the large chartered vessels had to fish outside the limit, whereas the locally owned vessels could fish anywhere. Catch rates in off-shore waters were low because the quantity of skipjack sighted and fished there was down on past seasons, schools in off-shore waters were generally small and scattered over a wide area, long periods of poor weather restricted fishing, and a large number of vessels fished the off-shore resource. By comparison, catches and catch rates in shore were the best for any season. There, good quantities of fish surfaced in small areas and were fished by a larger and more professional local fleet than in past seasons. In addition, fishing was less restricted by weather in shore than it was off shore.

Almost 38 000 skipjack were measured from 237 catches. Early and late season catches were predominantly of large fish (50 to 67 cm in length, 2.6 to 6.9 kg in weight). However, for most of the season small fish (42 to 48 cm, 1.4 to 2.3 kg) predominated in the catches. There was progression of the modes in the length-frequency distributions over a 4-month period from 42 to 48 cm, which may have reflected growth corresponding to an increase in weight of about 800 g.

Samples were measured for length and weight to test for changes in the length-weight relationship which could reflect growth in weight. Results were inconclusive.

Marked skipjack were placed in the brine tanks on the purse seiners to test recovery rates of such fish from the vessels and at the canneries during processing. Results are still being analysed.

Stomach contents were investigated in 908 skipjack during the season. Over two-thirds of the stomachs were empty. Those with food contained mainly the euphausiid *Nyctiphanes australis*. Other items of food were fish and liquid remains. Few skipjack contained much food: 89% of stomachs with food were less than one-quarter full, 7% between a quarter and half full, and 4% over half full. Peaks in feeding occurred in the early morning and late afternoon; lows in the late morning, early afternoon, and evening.

Gonads were examined in the fish dissected for stomach analyses: 461 were female, 447 male. All gonads were undeveloped.

Analysis by SPC of skipjack blood genetics data from the Pacific provided no evidence of genetically isolated subgroups separated by stable geographical boundaries, or of permanent barriers to the interaction of fisheries between neighbouring regions. Further, SPC could not use the blood genetics data to define the exact geographical extent of neighbouring regions. However, they did find that skipjack follow a form of population structuring across the Pacific, and they suggested a number of possible reasons for the structuring, including isolation-by-distance, in which reproducing fish in any one region mingle with reproducing fish in neighbouring regions, and the degree of mingling between regions decreases with increasing distance between them. With regard to New Zealand, the blood genetics data were inadequate for describing interactions between stocks of fish which have comprised the New Zealand fishery and stocks from elsewhere. We believe most interactions are likely to be latitudinal in direction.

Analysis by the University of Queensland of parasites from Pacific skipjack shows that skipjack from tropical regions (for example, Solomon Islands) have a parasite fauna distinct from temperate-water skipjack (for example, from New Zealand). Preliminary results have failed to match the parasite mix in New Zealand skipjack with that in skipjack from tropical areas.

Background to the recently completed SPC Skipjack Survey and Assessment Programme is presented, as are all skipjack tagging data to July 1981 with some New Zealand content which have not already been presented in our publications on New Zealand's skipjack fishery in previous seasons. The data show that New Zealand shares its skipjack resource with many of its Pacific neighbours. The extent of interactions between the New Zealand fishery and those in neighbouring countries is a problem being addressed by the SPC skipjack programme.

Movement towards international management of skipjack fisheries in the central and western Pacific has begun with the recent formulation of a Regional Research and Development Programme at meetings convened by the South Pacific Forum Fisheries Agency.

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Appendix

Data for tagged skipjack released in New Zealand waters during the 1979 season and recaptured in New Zealand in the same season (data from SPC Skipjack Survey and Assessment Programme).

Explanatory notes

Release length credibility:
- M — measured by tagger
- B — estimated from biological data
- T — estimated from tagging data

Recapture length credibility:
- A — measured by SPC staff
- D — measured by other supposedly reliable agents; for example, MAF staff
- J — estimated from weight
- U — unknown

Distance travelled is the straight-line distance between release and recapture positions. If a range of recapture positions is given, the distance is measured to the mid point between the two positions.

Where ranges of dates and positions are given, exact data are not available.

Release data				Recapture data				
Date	Position ° ' S ° ' E	General area	Fish length (cm)	Date	Position ° ' S ° ' E	General area	Fish length (cm)	Distance (km)
22.2.79	35 36 , 175 15	NNE Mokohinau Is	48.0 M	2.3.79	35 26 , 174 53	E Poor Knights Is	U	38
"	"	"	48.0 M	3.3.79	35 27 , 174 56	E Poor Knights Is	47.0 A	33
"	"	"	46.4 B	4.3.79	35 30 , 174 50	SE Poor Knights Is	47.9 D	39
"	"	"	48.0 M	5.3.79	35 52 , 175 35	N Great Barrier I	48.5 D	42
"	"	"	46.4 B	5.3.79	35 26 , 175 00	E Poor Knights Is	U	29
"	"	"	49.0 M	"	"	"	U	29
"	"	"	49.0 M	5.3.79	35 24 , 174 56	E Poor Knights Is	U	36
"	"	"	48.0 M	5.3.79	35 52 , 175 35	NNE Great Barrier I	46.8 D	42
"	"	"	46.4 B	21.3.79	35 43 , 175 27	NE Mokohinau Is	47.0 D	22
"	"	"	48.0 M	"	"	"	48.0 D	22
"	"	"	48.0 M	"	"	"	47.0 D	22
"	"	"	49.0 M	21.3.79	35 43 , 175 00	NW Mokohinau Is	48.0 D	26
"	"	"	46.0 M	21.3.79	35 43 , 175 27	NE Mokohinau Is	47.0 D	22
"	"	"	48.0 M	20.3.79 to 21.3.79	36 03 , 175 58 to 36 08 , 176 04	The Cross "	48.2 D	88
"	"	"	46.0 M	22.3.79	35 43 , 175 18	NNE Mokohinau Is	U	14
"	"	"	48.0 M	23.3.79	35 53 , 176 04	The Cross	46.5 D	80
22.2.79	35 23 , 174 50	NE Poor Knights Is	47.0 M	3.3.79	35 27 , 174 56	E Poor Knights Is	45.2 A	12
"	"	"	45.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	46.0 D	21
"	"	"	45.0 M	"	"	"	46.0 D	21
"	"	"	44.0 M	"	"	"	46.0 D	21
"	"	"	44.0 M	"	"	"	44.0 D	21
"	"	"	46.0 M	5.3.79	35 24 , 174 56	NE Poor Knights Is	46.0 D	9
"	"	"	46.0 M	5.3.79 to 6.3.79	35 55 " 175 38 to 35 56 , 175 40	NE Great Barrier I "	44.6 D	95
"	"	"	46.0 M	21.3.79	35 43 , 175 27	NE Mokohinau Is	46.0 D	67
"	"	"	46.0 M	20.3.79 to 21.3.79	36 03 , 175 58 to 36 08 , 176 04	The Cross "	46.1 D	133
"	"	"	44.5 B	23.3.79	35 53 , 176 04	The Cross	42.0 D	125
"	"	"	43.0 M	3.4.79	35 30 , 175 01	SE Poor Knights Is	44.0 D	21
22.2.79	35 20 , 174 48	N Poor Knights Is	46.0 M	28.2.79	35 13 , 174 39	Cape Brett	50.0 D	19
"	"	"	45.0 M	"	"	"	47.0 D	19
"	"	"	44.0 M	2.3.79	35 26 , 174 53	NE Poor Knights Is	43.0 A	13
"	"	"	45.0 M	4.3.79	35 25 , 175 00	NE Poor Knights Is	43.2 D	20
"	"	"	46.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	47.0 D	27
"	"	"	47.0 M	4.3.79	35 30 , 174 50	SE Poor Knights Is	47.9 D	19
"	"	"	45.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	44.4 D	20
"	"	"	46.0 M	"	"	"	46.0 D	20
"	"	"	45.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	46.0 D	27
"	"	"	45.0 M	"	"	"	45.0 D	27
"	"	"	46.0 M	4.3.79	35 30 , 174 50	SE Poor Knights Is	47.9 D	19
"	"	"	45.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	44.5 D	27
"	"	"	45.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	44.3 D	20
"	"	"	46.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	44.7 D	27
"	"	"	44.0 M	4.3.79	35 30 , 174 50	SE Poor Knights Is	47.9 D	19
"	"	"	44.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	46.7 D	20
"	"	"	46.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	46.0 D	27
"	"	"	47.0 M	"	"	"	U	27
"	"	"	44.0 M	"	"	"	45.0 D	27
"	"	"	46.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	45.4 D	20

Release data				Recapture data				
Date	Position ° ' S , ° ' E	General area	Fish length (cm)	Date	Position ° ' S , ° ' E	General area	Fish length (cm)	Distance (km)
22.2.79	35 20 , 174 48	N Poor Knights Is	45.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	44.8 D	20
"	"	"	45.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	45.0 D	27
"	"	"	47.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	45.0 D	20
"	"	"	47.0 M	4.3.79	35 30 , 174 50	SE Poor Knights Is	47.9 D	19
"	"	"	46.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	46.0 D	27
"	"	"	46.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	46.7 D	20
"	"	"	45.0 M	"	"	"	46.7 D	20
"	"	"	45.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	44.5 D	27
"	"	"	44.0 M	"	"	"	45.0 D	27
"	"	"	47.0 M	"	"	"	U	27
"	"	"	44.5 M	"	"	"	45.0 D	27
"	"	"	43.0 M	"	"	"	44.0 D	27
"	"	"	46.0 M	4.3.79	35 30 , 174 50	SE Poor Knights Is	47.9 D	19
"	"	"	44.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	45.0 D	27
"	"	"	47.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	46.8 D	20
"	"	"	44.0 M	"	"	"	42.7 D	20
"	"	"	43.0 M	4.3.79	35 30 , 174 50	SE Poor Knights Is	47.9 D	19
"	"	"	45.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	45.4 D	20
"	"	"	45.0 M	"	"	"	45.0 D	20
"	"	"	46.0 M	4.3.79	35 30 , 174 50	SE Poor Knights Is	47.9 D	19
"	"	"	45.0 M	"	"	"	47.9 D	19
"	"	"	46.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	47.4 D	20
"	"	"	46.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	45.3 D	27
"	"	"	44.0 M	"	"	"	U	27
"	"	"	44.0 M	"	"	"	U	27
"	"	"	44.0 M	"	"	"	44.0 D	27
"	"	"	45.0 M	"	"	"	44.8 D	27
"	"	"	45.0 M	"	"	"	44.0 D	27
"	"	"	45.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	46.7 D	20
"	"	"	45.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	45.0 D	27
"	"	"	45.6 B	4.3.79	35 25 , 175 00	E Poor Knights Is	43.1 D	20
"	"	"	45.0 M	"	"	"	46.7 D	20
"	"	"	44.0 M	"	"	"	44.8 D	20
"	"	"	46.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	U	27
"	"	"	45.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	43.8 D	20
"	"	"	44.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	44.0 D	27
"	"	"	48.0 M	"	"	"	49.0 D	27
"	"	"	44.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	43.5 D	20
"	"	"	45.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	44.0 A	21
"	"	"	46.0 M	"	"	"	45.5 A	21
"	"	"	46.0 M	"	"	"	43.0 A	21
"	"	"	45.0 M	5.3.79	35 52 , 175 35	NNE Great Barrier I	45.3 D	92
"	"	"	45.0 M	5.3.79	35 24 , 174 56	E Poor Knights Is	44.5 D	14
"	"	"	43.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	43.5 A	21
"	"	"	45.0 M	5.3.79	35 24 , 174 56	E Poor Knights Is	44.7 D	14
"	"	"	45.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	44.0 A	21
"	"	"	46.0 M	5.3.79	35 24 , 174 56	E Poor Knights Is	44.5 D	14
"	"	"	46.0 M	"	"	"	46.4 D	14
"	"	"	47.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	46.5 A	21
"	"	"	47.0 M	"	"	"	47.0 A	21
"	"	"	46.0 M	"	"	"	45.5 A	21
"	"	"	46.0 M	"	"	"	45.0 A	21
"	"	"	44.0 M	5.3.79	35 24 , 174 56	E Poor Knights Is	44.0 D	14

Release data				Recapture data				
Date	Position ° ' S ° ' E	General area	Fish length (cm)	Date	Position ° ' S ° ' E	General area	Fish length (cm)	Distance (km)
22.2.79	35 20 , 174 48	N Poor Knights Is	45.0 M	5.3.79	35 24 , 174 56	E Poor Knights Is	45.1 D	14
"	"	"	46.0 M	"	"	"	45.5 D	14
"	"	"	45.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	U	21
"	"	"	46.0 M	"	"	"	44.0 A	21
"	"	"	45.5 M	"	"	"	45.0 A	21
"	"	"	45.0 M	"	"	"	48.0 A	21
"	"	"	44.0 M	"	"	"	45.5 A	21
"	"	"	45.0 M	"	"	"	45.0 A	21
"	"	"	46.0 M	5.3.79	35 24 , 174 56	E Poor Knights Is	44.9 D	14
"	"	"	41.0 M	"	"	"	41.0 D	14
"	"	"	46.0 M	"	"	"	46.4 D	14
"	"	"	45.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	45.0 A	21
"	"	"	45.0 M	5.3.79	35 24 , 174 56	E Poor Knights Is	U	14
"	"	"	46.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	45.5 A	21
"	"	"	46.0 M	5.3.79	35 24 , 174 56	E Poor Knights Is	45.4 D	14
"	"	"	46.0 M	"	"	"	46.5 D	14
"	"	"	44.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	44.0 A	21
"	"	"	46.0 M	5.3.79	35 24 , 174 56	E Poor Knights Is	44.0 D	14
"	"	"	45.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	44.0 A	21
"	"	"	46.0 M	5.3.79	35 24 , 174 56	E Poor Knights Is	44.5 D	14
"	"	"	46.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	46.5 A	21
"	"	"	45.0 M	"	"	"	45.5 A	21
"	"	"	45.0 M	5.3.79	35 24 , 174 56	E Poor Knights Is	42.8 D	14
"	"	"	44.0 M	"	"	"	44.0 D	14
"	"	"	44.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	43.5 A	21
"	"	"	45.0 M	"	"	"	45.0 A	21
"	"	"	46.0 M	5.3.79	35 24 , 174 56	E Poor Knights Is	46.4 D	14
"	"	"	46.0 M	"	"	"	U	14
"	"	"	47.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	47.0 A	21
"	"	"	45.0 M	"	"	"	45.5 A	21
"	"	"	45.0 M	"	"	"	45.0 A	21
"	"	"	44.0 M	"	"	"	44.0 A	21
"	"	"	47.0 M	5.3.79	35 23 , 174 53	N Poor Knights Is	47.0 A	9
"	"	"	43.0 M	5.3.79	35 24 , 174 56	E Poor Knights Is	43.9 D	14
"	"	"	48.0 M	5.3.79 to 6.3.79	35 55 , 175 38 to 35 56 , 175 40	NNE Great Barrier I "	47.5 D	101
"	"	"	44.0 M	"	"	"	43.6 D	101
"	"	"	45.0 M	"	"	"	46.3 D	101
"	"	"	45.0 M	"	"	"	46.2 D	101
"	"	"	44.0 M	"	"	"	46.0 D	101
"	"	"	46.0 M	"	"	"	45.7 D	101
"	"	"	45.0 M	"	"	"	44.0 D	101
"	"	"	45.0 M	"	"	"	43.9 D	101
"	"	"	44.0 M	"	"	"	44.3 D	101
"	"	"	46.0 M	"	"	"	47.0 D	101
"	"	"	45.5 M	"	"	"	46.0 D	101
"	"	"	46.0 M	"	"	"	45.9 D	101
"	"	"	45.0 M	6.3.79 to 14.3.79	35 57 , 175 52 to 36 08 , 176 03	The Cross "	43.0 D	131
"	"	"	46.0 M	21.3.79	35 43 , 175 27	NE Mokohinau Is	46.0 D	73
"	"	"	45.0 M	"	"	"	46.0 D	73

Release data				Recapture data				
Date	Position ° ' S ° ' E	General area	Fish length (cm)	Date	Position ° ' S ° ' E	General area	Fish length (cm)	Distance (km)
22.2.79	35 20 , 174 48	N Poor Knights Is	46.0 M	21.3.79	35 43 , 175 27	NE Mokohinau Is	46.0 D	73
"	"	"	44.0 M	20.3.79	36 03 , 175 58	The Cross	45.4 D	138
				to	to			
				21.3.79	36 08 , 176 04	"		
"	"	"	44.0 M	21.3.79	35 43 , 175 27	NE Mokohinau Is	44.0 D	73
"	"	"	46.0 M	"	"	"	46.0 D	73
"	"	"	45.0 M	"	"	"	46.0 D	73
"	"	"	45.0 M	22.3.79	35 43 , 175 18	NE Mokohinau Is	U	71
				to	to			
				23.3.79	35 49 , 175 27	ENE Mokohinau Is		
"	"	"	47.0 M	"	"	"	U	71
"	"	"	44.0 M	"	"	"	U	71
26.2.79	34 52 , 173 53	NW Cavalli Is	54.0 M	2.3.79	34 43 , 173 42	NE Doubtless Bay	U	24
"	"	"	56.0 M	"	"	"	U	24
"	"	"	55.0 M	3.3.79	34 45 , 173 45	NE Doubtless Bay	55.5 D	18
"	"	"	54.0 M	2.3.79	34 43 , 173 42	NE Doubtless Bay	55.2 D	21
				to	to			
				3.3.79	34 45 , 173 45	"		
26.2.79	34 55 , 173 54	NW Cavalli Is	50.0 M	2.3.79	34 43 , 173 42	NE Doubtless Bay	50.3 D	29
"	"	"	49.0 M	"	"	"	49.1 D	29
"	"	"	48.0 M	"	"	"	48.7 D	29
"	"	"	51.0 M	"	"	"	U	29
"	"	"	49.0 M	2.3.79	34 43 , 173 42	NE Doubtless Bay	U	26
				to	to			
				3.3.79	34 45 , 173 45	"		
"	"	"	50.0 M	3.3.79	34 45 , 173 45	NE Doubtless Bay	51.0 D	23
"	"	"	49.0 M	2.3.79	34 43 , 173 42	NE Doubtless Bay	48.2 D	26
				to	to			
				3.3.79	34 45 , 173 45	"		
27.2.79	35 13 , 174 35	Cape Brett	46.0 M	2.3.79	34 43 , 173 42	NE Doubtless Bay	48.2 D	98
"	"	"	45.0 M	3.3.79	35 27 , 174 56	E Poor Knights Is	45.0 A	41
"	"	"	47.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	47.2 D	50
"	"	"	44.0 M	4.3.79	35 25, 175 00	E Poor Knights Is	44.3 D	44
"	"	"	45.0 M	"	"	"	44.7 D	44
"	"	"	45.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	U	50
"	"	"	46.0 M	"	"	"	47.0 D	50
"	"	"	46.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	46.7 D	44
"	"	"	46.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	46.0 D	50
"	"	"	46.0 M	"	"	"	U	50
"	"	"	46.0 M	"	"	"	U	50
"	"	"	46.0 M	"	"	"	46.0 D	50
"	"	"	49.0 M	"	"	"	U	50
"	"	"	45.0 M	"	"	"	45.0 D	50
"	"	"	44.0 M	5.3.79	35 25 , 175 00	E Poor Knights Is	44.0 D	44
"	"	"	46.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	46.0 A	45
"	"	"	46.0 B	"	"	"	46.5 A	45
"	"	"	46.0 M	5.3.79	35 24 , 174 56	NE Poor Knights Is	44.4 D	38
"	"	"	46.0 M	"	"	"	43.8 D	38
"	"	"	48.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	47.0 A	45
"	"	"	44.0 M	5.3.79	35 23 , 174 53	NE Poor Knights Is	44.5 A	33
"	"	"	44.0 M	5.3.79	35 55 , 175 38	NE Great Barrier I	U	124
				to	to			
				6.3.79	35 56 , 175 40	"		

Release data				Recapture data				
Date	Position ° ' S ° ' E	General area	Fish length (cm)	Date	Position ° ' S ° ' E	General area	Fish length (cm)	Distance (km)
27.2.79	35 13 , 174 35	Cape Brett	47.0 M	5.3.79	35 55 , 175 38	NE Great Barrier I	46.0 D	124
				to	to			
				6.3.79	35 56 , 175 40	"		
"	"	"	46.0 M	"	"	"	45.7 D	124
"	"	"	53.0 M	"	"	"	53.1 D	124
"	"	"	46.0 M	21.3.79	36.03 , 176 04	The Cross	46.0 D	163
"	"	"	46.0 M	21.3.79	35 43 , 175 27	NE Mokohinau Is	45.0 D	96
"	"	"	48.0 M	"	"	"	48.0 D	96
"	"	"	45.0 M	22.3.79	35 43 , 175 18	NNE Mokohinau Is	U	94
				to	to			
				23.3.79	35 49 , 175 27	ENE Mokohinau Is		
"	"	"	46.0 M	"	"	"	U	94
"	"	"	47.0 M	"	"	"	46.5 D	94
"	"	"	44.0 M	23.3.79	35 53 , 176 04	The Cross	44.5 D	153
"	"	"	47.0 M	1.5.79	35 25 , 175 00	E Poor Knights Is	45.3 D	44
27.2.79	35 16 , 174 41	SE Cape Brett	46.2 B	4.3.79	35 25 , 175 00	E Poor Knights Is	46.7 D	33
"	"	"	51.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	51.0 D	40
"	"	"	46.0 M	5.3.79	35 23 , 174 53	NE Poor Knights Is	45.5 A	22
"	"	"	43.0 M	5.3.79	35 24 , 174 56	NE Poor Knights Is	42.7 D	27
"	"	"	45.0 M	"	"	"	43.8 D	27
"	"	"	46.2 B	17.3.79	36 02 , 175 51	The Cross	45.0 D	135
28.2.79	35 13 , 174 39	E Cape Brett	45.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	46.0 D	39
"	"	"	45.6 B	"	"	"	45.7 D	39
"	"	"	46.0 M	5.3.79	35 24 , 174 56	NE Poor Knights Is	46.0 D	33
"	"	"	46.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	44.5 A	40
"	"	"	45.6 B	5.3.79	35 24 , 174 56	NE Poor Knights Is	44.5 D	33
"	"	"	46.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	44.0 A	40
"	"	"	46.0 M	5.3.79	35 24 , 174 56	NE Poor Knights Is	44.8 D	33
"	"	"	46.0 M	21.3.79	35 43 , 175 27	NE Mokohinau Is	46.0 D	91
"	"	"	45.0 M	20.3.79	36 03 , 175 58	The Cross	45.9 D	157
				to	to			
				21.3.79	36 08 , 176 04	"		
"	"	"	46.0 M	21.3.79	35 43 , 175 27	NE Mokohinau Is	45.0 D	91
"	"	"	45.0 M	20.3.79	36 03 , 175 58	The Cross	44.2 D	157
				to	to			
				21.3.79	36 08 , 176 04	"		
"	"	"	47.0 M	22.3.79	35 43 , 175 18	NNE Mokohinau Is	U	90
				to	to			
				23.3.79	35 49 , 175 27	"		
2.3.79	35 26 , 174 53	E Poor Knights Is	44.5 M	4.3.79	35 25 , 175 00	E Poor Knights Is	43.8 D	11
"	"	"	47.0 M	"	"	"	46.6 D	11
"	"	"	47.0 M	"	"	"	46.9 D	11
"	"	"	50.0 M	"	"	"	48.0 D	11
"	"	"	45.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	45.0 D	14
"	"	"	45.0 M	"	"	"	45.0 D	14
"	"	"	44.0 M	"	"	"	U	14
"	"	"	45.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	44.7 D	11
"	"	"	43.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	44.0 D	14
"	"	"	48.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	47.0 D	11
"	"	"	46.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	U	14
"	"	"	46.0 M	"	"	"	46.0 D	14
"	"	"	45.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	43.5 D	11
"	"	"	46.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	46.0 D	14

Release data				Recapture data				
Date	Position ° ' S ° ' E	General area	Fish length (cm)	Date	Position ° ' S ° ' E	General area	Fish length (cm)	Distance (km)
2.3.79	35 26 , 174 53	E Poor Knights Is	47.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	47.4 D	11
"	"	"	46.0 M	4.3.79	35 30 , 174 50	SE Poor Knights Is	47.9 D	9
"	"	"	46.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	46.0 D	14
"	"	"	46.0 M	"	"	"	48.5 D	14
"	"	"	47.0 M	"	"	"	U	14
"	"	"	45.0 M	"	"	"	44.0 D	14
"	"	"	46.0 M	"	"	"	47.0 D	14
"	"	"	46.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	46.0 D	11
"	"	"	44.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	45.0 D	14
"	"	"	47.0 M	4.3.79	35 30 , 174 50	SE Poor Knights Is	47.9 D	9
"	"	"	44.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	44.0 D	14
"	"	"	48.0 M	4.3.79	35 30 , 174 50	SE Poor Knights Is	47.9 D	9
"	"	"	46.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	U	14
"	"	"	44.0 M	"	"	"	44.0 D	14
"	"	"	45.0 M	5.3.79	35 24 , 174 56	E Poor Knights Is	46.4 D	6
"	"	"	48.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	45.0 A	11
"	"	"	46.4 B	5.3.79	35 24 , 174 56	E Poor Knights Is	47.5 D	6
"	"	"	47.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	47.0 A	11
"	"	"	45.0 M	"	"	"	44.0 A	11
"	"	"	45.0 M	5.3.79	35 24 , 174 56	E Poor Knights Is	44.7 D	6
"	"	"	46.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	45.5.A	11
"	"	"	47.0 M	5.3.79	35 24 , 174 56	E Poor Knights Is	42.2 D	6
"	"	"	50.0 M	"	"	"	51.5 D	6
"	"	"	48.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	48.0 A	11
"	"	"	46.0 M	5.3.79	35 24 , 174 56	E Poor Knights Is	46.0 D	6
"	"	"	46.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	46.0 A	11
"	"	"	47.0 M	5.3.79	35 24 , 174 56	E Poor Knights Is	43.7 D	6
"	"	"	51.0 M	"	"	"	52.2 D	6
"	"	"	50.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	49.5 A	11
"	"	"	46.0 M	5.3.79	35 24 , 174 56	E Poor Knights Is	46.5 D	6
"	"	"	44.0 M	5.3.79 to 6.3.79	35 55 , 175 38 to 35 56 , 175 40	NNE Great Barrier I "	U	88
"	"	"	45.0 M	"	"	"	46.2 D	88
"	"	"	44.0 M	"	"	"	44.3 D	88
"	"	"	47.0 M	21.3.79	36 03 , 176 04	The Cross	47.5 D	127
"	"	"	46.0 M	21.3.79	35 43 , 175 28	NE Mokohinau Is	48.0 D	61
"	"	"	43.0 M	21.3.79	35 43 , 175 27	NE Mokohinau Is	44.0 D	60
"	"	"	47.0 M	"	"	"	47.0 D	60
"	"	"	44.0 M	"	"	"	45.0 D	60
"	"	"	46.0 M	22.3.79 to 23.3.79	35 43 , 175 18 to 35 49 , 175 27	NNE Mokohinau Is ENE Mokohinau Is	U	58
"	"	"	46.0 M	"	"	"	U	58
"	"	"	45.0 M	"	"	"	U	58
2.3.79	35 27 , 174 52	E Poor Knights Is	46.0 M	2.3.79	35 26 , 174 53	E Poor Knights Is	46.5 A	2
"	"	"	46.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	45.5 D	15
"	"	"	45.0 M	4.3.79	35 30 , 174 50	SE Poor Knights Is	47.9 D	6
"	"	"	46.0 M	"	"	"	47.9 D	6
"	"	"	44.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	45.0 D	15
"	"	"	47.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	46.7 D	13
"	"	"	46.0 M	"	"	"	44.5 D	13
"	"	"	46.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	U	15

Release data				Recapture data				
Date	Position ° ' S ° ' E	General area	Fish length (cm)	Date	Position ° ' S ° ' E	General area	Fish length (cm)	Distance (km)
2.3.79	35 27 , 174 52	E Poor Knights Is	47.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	46.8 D	13
"	"	"	46.0 M	"	"	"	44.6 D	13
"	"	"	46.0 M	4.3.79	35 30 , 174 50	SE Poor Knights Is	47.9 D	6
"	"	"	44.0 M	"	"	"	47.9 D	6
"	"	"	43.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	43.3 D	13
"	"	"	51.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	51.0 D	15
"	"	"	43.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	43.2 D	13
"	"	"	46.4 B	4.3.79	35 30 , 174 50	SE Poor Knights Is	47.9 D	6
"	"	"	46.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	45.3 D	13
"	"	"	45.0 M	"	"	"	45.3 D	13
"	"	"	46.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	46.0 D	15
"	"	"	45.0 M	"	"	"	U	15
"	"	"	47.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	45.0 A	12
"	"	"	48.0 M	5.3.79	35 24 , 174 56	E Poor Knights Is	46.6 D	8
"	"	"	46.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	46.0 A	12
"	"	"	46.0 M	5.3.79	35 24 , 174 56	E Poor Knights Is	46.5 D	8
"	"	"	45.0 M	"	"	"	45.0 D	8
"	"	"	46.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	45.0 A	12
"	"	"	44.0 M	"	"	"	46.0 A	12
"	"	"	48.0 M	5.3.79	35 24 , 174 56	E Poor Knights Is	42.8 D	8
"	"	"	45.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	46.0 A	12
"	"	"	46.0 M	"	"	"	U	12
"	"	"	46.0 M	5.3.79	35 23 , 174 53	NE Poor Knights Is	46.0 A	8
"	"	"	47.0 M	5.3.79 to 6.3.79	35 55 , 175 38 to 35 56 , 175 40	NE Great Barrier I "	46.0 D	88
"	"	"	46.0 M	"	"	"	45.4 D	88
"	"	"	46.0 M	17.3.79	36 02 , 175 51	The Cross	47.0 D	110
2.3.79	35 25 , 174 53	E Poor Knights Is	51.6 B	3.3.79	35 27 , 174 56	E Poor Knights Is	51.0 A	6
"	"	"	48.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	48.0 D	15
"	"	"	51.0 M	"	"	"	51.0 D	15
"	"	"	52.0 M	"	"	"	50.0 D	15
"	"	"	51.6 B	4.3.79	35 25 , 175 00	E Poor Knights Is	55.2 D	11
"	"	"	52.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	53.5 D	15
"	"	"	52.0 M	"	"	"	52.0 D	15
"	"	"	54.0 M	"	"	"	51.0 D	15
"	"	"	50.5 M	"	"	"	51.0 D	15
"	"	"	54.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	53.3 D	11
"	"	"	51.0 M	4.3.79	35 30 , 174 50	SE Poor Knights Is	47.9 D	10
"	"	"	48.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	49.0 D	15
"	"	"	50.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	49.0 D	11
"	"	"	47.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	48.0 D	15
"	"	"	49.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	48.5 A	11
"	"	"	51.0 M	"	"	"	50.0 A	11
"	"	"	52.0 M	5.3.79	35 24 , 174 56	E Poor Knights Is	51.7 D	5
"	"	"	49.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	49.0 A	11
"	"	"	51.0 M	"	"	"	49.0 A	11
"	"	"	54.0 M	5.3.79	35 24 , 174 56	E Poor Knights Is	54.0 D	5
"	"	"	48.0 M	5.3.79 to 6.3.79	35 55 , 175 38 to 35 56 , 175 40	NE Great Barrier I "	U	90
"	"	"	49.0 M	"	"	"	U	90
"	"	"	54.0 M	"	"	"	52.3 D	90

Release data				Recapture data				
Date	Position ° ' S ° ' E	General area	Fish length (cm)	Date	Position ° ' S ° ' E	General area	Fish length (cm)	Distance (km)
2.3.79	35 25 , 174 53	E Poor Knights Is	50.0 M	22.3.79	35 43 , 175 18	NNE Mokohinau Is	U	59
				to	to			
				23.3.79	35 49 , 175 27	ENE Mokohinau Is		
2.3.79	35 24 , 174 54	E Poor Knights Is	47.0 M	2.3.79	35 26 , 174 53	NE Poor Knights Is	49.0 A	4
"	"	"	46.0 M	"	"	"	49.0 A	4
"	"	"	47.0 M	3.3.79	35 27 , 174 56	E Poor Knights Is	46.5 A	6
"	"	"	44.0 M	"	"	"	44.2 A	6
"	"	"	45.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	46.0 D	15
"	"	"	44.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	44.1 D	9
"	"	"	45.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	45.5 D	15
"	"	"	44.0 M	4.3.79	35 30 , 174 50	SE Poor Knights Is	47.9 D	13
"	"	"	46.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	44.5 D	9
"	"	"	44.0 M	4.3.79	35 30 , 174 50	SE Poor Knights Is	47.9 D	13
"	"	"	46.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	45.4 D	9
"	"	"	45.0 M	"	"	"	44.8 D	9
"	"	"	45.0 M	"	"	"	45.0 D	9
"	"	"	46.0 M	"	"	"	46.2 D	9
"	"	"	45.0 M	4.3.79	35 30 , 174 50	SE Poor Knights Is	47.9 D	13
"	"	"	45.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	45.0 D	15
"	"	"	46.0 M	4.3.79	35 30 , 174 50	SE Poor Knights Is	47.9 D	13
"	"	"	45.9 B	4.3.79	35 25 , 175 00	E Poor Knights Is	45.0 D	9
"	"	"	45.9 B	"	"	"	42.0 J	9
"	"	"	45.9 B	4.3.79	35 30 , 175 01	SE Poor Knights Is	46.0 D	15
"	"	"	45.0 M	"	"	"	U	15
"	"	"	46.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	44.1 D	9
"	"	"	46.0 M	"	"	"	44.9 D	9
"	"	"	45.0 M	"	"	"	46.7 D	9
"	"	"	44.0 M	"	"	"	43.1 D	9
"	"	"	46.0 M	"	"	"	45.9 D	9
"	"	"	45.9 B	"	"	"	52.5 D	9
"	"	"	45.0 M	"	"	"	43.6 D	9
"	"	"	45.9 B	"	"	"	45.3 D	9
"	"	"	45.9 B	"	"	"	43.0 J	9
"	"	"	45.9 B	"	"	"	44.7 D	9
"	"	"	45.9 B	"	"	"	44.5 D	9
"	"	"	45.9 B	"	"	"	46.7 D	9
"	"	"	45.0 M	"	"	"	44.4 D	9
"	"	"	47.0 M	"	"	"	47.9 D	9
"	"	"	44.0 M	"	"	"	46.0 D	9
"	"	"	48.0 M	"	"	"	47.0 D	9
"	"	"	46.0 M	"	"	"	44.9 D	9
"	"	"	46.0 M	"	"	"	45.4 D	9
"	"	"	48.0 M	"	"	"	42.0 J	9
"	"	"	46.0 M	"	"	"	46.0 D	9
"	"	"	45.0 M	"	"	"	44.4 D	9
"	"	"	46.0 M	"	"	"	43.0 J	9
"	"	"	46.0 M	"	"	"	46.0 D	9
"	"	"	44.0 M	"	"	"	43.8 D	9
"	"	"	44.0 M	"	"	"	44.2 D	9
"	"	"	45.0 M	"	"	"	44.9 D	9
"	"	"	45.0 M	"	"	"	44.2 D	9
"	"	"	47.0 M	"	"	"	47.1 D	9
"	"	"	43.0 M	"	"	"	42.5 D	9

Release data				Recapture data				
Date	Position ° ' S ° ' E	General area	Fish length (cm)	Date	Position ° ' S ° ' E	General area	Fish length (cm)	Distance (km)
2.3.79	35 24 , 174 54	E Poor Knights Is	46.3 B	4.3.79	35 25 , 175 00	E Poor Knights Is	46.0 D	9
"	"	"	45.0 M	"	"	"	44.2 D	9
"	"	"	45.0 M	"	"	"	46.7 D	9
"	"	"	45.0 M	"	"	"	44.1 D	9
"	"	"	47.0 M	4.3.79	35 30 , 174 50	SE Poor Knights Is	47.9 D	13
"	"	"	44.0 M	"	"	"	47.9 D	13
"	"	"	40.0 M	"	"	"	47.9 D	13
"	"	"	46.0 M	"	"	"	47.9 D	13
"	"	"	44.0 M	"	"	"	47.9 D	13
"	"	"	56.0 M	"	"	"	47.9 D	13
"	"	"	45.0 M	"	"	"	47.9 D	13
"	"	"	45.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	U	15
"	"	"	45.9 B	"	"	"	45.0 D	15
"	"	"	45.9 B	"	"	"	42.2 D	15
"	"	"	49.0 M	"	"	"	48.0 D	15
"	"	"	46.0 M	"	"	"	47.0 D	15
"	"	"	48.0 M	"	"	"	48.0 D	15
"	"	"	48.0 M	"	"	"	47.3.D	15
"	"	"	44.0 M	"	"	"	45.0 D	15
"	"	"	46.0 M	"	"	"	U	15
"	"	"	47.0 M	"	"	"	47.0 D	15
"	"	"	46.0 M	"	"	"	U	15
"	"	"	46.0 M	"	"	"	46.5 D	15
"	"	"	45.0 M	"	"	"	46.0 D	15
"	"	"	47.0 M	"	"	"	47.0 D	15
"	"	"	46.3 B	"	"	"	47.5 D	15
"	"	"	45.0 M	5.3.79	35 24 , 174 56	E Poor Knights Is	45.8 D	3
"	"	"	49.0 M	"	"	"	48.5 D	3
"	"	"	49.0 M	"	"	"	48.2 D	3
"	"	"	46.0 M	"	"	"	45.0 D	3
"	"	"	46.0 M	"	"	"	47.6 D	3
"	"	"	45.0 M	"	"	"	45.8 D	3
"	"	"	45.9 B	"	"	"	44.3 D	3
"	"	"	45.9 B	"	"	"	45.5 D	3
"	"	"	45.9 B	"	"	"	45.2 D	3
"	"	"	45.9 B	"	"	"	44.8 D	3
"	"	"	45.9 B	"	"	"	45.5 D	3
"	"	"	46.0 M	"	"	"	46.2 D	3
"	"	"	44.0 M	"	"	"	45.5 D	3
"	"	"	45.0 M	"	"	"	44.8 D	3
"	"	"	45.0 M	"	"	"	U	3
"	"	"	46.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	45.0 A	10
"	"	"	46.0 M	"	"	"	46.0 A	10
"	"	"	47.0 M	"	"	"	47.0 A	10
"	"	"	45.9 B	"	"	"	43.0 A	10
"	"	"	45.0 M	"	"	"	U	10
"	"	"	47.0 M	"	"	"	46.0 A	10
"	"	"	45.9 B	"	"	"	46.0 A	10
"	"	"	45.9 B	"	"	"	45.5 A	10
"	"	"	45.0 M	"	"	"	44.5 A	10
"	"	"	45.9 B	"	"	"	44.5 A	10
"	"	"	45.9 B	"	"	"	43.0 A	10
"	"	"	45.9 B	"	"	"	43.5 A	10

Release data				Recapture data				
Date	Position ° ' S ° ' E	General area	Fish length (cm)	Date	Position ° ' S ° ' E	General area	Fish length (cm)	Distance (kg)
2.3.79	35 24 , 174 54	E Poor Knights Is	45.9 B	5.3.79	35 26 , 175 00	E Poor Knights Is	45.5 A	10
"	"	"	44.0 M	"	"	"	44.5 A	10
"	"	"	46.0 M	"	"	"	46.0 A	10
"	"	"	44.0 M	"	"	"	43.0 A	10
"	"	"	45.9 B	5.3.79	35 55 , 175 38	NE Great Barrier I	46.4 D	90
				to	to			
				6.3.79	35 56 , 175 40	"		
"	"	"	45.9 B	"	"	"	46.9 D	90
"	"	"	44.0 M	"	"	"	45.2 D	90
"	"	"	47.0 M	"	"	"	48.2 D	90
"	"	"	45.9 B	"	"	"	47.4 D	90
"	"	"	45.9 B	"	"	"	44.3 D	90
"	"	"	45.9 B	"	"	"	44.9 D	90
"	"	"	44.0 M	"	"	"	U	90
"	"	"	43.0 M	"	"	"	43.8 D	90
"	"	"	48.0 M	"	"	"	48.4 D	90
"	"	"	45.0 M	"	"	"	44.0 D	90
"	"	"	47.0 M	"	"	"	45.1 D	90
"	"	"	44.0 M	"	"	"	44.8 D	90
"	"	"	44.0 M	21.3.79	35 43 , 175 27	NE Mokohinau Is	44.0 D	61
"	"	"	45.0 M	"	"	"	46.0 D	61
"	"	"	46.0 M	"	"	"	46.0 D	61
"	"	"	45.0 M	"	"	"	46.0 D	61
"	"	"	46.0 M	"	"	"	46.0 D	61
"	"	"	46.0 M	21.3.79	35 43 , 175 28	NE Mokohinau Is	47.0 D	62
"	"	"	45.0 M	23.3.79	35 43 , 175 27	NE Mokohinau Is	45.8 D	61
"	"	"	47.0 M	22.3.79	35 43 , 175 18	NNE Mokohinau Is	U	59
				to	to			
				23.3.79	35 49 , 175 27	ENE Mokohinau Is		
"	"	"	46.0 M	"	"	"	U	59
"	"	"	45.9 B	"	"	"	U	59
"	"	"	45.9 B	"	"	"	46.7 D	59
"	"	"	46.0 M	22.3.79	35 43 , 175 18	NNE Mokohinau Is	U	59
				to	to			
				23.3.79	35 46 , 175 29	ENE Mokohinau Is		
"	"	"	46.0 M	22.3.79	35 43 , 175 18	NNE Mokohinau Is	U	59
				to	to			
				23.3.79	35 49 , 175 27	ENE Mokohinau Is		
3.3.79	35 32 , 174 49	SE Poor Knights Is	47.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	44.3 D	21
"	"	"	47.0 M	"	"	"	46.6 D	21
"	"	"	45.0 M	"	"	"	44.8 D	21
"	"	"	45.0 M	"	"	"	45.2 D	21
"	"	"	47.0 B	"	"	"	46.7 D	21
"	"	"	46.0 M	"	"	"	45.6 D	21
"	"	"	46.0 M	"	"	"	45.9 D	21
"	"	"	46.0 M	"	"	"	45.0 D	21
"	"	"	45.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	46.0 D	18
"	"	"	46.0 M	"	"	"	46.5 D	18
"	"	"	48.0 M	"	"	"	48.0 D	18
"	"	"	51.0 M	"	"	"	52.0 D	18
"	"	"	49.0 M	"	"	"	U	18
"	"	"	45.0 M	"	"	"	46.0 D	18
"	"	"	48.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	47.5 A	20

Release data				Recapture data				
Date	Position ° ' S ° ' E	General area	Fish length (cm)	Date	Position ° ' S ° ' E	General area	Fish length (cm)	Distance (km)
3.3.79	35 32 , 174 49	SE Poor Knights Is	46.0 M	5.3.79	35 26 , 175 00	E Poor Knights Is	45.0 A	20
"	"	"	49.0 M	"	"	"	49.5 A	20
"	"	"	47.0 B	"	"	"	47.0 A	20
"	"	"	47.0 M	"	"	"	44.0 A	20
"	"	"	50.0 M	"	"	"	50.0 A	20
"	"	"	47.0 B	5.3.79	35 24 , 174 56	NE Poor Knights Is	44.8 D	18
"	"	"	47.0 M	"	"	"	47.9 D	18
"	"	"	46.0 M	"	"	"	46.0 D	18
"	"	"	46.0 M	5.3.79	35 55 , 175 38	NE Great Barrier I	46.7 D	87
				to	to			
				6.3.79	35 56 , 175 40	"		
"	"	"	47.0 B	"	"	"	44.8 D	87
"	"	"	48.0 M	"	"	"	47.3 D	87
"	"	"	46.0 M	"	"	"	46.2 D	87
3.3.79	35 31 , 174 50	SE Poor Knights Is	46.0 M	4.3.79	35 25 , 175 00	E Poor Knights Is	44.8 D	19
"	"	"	46.0 M	"	"	"	43.0 J	19
"	"	"	46.0 M	"	"	"	43.5 J	19
"	"	"	47.0 M	"	"	"	47.7 D	19
"	"	"	48.8 T	"	"	"	44.5 D	19
"	"	"	48.8 T	"	"	"	46.0 D	19
"	"	"	47.0 M	"	"	"	47.3 D	19
"	"	"	47.0 M	"	"	"	46.7 D	19
"	"	"	47.7 T	"	"	"	44.2 D	19
"	"	"	45.0 M	4.3.79	35 30 , 175 01	SE Poor Knights Is	46.0 D	17
"	"	"	48.0 M	"	"		U	17
"	"	"	44.0 M	5.3.79	35 24 , 174 56	NE Poor Knights Is	44.6 D	16
"	"	"	50.0 M	"	"	"	49.0 D	16
"	"	"	49.0 M	"	"	"	48.8 D	16
"	"	"	49.0 M	"	"	"	49.2 D	16
"	"	"	54.5 M	5.3.79	35 26 , 175 00	E Poor Knights Is	53.5 A	18
"	"	"	47.0 M	"	"	"	46.5 A	18
"	"	"	47.0 M	"	"	"	U	18
"	"	"	48.0 M	5.3.79	35 55 , 175 38	NE Great Barrier I	47.5 D	87
				to	to			
				6.3.79	35 56 , 175 40	"		
5.3.79	35 37 , 175 11	NNE Mokohinau Is	46.0 M	20.3.79	36 03 , 175 58	The Cross	47.0 D	92
				to	to			
				21.3.79	36 08 , 176 04	"		
6.3.79	35 51 , 175 30	NNE Great Barrier I	47.0 M	6.3.79	35 55 , 175 38	NE Great Barrier I	U	16
					to			
					35 56 , 175 40	"		
"	"	"	45.0 M	"	"	"	U	16
"	"	"	48.0 M	21.3.79	36 03 , 176 04	The Cross	48.8 D	56
"	"	"	48.0 M	"	"	"	48.7 D	56
"	"	"	46.0 M	21.3.79	35 43 , 175 27	NE Mokohinau Is	47.0 D	15
"	"	"	44.0 M	20.3.79	36 03 , 175 58	The Cross	43.5 D	54
				to	to			
				21.3.79	36 08 , 176 04	"		
"	"	"	46.0 M	23.3.79	35 43 , 175 27	NE Mokohinau Is	46.0 D	15
"	"	"	45.0 M	23.3.79	35 53 , 176 04	The Cross	45.1 D	51
"	"	"	47.0 M	27.3.79	37 19 , 176 14	W Bay of Plenty	47.5 D	176
6.3.79	35 53 , 175 34	NNE Great Barrier I	46.0 M	17.3.79	36 02 , 175 51	The Cross	45.5 D	30
"	"	"	46.0 M	21.3.79	35 43 , 175 27	NE Mokohinau Is	46.0 D	21

Release data				Recapture data				
Date	Position ° ' S ° ' E	General area	Fish length (cm)	Date	Position ° ' S ° ' E	General area	Fish length (cm)	Distance (km)
6.3.79	35 53 , 175 34	NNE Great Barrier I	45.0 M	20.3.79 to 21.3.79	36 03 , 175 58 to 36 08 , 176 04	The Cross "	43.0 J	47
"	"	"	44.0 M	"	"	"	44.4 D	47
"	"	"	45.0 M	21.3.79	36 03 , 176 04	The Cross	45.5 D	49
"	"	"	46.0 M	"	"	"	45.4 D	49
6.3.79	35 46 , 175 28	NE Mokohinau Is	47.0 M	20.3.79 to 21.3.79	36 03 , 175 58 to 36 08 , 176 04	The Cross "	46.0 D	61
"	"	"	47.0 M	"	"	"	46.8 D	61
7.3.79	37 40 , 176 57	C Bay of Plenty	46.5 M	8.3.79	37 45 , 177 00	C Bay of Plenty	46.8 A	10
8.3.79	37 41 , 177 26	E Bay of Plenty	56.0 M	25.3.79	37 49 , 176 58	C Bay of Plenty	U	44
"	"	"	56.0 M	17.4.79	37 38 , 176 16	W Bay of Plenty	U	103
"	"	"	56.0 M	5.5.79	37 30 , 176 16	W Bay of Plenty	56.5 D	105
13.3.79	37 38 , 176 33	W Bay of Plenty	50.0 M	"	"	"	51.5 D	29
14.3.79	37 37 , 176 30	W Bay of Plenty	46.0 M	27.3.79	37 19 , 176 14	W Bay of Plenty	46.0 D	41
"	"	"	48.0 M	29.3.79	37 29 , 178 05	E Bay of Plenty	49.0 D	140
"	"	"	43.0 M	7.4.79	37 19 , 176 13	W Bay of Plenty	43.3 D	42
14.3.79	37 41 , 176 51	C Bay of Plenty	59.9 B	3.4.79	37 53 , 176 45	C Bay of Plenty	U	24

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