NEW ZEALAND
MINISTRY OF AGRICULTURE AND FISHERIES

FISHERIES TECHNICAL REPORT
NO. 143

ASPECTS OF THE SOUTHERN SPIDER CRAB (JACQUINOTIA EDWARDS II FISHERY OF SOUTHERN NEW ZEALAND ISLANDS AND PUKAKI RISE

M. R. RYFF AND R. W. VOLLER

WELLINGTON, NEW ZEALAND
1976

FISHERIES TECHNICAL REPORT

ASPECTS OF THE SOUTHERN SPIDER CRAB (JACQUINOTIA EDWARDSII) FISHERY OF SOUTHERN NEW ZEALAND ISLANDS AND PUKAKI RISE

M.R. RYFF & R.W. VOLLER
FISHERIES MANAGEMENT DIVISION
WELLINGTON

CONTENTS

LIST OF MAPS, FIGURES, AND TABLES

LIST OF MAPS, FIGURES, AND TABLES (Cont'd)

ABSTRACT

A joint New Zealand-Japanese venture using a 497-ton Japanese vessel fished for *Jacquinotia edwardsii* (Jacquinot, 1853) at the Auckland Islands (52°S, 166°E) 15 December 1973, Campbell Island (52 30'S, 169 E) 25 December 1973 and Pukaki Rise (49°S, 172°E) from 28 December 1973 to 2 March 1974.

Ling (*Genypterus blacodes*) was found to be the best bait.

The average catch per unit of effort was 59 kg per 10 pots at the Pukaki Rise (i.e., approximately 3 takeable crabs per pot - where a takeable crab is one greater than 12 cm carapace width), 15.3 kg per 10 pots at the Auckland Islands and nil at Campbell Island. Rough conditions and removal of bait by lice were problems at the Auckland Islands.

Methods of processing and fishing are described.

Meat recovery was 15% for hard-shelled crabs and 7% for soft-shelled when extracted by hand. Overall meat recovery was 10-11%.

Biological aspects, including moulting, are discussed.

Management aspects are considered and a possible New Zealand venture examined.

Other commercial species are noted.

SUMMARY

1. A joint venture using a 497 ton Japanese crab boat fished for the Southern Spider crab, *J. edwardsii* at the Auckland Islands, Campbell Island and the Pukaki Rise.

2. The longest period was spent at the Pukaki Rise (56 days), then the Auckland Islands (10 days) and Campbell Island (1 day).

3. Gear consisted of sets of pots, approximately 2 miles long and containing about 180 pots. A full set of gear usually took about 1½ hours to haul.

4. A wide variety of bait was used, both frozen and fresh, with Ling appearing to be the best.

5. Descriptions of the setting and the hauling of gear are given.

6. The average catch per unit of effort was 59 kg/10 pots (i.e. approximately 3 crabs per pot) at the Pukaki Rise, 15.3 kg/10 pots at the Aucklands, and negligible at Campbell Island and the Stewart Island shelf.

7. Catch rate may have been higher at the Aucklands as only pollock bait was used and lice removed this bait after eight hours.

8. A description of processing is given. Only takeable crabs were processed (those over 12 cm carapace width).

9. Meat recovery was 15.4% for hard-shell crabs and 7% for soft-shell crabs when extracted by hand. Actual meat recovery (mechanical) was 11.4% at the Pukaki Rise, 10.0% at the Aucklands and 9.9% at Campbell Island.

10. 218 takeable crabs were tagged at the Pukaki Rise. One was recaptured and showed movement of about 2 km.

11. Moulting appears to be continuous from November to March. A photograph of a crab in the process of moulting was taken.

12. Evidence supports Ritchie (1970) in that females tended to be in greater numbers in shallower waters.

13. Management aspects of the Pukaki Rise and the Auckland Islands are considered. Conservatory legislation is recommended.

14. An estimate of the population is made at the Pukaki Rise.

15. A possible New Zealand venture is considered with a stern trawler being considered a suitable vessel.

16. Other commercial species are considered, including crabs, octopus, whelks, ling, cod and southern blue whiting.

17. A complete record of the weather conditions and set information is given in the appendices.

INTRODUCTION

Presence of large stocks of the southern spider crab Jacquinotia edwardsii (Jacquinot, 1853) in depths of less than 200 m at the Auckland Islands has been shown by Ritchie (1970, 1973) and at the Pukaki Rise by the Japanese Fishing Agency (unpublished report 1971).

The "Satsu Maru 17" a 497 ton Japanese crab fishing vessel was chartered by the fishing company Sealord Products Limited, Nelson, New Zealand, to examine the commercial viability of the southern spider crab fishery at the southern New Zealand Islands and Pukaki Rise. This report details the fishing operations of the "Satsu Maru 17" between 15 December 1973 and 2 March 1974 and includes fishing method, catch, and processing. The biology of J. edwardsii is reviewed and some data from this expedition is included. Also, aspects of the crab fishing resource are discussed. Finally, a possible New Zealand vessel and gear are examined and with this in mind other commercial species noted.

WEATHER

The "Satsu Maru 17" received isobaric charts from Canberra and Tokyo with a Kyodo weather facsimile recorder. From these charts weather predictions for the next four or five days could be made and gear was set in a direction relevant to expected winds. Weather data recorded by the ship are shown in Appendix 1.

The weather on the Pukaki Rise frequently made fishing difficult and winds of 25 knots were common. Two days fishing were lost when force 7 (Beaufort) conditions occurred (35 knots). At the Auckland and Campbell Islands the weather was calmer as the Islands provided a buffer against the strong westerly winds.

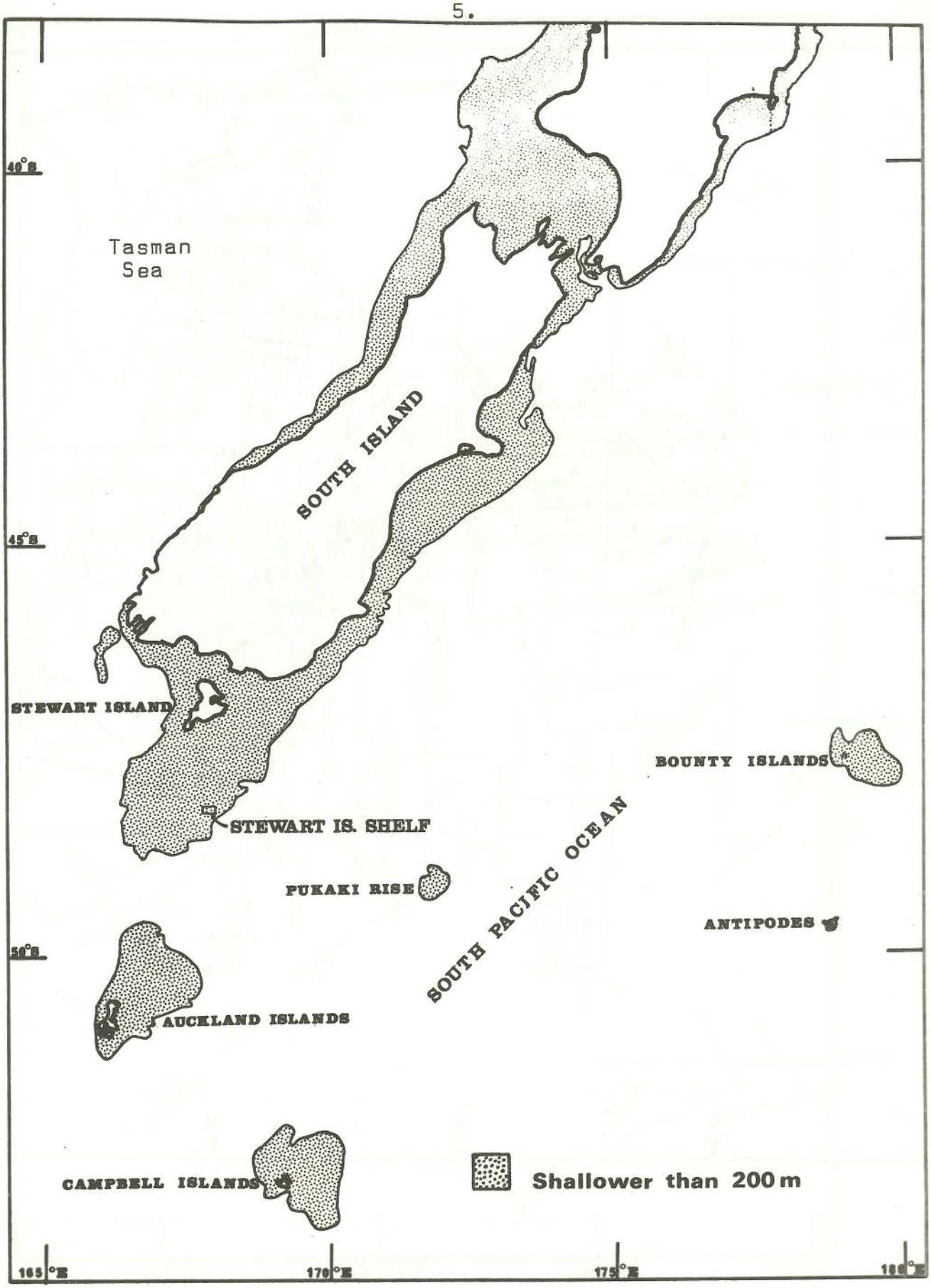
FISHING AREAS

Fifty-six days fishing (28 December - 2 March) was carried out on Pukaki Rise (49°S, 172°E) (Map 1) over an area of 2126 km^2 with depths averaging 145 m. However, the bottom was very uneven and trenches as deep as 452 m occurred on the fringes of the area. Pinacles were numerous and depths as shallow as 60 m occurred. Tidal currents of 1-2 knots occurred in a S.W.-N.E. direction.

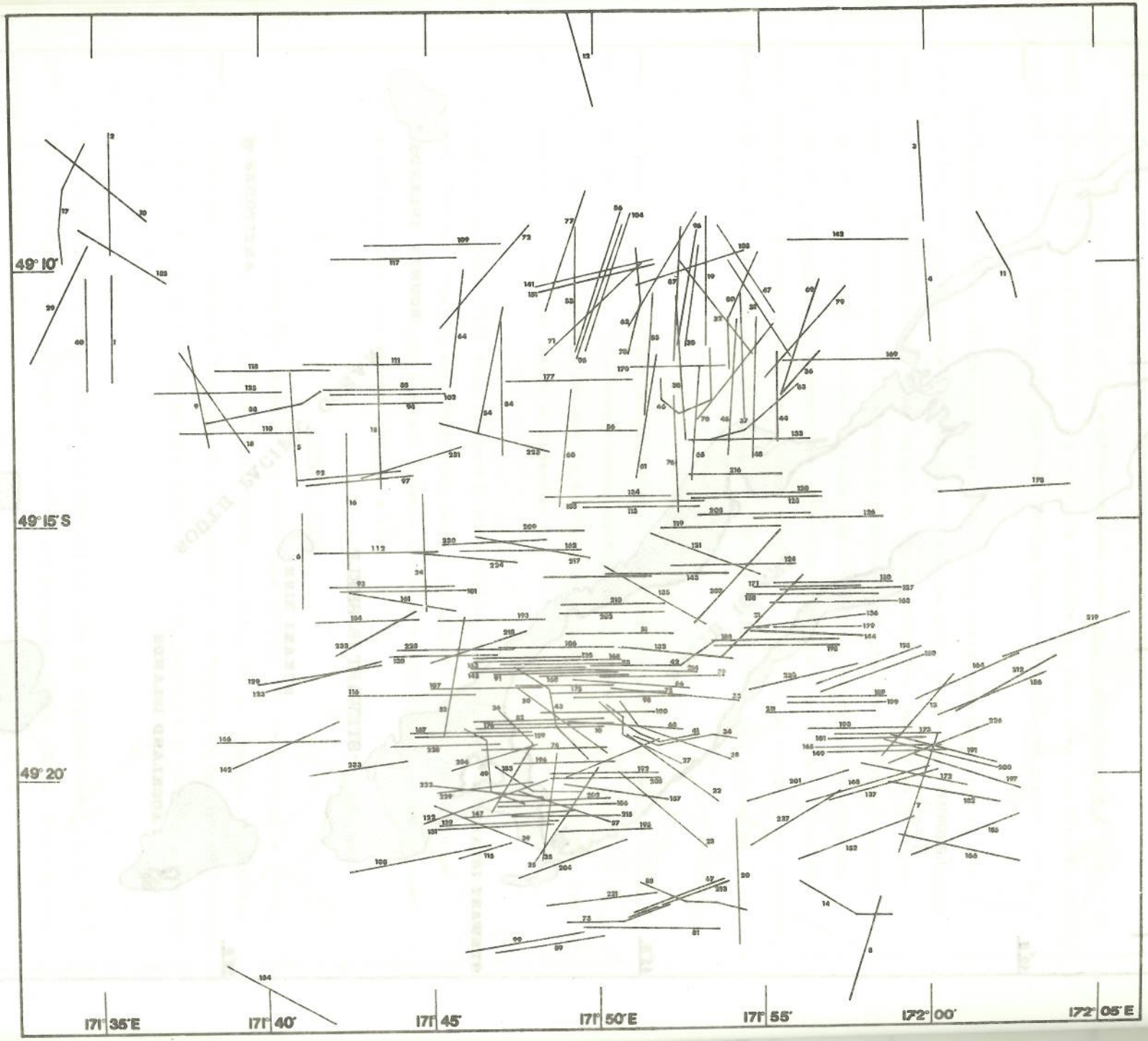
Ten days fishing (15 - 23 December) was carried out east of the Auckland Islands (52°S, 166°E) (Map 1) in depths ranging from 21 to 470 m and averaging about 110 m. South moving currents of 2-3 knots occurred.

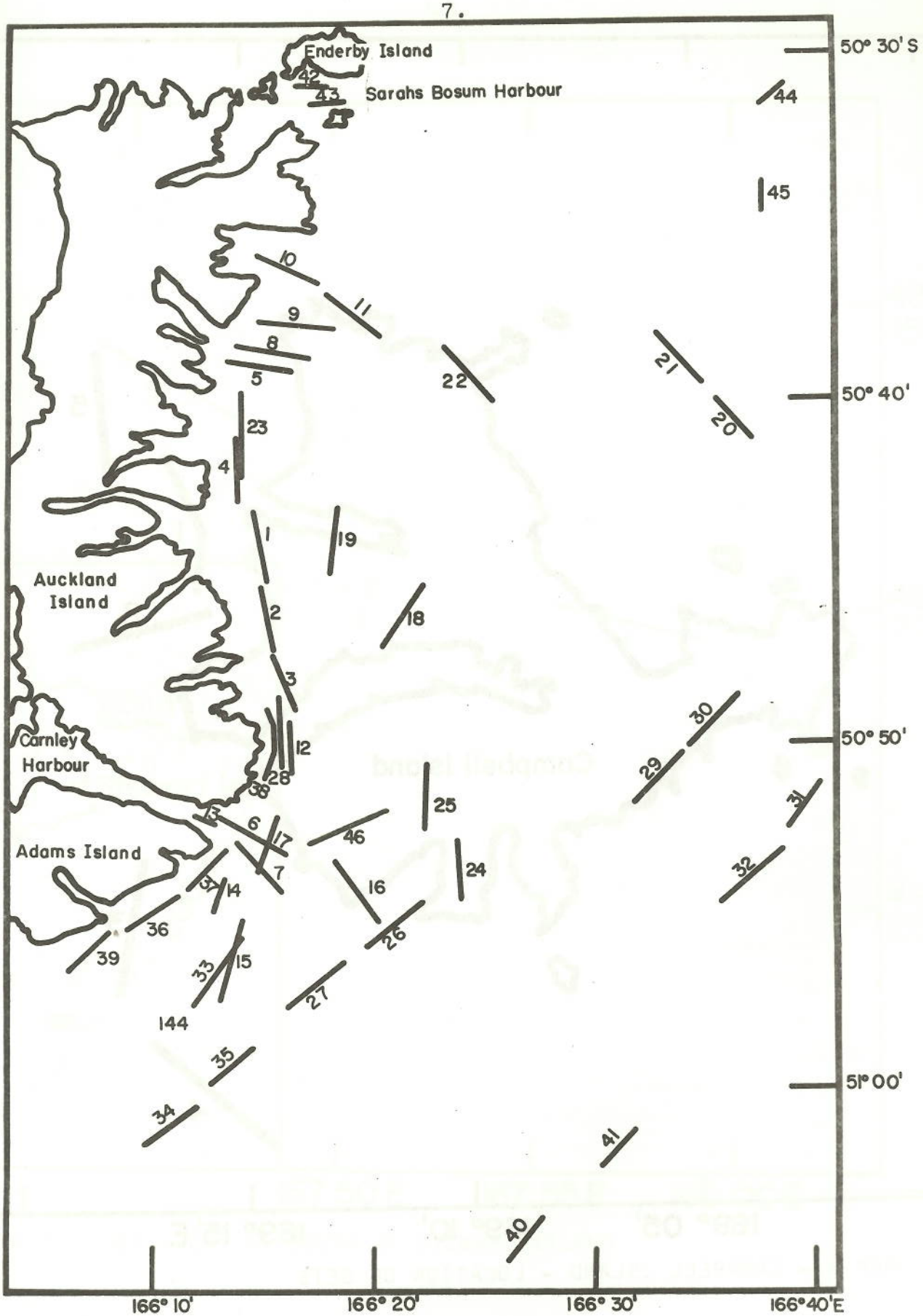
One day of fishing (25 December) was carried out east of Campbell Island (52°30'S, 169°E). (Map 1) in depths ranging from 157 to 78 m and averaging 98 m.

One day of fishing (14 February) was carried out on the Stewart Island shelf (48°S, 167°50'E). (Map 1) in open sea at depths of 140 m.

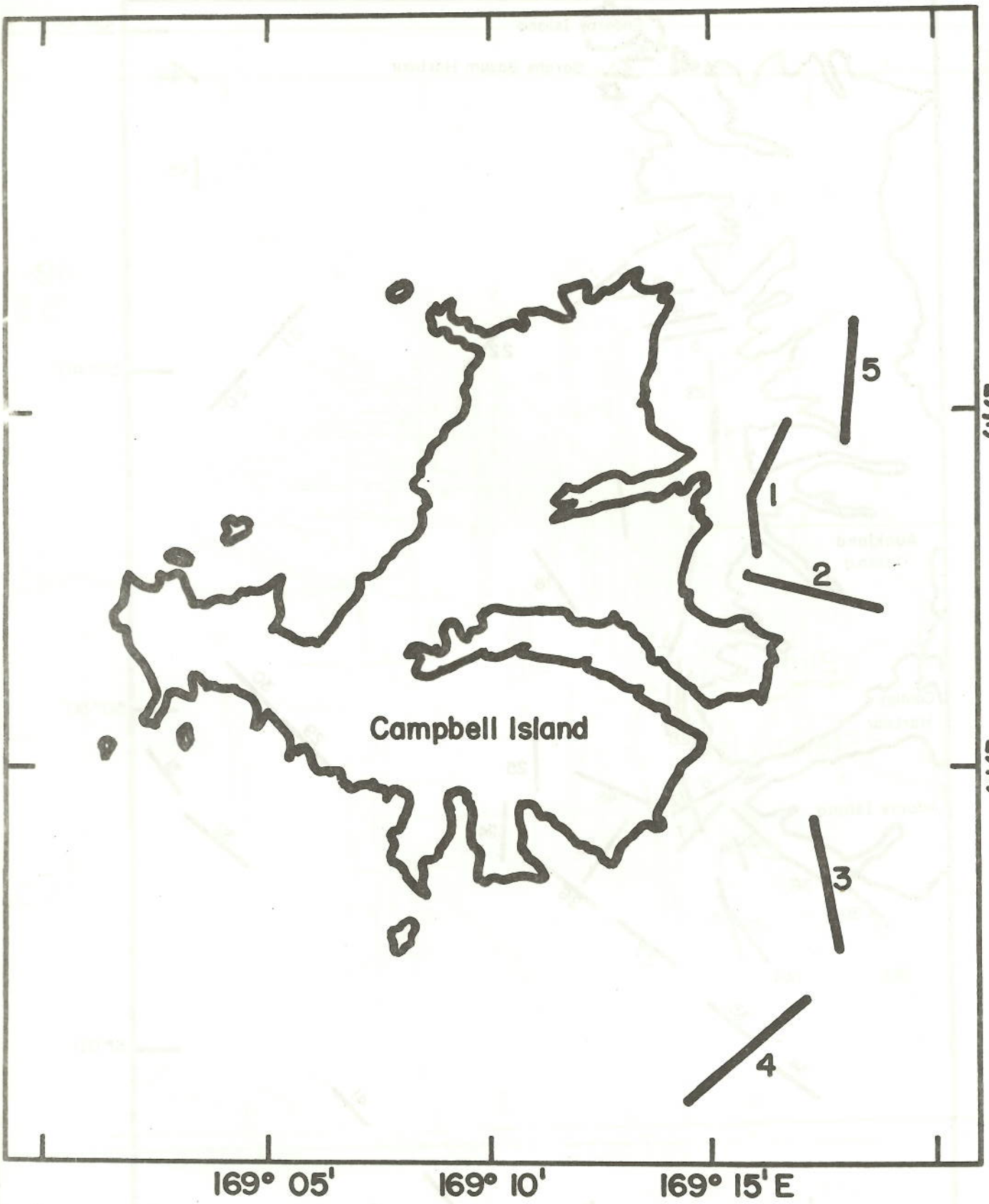


MAP 1 - GENERAL LOCATION OF AREAS FISHED

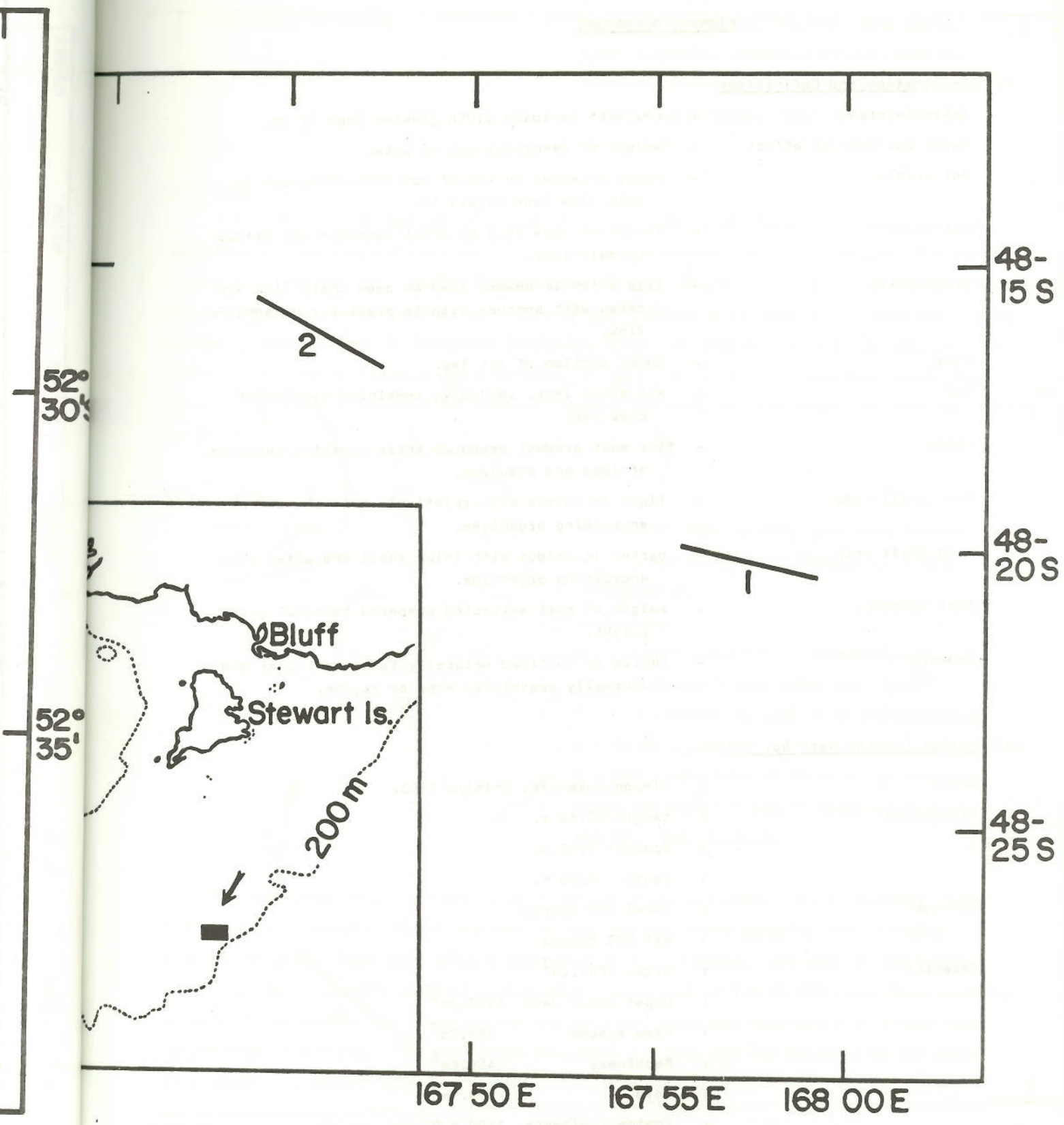

49° 10'
49° 15' S
49° 20'
171° 35' E
171° 40'
171° 45'
171° 50' E
171° 55'
172° 00'
172° 05' E



MAP 3 - AUCKLAND ISLANDS - LOCATION OF SETS



MAP 4 - CAMPBELL ISLAND - LOCATION OF SETS



MAP 5 - SET LOCATION SOUTH OF STEWART ISLAND

FISHING OPERATION

(a) Explanation and Definitions

Takeable crab	-	one with carapace width greater than 12 cm.
Catch per unit of effort	-	weight of takeables per 10 pots.
Pot bridle	-	ropes attached to top of pot connecting pot to main line (see Figure 1).
Pot Snood	-	length of rope (4.2 m) which connects pot bridle to main line.
Sister clip	-	clip which is shaped like an open chain link and mates with another clip to provide a detachable link.
Claw	-	lower section of 1st leg.
Leg	-	all other legs, including remaining section of claw leg.
Flake	-	fine meat product produced after crushing sections of legs and shoulder.
Soft shell crab	-	light in colour with relatively thin shell - no encrusting organisms.
Hard shell crab	-	darker in colour with thick shell and often with encrusting organisms.
Meat Recovery	-	weight of meat extracted compared to total green weight.
Endemic	-	native or confined naturally to a particular and unusually restricted area or region.

(b) Vessel ("Satsu Maru No. 17")

Built	:	Nippon Kokan KK, Shimizu 1963.
Dimensions	:	Length 50.40 m.
	:	Breadth 9.75 m.
	:	Depth 4.20 m.
Tonnage	:	Total 507 tonnes
	:	Net 270 tonnes
Capacity	:	Gross 1048.2m^3
	:	Upper under deck 1206.1m^3
	:	Crew spaces 193.7m^3
	:	Machinery 450.6m^3
	:	Hold 779.6m^3
	:	Engine - Niigata 1400 H.P.
	:	Speed - Maximum 10.5 Knots
	:	- Average 9.8 Knots
	:	Fuel - Volume 266 Kilolitres
Average consumption	:	4.5 kilolitres/day
Freezer capacity	:	3.3 tonnes/day (to - 25^{o}C)

Auxillary equipment : Radar, gyro compass, sounder, auto pilot, Loran Automatic direction finder, weather facsimile receiver, single side band radios, loud hailer systems, fresh water generator, compressor.

(c) Crew

The Chief of Business was in charge of all operations of the ship. Crew members who were mostly concerned with the running of the ship included Master, 2 officers, 3 engineers, 2 oilers, radio officer, doctor, 2 cooks, electrician, welder-blacksmith and bosun, although some did help with crab processing. Crew mainly involved with fishing included the fishing master, 2 technicians, 21 fishermen (including 4 New Zealanders). There was also an Associate New Zealand Master and a Ministry of Agriculture and Fisheries biologist, the former acting as an observer for Sealord Products Limited, and the latter for the New Zealand Government.

(d) Fishing Gear

Catching gear : 13 sets of crab-catching gear were carried and one set is shown in Figure 1. A set consisted of:

: radio buoy

: 2 x 4 trawl buoys (35 cm diameter)

: 2 x end marker bamboo poles and flags

: 2 x 200 m anchor rope of 24 mm polypropylene

: 2 x 30 kg anchor

: 1 x 360 m main line of 24 mm polypropylene

: About 180 pots for actual numbers for each set shot (see Appendix 1).

The crab pots (Figures 1 and 2) were made of steel rod (base 1.5 cm (diameter) rest 1.0 cm (d)). A plastic throat was used to help prevent crabs escaping and to enable stacking of pots. Pots were covered with mesh of 5.5 cm nylon. The mesh on the bottom of the pot was loose and could be opened with a draw cord of 1.5 cm (D) rope, thus enabling release of the catch. To close the pot the cord was drawn and fastened with a slip knot to the side of the pot. The pot bridle was about 5 m long and was attached to the main line snood by a sister clip.

(e) Fishing Machinery

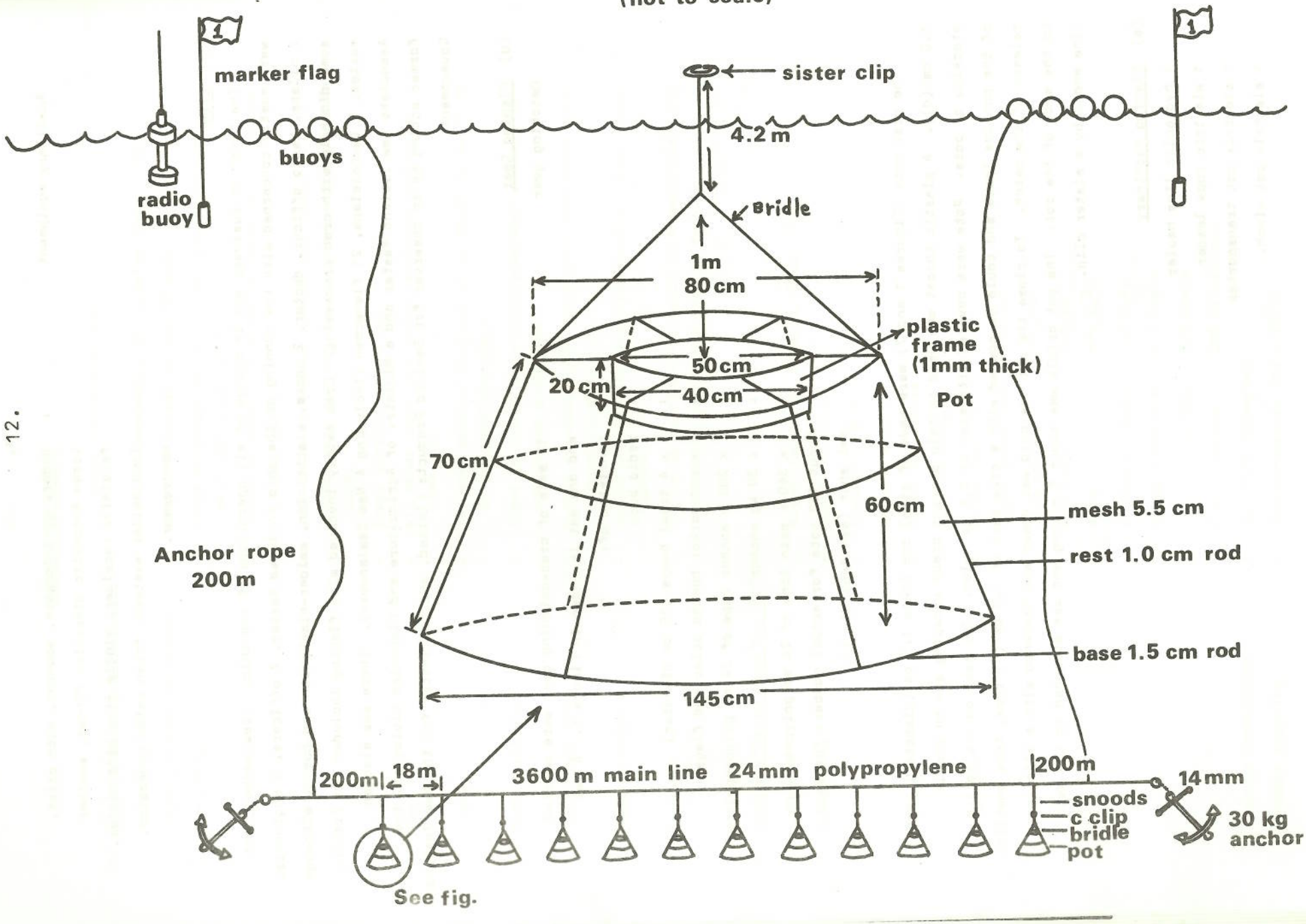
1 hydraulic line hauler

1 electric rope leader

1 electric pot transporter

1 electric pot winch.

Fig. 1 : CATCHING GEAR
(not to scale)



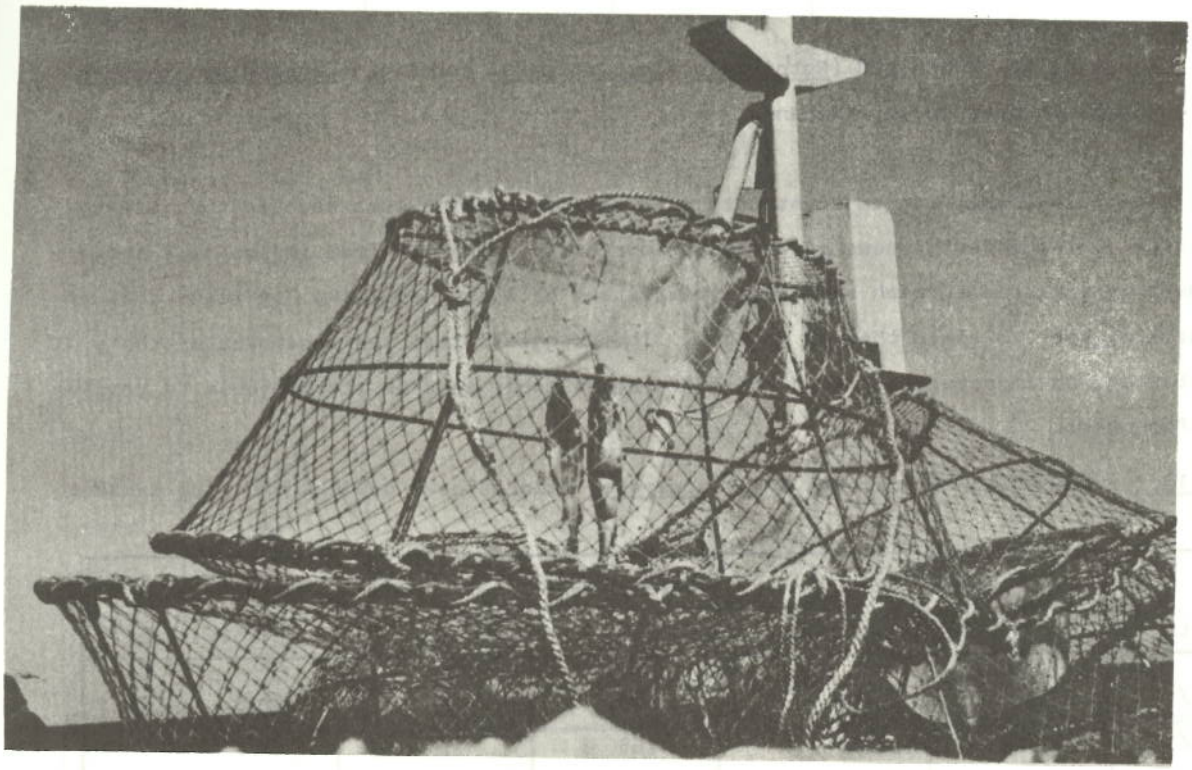


Figure 2 : A baited pot.

Fig. 1 : CATCHING GEAR
(not to scale)

(f) Bait

Three types of bait were used. These were:-

1. Frozen old bail - Alaska pollock (Theragra chalocogramma), caught Berring Sea the previous season.

2. Frozen fresh bait - dogfish (Squalus acanthias), gurnard (Cheilodonichthyes kumu), kingfish (Seriola grandis), horse mackerel (Trachurus declivis), snapper (Chrysophrys auratus) and stargazer (Geniagnus monopterygius) - caught this season in New Zealand.

3. Fresh bait - Black cod (Notothenia microlepidota) and ling (Genypterus blacodes) caught in pots during fishing.

Takeable crabs from adjacent pots with different baits were counted thus giving an idea of the effectiveness of these various baits. Results from Tables 1, 2 and 3 show that ling had a catch rate three times that of Alaska pollock, 2.4 times that of stargazer and 1.3 times that of dogfish. This suggests that the freshness of the bait could be important although the differences could also be attributable to species preferences.

Table 1 : Comparison of catches of J. edwardsii using Alaska pollock and ling as bait

Date	Set No.	No. prs.	Catch (Nos. of crabs) using		Ratio L : P
			Ling	Alaska Pollock	
2/1	17	14	96	42	2.3 : 1
3/1	30	28	265	79	3.5 : 1
3/1	28	10	103	40	2.6 : 1
4/1	31	6	62	30	2.1 : 1
4/1	32	49	172	62	2.6 : 1
5/1	26	5	38	17	2.3 : 1
6/1	35	9	69	32	2.2 : 1
6/1	38	34	284	86	3.3 : 1
10/1	40	15	156	54	2.8 : 1
10/1	45	75	534	146	3.7 : 1
10/1	44	19	162	72	2.3 : 1
11/1	39	11	84	16	5.3 : 1
11/1	43	17	177	39	4.5 : 1
				$\bar{x}$ =	3.00 : 1

Table 2 : Comparison of catches of J. edwardsii using Alaska pollock and dogfish as bait

Date	Set No.	No. of Pairs	Catch (Nos. crabs) using		Ratio D : P
			Dogfish	Alaska Pollock	
12/1	48	2	7	0	7 : 1
12/1	47	1	3	1	3 : 1
13/1	49	4	1	2	05 : 1
13/1	50	5	10	11	09 : 1
13/1	51	3	2	5	04 : 1
14/1	54	6	24	12	2 : 1
15/1	60	4	4	-	-
15/1	58	7	19	17	1.1 : 1
16/1	61	6	11	9	1.2 : 1
16/1	63	2	7	1	7 : 1
16/1	62	5	25	14	1.8 : 1
17/1	84	4	15	26	0.58 : 1
18/1	72	5	16	13	1.2 : 1
20/1	77	12	35	18	1.9 : 1
21/1	81	2	15	9	1.7 : 1
21/1	84	4	14	10	1.4 : 1
21/1	83	4	18	6	3 : 1
22/1	88	13	28	35	0.8 : 1
22/1	85	3	17	16	1 : 1
22/1	86	1	0	3	1 : 1
					$\bar{x}$ = 1.3 : 1

Table 3 : Comparison of catches of J. edwardsii using Alaska pollock and stargazer as bait

Date	Set No.	No. of Pairs	Catch (No. crabs) Using		Ratio S : P
			Stargazer	Alaska Pollock	
12/1	48	11	42	26	1.6 : 1
12/1	47	2	11	11	1 : 1
13/1	49	1	0	0	-
13/1	51	3	8	0	-
14/1	54	3	10	3	3.3 : 1
14/1	53	9	20	5	4 : 1
14/1	55	2	38	10	3.8 : 1
15/1	41	2	4	2	2 : 1
15/1	59	1	7	0	-
15/1	58	1	3	9	0.33 : 1
16/1	61	6	25	3	8.3 : 1
16/1	63	1	5	2	2.5 : 1
16/1	62	4	31	6	5.1 : 1
17/1	66	2	21	11	1.9 : 1
17/1	65	1	7	3	2.3 : 1
20/1	77	2	2	5	0.4 : 1
21/1	84	1	0	1	
					x = 2.4 : 1

(g) Gear Shooting

(Figure 3 shows the path of pots during hauling and selling.)

The pot shooting crew consisted of:-

Ship handler	-	Captain
Communicator	-	Chief of Business
Pot Launcher		Fishermen
Clipper		
Clip passer		
8 pot handlers		

Fishing areas were located with an echo sounder to avoid foul ground. When shooting gear the ship was turned stern to weather and steamed forward at 2 knots. Fishing communications from bridge control to stern was done by loud hailer. The stern deck ready for shooting is shown in Figure 4. Shooting of the crab fishing gear is shown in Figure 5. First the radio buoy, trawl buoys, anchor rope and

anchor were paid out. As the main line moved out of the setting box, the clip handler removed the pot clip from the clip rack and passed it to the clipper who clipped it to the pot snood. The pot was then thrown astern by the pot launcher. The pot handlers readied pots into position for clipping and launching. (Figure 6) This entailed tipping over the stacks of pots, making sure they were baited tying up the bottoms and presenting them to the pot launcher.

(h) Gear Hauling

Hauling crew consisted of:-

Ship handler	-	Chief of Business or Captain
Drum end hand	-	Fisherman
Pot Release man	-	Fisherman
2. Pot handlers	-	Fisherman
Pot hanger	-	Fisherman
Baiter (mid-ships)	-	Fisherman
Pot stackers (aft)	-	Fisherman
2. Pot stackers	-	Fisherman
2. Line handlers	-	Fisherman
Pot repair man	-	Fisherman

Sets were located with D.R. navigation checked with sunline sights and the radio buoy. When sets were hauled the vessel was steamed into the weather and tide. The set was picked up on the starboard bow with a grapnel (Figure 7) and the main line lead through a line hauler (Figure 8), and carried by an electric rope leader to the stern, where it was coiled in the setting box ready for shooting (Figure 9). The radio buoy, trawl buoys and anchor were carried to the stern. Pots were hauled aboard by hooking the pot bridles with a long metal hook, attached to the drum end of the line hauler by a cable (Figure 10). Pots were then disconnected from the main line by unhooking the sister clip, placed on the sorting table, opened and emptied (Figure 11). The pots were then placed on a flying fox transporter (Figures 12 and 13) (which ran along the starboard side) and carried to the stern where they were stacked in heaps of 50 ready for shooting (Figure 14). Bait was added either as the pots went by on the transporter or at the stern. The bait consisted of 2-3 fish (see bait section for types) and was attached by a piece of thin wire approximately 30 cm long. Many pots were damaged during hauling and these were immediately repaired at the stern. Hauling a full set of gear usually took about 1.5 hours.

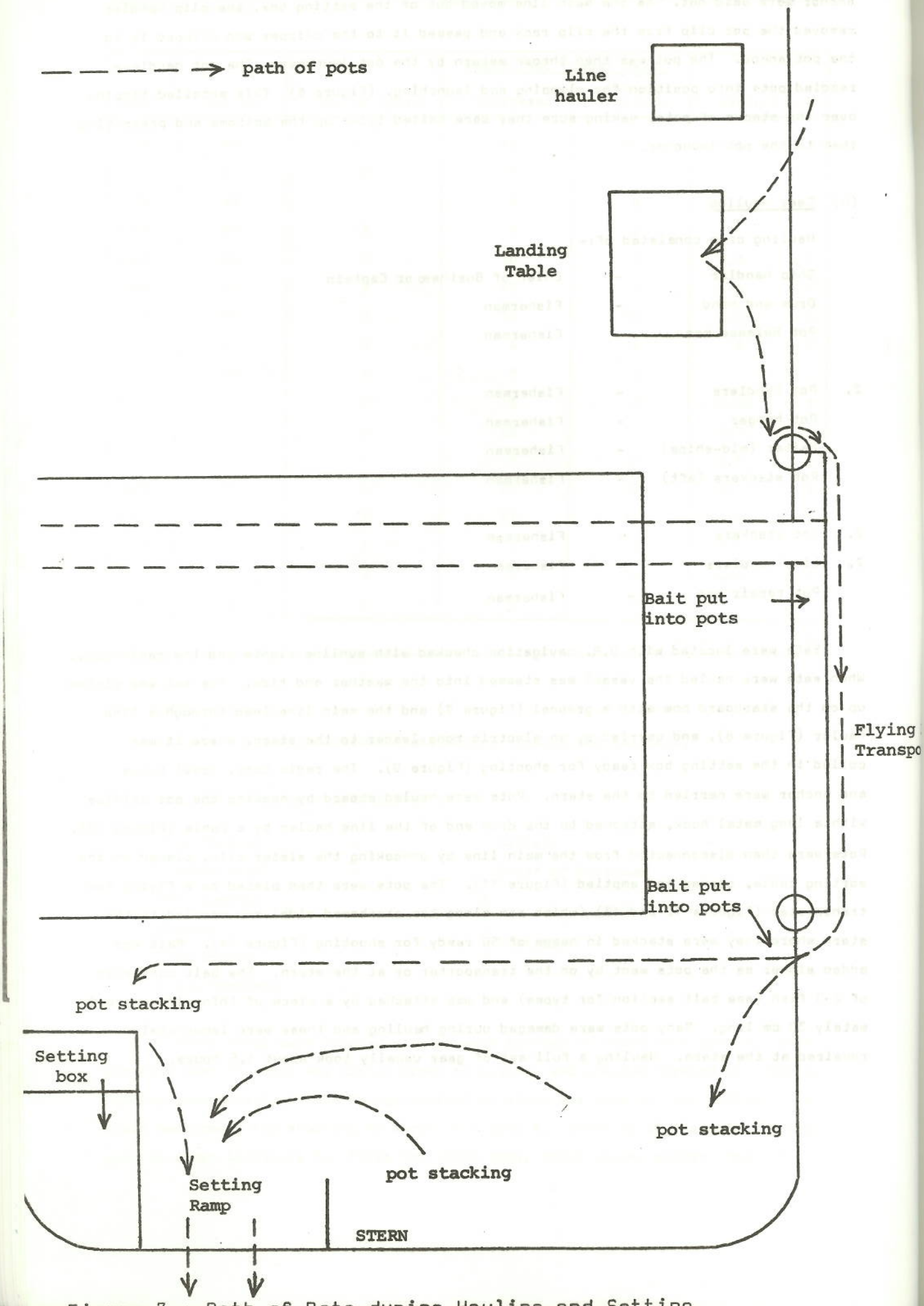


Figure 3 : Path of Pots during Hauling and Setting

Figure 4 : The stern deck ready for shooting.

NOTE: Marker flag pole, trawl buoys and main line in the setting box - also the clip rack on the side of the box.

Flying Fo
Transport

Figure 5 : Shooting the gear.

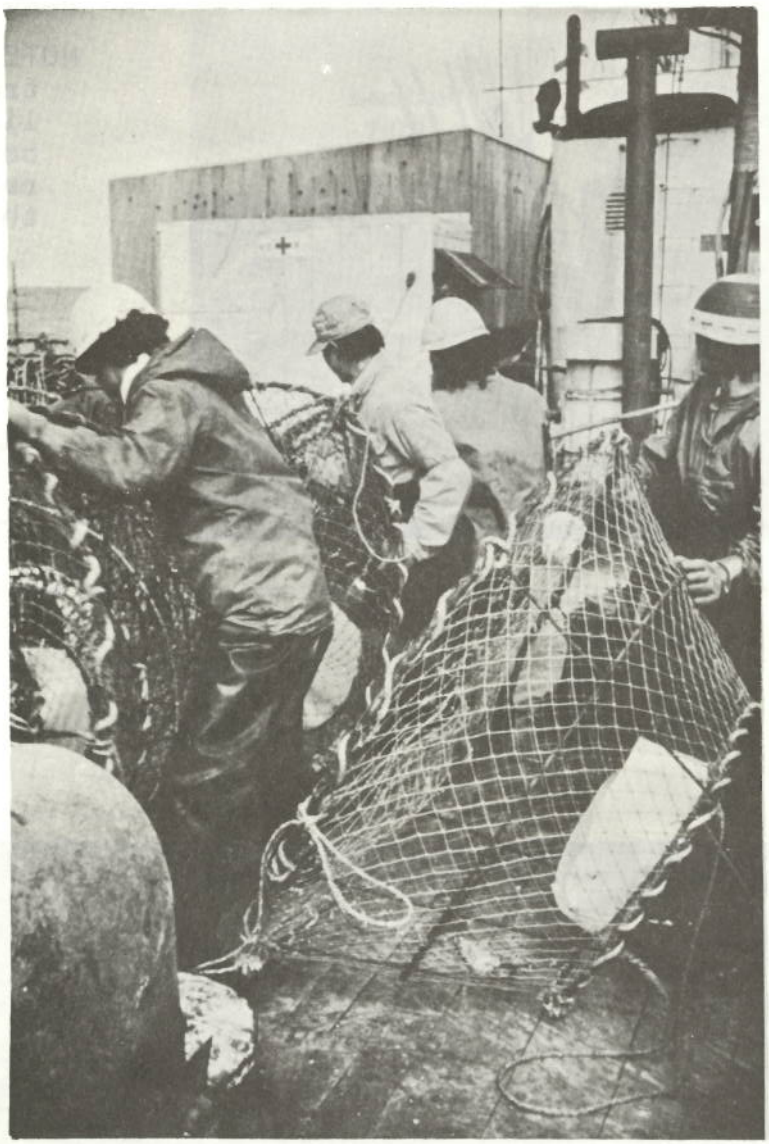


Figure 6 : Pots being positioned for shooting.

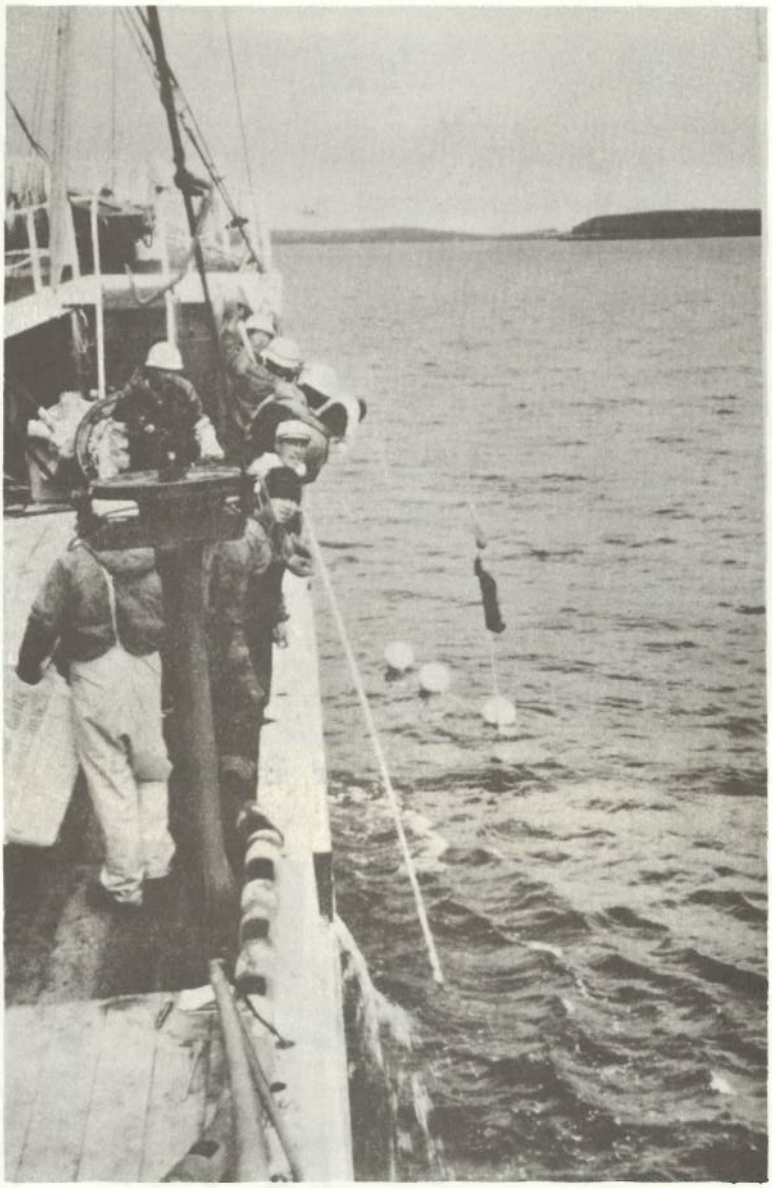


Figure 7 : Picking up the gear.

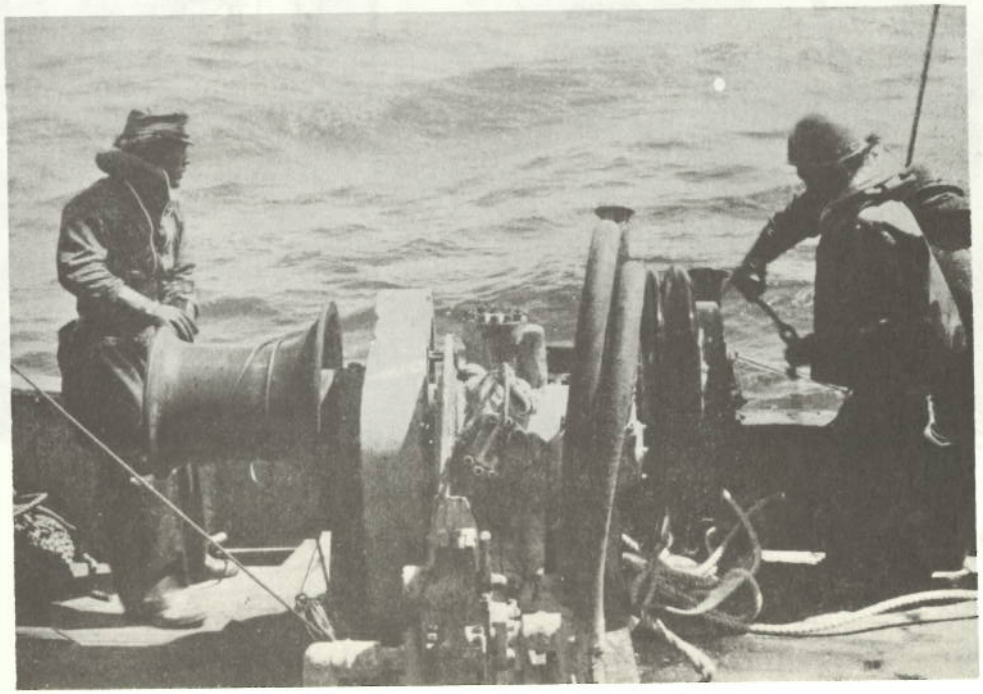


Figure 8 : Line hauler.

Figure 9 : Coiling main line ready for shooting.

Figure 10 : Hauling pots aboard.

Figure 11 : Pots being opened.

Figure 12 : Pots being placed on a flying fox transporter.

Figure 13 : Flying fox transporter.

Figure 14 : Pots readied for shooting.

FISHING RECORD

The location of sets at the Pukaki Rise is shown in Map 2, those at Auckland Islands (Map 3), Campbell Island (Map 4), and the Stewart Island Shelf in (Map 5).

The following information was obtained for each set fished and is shown in Appendix 2.

(i) Date of shot.

(ii) Average depth.

(iii) Set time - length of time the pots were immersed.

(iv) Number of pots.

(v) Number of takeable crabs caught.

(vi) Total weight of takeables obtained by individually weighting with a spring balance about 10%, calculating the average weight and multiplying this value by the total number caught.

(vii) Catch per unit effort - catch weight (kg) per 10 pots.

The total catch and processing data for each day is shown in Table 4 and mean data of this for the fishing areas shown in Table 5.

TABLE 4 : Total catch and processing data for each date

Date	Area	No. of Pots	No. of take-able crabs	Avge. Wt. of crabs (kg)	Total Catch (kg)	Catch wt. per 10 pots (kg)	WEIGHT OF PROCESSED MEAT IN LEG						Total Meat reco-very (kg)	Reco-very
							Claws A	Claws B	Legs A	Legs B	Flake A	Flake B		
Dec. 15	Auckland Islands	812	635	2.50	1587.0	19.54	27.0	9.0	9.0	27.0	-	80.0	152.0	9.5
16	" "	782	283	1.40	421.0	5.38	13.5	-	-	-	-	30.0	43.5	10.3
17	" "	915	514	2.10	1106.0	12.08	36.0	4.5	13.5	13.5	-	80.0	147.5	13.4
18	" "	951	381	1.38	525.0	5.52	18.0	4.5	9.0	4.5	4.5	45.0	81.0	15.4
19	" "	914	507	2.06	1318.0	14.42	40.5	4.5	9.0	9.0	55.0	10.0	128.0	9.7
20	" "	705	630	2.30	1459.0	20.69	40.5	4.5	18.0	9.0	65.0	35.0	172.0	11.78
21	1973	942	519	1.78	924.0	9.80	13.5	4.5	4.5	4.5	-	45.0	72.0	7.8
22		867	545	2.22	1210.0	13.95	40.5	4.5	18.0	4.5	75.0	15.0	157.5	13.0
23		713	1134	2.72	3082.0	43.22	85.5	13.5	27.0	22.5	222.0	-	368.5	11.0
24	Sub total	7601	5148	2.26	11632.0		-	-	-	-	-	-	-	-
25	Campbell Island	930	540	1.20	648.0	6.96	13.5	4.5	-	4.5	35.0	30.0	87.5	13.0
28	Pukaki Rise	715	990	1.65	1640.0	22.93	27.0	13.5	13.5	9.0	12.0	-	183.0	11.0
29	" "	880	1596	2.09	3340.0	37.95	72.0	27.0	31.5	27.0	215.0	-	372.5	11.0
30	" "	830	872	1.95	1706.0	20.55	40.5	9.0	18.0	9.0	120.0	-	196.5	11.5
31	" "	880	2058	2.20	4543.0	51.62	99.0	31.5	27.0	36.0	34.0	-	535.5	11.7
Jan. 1	1974	430	725	2.16	1570.0	36.51	49.0	4.5	13.5	9.0	120.0	-	196.5	12.5
2		872	2717	2.00	5446.0	62.45	162.0	13.5	40.5	45.5	420.0	-	681.0	12.5
3		858	2629	2.01	5538.0	64.54	184.5	22.5	45.0	45.0	415.0	-	712.0	12.9
4		742	2268	2.00	4557.0	61.41	135.0	18.0	25.5	36.0	320.0	-	531.5	11.0
5		861	2141	2.06	4430.0	51.45	153.0	13.5	36.0	45.0	325.0	-	572.5	12.0
6		678	2629	2.09	5502.0	81.15	166.5	31.3	40.5	40.5	370.0	-	649.0	11.0
10	Bluff	648	2907	1.93	5624.0	86.79	148.5	40.5	36.0	31.5	400.0	-	656.5	11.0

TABLE 4 (Continued)

TABLE 4 (Continued)

Date	Area	No. of Pots	No. of take-able Crabs	Avge. wt. of Crabs (kg)	Total catch (kg)	Catch weight per 10 pots (kg)	WEIGHT OF PROCESSED MEAT IN LEG						Total Meat Reco-very (kg)	Reco-very
							Claws A	Claws B	Legs A	Legs B	Flake A	Flake B		
Jan. 11	Bluff	867	2653	2.11	5641.0	65.06	193.5	27.0	49.5	49.5	455.0	-	774.0	13.0
12		809	3078	1.95	6019.0	74.40	189.0	36.0	63.0	40.5	400.0	5	733.5	12.0
13		676	1456	2.15	3138.0	46.42	103.5	9.0	22.5	22.5	155.0	-	312.5	9.9
14		873	3338	2.11	7075.0	81.04	202.5	40.5	54.0	49.5	390.0	-	736.5	10.4
15		849	3558	2.12	7566.0	89.11	216.0	40.5	54.0	49.5	410.0	-	770.0	10.1
16		867	3344	2.13	7145.0	82.41	198.0	27.0	27.0	36.0	240.0	-	528.0	7.3
17		882	2951	2.28	6732.0	76.32	166.5	45.0	45.0	58.5	370.0	55.0	740.0	10.9
18		872	3350	2.21	7396.0	84.81	193.5	40.5	36.0	49.5	335.0	5.0	659.0	8.9
19		863	2949	2.22	6546.0	75.85	184.5	36.0	36.0	45.0	495.0	-	796.0	12.1
20		843	2468	2.12	5231.0	62.05	180.0	31.5	45.0	36.0	440.0	-	732.5	14.0
21		864	2964	2.14	6350.0	73.49	180.0	40.5	40.5	40.5	400.0	-	701.5	11.0
22		874	3050	2.06	6278.0	71.83	180.0	45.0	45.0	49.5	490.0	-	809.5	12.8
23		856	2419	1.93	4669.0	54.54	139.5	27.0	31.5	40.5	340.0	-	578.5	12.3
24		823	2021	2.05	4132.0	50.20	108.0	27.0	36.0	27.0	250.0	-	448.0	10.8
25		835	2545	2.08	5283.0	63.26	153.0	31.5	45.0	40.5	400.0	-	670.0	12.6
26		807	1912	2.02	3862.0	47.85	121.5	18.0	31.5	31.5	305.0	-	507.5	13.1
27		689	1840	2.06	3790.0	55.00	108.0	22.5	36.0	27.0	265.0	-	458.5	12.0
29		581	1689	1.93	3266.0	56.21	94.5	22.5	27.0	22.5	270.0	-	436.5	13.3
30		593	1597	2.03	3248.0	54.77	94.5	13.5	27.0	22.5	210.0	-	367.5	11.3
31		391	1200	2.03	2437.0	60.02	76.5	18.0	31.5	9.0	160.0	-	295.0	12.1
Feb. 1		784	2291	1.99	4554.0	58.08	139.5	22.5	54.0	27.0	300.0	-	543.0	11.9
2		858	2511	1.97	4936.0	57.52	144.0	40.5	40.5	36.0	435.0	-	696.0	14.1
3		830	2423	2.19	5318.0	64.07	130.5	30.5	40.5	30.5	385.0	-	617.0	11.6

TABLE 4 (Continued)

Date	Area	No. of Pots	No. of take-able Crabs	Avge. Wt. of Crabs (kg)	Total Catch (kg)	Catch weight per 10	WEIGHT OF PROCESSED MEAT IN LEG						Total Meat Recovery (kg)	Recovery
							Claws A	Claws B	Legs A	Legs B	Flake A	Flake B		
Feb. 4	Bluff	778	2106	2.08	4382.0	56.32	121.5	30.5	27.0	27.0	370.0	-	576.0	13.1
5		973	1876	2.24	4209.0	43.25	99.0	36.0	22.5	31.5	255.0	-	444.0	10.5
6		992	2465	2.25	5543.0	55.87	135.0	49.5	36.0	27.0	325.0	-	572.5	10.32
7		783	1840	1.93	3569.0	45.58	103.5	18.0	22.5	22.5	230.0	-	396.5	11.10
8		762	1565	2.20	3446.0	45.22	94.5	18.0	22.5	22.5	250.0	-	407.5	11.82
9		781	1353	2.19	2961.0	37.91	81.0	18.0	27.0	18.0	210.0	-	354.0	11.95
10		948	1893	2.24	4240.0	44.83	108.0	27.0	27.0	27.0	315.0	-	504.0	11.88
11		575	1065	2.26	2410.0	41.91	63.0	9.0	22.5	13.5	165.0	-	273.0	11.32
12		772	2460	2.10	5268.0	58.86	-	-	-	-	-	-	-	-
14	Stewart Is.Shelf	359	Nil	-	-	-	-	-	-	-	-	-	-	-
15	Pukaki Rise	743	3593	2.29	8242.0	110.92	184.5	40.5	36.0	54.0	530.0	-	845.0	10.25
16		934	2237	2.12	4719.0	50.52	130.5	27.0	31.5	36.0	370.0	-	595.0	12.60
17		897	2452	2.08	5118.0	57.05	157.5	27.0	40.5	40.5	420.0	-	685.5	13.39
18		698	1594	2.14	3450.0	49.42	99.0	22.5	27.0	27.0	280.0	-	455.5	13.20
19		891	2684	2.25	5955.0	66.83	189.0	36.0	31.5	40.5	480.0	-	777.0	13.04
20		858	1820	2.05	3835.0	44.69	90.0	31.5	22.5	27.0	340.0	-	511.0	13.32
21		862	2475	2.22	5408.0	62.73	144.0	36.0	40.5	36.0	445.0	-	701.5	12.97
22		661	1365	2.31	3286.0	49.71	85.5	22.5	13.5	31.5	230.0	-	383.0	11.65
24		797	2424	2.29	4398.0	55.10	108.0	27.0	27.0	27.0	365.0	-	554.0	12.59
25		781	1374	2.44	3363.0	43.0	76.5	27.0	22.5	22.5	270.0	-	418.5	12.44
26		643	1411	2.09	2951.0	45.8	67.5	22.5	13.5	22.5	255.0	-	381.0	12.91
27		721	2004	2.36	4235.0	58.7	85.5	22.5	27.0	22.5	325.0	-	482.5	11.39
28		772	1157	2.23	2554.0	33.07	54.0	13.5	9.0	13.5	190.0	-	280.0	10.96
Mar. 1		838	2172	2.30	5016.0	59.8	112.5	22.5	31.5	27.0	375.0	-	568.5	11.33
2		815	1815	2.34	4254.0	52.1	85.5	18.0	18.0	22.5	310.0	-	454.0	10.67

KGS PER DAY

		772	1737	2.25	2554.0	33.07	54.0	13.5	9.0	13.5	190.0	-	280.0	10.96
Mar. 1		838	2172	2.30	5016.0	59.8	112.5	22.5	31.5	27.0	375.0	-	568.5	11.33
2		815	1815	2.34	4254.0	52.1	85.5	18.0	18.0	22.5	310.0	-	454.0	10.67

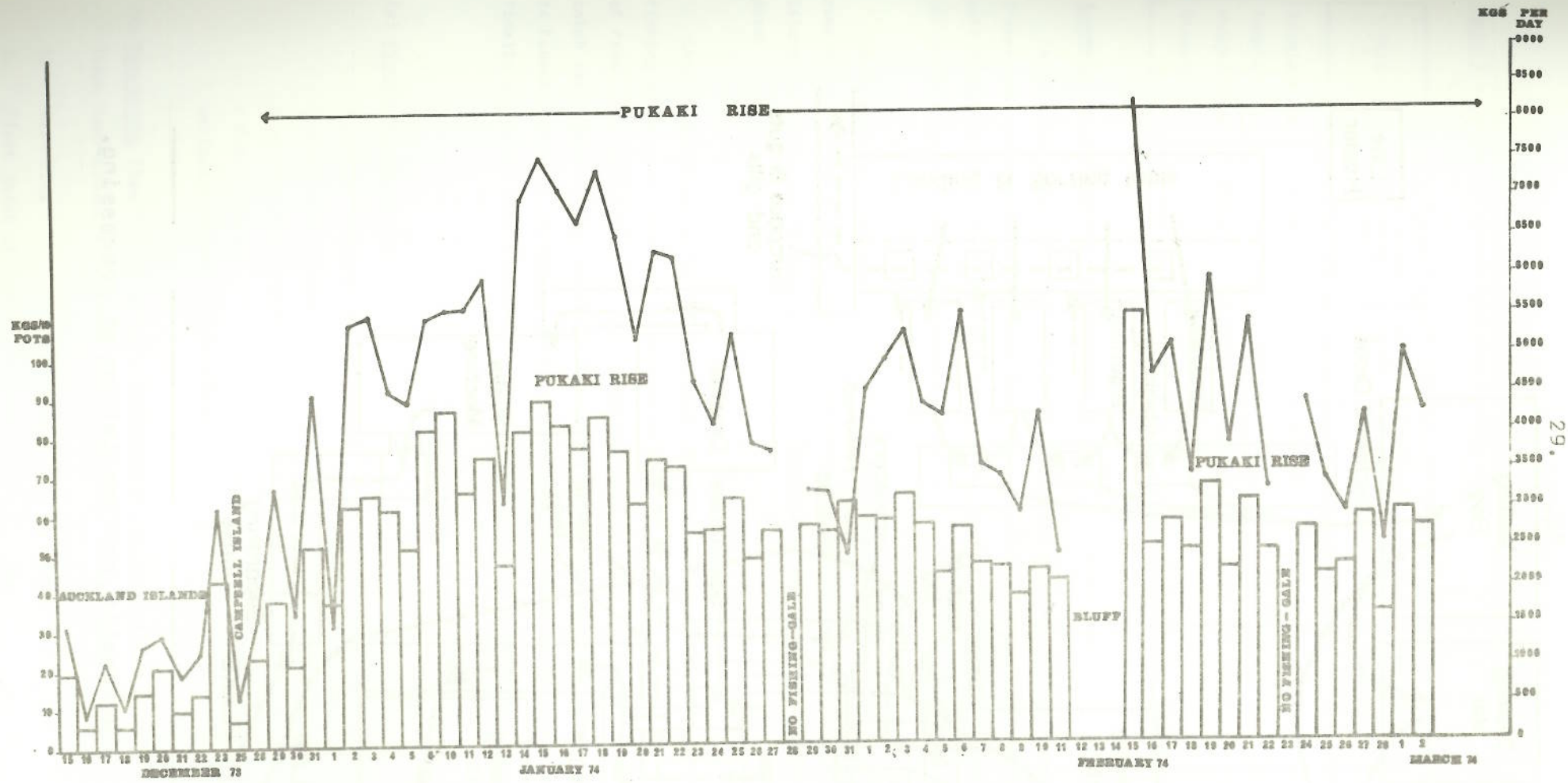


Fig 15 : Daily catch rates of J. edwardsii

KEY: Line graph gives kilograms per day
Bar graph gives kilograms per 10 pots per day.

NOTE: Data from Table 4.

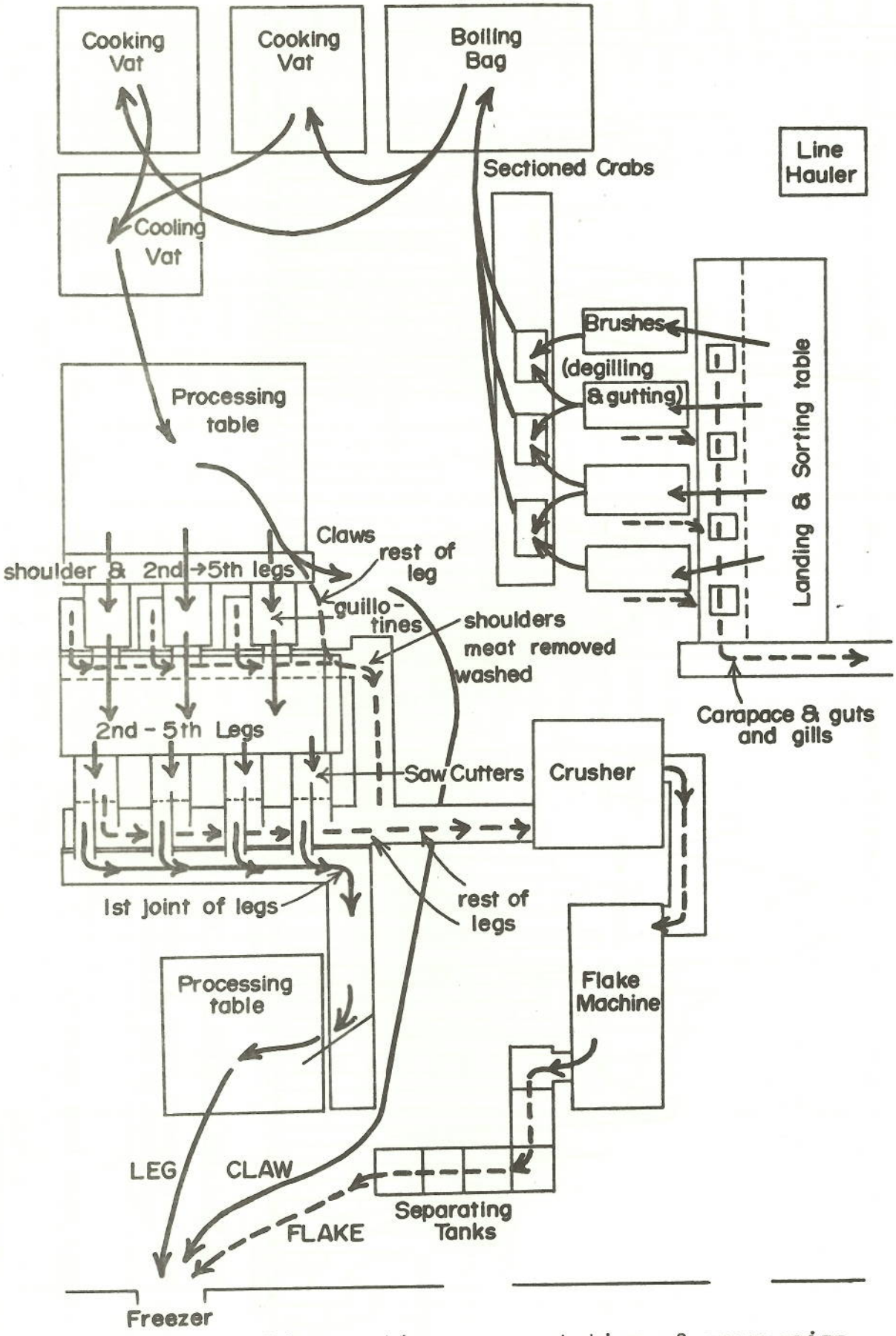


Figure 16 : Diagramatic representation of processing.

Table 5 : Summary of Catch Data for fishing areas

Area NOTE:	No. of Takeable crabs caught - = No Data.	No. of Pots	Total wt. of catch (kg)	Average weight of crab	Mean catch per unit of effort (kg)	Meat Recovery (kg)	% Meat Recovery to whole crab
Auckland Is.	5148	7601	11632	2.3	15.3	1322	11.4
Campbell Is.	540	930	-	-	-	-	-
Pukaki Rise	93303	33161	195268	2.1	59.0	22441	10.0
Stewart Is.	-	359	-	-	-	-	-

Summaries of Information from Appendix 2

The average catch per unit effort at the Pukaki Rise was 59 kg/10 pots (approximately 3 crabs per pot), this being about four times greater than the Auckland Islands. Catch per unit effort at Campbell Island was low (9.3 kg) and at the Stewart Island shelf only a few montakeable (undersized) crabs were caught.

Catch rate may have been higher at the Aucklands as only pollock bait was used and lice removed this after eight hours. It had been intended to fish for a month at the Auckland Islands but this was reduced to ten days because of the poor catches and the loss of 148 pots.

Catch rates (Figure 15) at the Pukaki Rise increased up to January 6 as better fishing areas were found and continued to rise until about January 15 due to the use of fresh bait obtained at Bluff. (This was used in half the pots from 10 January.) The catch rate steadily declined from then until more fresh bait was obtained at Bluff on 14 February when it increased again. Catch rate increased again with fresh bait but finally the catch rate appeared to level off if not show a decline.

PROCESSING

(a) Processing Machinery

2 x 3.5m^3 boilers (diesel fired)
3 power guillotines
3 roller leg cutters
1 flake machine
various conveyors (230V A.C.)

(b) Processing (See Figure 16 for a diagramatic representation)

Three meat products resulted from processing. These were:-

1. Main claw = claw
2. First joint of legs = leg
3. Flake = rest of crab section

Pots were emptied onto a table wh re takeable crabs (crabs with maximum carapace width greater than 12 cm) were soreted for processing (Figure 17). Thirty cm square holes in the table enabled non-takeable crabs to be returned to the sea via a conveyor belt. For crabs over 12 cm carapace width, the carapace was removed by striking the anterior projection against a length of angle iron secured to the table edge. The body was then broken in half by hand (Figure 18) and the gut and gills removed from each section with a rotating nylon brush (Figure 19). These sections were then put in plastic baskets and transferred to a large basket net (1 m diameter mouth and 1.3 m deep) hung in a frame at the forward end of the processing deck. These nets held about 700 kg of crab sections and were lifted into a cooking vat with derricks situated on the forcastle (Figure 20). After 25 minutes cooking in boiling sea water the crab sections were cooled in a tank of sea water for five minutes (Figure 21). Crab sections were then deposited on a galvanized iron table (3 x 4 m) (Figure 22) for further hand sorting and processing. From the sections, the first leg was separated by hand (Figure 23). The main claw was separated from the first leg and its meat removed by cracking the shell with a hammer and extracting by hand. (Figure 24)

The rest of the leg was taken by conveyor belt to the crusher (Figure 25) where its shell was crushed by grinders, and then to the flake machine. At the flake machine, meat and shell were separated in a tank of water with a rotating stainless steel drum full of holes; inside this drum a set of paddles rotated at a slightly faster rate. The paddles beat the meat from the crushed shell and forced it through the holes in the drum. Shellwas removed to the end of the drum by a spiral screw channel on its inside edge. The meat (flake) flowed along a water bath about 2 m long where shell fragments which had passed through the drum holes would sink to the bottom. Flake floated to the end of the waterway where it was caught in a fine steel mesh basket.

The rest of the crab section went to the power guillotines where the shoulder (Thoracic sections) was cut off. (Figure 26) The other legs (Nos. 3-10) were then passed to the next table where the first joint was cut off with a roller cutter (Figure 27). Meat was removed by hand from the first joint at another table (Figure 28). Remaining legs and shoulder went to the flake machine by conveyor belt for meat extraction (as previously described).

Prior to packing, these meat varieties were washed in sea water. In the packing room (Figure 29) claw and leg meat was separated into two grades. Grade A comprised meat which was not damaged by processing whereas B was damaged. All products were packed in 4.5 kg lots in a polythene liner inside a wax sealed cardboard carton. An extra 150 g of meat was added to packs to allow for freezer loss. Cartons were then placed in a blast freezer at $-25^{\circ}C$ for 24 hours and subsequently stored in the main freezer hold.

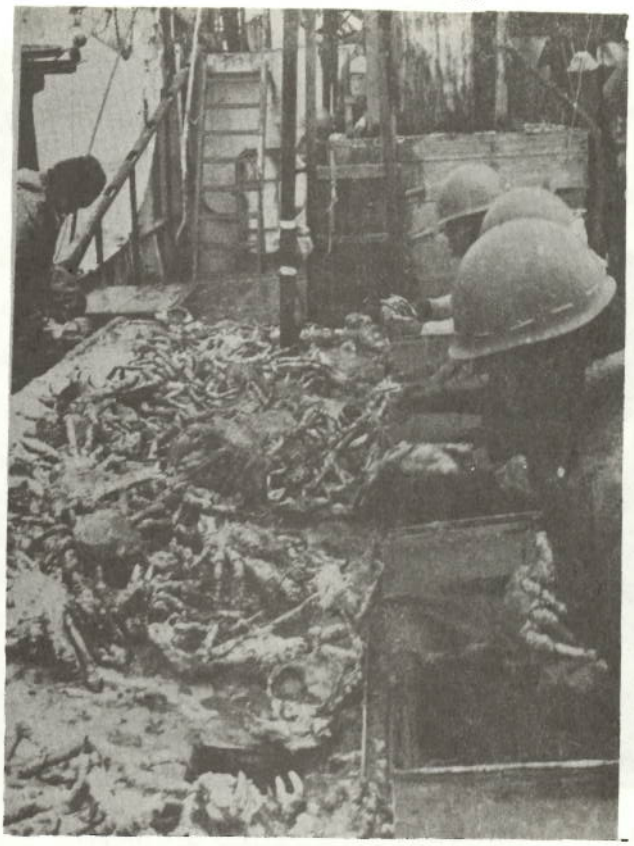


Figure 17 : Sorting and removing carapace.

Figure 18 : Breaking crab in half.

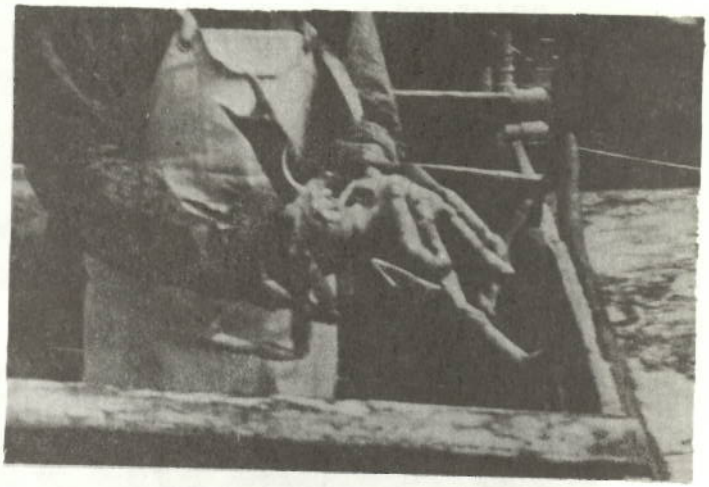


Figure 19 : Brushing gills.

Figure 20 : Lifting crab sections into cooking vat.

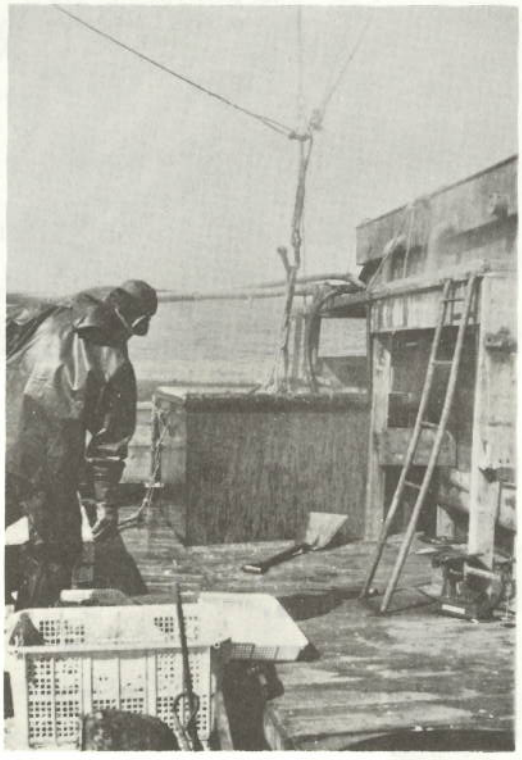


Figure 21 : Crab sections in cooling tank.

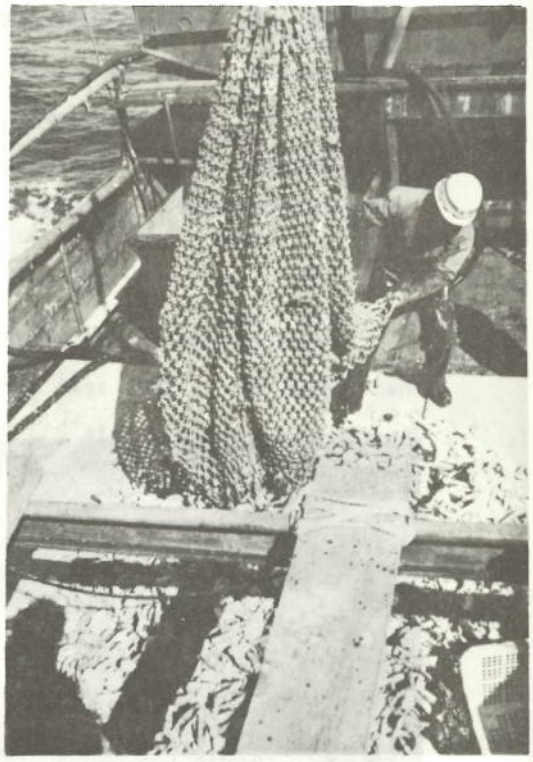


Figure 22 : Emptying onto table.

Figure 23 : First leg separated from section by hand.

Figure 24 : Removing claw meat.

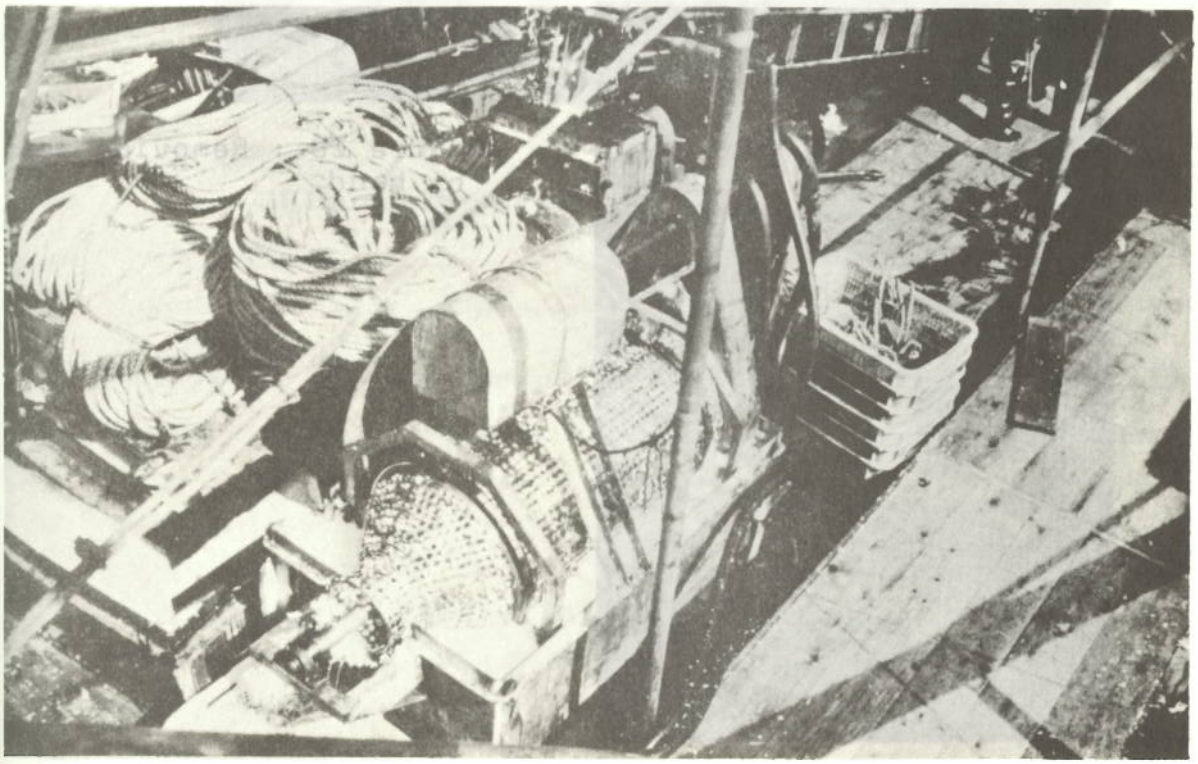


Figure 25 : Crusher and flake machine.

Figure 26 : Shoulders cu
off in power guillotine

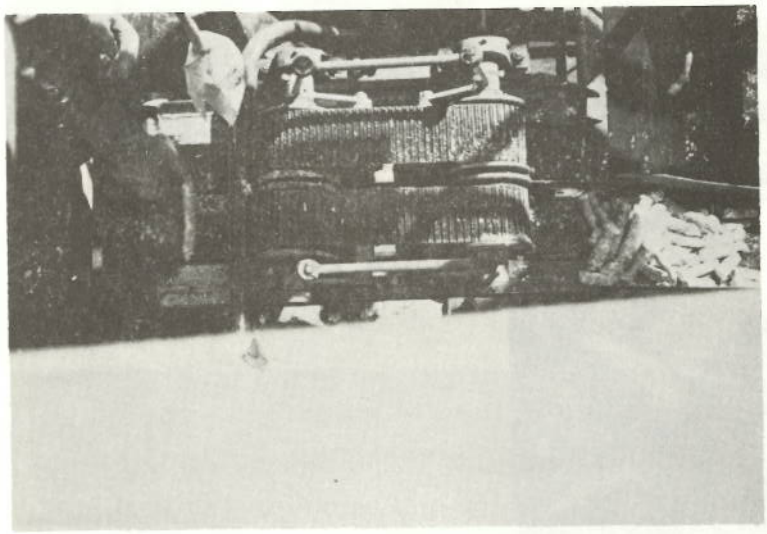


Figure 27 : Roller Cutte

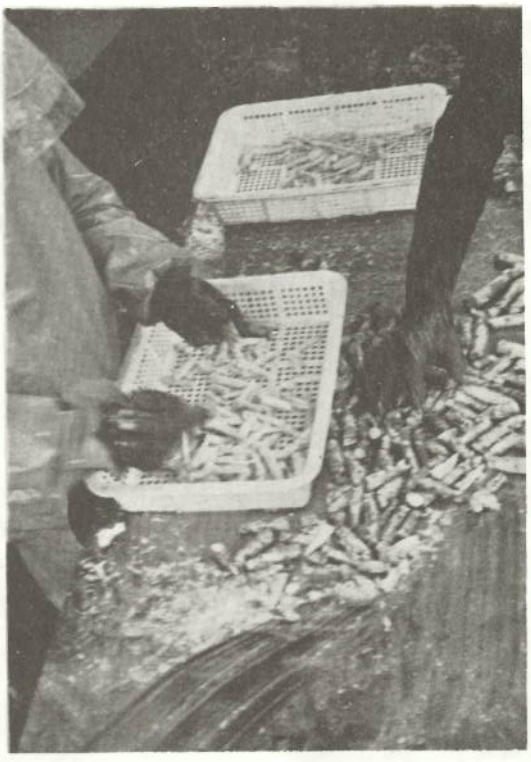


Figure 28 : Removing mea
by hand.

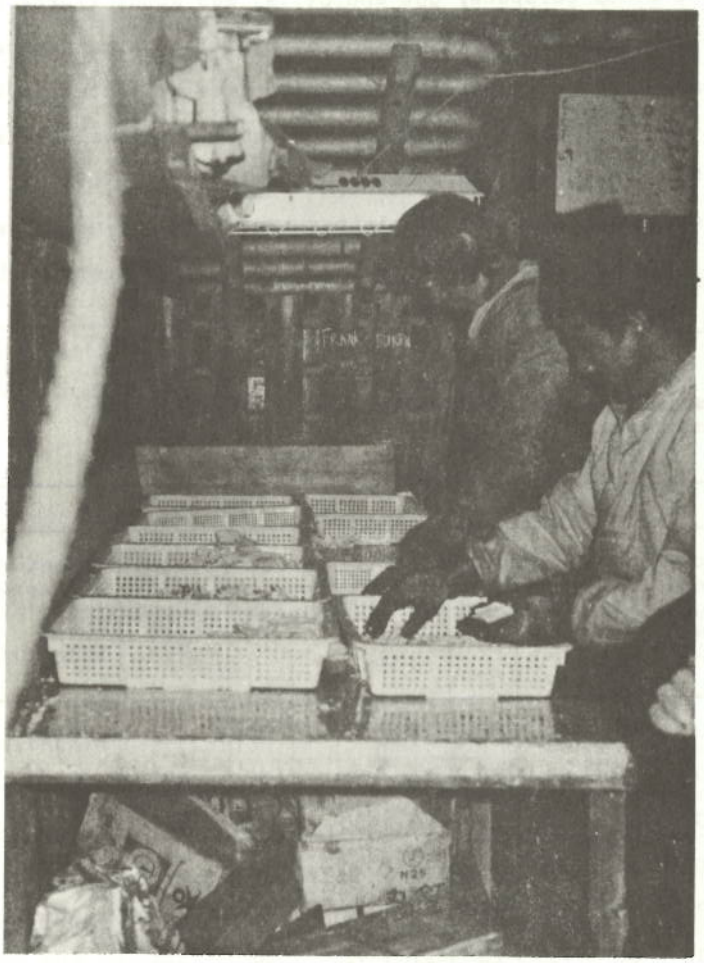


Figure 29 : Packing room.

(c) Meat Recovery

The weight of each type of meat (claw, leg and flake) recovered from processing as well as daily total meat recovered are shown in Table 4.

Crabs larger than 12 cm carapace were of either the soft shell (recently moulted) or hard shell (older moulted) type. Both hard and soft shelled crabs were processed by hand and the results are shown in Table 6. Results show that crab sectioned weight (total weight minus carapace, gut and gills) was about 2/3rds that of total weight for both types. However, with cooking, soft shell lost a further 18% of total body weight; whereas hard shell lost only 4%. This was reflected in the meat recovery, which was 15% for hard shell and 7% for soft shell. Actual average meat recovery was 11.4% at the Pukaki Rise, 10.0% at the Aucklands and 9.9% at Campbell Island. However, the lower values at the latter two areas may have been caused by the taking of both hard and soft shelled animals from these areas; whereas at the Pukaki Rise only hard shelled animals were taken.

TABLE 6 : Percentage breakdown of processing and hand meat extraction for hard and soft shell crabs

HARD SHELL											
Carapace width (cm)	Whole crab wt. (g)	Sectioned wt. of crab	Sectioned weight after Boiling	Shoulder	Hand Extraction					Total recovered meat wt.	% Meat recovery from total weight
					1st	2nd	3rd	Claw	Claw leg		
14.8	1700	1165	1190	140	71	25	20	65	33	354	20%
16.5	2500	1650	1630	205	88	30	34	94	57	508	20%
16.2	2400	1600	1680	144	72	20	20	100	52	408	17%
15.5	2000	1480	1380	143	72	28	25	90	45	403	20%
14.8	1500	1110	1080	90	54	21	19	62	40	286	19%
15.0	1800	1300	1160	138	71	25	27	72	38	371	20%
17.0	2600	1580	1450	133	61	20	22	77	38	351	13%
16.1	2600	1750	1305	175	91	29	26	95	51	467	17%
13.7	1500	980	960	136	74	24	25	75	44	378	25%
Av.15.5	2067	1398	1312	145	73	25	24	81	44	319	18%
Av. % of total Grn Wt.		67%	63%	Av. % meat recovery for each section:- 36%		18%	6%	6%	10%	11%	15.4%

	SOFT SHELL											
	Carapace width (cm)	Whole crab wt. (g)	Sectioned wt. of crab	Sectioned wt. after boiling	Shoulder	Hand Extraction					Total Recovered meat wt.	% Meat recovery from total wt.
						1st	2nd	3rd	Claw	Claw leg		
	12.2	800	500	330	37	15	4	2	9	6	73	9%
	12.1	900	550	400	22	12	6	2	11	7	60	6%
	13.5	1100	640	400	22	20	7	2	12	12	75	6%
	12.0	800	550	410	20	12	6	2	12	6	58	7%
	11.0	500	340	300	17	9	2	2	7	7	44	8%
	12.7	810	550	350	25	12	3	2	11	7	60	7%
	12.6	800	410	260	25	11	4	2	6	6	54	6%
	11.7	700	370	270	16	8	3	2	6	3	38	5%
Av.	12.2	800	489	340	23	12	4	2	9	8	58	7%
	Av. % of total Grn. Wt.		61%	42.5%								

BIOLOGY

(a) Introduction

This section briefly reviews the present knowledge of the biology of the southern spider crab (Jacquinotia edwardsii) (Jacquinot) and includes some data collected during this venture.

A taxonomic description of J. edwardsii by Bennett (1964), noted that this crab in unmistakeable on account of its size alone. Size of males (carapace width at its widest point) reach 21 cm whereas females seldom reach 12 cm.

J. edwardsii is endemic to southern New Zealand and Neozealandic areas (46-50°S, 165-180°E). It has been recorded in decreasing quantities at the Pukaki Rise, Auckland Islands, Campbell Islands, Bounty Islands (Japanese Fishing Agency), Stewart Island (Chilton 1911), Stewart Island Shelf, Puysegur Banks (Webb 1972) and off Otago Heads (Thompson 1913).

(b) Movements

Little is known of the general movements of J. edwardsii. However, the seasonal swarming of J. edwardsii, usually occurring in shallower areas, is well documented by Ritchie (1970), and it may assist moulting and reproduction (mounding behaviour - see later relevant sections).

J. edwardsii has been observed on land (see Ritchie 1970). Two hundred crabs were tagged by Ritchie (1973) in Sarah's Bosum Harbour. Four recaptured crabs showed little movement after periods of up to six days.

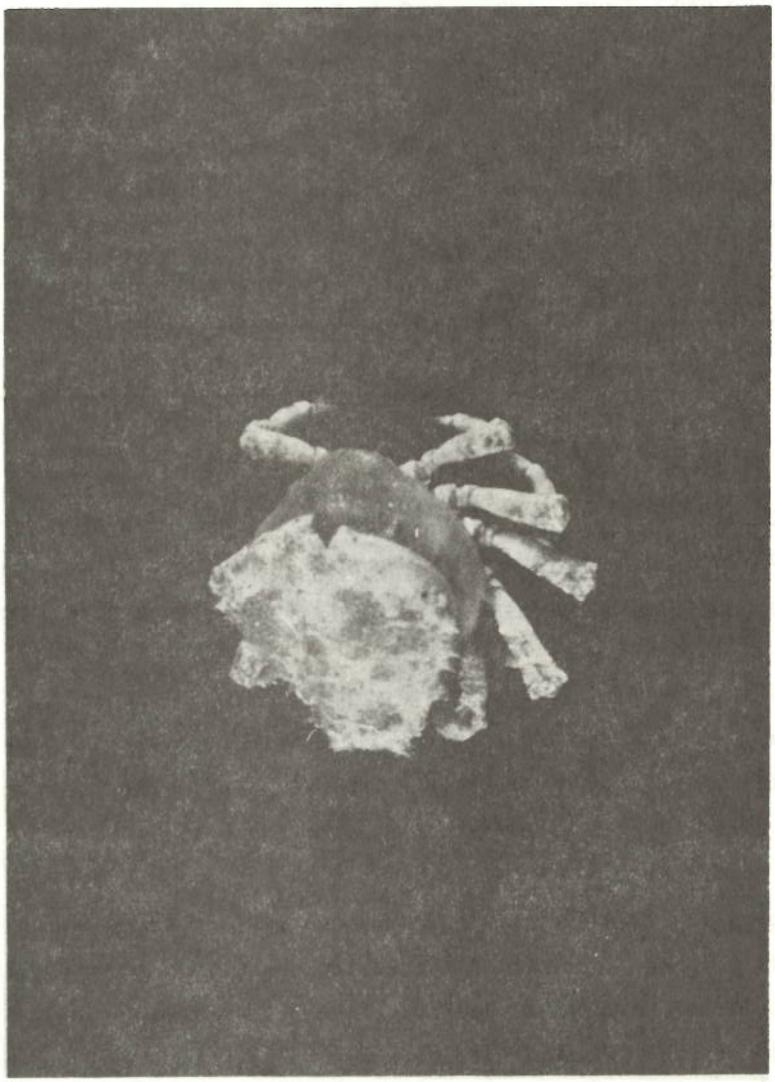


Figure 30 : J. edwardsii moulting. Carapace is in the process of tilting forward (actual size 9.5 cm carapace width).

During this survey on 24 January, 218 takeable crabs were tagged at the Pukaki Rise from the first 100 pots of set 101, and released at the same place. Circular yellow or white plastic tags of 60 mm diameter with wire fastener were attached around the last pereiopod (walking leg) close to the thorax to avoid impairing locomotion. Tag record is shown in Appendix 3. One tagged crab was recaptured 17 days later at 49°-10S', 171°-50E'. Allowing for navigational errors this crab had moved about 2 km.

(c) Moulting

Three exoskeleton phases of J. edwardsii have been described by Ritchie (1970). They were:-

1. Dark phase - old exoskeleton - carapace and leg armour thick and heavy, dorsal surface dark red-brown and heavily encrusted with epizoa, e.g. algae (Lithothamnion sp. and filmy Rhodophyceae), tubeworms (Pomatoceros sp), chiton (Arthochiton spp?), barnacles (Balanus sp) and encrusting ectroprocta. Ventral surface yellow-brown.

2. Intermediate phase - exoskeleton of intermediate age-carapace dark and fully hardened, but encrusting organisms few or absent, ie. spots of Lithothamnion.

3. Light-phase - exoskeleton - carapace and leg armour thin (may be soft), dorsal surface pinkish red, spines and protrusions sharp, completely lacking encrusting organisms. Ventral surface white.

Moulting appears to be continuous from at least November to March since at the Auckland Islands large numbers of light phase crabs were found in December and at the Pukaki Rise from January to March. Also, Falla (in Ritchie 1970) recorded extensive moulting in March and Inkster (in Ritchie 1970) in November at the Auckland Islands.

One crab which was in the process of moulting was obtained at the Pukaki Rise (see Figure 30). It appears that the old carapace is sloughed off in one piece tilting from the posterior anteriorly.

(d) Reproduction

Three overlapping reproductive states of Jacquinotia females have been described by Ritchie (1973). These were:-

1. New berry - pleopods covered with a mass of recently attached orange eggs.

2. Late berry - carrying a full complement of late stage larvae or carrying a reduced mass of larvae indicating that larval release was occurring.

3. Spent - Larvae released - a few infertile or empty egg capsules remain.

Ritchie (1973) suggested that egg laying occurred in September and October with a peak in mid-late September and that egg development was delayed for at least five months. Further evidence for delayed egg development was found during this survey as only new berry and spent crabs were found. This latter information also substantiates evidence that larval release occurs between September and November with a probable peak in late September; since if it occurred during the survey we should have seen some crabs in late berry. (Roberts unpublished 1968).

Pair formation occurs mainly with spent females during September to November (Ritchie, 1973) and may be assisted by the swarming habits of the crabs in shallow water (Roberts unpublished 1968).

Copulation was observed by Ritchie (1973).

Moulting behaviour (see moulting) may assist mating as large numbers of females may mature simultaneously (undergo puberty moult) and become available for mating. Ritchie (1970) found that at the Auckland Islands females were found in greater numbers in shallower waters in the area from Enderby Island southward to Carnley Harbour. South and east of these areas, in deeper waters, large takeable males were more predominant. Further evidence of this was found during the present study. From a number of sets, male takeables, non-takeables and females were recorded. See Table 7.

Ritchie suggests, the reason for this is that pair formation occurs in shallow waters. Mature males then move out into deeper water, away from the major concentrations of prepuberty males, prepuberty females and mature females.

At the Pukaki Rise there did not appear to be different spatial distributions of the sexes and this was probably due to similar depths (140-160m) found in this area.

TABLE 7 : Comparison of Male and Female Crabs with Depth

Set No.	Depth (metres)	Male No.	Takeable % Total	Male No.	Untakeable % Total	No.	Female % Total	Total
42	21	4	11%	13	37%	18	51%	35
10	48	3	7%	29	66%	12	27%	44
9	56	2	4%	26	56%	18	40%	46
8	73	6	8%	30	38%	44	55%	80
5	76	8	13%	32	53%	20	33 1/3%	60
4	65	2	10%	15	75%	3	15%	20
3	101	6	14%	24	56%	13	30%	43
28	76	8	13%	32	53%	20	33½%	60
12	91	28	29%	27	28%	42	43%	97
25	111	21	96%	1	4%	0	0	24
31	148	31	46%	37	54%	0	0	68
13	68	4	10%	24	61%	11	28%	39
7	105	38	100%	0	0	0	0	38
33	144	40	98%	0	0	1	2%	41

(e) Feeding

Ritchie (1973) describes feeding in J. edwardsii.

(f) Predators

Hookers Sealion (Otaria hookeri) an endemic species may be dependent on soft shelled J. edwardsii in March when post-breeding animals are in no condition to pursue either fish or squid, their staple diet for most of the year. (Falla 1965). This was hypothesised from observations of regurgitations of soft shelled crabs. Sandy Bay, Enderby Island, and a subsidiary on Dundas Island are the only places in the total range of the sea lion in which its breeding productivity is significant for the population. Elsewhere at the Aucklands and at Campbell Island, the breeding pattern is only marginally productive.

However, Best (1974) (Pers. Comm) (from Marlows) found at Sandy Bay, Enderby Island, that most pups were born in the third and fourth week of December, and that most of the sea lions had left Sandy Bay by early February. Until more study takes place, reasons for or the extent of sea lion dependence on J. Ewardsii are not known.

MANAGEMENT

The two possible fishing areas, the Auckland Islands and the Pukaki Rise are treated separately. The Auckland Islands is an inshore fishery with relatively sheltered waters, and the waters within 12 miles radius are under New Zealand jurisdiction. The Pukaki Rise, however, is an oceanic fishery, prone to adverse weather conditions and is in international waters.

(a) Pukaki Rise

The largest concentrationsof *J. edwardsii* appear to be on the Pukaki Rise and this area has been fished by the Japanese for the past four seasons. This season, two other Japanese crab fishing vessels were fishing in this area. These were, the "Eitan Maru" which was of similar size to the "Satsu Maru" and fished from 25 October 1973 to 17 February 1974 and the "Hakko Maru No. 27", a smaller vessel about 30 m long which fished from 10 February and was still fishing when the "Satsu Maru" left on 2 March.

An end of season, standing stock estimate at the Pukaki Rise, has been made from the decline in catch per unit effort (see estimate of population calculation on). For the population estimate, two ten day periods of fishing (data from Table 4), 12-21 January and 17-26 February were chosen. During these times fishing conditions were similar, in that fresh bait obtained from Bluff was used in about half the pots. The average catch per unit of effort for these fishing periods was 75 kg/10 pots for the former and 53 kg/10 pots for the latter. The catchability of the crabs were obtained from this decline in catch per unit of effort.

Estimate of Population

Now C_i is catch in short period

and $C_i = q_i \times p_i \times E_i$ or $\frac{Ci}{Ei} = q_i \times P_i$

where q = catchability

E = effort

P = population

The if C crabs are taken between periods 1 and 2

$C = P_1 - P_2$ (Catch = Population at start - population at finish).

(Disregarding, natural mortality, predators, etc.)

$$= \frac{C1}{q \times E1} - \frac{C2}{q \times E2}$$

where $C^1 + C^2$ are the average catch per unit effort for periods one and two.

$$= \frac{1}{q} \left(\frac{C1}{E1} - \frac{C2}{E2}\right)$$

Now C = 160,000 (i.e. catch of all boats between the mid points of periods 1 and 2)

$$\therefore \quad 160{,}000 = \frac{75-53}{Q}$$

$$q = \frac{22}{160{,}000}$$

Population at end of period is then

$$P = \frac{C2}{E2} \times \frac{1}{q} \qquad \left(\frac{C}{E} = \text{catch per unit effort}\right)$$

$$= \frac{160{,}000}{22} \times 53$$

$$= 385{,}000$$

Values for C of 220,000 and for P of 530,000 can be extrapolated using catch data from "Eitan Maru" and "Haako Maru", if it is assumed that these vessels had similar catches to that of the "Satsu Maru". Then 530,000 probably represents the upper limit of takeable crab numbers and 385,000 the lower limit. Actual values are likely to be nearer the lower limit as neither of the other Japanese boats had fresh bait and the "Haako Maru" was a smaller vessel. These figures only represent takeable crabs remaining at the end of the venture and recruitment should increase the number available for next season.

Initially, catches at the Pukaki Rise by the Japanese (1969-70) were about five times the present level of three crabs per pot. (I. Ishizaki, "Satsu Maru" technician pers. com. 1974.)

Should fishing continue at its present level at the Pukaki Rise, the possibility of the catastrophic failure of this fishery could exist. However, Cushing (1968) points out that there is often no relation between parent stock and subsequent recruitment at levels of stocks that support fisheries and that failure of recruitment might result from a single event never to be repeated in quite the same frame of circumstances. Although it would appear that the present standing crop is very much smaller than the original unfished stock, there is no reason why this resource should not be utilized if it is properly managed. The major problem at this stage is to determine the maximum sustainable yield. Liaison is needed with the Japanese at diplomatic level so that the research and management procedures for this fishery can be co-ordinated. The possibility of a fisheries management zone of 200 miles surrounding New Zealand will result in negotiations with the Japanese about this resource as part of the Pukaki Rise is within this zone. However, some parts of the Rise are slightly further than 200 miles and this aspect needs consideration by the New Zealand Government.

It is recommended:-

1. Conservation measures should be applied to this fishery, even though it is in international waters.

2. The fishing principles should be adopted:

   (a) The number of vessels, of all nationalities, should be stricly limited.

   (b) A maximum catch should be determined, to be shared between appropriately licensed vessels.

   (c) The taking of crabs less than 12.0 cm carapace width (at its widest point) be prohibited.

   (d) Pots should be fitted with escape gaps to permit crabs less than 12.0 cm carapace width to escape.

   (e) Deck arrangements aboard licensed vessels, should be such,that undersized crabs can be immediately returned to the fishing grounds.

   (f) The taking of berried female crabs be prohibited.

   (g) All licensed vessels and their catches be liable to inspection.

   (h) Detailed catch records include data, location, depth, number of pots per set, time shot, time hauled, number of takeable crabs (assuming a 12.0 cm minimum carapace length) and estimated weight of takeable crabs be kept by each licensed vessel for analysis to assist with long term management of the fishery.

   (i) That only dark phase crabs be processed.

3. That the New Zealand authorities initiate discussions, with the appropriate authorities, to ensure appropriate conservation measures are drawn up and put into effect.

(b) Auckland Islands

From this venture it would appear that the crab resource of the Auckland Islands is much less than that of the Pukaki Rise, although there are some factors which make this uncertain. Firstly, nothing is known about the stocks of J. edwardsii on the exposed western side of the island and some areas to the south of the island. Secondly, catch rates at the Aucklands were affected by sea lice removing the bait within eight hours. (Bait pots would probably solve this.) Thirdly, catch rates from previous expeditions (Table 8) suggest that the catch rate could be higher with different fishing gear and methods. The Bluff-type pots used by Ritchie 1970 and 1973 were larger, i.e. 6' x 6' x 2'6" and 6' x 3' x 1'6", and had solid wire mesh which made them more stable

than the lighter "Satsu Maru" pots. It is likely, that many of the latter pots were moving due to strong currents. It has also been suggested that crabs have difficulty climbing up the flexible mesh, especially on pots which are constantly moving in the strong currents.

TABLE 8 : Comparison of catches of J. edwardsii with previous expeditions.

Carnley Harbour Entrance	Nov. 1969 Inkster 1	Feb. 1970 F.I.B. 2	Oct. 1971 Wonderfoods	Dec. 1973 Sealord 4
Total (approx. kg/10 pots)	323	519	352	30

Another factor which has to be considered when examining the future of the crab resource at the Auckland Islands is that the Islands are a flora and fauna reserve administered by the Lands and Survey Department which would prevent landing and processing or re-supply. Also, any large scale fishing venture will affect the general ecology of the Islands and one particular case is the possible dependence of the post breeding hookers sealions, on soft shelled crabs during March. The Auckland Island's population of crabs is probably much smaller than that of the Pukaki Rise and as little is known of the biology of Jacquinotia especially about recruitment, unrestricted fishing in this area could result in rapid decline in stocks. The conflict, therefore, arises as to whether it is desirable to fish these crabs for an expensive luxury market, bearing in mind that it could be an easily depleted resource and only initially a profitable venture, or should the Islands and their fauna and flora be left undisturbed.

It would be valuable to learn more of the availability of the resource on the western side of the Auckland Islands.

It is therefore recommended, that the Auckland Islands be closed meanwhile to commercial crab fishing within the 12 mile territorial zone surrounding the Islands until the ecological and aesthetic values of the Island have been determined, as well as the crab biology being clearly understood.

A relatively large resource of Jacquinotia edwardsii was found at the Pukaki Rise which was about three times that of the Auckland Islands. It was obvious that the Japanese gear was not suited to the Auckland Islands where strong currents wrecked pots and lice removed bait within eight hours.

POSSIBLE NEW ZEALAND VENTURE

Should a maximum catch rate of three crabs per pot be economic for the crab resource at the Pukaki Rise and perhaps later at the Aucklands, the most suitable crab fishing vessel would be a stern trawler of the length 30 m or greater. The reason for this is that the deck layout aft of the wheelhouse could be easily arranged for catching and processing. As the crab season would appear to be from November to March, some off season utilization for the vessel is needed. A stern trawler could work in deep water areas such as the Chatham Rise and other grounds distance from New Zealand.

Equipment recommended for any projected vessel includes:-

1. A variable pitch propellor.
2. Auto pilot.
3. Gyro compass with gyro stabilisation to both a radar and the radio direction finder.
4. Sounder, preferably with a digital display as well as recording paper.
5. Sonar.
6. Semi-automatic engine control system which allows the vessel to be manoeuvred from the bridge and does not require the engine room to be continuously manned.
7. Ample electric and pneumatic (for the guillotines) power of at least 50-70 kva.
8. A line hauler similar to that of the "Satsu Maru" where the down line is passed around the sheave of the hauling drum, which grips it and hauls automatically and does not require handling. The man tending the line can then be engaged coiling down the line ready for subsequent re-launching. A standard drum end would be fitted on the line hauler enabling hauling of the pots using a cable and metal hook passing through a pulley.
9. Pots need to be strongly constructed and must be suitable for stacking to conserve room.
10. Bait
    (i) Bait holders are needed to prevent sea lice removing bait, particularly at the Auckland Islands.
    (ii) Bait should be hung as close to the top of the pot as possible as it has been found that crabs form a peck order in the pots (Ritchie 1973) and bait hung close to the top allows more free space within the pots for crabs further down the pecking order.

(iii) It should be noted that the fresher the bait the higher the catch rate. It would be possible to have one set of gear for catching bait in the deeper waters (200 m). This may produce sufficient quantity depending on how well it lasts in bait pots (i.e. how long it takes before sea lice remove it).

11. Maximum processing efficiency is desirable and because of limited deck space most processing should be carried out on land, i.e. at Bluff. Processing on board should be limited to removal of carapace, gills and gut, followed by cooking and cooling in sea water. The carapace should be removed with minimal force and similarly, the crab should be sectioned without excessive force as this shatters the cartilaginous plates below the gills and makes cleaning difficult. This will result in a low grade product. With regard to the operating of the degilling brushes, operators should be informed that as little shoulder as possible should be removed. At least two vats are needed for cooking and cooling, as crabs need to be cooked for about 25 minutes in sea water at 100°C and cooled for about five minutes.

Shore Processing

A small factory could be established at Bluff for final processing to a marketable product. Air operated guillotines could be utilized to remove the shoulder and first legs and a suitable flake machine could be designed to process the left-over meat.

OTHER POSSIBLE COMMERCIAL SPECIES

The following species should be investigated as possible alternative resources for a diversified fishery in southern New Zealand waters.

(a) Crabs

On the Pukaki Rise the camoflage crab *Leptomithrax australis* was caught especially where few spider crabs were caught. Moults of *L. australis* have been found (but no live specimens) at the Auckland Islands and a live specimen at Campbell Island (Ritchie 1970).

Large numbers of the smooth red swimming crab *Nectocarcinus bennetti* were caught at the Auckland Islands, especially in the deeper off shore waters where there were few spider crabs. *N. bennetti* was also present at the Pukaki Rise but in smaller numbers. Some of these crabs were cooked on board and were found to be quite palatable and as good as, if not better, than the spider crab. A sample of these was taken back to Japan but as L. Ritchie (1973) concluded "although numerous in all exposed fishing areas they are probably too small (5-8 cm in carapace length) to be commercially exploitable."

(b) Octopus

A species of Octopus occurred in pots at the Auckland Islands, with often 8-15 a set being caught. These were often boiled in the crab boiler by the Japanese and were quite palatable.

(c) Whelks

Large whelks were brought up in the pots in some areas. These could be suitable for soup.

(d) Fish

(i) Ling : (Genypterus blacodes)

This species was found in the deeper waters at both the Auckland Islands and the Pukaki Rise (e.g. Set No. 40 at the Auckland Islands in 470 m contained no crabs but 20 ling). The value of this fish on the local market is unsure as a number examined contained menatodes. However, there may be other uses for this species. Recent inquiries as to the availability of ling and cod bladders have been made by some East Asian countries and these are apparently quite valuable. (Fishing Industry Board (pers. Comm 1974)).

(ii) Cod

A few Black Cod Lotothenia filholi, were caught at the Auckland Islands and Pukaki Rise, but hand lining over pinnacles at the Pukaki Rise produced no results suggesting they are not very abundant.

(iii) Southern Blue Whiting (Micromesistius australis)

Resources of this species were found by the Japanese (Immediate Report, Japanese Fisheries Agency, 1971) on the "Kaiyo Maru". This is not a commercially valuable species and is used by the Japanese and Russians as fish meal. Traces on the echo sounder suggested schools of this species could have been present over the Pukaki Rise.

It is recommended that mid-water trawling trials be carried out in this area to determine if there is a resource available.

ACKNOWLEDGEMENTS

We wish to thank Sealord Products Limited for the great assistance given during the project. Our thanks are also extended to R.J. Rae, Sealords Observer, for his help in all ways, especially in the collection of data, and for allowing us to use data from his own confidential report. A. Woods, D. Woods and J. Hill and the Japanese crew of the "Satsu Maru No. 17" were also of great help.

Dr Booth of Fisheries Research Division, B. Brun, L. Ritchie, B.T. Cunningham, V.T. Hinds, and K. O'Sullivan of Fisheries Management Division, gave us invaluable criticism and help with this report.

REFERENCES

Anon 1971 - Kaiyo-Maru's survey report - New Zealand southern waters - for the year 1970. (mimeographed immediate report, (April 1971)). Japanese Fisheries Agency.

Bennett, E.W. - The marine fauna of New Zealand, crustacea brachyura, N.Z. Department of Scientific and Industrial Research (D.S.I.R.) Bulletin 153.

Falla, R. 1965 - Birds and mammals of Subantartica, Proc. N.Z. Ecological Soc. V. 12 p. 63-68.

Cushing, D.H. 1970 - Fisheries biology, a study in population dynamics. Madison, University of Wisconsin Press.

Green, J. 1963 - A biology of crustacea. Northumberland Press.

Griffin, D.J.G. 1966 - The marine fauna of New Zealand: Spider Crabs family majidae (crustacea, brachyura) N.Z. D.S.I.R. Bulletin 172.

Gulland, J.A. 1966 - Manual of sampling and statistical methods for fisheries biology. F.A.O.

Hartnell, R.G. 1969 - Mating in the Brachyura, Crustaceana 16.

Hinsch, G.W. 1968 - Reproductive behaviour in the spider crab Libinia emarginata. Biol. Bulletin 135(2)

Laevastu, T. 1965 - Manual of methods in fisheries biology. F.A.O.

Marlows, 1974 - Subantartic sea lion - Interim Report. Australian Museum, Sydney

Moreland, J.M. 1973 - Marine fishes of N.Z. Reed, A.H. & A.W.

Simpson, R.R. & Shippen, H.H. 1968 - Movement and recovery of tagged King Crabs in the Eastern Bering Sea 1955-63. Bureau of Commercial Fisheries, U.S. Fish and Wildlife Service, Washington D.C. I.N.P.F.C. Doc. 871 Bulletin 24. Int. North Pac. Fish Comm.

Rae, R.J. 1974 - The southern spider crab fishery (Jacquinotia edwardsii) with suggestions for its utilization as a New Zealand enterprise. Confidential for limited distribution by Sealord Products only.

Ritchie, L.D. 1970 - Southern spider crab (Jacquinotia edwardsii) (Jacquinot, 1853) Survey - Auckland Islands and Campbell Island. Fisheries technical report No. 52.

Ritchie, L.D. 1971 - Commercial fishing for southern spider crab (Jacquinotia edwardsii) at the Auckland Islands, October 1971. Fisheries Technical Report No. 101.

APPENDIX I

Noon Weather Data Recorded Daily on the "Satsu Maru 17"

Date	Area	Air Temperature °C	Wind Direction	Force	Barometric Pressure
Dec. 15	Auckland Islands	12	W	2	1022
16	" "	14	NW	5	1014
17	" "	8	WSW	4	1006
18	" "	7	SW	5	1016
19	" "	11	WNW	5	1013
20	" "	11	NW	5	1013
21	" "	12	NNW	2	1018
22	" "	12	N	6	1015
23	" "	11	NE	5	1008
26	Pukaki Rise	10	NE	5	1001
27	" "	12	NNE	3	999
28	" "	9	NW	6	998
29	" "	13	W	4	1016
30	" "	9	SE	2	1029
31	" "	11	NE	5	1022
Jan. 1	" "	12	NE	4	1006
2	" "	14	NNW	3	1012
3	" "	10	WSW	6	1007
4	" "	10	SW	6	1020
5	" "	12	NNW	4	1017
6	" "	12	NW	4	1005
10	" "	12	WNW	4	1028
11	" "	12	NNW	4	1022
12	" "	13	E	2	1028
13	" "	11	W	4	1017
14	" "	10	NW	3	1020
15	" "	11	NW	4	1012
16	" "	11	SSW	3	1021
17	" "	12	NW	1	1024
18	" "	13	N	5	1011
19	" "	12	W	3	1014
20	" "	12	WNW	4	1015
21	" "	13	NW	6	1005
22	" "	14	W	2	1004
23	" "	12	W	4	1008
24	" "	9	WSW	5	1018
25	" "	12	NW	3	1027

Date	Area	Air Temperature °C	Wind Direction	Force	Barometric Pressure
Jan. 26	Pukaki Rise	11	W	2	1013
27	" "	11	W	6	1013
28	" "	13	WNW	7	1004
29	" "	11	WNW	6	1011
30	" "	10	WNW	6	1007
31	" "	10	WSW	6	1020
Feb. 1	" "	12	WNW	4	1016
2	" "	13	WNW	5	1011
3	" "	10	SE	4	1017
4	" "	11	ESE	2	1014
5	" "	13	W	3	1009
6	" "	14	SW	2	1016
7	" "	12	N	5	1003
8	" "	10	SW	2	1019
9	" "	9	ESE	4	1015
10	" "	9	SSE	3	1023
11	" "	12	WNW	2	1030
14	Stewart Is. Shelf	13	SSW	3	1010
15	Pukaki Rise	12	SW	3	1022
16	" "	11	WNW	2	1030
17	" "	12	W	2	1031
18	" "	13	N	3	1027
19	" "	12	NNW	3	1014
20	" "	12	SW	4	1020
21	" "	13	SE	3	1032
22	" "	10	NE	6	1028
23	" "	11	N	7	1007
24	" "	11	NE	2	1009
25	" "	13	NNW	4	1008
26	" "	12	W	6	1012
27	" "	12	NW	6	1008
28	" "	11	W	5	1001
March 1	" "	8	SW	5	1013
2	" "	11	W	6	1002

APPENDIX II

Set information and catch rate at Pukaki Rise

Set No.	Date	Avge. Depth (m)	Set Time (hr)	No. of Pots	No. of Takeables	Total weight of takeables (kg)	Catch rage (Wt/10 Pots) (kg)
1	26.12.73	145	23	171	235	470	27.4
2	"	219	36	165	466	780	47.2
3	27.12.73	188	31	198	103	144	7.2
4	"	153	28	163	206	247	14.1
5	"	158	29	218	335	723	33.1
6	"	130	48	219	437	830	37.8
7	"	106	34	195	250	582	29.8
8	"	158	37	217	574	205	55.5
9	28.12.73	190	49	215	394	906	42.1
10	"	203	43	209	305	622	29.7
11	"	278	46	188	46	90	4.7
12	"	168	45	218	127	169	7.7
13	29.12.73	142	46	215	463	995	46.2
14	"	144	46	217	1001	2242	103.3
15	"	119	46	224	249	513	22.9
16	"	155	48	224	345	793	35.4
17	30.12.73	226	77	217	738	1410	64.9
18	"	130	54	221	297	594	26.8
19	"	152	74	223	1018	1853	83.0
20	"	150	66	209	428	976	46.6
21	31.12.73	142	70	210	241	482	22.9
22	"	118	44	215	556	1251	58.1
23	"	133	42	217	405	932	42.9
24	"	157	87	-	356	780	90.6
25	1. 1.74	120	63	220	607	1360	61.8
26	"	124	107	212	513	1216	57.3
27	2. 1.74	121	56	225	716	511	67.1
28	"	115	51	215	523	1098	51.0
29	"	452	91	219	644	1140	52.0
30	"	141	40	223	1149	2447	109.7
31	3. 1.74	142	28	215	824	1426	66.3
32	"	145	28	221	481	991	44.8
33	"	104	49	217	322	644	29.7
34	"	132	67	213	662	1430	67.1
35	4. 1.74	143	46	212	548	1277	60.2

Set No.	Date	Avge Depth (m)	Set Time (hr)	No. of Pots	No. of Takeables	Total weight of takeables (kg)	catch rate (Wt/10 Pots) (kg)
36	4.1.74	143	47	82	384	641	78.0
37	"	-	47	203	962	1924	94.7
38	"	115	46	56	664	1298	78.6
39	5.1.74	117	142	212	656	1378	65.0
40	"	203	117	213	752	1399	65.6
41	"	122	143	224	531	1120	50.0
42	"	135	139	220	587	1209	54.9
43	6.1.74	133	92	210	879	1934	92.0
44	"	148	101	219	1403	2736	124.9
45	"	146	95	215	752	1489	69.2
46	10.1.74	140	41	205	1240	2557	124.7
47	"	149	48	222	667	1221	55.0
48	"	147	42	217	507	943	43.4
49	11.1.74	105	46	204	337	732	21.7
50	"	145	46	213	487	1091	51.2
51	"	139	46	229	488	1010	44.1
52	"	120	lost part	30 104	144 362	305 804	101.6
53	12.1.74	109	47	209	662	1361	65.1
54	"	117	41	214	540	1193	55.7
55	"	136	46	228	1587	3333	146.1
56	"	-	47	222	609	1188	53.5
57	13.1.74	151	56	216	820	1624	75.8
58	"	127	50	214	968	2139	99.9
59	14.1.74	127	40	217	1387	3010	138.7
60	"	143	24	201	383	793	39.4
61	"	120	45	213	451	992	46.5
62	"	143	47	219	1174	2595	118.4
63	"	143	41	212	675	1418	66.8
64	"	155	44	223	1044	2140	95.9
65	15.1.74	135	55	222	778	1766	79.5
66	"	150	50	224	962	2203	98.3
67	"	157	39	219	581	1301	59.4
68	"	137	37	217	630	1462	67.3
69	16.1.74	142	53	220	1117	2524	114.7
70	"	147	53	221	648	1309	59.2
71	"	117	43	219	882	2135	97.5
72	"	164	37	221	703	1428	64.3
73	17.1.74	168	46	218	634	1319	60.5

Set No.	Date	Avge. Depth (m)	Set Time (hr)	No. of Pots	No. of Takeables	Total weight of takeables (kg)	Catch rate (Wt/10 Pots) (kg)
74	17.1.74	152	46	216	880	1874	86.7
75	"	153	47	222	958	2251	101.3
76	"	137	47	207	477	1102	53.2
77	18.1.74	154	46	218	557	1086	49.8
78	"	110	46	202	561	1252	62.0
79	"	140	49	214	712	1561	72.9
80	"	120	44	209	638	1332	63.7
81	19.1.74	156	46	211	684	1576	74.6
82	"	154	48	210	958	2036	96.9
83	"	125	47	225	868	1845	82.0
84	"	150	46	218	456	893	40.9
85	20.1.74	117	49	224	880	1857	82.9
86	"	150	50	222	1123	2312	104.1
87	"	137	50	207	466	876	42.3
88	"	175	36	221	581	1238	56.0
89	21.1.74	178	53	217	774	1425	65.7
90	"	153	52	208	506	1047	50.3
91	"	110	43	217	576	1156	53.3
92	"	167	35	214	563	1041	48.6
93	22.1.74	168	46	199	313	5856	29.4
94	"	173	46	203	689	1342	66.1
95	"	134	48	211	516	1049	49.7
96	"	122	42	210	503	1152	54.9
97	23.1.74	172	46	211	519	958	45.4
98	"	120	46	210	715	1601	76.2
99	"	172	46	211	771	1550	73.5
100	"	145	42	203	540	1174	57.8
101	24.1.74	154	54	203	464	955	47.0
102	"	127	47	196	582	1184	60.4
103	"	146	38	201	540	1061	52.8
104	"	163	38	207	326	662	32.0
105	25.1.74	113	46	200	535	1145	57.3
106	"	148	45	205	344	678	33.1
107	"	154	48	203	538	1044	51.4
108	"	140	42	81	425	923	114.0
109	26.1.74	168	70	205	628	1226	59.8
110	"	181	74	185	454	822	44.4
111	"	145	66	191	607	1218	63.8
112	"	153	88	199	629	1339	67.3

Set No.	Date	Avge. Depth (m)	Set Time (hr)	No. of Pots	No. of Takeables	Total Weight of takeables (kg)	Catch rate (Wt/10 Pots) (kg)
113	27.1.74	110	70	196	332	642	32.8
114	"	155	142	201	803	1535	76.4
115	"	160	71	198	636	1267	64.0
116	"	160	90	178	485	849	47.7
117	29.1.74	168	70	203	405	644	31.7
118	"	140	70	192	610	1079	56.2
119	"	128	47	197	634	1373	69.7
120	30.1.74	125	55	193	886	1992	103.2
121	"	137	49	196	390	839	42.8
122	"	123	69	183	684	1323	72.3
123	31.1.74	153	41	178	485	849	50.0
124	"	134	49	192	177	425	22.1
125	"	174	46	196	404	751	38.3
126	"	143	47	190	430	948	49.9
127	"	140	48	185	807	1805	97.6
128	"	135	44	188	347	821	43.7
129	2.2.74	142	55	177	591	1088	61.5
130	"	156	46	199	615	1238	62.2
131	"	124	44	204	596	1357	66.5
132	"	143	34	198	304	699	37.0
133	3.2.74	126	48	180	299	634	35.2
134	"	110	43	196	240	526	26.8
135	"	141	44	195	344	795	40.8
136	"	137	45	197	471	1111	56.4
137	4.2.74	148	53	192	456	1029	53.6
138	"	151	32	205	522	1143	55.8
139	"	130	44	185	207	472	25.5
140	"	181	38	208	660	1419	68.2
141	5.2.74	107	46	191	499	1118	58.5
142	"	147	48	184	610	1153	62.7
143	"	150	24	202	828	1913	94.7
144	"	137	25	205	314	710	34.6
145	"	126	43	190	256	545	28.7
146	6.2.74	183	33	210	475	893	42.5
147	"	148	43	197	172	339	17.2
148	"	153	44	185	146	293	15.8
149	"	123	45	191	669	1472	77.1

Set No.	Date	Avge. Depth (m)	Set Time (hr)	No. of Pots	No. of Takeables	Total weight of takeables (kg)	Catch rate (Wt/10 Pots) (kg)
150	6.2.74	140	44	189	578	1342	71.0
151	7.2.74	122	45	191	300	645	33.8
152	"	170	43	191	247	576	30.2
153	"	153	45	200	436	971	48.6
154	"	192	45	199	370	769	38.6
155	8.2.74	164	53	188	155	366	19.5
156	"	146	45	188	691	1491	79.3
157	"	158	45	187	211	403	21.6
158	"	140	38	189	276	619	32.8
159	9.2.74	139	55	196	560	1361	69.4
160	"	145	43	196	488	1180	60.2
161	"	143	39	199	265	553	27.8
162	"	112	37	180	312	677	37.2
163	10.2.74	143	122	186	786	1714	92.2
164	"	150	127	182	1086	2509	137.9
165	"	149	123	191	951	2187	114.5
166	"	122	118	184	770	1833	99.6
167	"	120	134	173	377	976	56.4
168	"	146	132	208	729	1422	68.4
169	15.2.74	105	28	179	484	1118	27.0
170	"	145	26	186	430	783	42.1
171	"	146	28	188	217	421	22.4
172	"	145	40	186	805	1723	79.4
173	"	120	39	182	412	808	44.4
174	"	148	35	180	633	1298	72.1
175	16.2.74	138	32	188	285	624	33.2
176	"	140	26	161	317	666	41.4
177	"	142	40	171	234	449	26.3
178	"	148	41	197	483	956	48.5
179	"	138	44	177	537	1235	69.8
180	17.2.74	128	46	180	518	1171	65.1
181	"	148	47	168	411	945	56.3
182	"	158	46	170	972	2041	120.1
183	"	105	22	153	340	809	52.9
184	"	160	46	190	271	621	32.7
185	18.2.74	188	46	175	149	270	15.4
186	"	153	24	183	512	1178	64.4
187	"	115	45	143	270	529	37.0
188	"	136	48	176	496	1116	63.4
189	"	145	45	172	493	1119	65.1
190	19.2.74	148	48	169	279	664	39.3

Set No.	Date	Avge. Depth (m)	Set Time (hr)	No. of Pots	No. of Takeables	Total Weight of takeables (kg)	Catch rate (Wt/10 pots) (kg)
191	19.2.74	161	26	170	553	1156	68.0
192	"	120	56	178	656	1484	83.4
193	"	115	15	194	352	764	39.4
194	20.2.74	106	30	177	543	1108	62.6
195	"	110	43	183	244	530	29.0
196	"	131	46	138	421	1002	72.6
197	"	157	17	166	504	1033	62.2
198	"	138	44	170	472	1076	63.3
199	21.2.74	116	78	156	413	962	61.7
200	"	160	79	155	461	968	62.5
201	"	128	66	161	300	705	43.8
202	"	110	19	170	278	678	39.9
203	"	114	66	167	444	962	57.6
204	22.2.74	158	46	170	972	914	49.7
205	"	149	72	165	411	991	60.1
206	"	120	68	134	222	533	39.8
207	"	105	41	158	306	728	46.1
208	23.2.74	271	28	154	195	470	30.5
209	"	205	29	144	186	456	31.7
210	"	122	41	160	349	747	46.7
211	"	145	44	149	270	750	50.3
212	"	165	39	150	454	890	59.3
213	25.2.74	155	31	184	338	750	40.8
214	"	285	46	128	178	435	34.0
215	"	153	41	149	341	801	53.8
216	"	136	43	159	229	534	33.6
217	"	122	44	136	533	1269	93.3
218	26.2.74	122	32	149	525	1197	80.3
219	"	242	43	137	236	422	30.8
220	"	153	42	139	258	515	37.1
221	"	165	41	179	266	609	34.0
222	27.2.74	148	27	149	237	586	39.3
223	"	140	41	178	451	1032	58.0
224	"	124	24	168	160	422	25.1
225	"	121	39	172	318	763	44.4
226	28.2.74	160	31	159	484	1045	65.7
227	"	126	27	155	245	578	37.3
228	"	115	21	174	674	1597	91.8
229	"	112	39	138	257	614	44.5
230	"	145	42	179	541	1315	73.5

Set No.	Date	Avge. Depth (m)	Set Time (hr)	No. of Pots	No. of Takeables	Total weight of takeables (kg)	Catch rate (Wt/10 pots) (kg)
231	1.3.74	122	30	170	410	972	57.2
232	"	121	23	187	339	807	43.2
233	"	151	19	141	268	547	38.8

AUCKLAND ISLANDS

Set No.	Date	Avge. Depth (m)	Set Time (hr)	No. of Pots	No. of Takeables	Total weight of takeables (kg)	Catch rate (Wt/10 pots) (kg)
1	11.12.73	90	87	191	50	-	-
2	"	96	110	195	28	-	-
3	"	101	120	185	160	218	11.8
4	12.12.73	65	116	200	156	187	9.4
5	"	76	118	197	140	148	7.5
6	"	87	71	198	218	588	29.7
7	"	105	67	193	207	579	30.0
8	13.12.73	73	75	194	69	155	8.0
9	"	66	80	195	46	780	4.0
10	"	48	91	182	29	680	3.7
11	"	36	94	165	57	122	7.4
12	"	91	109	197	334	434	22.0
13	"	68	40	44	No data	-	-
14	15.12.73	113	45	44	35	77	17.5
15	"	140	90	198	198	594	30.8
16	"	114	48	180	90	256	14.2
17	"	102	47	188	182	473	25.2
18	"	109	60	176	21	32	1.8
19	16.12.73	100	50	188	12	29	15.4
20	"	100	51	192	8	28	1.5
21	"	95	49	198	6	13	0.8
22	"	64	110	189	13	23	1.2
23	17.12.73	61	70	206	156	187	9.1
24	"	139	50	182	28	77	4.2
25	"	111	48	172	125	200	11.6
26	"	123	37	177	66	198	11.2
27	"	147	39	185	90	261	14.1
28	18.12.73	93	46	192	319	590	29.8
29	"	132	97	194	4	88	0.5
30	"	131	97	167	4	88	0.5
31	"	148	68	195	11	196	1.0
32	"	149	44	176	17	39	2.2
33	19.12.73	144	27	191	230	644	33.7
34	"	186	93	172	353	1023	59.5
35	"	176	95	186	603	1568	84.3
36	"	88	12	146	58	186	12.7
37	"	81	47	182	127	394	21.6
38	20.12.73	80	46	195	193	475	24.4
39	"	84	50	159	103	289	15.2

Set No.	Date	Avge. Depth (m)	Set Time (hr)	No. of Pots	No. of Takeables	Total weight of takeables (kg)	Catch rate (Wt/10 pots) (kg)
40	20.12.73	470	43	44	-	-	-
41	"	310	43	67	43	95	14.2
42	"	21	14	85	94	131	15.4
43	"	30	16	85	119	169	19.9
44	21.12.73	75	29	84	63	170	20.2
45	"	83	28	85	203	276	32.5
46	"	113	35	196	75	202	10.31

CAMPBELL ISLAND

Set No.	Date	Avge. Depth (m)	Set Time (hr)	No. of Pots	No. of Takeables	Total weight of takeables (kg)	Catch rate (Wt/10 pots) (kg)
1	24.12.73	78	24	191	387	464	24.2
2	"	78	27	191	24	63.8	3.3
3	"	98	27	192	15	33	1.7
4	"	157	29	168	86	227	13.5
5	"	79	17	188	28	75	4.0

STEWART ISLAND SHELF

1	12. 2.74	142	58	179	Nil		
2	"	140	55	180	Nil		

APPENDIX III

Tag Record for Jacquinotia edwardsii tagged on 24/1/74 on the Pukaki Rise.

Number		Total
9455 - 9472	inclusive	18
18530 - 18600	"	71
18701 - 18829	"	129
	TOTAL TAGGED:	218

A. R. SHEARER, GOVERNMENT PRINTER, WELLINGTON, NEW ZEALAND—1976