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FISHING INDUSTRY RESEARCH COMMITTEE

FINAL REPORT: STUDIES OF THE WESTERN POPULATION OF SOUTHERN ROCK LOBSTER IN THE SOUTH EAST REGION OF SOUTH AUSTRALIA

- FEEDING BEHAVIOUR AND MOVEMENT.

INTRODUCTION

The southern rock lobster *Jasus novaehollandiae* Holthuis is one of six species of the commercially important genus *Jasus* found in southern temperate waters. The *J. novaehollandiae* fishery occurs along the southern coastline of Australia to depths of 200 metres and is South Australia's most important single species fishery with an average production of $2.3.10^6$ kgs $year^{-1}$. Despite this importance little published documentation on *J. novaehollandiae* is available, recognition of the species occurring in 1963 with a preliminary description by Holthuis (1963) and verification by George and Kensler (1970). Early reports on the biology of southern rock lobster are given by Hickman (1946) and the colourful T. Challenger (1943). More recent publications are Olsen (1958), Bradbury (1974) and Wolfe (1975) who described variations in population structure throughout Tasmania. In South Australia the only previous studies have been in behaviour, growth and reproduction under laboratory conditions by Fielder (1964 a, b, c: 1965 a, b). Olsen and Fielder (1968) incorporated available *J. novaehollandiae* biological data in their synopsis of the "lalandii" complex.

In 1973 study of the larval settlement, growth, movement, population dynamics and fishery commenced in the south-east region of South Australia.

MATERIALS AND METHODS

Taging of juvenile and adult rock lobsters on all known rock lobster fishing grounds in the south-east of South Australia commenced in 1973 with 7,500 releses by October 1976. Suitably inscribed Floy manufactured FD 67 toggle tagswere inserted dorsally between the second and third abdominal segments intothe superficial extensor and anterior oblique (flexor) muscles. Olsen and Helder (1969) and Winstanley (1976) have described tagging techniques and effects on *J. novaehollandiae* using the Floy manufactured FA6C dart tag. Winstanley described the deleterious effects of necrotic growth, exoskeleton deformity, reduced growth rates and low retention rates of the dart tag. Initially both dart (FA6C) and toggle (FD 67) tags were tested in this study but the dart tag was found to be completely unsatisfactory for the reasons outlined by Winstanley, particularly the low retention rate as the barb on the FA6C dart tag is too small and lacks rigidity to properly imbed in the soft rock lobster musculature.

The FD 67 toggle tag does cause some necrotic growth and abdominal tergite deformation but not to the extreme extent reported by Winstanley. Observations during this programme and during the development of a tag for western rock lobster (Chittleborough, 1974) have shown that the suitability of rock lobster tags is dependent upon shaft rigidity, a rigid tag does not allow tag wounds to heal completely due to its constant movement during normal muscular activity. Comparison of the FA6C dart tag and the FD 67 toggle tag shows that the former is far more rigid (shaft diameter 1.0 mm) than the latter (shaft diameter 0.5 mm). The western rock lobster tag (filament diameter 0.3 mm) is now used for southern rock lobster studies in Australia (Winstanley, Victorian Fisheries and Wildlife Division and Bradbury, Tasmanian Department of Agriculture, Fisheries Division, personal communication, 1977).

Rock lobsters were collected by either trapping in pots from research and commercial fishing vessels or by diving. Diving observations both during the day and night were carried out to determine feeding patterns of animals in the wild. As well as operating in the commercially exploited areas three sanctuary areas for research purposes were declared inthe study area (Fig. 1). These areas were designated

1. Margaret Brock Reef Rock Lobster Sanctuary - in the north of the study area, eight kilometres offshore covering a total sea area of approximately 800 hectares.

2. Penguin Island Rock Lobster Sancturary - in the centre of the study area, onshore and 200 hectares.

3. Bucks Bay Rock Lobster Sanctuary - in the south of the study area, inshore and 12 hectares.

RESULTS AND DISCUSSION

583 rock lobster tags were returned during the period covered in this report, but only 439 were accompanied with reliable data as to size and/or location of capture. The majority of the remaining 144 outstanding tags were found on the processing lines of a number of local processing works after separation of the tail from the carapace.

This study indicates that movement by *J. novaehollandiae* in south-eastern waters of South Australia falls within two and possibly three distinct behavioural patterns.

(1) shelter residency and foraging

(2) dispersive movement

(3) migratory movement

(1) Shelter residency and foraging

J. novaehollandiae exhibit a diurnal shelter residency and feeding behaviour similar to that described for other palinurids by a number of authors. Activity ceases or is reduced during daylight hours when the protection of caves and crevices is sought. The rock lobsters sit at the entrance of the cave, facing the opening, with their thoracic sternum in contact with the substrate and their tail curled up under themselves. In shallow water lobsters are found well to the forefront of the cave during periods of mild to moderate swell or surge but retreat to the added protection of the rear of the cave during periods of heavy swell.

On approach of a predator a resting rock lobster raises itself onto the tips of its periopods, straightens its tail and fans out the uropods and pleopods in readiness for a backward escape reaction by contraction of the abdominal muscles. As the lobster raises itself onto its periopods it directs antennae and antennules towards the predator and frequently will move towards the predator forming a barrier between itself and adversary by the forward projecting antennae which slowly wave backwards and forwards across the front of the lobster. Throughout this action the outer flagella of the antennule vibrates at a rapid rate. Patterson (1968) found that antennule setae are capable of either mechano- or chemo-reception. Ache (1977) states that it is likely that this vibration of the outer flagella enhances monitoring of changes in stimulus concentration rather than presence/absence of chemical stimuli *per se*. After any

intitial forward movement the rock lobster will then remain in the alert position ready for an escape reaction or slowly retreat to the rear of the cave. The backward escape reaction is executed if the predator comes within close proximity or within contact of the antennae.

Feeding activity was found to commence just before dusk and continue throughout the night ceasing at dawn, peak feeding activity occurring just after sunset. Fielder found similar feeding times with peak activity one to two hours after the onset of darkness. Diving observations on rock lobsters feeding at night have shown that individual rock lobsters move out of their caves and forage alone for food amongst reef communities and seagrass beds. The characteristic stance of a foraging rock lobster is similar to the alert position described above, as the lobster moves over the substrate it is raised up on its periopods with the antennae and antennules constantly traversing the direction of movement and the tail straight with all uropods and pleopods splayed, ready for a backward escape reaction. During the searching activity the outer flagella of the antennules vibrate extremely rapidly and the first two pairs of periopods are somewhat spread apart as the lobster walks.

Many underwater observations of foraging and feeding rock lobsters in the field have highlighted differences in behaviour to various baits and food sources. When a marine bait is offered to a rock lobster by a diver those rock lobsters that respond usually do by orienting themselves in the direction of the bait, testing the chemical stimulus with aid of increase in outer flagella vibration of the antennule, and then move rapidly forward towards the bait and grasp it between the first pair of periopods and maxillipeds as described by Fielder.

The lobster then retreats back into its cave with the bait before the commencement of feeding. However, the foraging behaviour of rock lobster at night differs in that the animal is acutely more cautious and alert, continually in the alert configuation described above. The foraging lobster moves slowly forward over the search area and on many occasions it appeared that food was not detected until the rock lobster came into physical contact with it, hence the spreading of the first two pairs of periopods to increase the search area. These walking legs possess a large number of sensory setae on the dactyls which appear to be important for finding food when in the alert configuration. Ache (1977) states that for *P. argus* the "dactyl chemo receptors are commonly contrasted with the antennular receptors as serving a higher threshold" and are used for close range or contact chemo-reception.

These observations suggest that in the feeding behaviour of *J. novaehollandiae* food identification and capture is carried out by long range reception of stimuli by the antennules and short range or contact reception of stimuli by sensory setae on the dactylopodites of the first two pairs of walking legs.

Once food has been grasped by the rock lobster it then returns to its cave before feeding commences in the manner described by Fielder (1965). If a rock lobster was observed not to return to the cave when it was seen to leave at the commencement of feeding , it sought another adequate cave or crevice before feeding commenced. In no cases was it observed that on returning to a cave jointly occupied by other lobsters was the food forcibly taken by another lobster, although it could be shared if it was sufficiently large. In one case a rock lobster was seen to relinquish its food to a cleft-fronted shore crab *(Plagusia chabrus)*

when it moved to the feeding rock lobster and displaced it by tapping it sharply on the dorsal surface of the carapace with a chela, although the lobster was considerably larger than the crab. The displaced rock lobster then sat 15 cm away while the crab fed.

The range of foraging rock lobsters as determined by diver observation was in general found to be restricted to the vicinity of the home reef and rarely extended greater than 100 m when food and shelter are adequate.

Although nocturnal foraging behaviour is exhibited by all southern rock lobsters the level of activity at different times of the year was found to be dependent on the physiological state of the individual. This leads to a change in availability of individuals to the commercial catch by suppression of feeding behaviour, as shown in Table 1, which presents the percentage of male and female southern rock lobsters in commercial catches presented at three ports of landing in South Australia. The percentage occurrence is presently at fortnightly intervals for the period November 1975 - May 1976.

Table 1 shows that female rock lobsters predominate in the commercial catch during the months November-December with males predominating from January. No data are available for October as a total closed season on southern rock lobster in South Australia is enforced. These changes in composition of the commercial catch are directly related to the changing physiological state of the rock lobster (Lewis, unpublished). In south-eastern waters of South Australia adult female southern rock lobsters moult annually during June-July, while males moult during October-November.

TABLE 1: FORTNIGHTLY PERCENTAGE MALE & FEMALE IN COMMERCIAL CATCH 1975-77

DATE	PORT MACDONNELL			SOUTHEND			KINGSTON/CAPE JAFFA		
	No.	M %	F %	No.	M %	F %	No.	M %	F %
1.11 - 14.11	1 759	48.2	51.6	4 163	36.0	64.0	4 969	53.5	46.5
15.11 - 28.11		NO DATA		3 525	37.1	62.9	2 508	41.4	58.6
29.11 - 12.12		NO DATA		5 029	39.2	60.8	5 007	40.8	59.2
13.12 - 26.12	4 473	54.9	45.1	4 026	51.2	49.8	5 029	45.9	54.1
27.12 - 9.1	3 270	59.9	40.1	4 492	55.0	45.0	5 070	55.0	45.0
10.1 - 23.1	4 822	61.4	38.6	5 009	59.8	40.2	4 157	58.7	41.3
24.1 - 6.2	4 234	59.4	40.6	4 291	56.4	43.7	5 069	59.2	40.8
7.2 - 20.2	2 724	61.6	38.4	4 043	57.0	43.0	5 005	61.2	38.8
21.2 - 5.3	3 570	61.6	38.4	3 452	56.3	43.7	4 986	58.0	42.0
6.3 - 19.3	3 818	59.4	40.6	4 096	58.4	41.6	5 041	57.8	42.2
20.3 - 2.4	1 915	57.6	42.4	2 786	56.8	43.2	5 050	57.1	42.9
3.4 - 16.4	1 352	58.7	41.3	1 410	55.8	44.2	4 978	62.4	37.6
17.4 - 2.5		NO DATA		468	57.1	42.9		NO DATA	
3.5 - 15.5		NO DATA		1 241	62.6	37.4		NO DATA	

Therefore the southern rock lobster in South Australian waters exhibits a nocturnal foraging activity in close proximity to its home shelter using long and short distance chemo-receptors. Other receptors used in this foraging activity include mechano- and photo-receptors. Fielder (1965) reported that this feeding activity is correlated to the light-dark (LD) regime the rock lobster experiences and the periodicity of the activity can be altered by changes in the LD regime. Observations in this study show that this feeding activity is also altered by moult occurrence, with periods of abstinence in times of moulting to increased activity (daylight) after moulting.

(2) Dispersive Movement

Evidence of gross movement by other than foraging activity discussed in Section 1, is available from data provided with recaptured tagged rock lobsters. Of tag returns with information 167 (37.4%) were recaptured in the same area as released, duration of freedom ranging from 12 to 963 days; 249 (56.9%) were recaptured greater than two nautical miles distance or 10 metres depth from area of release with the duration of freedom ranging from 12 to 1 620 days; 22 (5.0%) returns did not contain adequate information to provide reliable movement data.

Table 2 presents gross recapture and movement data, the study area divided into 3 regions (Fig. 1) ranging from north to south - Cape Jaffa, Beachport/Southend and Port MacDonnell.

TABLE 2: PERCENTAGE RECAPTURES INDICATING MOVEMENT

AREA	NO. RECAPTURES	PERCENTAGE MOVED		PERCENTAGE NO. MOVEMENT	
Cape Jaffa	51	70.6	(36)	17.7	(9)
Beachport/Southend	213	61.5	(130)	32.4	(69)
Port MacDonnell	174	47.1	(83)	49.4	(86)
TOTAL	438	56.9	(249)	37.4	(167)

Movement of southern rock lobsters from tag recoveries, along the south eastern coastline of South Australia is shown in Figs. 2 and 3 (Kingston), 4 (Beachport/Southend) and 5 (Port MacDonnell). The coastline has been sectioned this way to aid presentation of data as the general coastline bearing varies with regions. Figs. 2-5 represent hypothetical straight line tracks as depicted from the area of release to position of recapture and present an overall picture of movement although the actual time of movement and path of travel is unknown as it was not possible to employ ultra-sonic telemetry techniques. Each arrow represents the movement of one or more rock lobsters, the number of rock lobsters involved where multiples is indicated with a sub-script near the arrowhead.

(a) Cape Jaffa

A total of 51 recaptures occurred in Cape Jaffa waters with 36 (70.6 %) showing movement (Figs. 2 and 3); the most distant being 44 miles from inshore (6-10 fathoms) waters north of Kingston to 32 miles west of Cape Jaffa (25 fathoms). Four

recaptures have shown similar movement (tag numbers 5142, 5416 5478 and 4619) over distances ranging from 38 to 44 miles. Duration of freedom ranged from 104 to 112 days for the first trhee of these returns with an average straight line ground speed of 0.39 miles per day. Tag number 4619 was found 38 miles from release location 1 620 days after release. All these long distance movements were in a south-westerly direction (Fig. 2). Movement of other recaptures north of Cape Jaffa were generally along or offshore. South of Cape Jaffa (Fig. 3) all movements were offshore, generally in a north-westerly direction over distances of 2 to 11 miles and duration of freedom ranged from 12 to 783 days. The percentage of movement for each 45^{o} (magnetic) sector (Table 3) indicates that 83.3% of movement was offshore as shoreline direction is approximately north/south along this section of coastline.

The temporal distribution of recaptures (Table 2) shows that 83.3% (30) recaptures occurred within 6 months of release, 11.1% (4) approximately one year from release and 2.7% two years and 4 years from release. Almost all recaptures occurred during November to February due to the traditional distribution of fishing effort (source of recaptures) in South Australia. The rock lobster fishing season in the study area commences on November 1 and extends until May 30 for females and September 30 for males, but due to prevailing weather conditions and the physiological state of the rock lobster the largest concentration of effort and catches occurs during the period November to February (Lewis, unpublished). Table 4 represents the monthly proportion of catch caught by professional fishermen in the study area during the 1976/77 fishing season.

TABLE 3: PERCENTAGE DIRECTION OF MOVEMENT IN SOUTH-EAST REGION PER 45° M SECTOR

SECTOR	KINGSTON (000-180)[1]	BEACHPORT/SOUTHEND (315-135)[1]	PORT MACDONNELL (315-090)[1]
001-045	2.8 (1)[2]	7.7 (10)	2.4 (2)
046-090	0.0 (0)	0.08 (1)	4.9 (4)
091-135	5.6 (2)	4.6 (6)	8.5 (7)
136-180	8.3 (3)	16.9 (22)	9.8 (8)
181-225	11.1 (4)	26.9 (35)	20.7(17)
226-270	25.0 (9)	14.6 (79)	18.3(15)
271-315	27.8(10)	18.5 (24)	28.1(23)
316-360	19.4(13)	18.0 (13)	7.3 (6)

1 - general bearing of coastline (° magnetic)

2 - number

TABLE 4: MONTHLY PROPORTION OF SOUTHERN ROCK LOBSTER CATCH IN SOUTH-EASTERN SOUTH AUSTRALIA 1976-77

MONTH	N	D	J	F	M	A	M	J	J	A	S
% CATCH	17.0	14.3	21.2	18.0	11.9	3.5	1.3	0.2	1.4	4.9	6.2

(b) Beachport/Southend

213 recaptures occurred in the Beachport/Southend area with 131 (61.5%) showing movement (Fig. 4) up to 13 nautical miles from release site with duration of freedom ranging from 25 to 714 days. 69 (32.4%) recaptures were at the release site up to 658 days after release. 76.9% of movement was offshore (coastline bearing approximately north-west/south-east). Inshore lobsters were found to disperse radially from release sites into available offshore areas while offshore lobsters also dispersed radially with a high proportion moving along the coastline in the 10 to 20 fathom range.

The average distance travelled was 5.0 nm with an average time interval of 262 days giving a resultant average ground speed of 0.02 nm per day. Maximum ground speed determined from tag returns from this area was 0.11 nm per day (4.5 nm, 43 days). Maximum depth change with movement was 35 fathoms from close inshore in Rivoli Bay (5 fathoms) south-west from release site to 40 fathoms. Recapture of this rock lobster was 437 days after release over 9 nm distance. 96 (73.8%) of recaptures occurred within one year of release and 34 (26.6%) during the second year.

(c) Port MacDonnell

174 recaptures occurred in the Port MacDonnell area with 82 (47.1%) showing movement (Fig. 5) up to 14.0 nm from the release site with duration of freedom from 25 to 931 days, 86 (49.4%) recaptures were at the release location up to 963 days after release. 85.4% of movement was in an offshore direction (coastline bearing from north-west to east) dispersed radially from release sites, the average distance being 3.6 nm, average time interval of 229 days, giving a resultant ground speed of 0.015 nm per day. Maximum ground speed determined from tag returns from this area was 0.11 nm per day (11.5 nm, 109 days). As the continental shelf (185 metres) comes to within 16 nm of the coastline, bottom gradient to shelf depth is the steepest of any other area of the study range and it is in this area that the greatest depth change of 100 metres occurred. Rock lobster tag number 823 was recaptured 14 miles from release site in 100 metres after being released in 10 metres of water 912 days previously. Rock lobster tag number 3994 was recaptured 10 miles from release site in 120 metres of water after being released in 28 metres of water 129 days previously. 68 (82.9%) of recaptures occurred within one year of release, 13 (15.9%) during the second year of freedom and 2 (2.4%) during the third. Monthly recapture rates (Table 5) again reflect the seasonal distribution of effort within the fishery.

These data indicate that movement of southern rock lobster in south-eastern waters of South Australia occurs over distances greater than that attributed to foraging activity previously described by earlier workers, 56.9% of recaptured tagged rock

TABLE 5: MONTHLY PERCENTAGE RETURN TAGGED ROCK LOBSTERS EXHIBITING MOVEMENT

MONTH	SEX	CAPE JAFFA		BEACHPORT/SOUTHEND		PT. MADONNELL	
JANUARY	M	5.6	(2)	2.3	(3)	2.4	(2)
	F	13.9	(5)	13.0	(17)	6.0	(5)
FEBRUARY	M	2.7	(1)	7.7	(10)	8.4	(7)
	F	11.1	(4)	9.2	(12)	4.8	(4)
MARCH	M	-		4.6	(6)	6.0	(5)
	F	2.7	(1)	8.5	(11)	2.4	(2)
APRIL	M	-		2.3	(3)	3.6	(3)
	F	-		6.9	(9)	4.8	(4)
MAY	M	-		0.8	(1)	2.4	(2)
	F	-		3.9	(5)	1.2	(1)
JUNE	M	-		-		-	
	F	-		-		-	
JULY	M	-		-		-	
	F	-		0.8	(1)	-	
AUGUST	M	5.6	(2)	1.5	(2)	1.2	(1)
	F	-		-		-	
SEPTEMBER	M	2.7	(1)	2.3	(3)	3.6	(3)
	F	2.7	(1)	3.9	(5)	-	
OCTOBER	M	CLOSED SEASON					
	F						
NOVEMBER	M	2.7	(1)	1.5	(2)	13.2	(11)
	F	36.1	(13)	15.4	(20)	19.3	(16)
DECEMBER	M	-		7.7	(10)	8.4	(7)
	F	13.9	(5)	7.7	(10)	12.1	(10)
TOTAL	M	19.4	(7)	30.8	(40)	48.2	(40)
	F	0.6	(29)	69.2	(90)	51.8	(43)

Brackets - number

lobsters were found to have moved greater than 2 nautical miles and/or 10 metres. These rock lobsters dispersed radially from tag sites with a total of 80.7% movement in an offshore direction. Locomotor stimuli for this activity is believed to be intra-specific interations for cover with increase in size. The puerulus stage of the southern rock lobster has been found to settle onto inshore reef communities duirng July-September (Lewis in prep.). Dive sampling on these areas of settlement have shown that at the time of settlement almost all pueruli and post-pueruli are able to obtain the protection of small crevices but become more exposed due to inadequacy of the crevice with in crease in size of the rock lobster. This increase in size and subsequent decrease in protection has been found to result in a decrease in density of rock lobsters in the monitored settlement areas prior to influx of the new settlement.

Reef communities just seaward of the settlement areas are found to contain large numbers of juvenile rock lobsters which are gregarious with densities of up to 30 rock lobsters per cubic metre, whilst further offshore smaller numbers of larger rock lobsters are found to be solitary or congregate in smaller groups of 1 or 2 rock lobsters per cubic metre in inhabited caves (Lewis, unpublished).

Although some inshore movement occurred (19.3% returns) only four tag returns indicated movement to close inshore areas, all others generally being along the coastline with minimum depth decrease. Table 6 summarises dispersive movement data in the south-eastern waters of South Australia.

TABLE 5: SUMMARY OF MOVEMENT DATA FOR SOUTHERN ROCK LOBSTER - SOUTH -EASTERN SOUTH AUSTRALIA

LOCATION	DURATION OF FREEDOM (days)	DISTANCE MOVED (nm)	GROUND SPEED (NM/DAY) average	GROUND SPEED (NM/DAY) maximum	CHANGE IN DEPTH (fathoms)	% RECAPTURES FROM RELEASE DATA 1 yr	2 yr	3 yr	% MOVEMENT OFFSHORE
Cape Jaffa	12-1, 620(-)[1]	2-44 (-)	-	-	3-25	94.4(34)[2]	2.7(1)[2]	2.7(1)[2]	83.3(30)[2]
Beachport/ Southend	25-714(262)[1]	2-13(5)[1]	0.02	0.11	3-40	73.8(90)[2]	26.2(34)[2]		76.9(100)[2]
Port Mac-	25-931(229)[1]	2-14(3.6)[1]	0.015	0.11	0.65	82.9(68)[2]	15.9(13)[2]	2.4(2)[2]	85.4(71)[2]

1 - average

2 - number of recaptures.

(3) Migration

Herrnkind (1977) defines migration as "direct locomotory movements of a population (or district component) within some confined time period over relatively long distances". Although migration of rock lobster populations have been reported by Street (1971), Herrnkind *et al* (1973) and Moore and MacFarlane (1977) no conclusive evidence for migration within southern rock lobster populations has been found in this study. The only tagged rock lobsters to exhibit unified long distance movement were in the Cape Jaffa area from 30 miles north of Kingston to 25-30 miles west of Cape Jaffa with recapture times 104-120 days after release. An ongoing programme is in progress in the Cape Jaffa area to determine the existence of any migration from the area and causal effects.

Movement and migration within the palinurid lobsters has been documented by many authors and the subject reviewed by Herrnkind (1977) who distinguished between homing, nomadism and migration. Within a genus intensity and extent of movement has been found to vary with different species.

In the genus panulirus this is illustrated by a progression seen in *P. longipes cygnus*, lack of mass migration other than maturing animals from inshore to offshore at 2 to 5 years of age (Chittleborough, 1970), *P. ornatus*, seasonal movement across the Gulf of Papua (Moore and MacFarlane, 1977) to *P. argus*, spectacular seasonal queing and migration in Caribbean waters (Herrnkind 1969, 1970).

Movement in the genus Jasus has long been described as localised and random in search of food following a cycle of remaining in shelter during daylight and feeding during darkness with peak feeding activity around dusk (Fielder 1965 b; Olsen and Fielder, 1968) with large scale movements

reported only for *J. edwardii* in New Zealand waters, Street (1971), Booth (1977) has found tagged *J. verreauxi* 50 km from release site after a year of freedom in the North Island of New Zealand. Olsen (unpublished) found the maximum distance travelled by *J. novaehollandiae* from release point at Cape Sorrell (Tasmania) was 1 000 m after 3 years freedom.

This study, however, found that movement of *J. novaehollandiae* in the south-east of South Australia occurred over distances up to 44 nautical miles, although there was not conclusive evidence to determine if migration from one area to another occurs. Movement in the area was found to fall within two behavioural patterns

(1) Shelter residency and foraging - short range movement whilst seeking food in the vicinity of shelter

(2) Dispersive - longer range movement radiating from any location but often from shallow inshore areas out to offshore areas.

ACKNOWLEDGEMENT

This study was funded by grants from the Fishing Industry Research Trust Account

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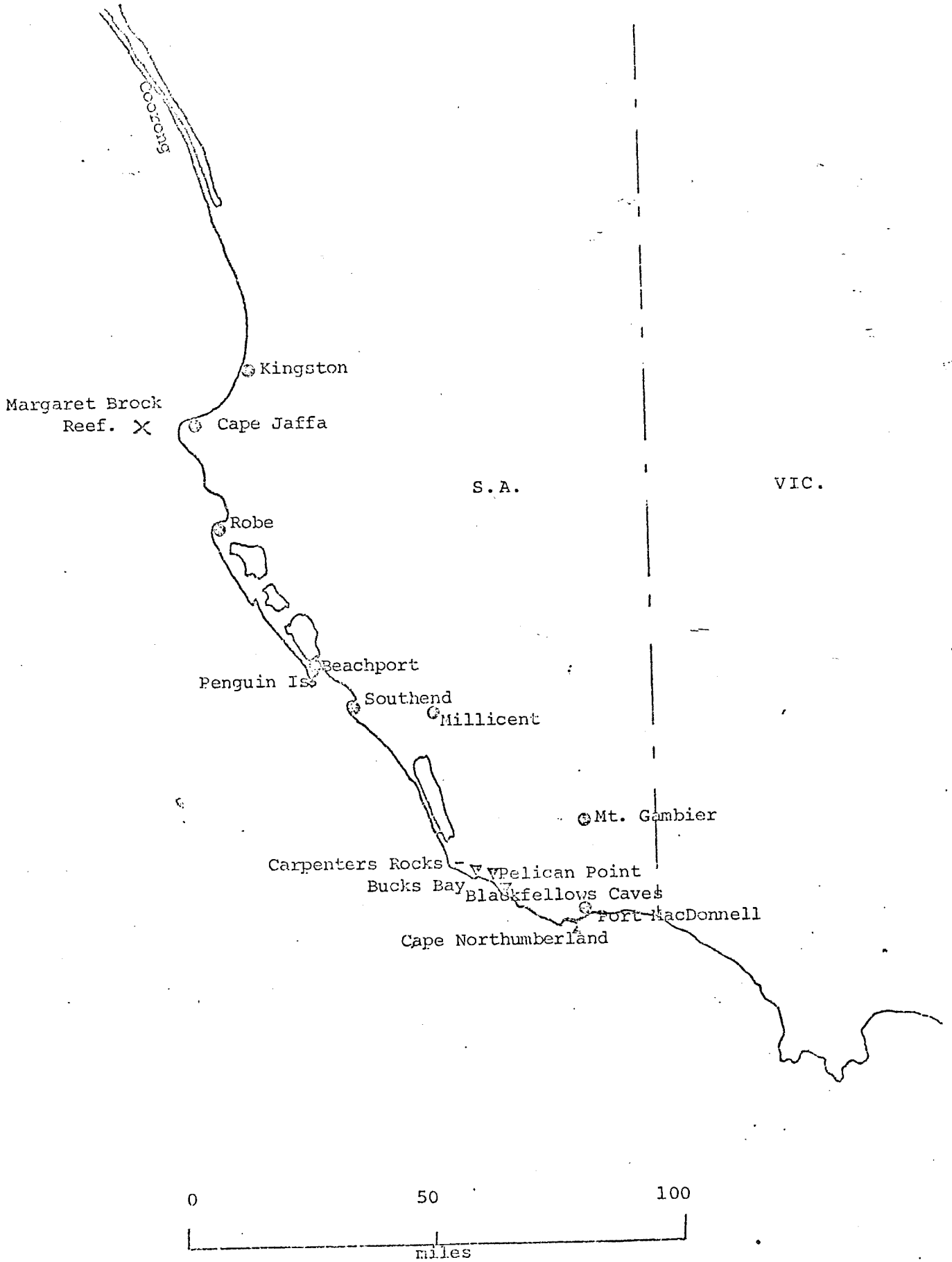

Figure 1. Location of major fishing ports and rock lobster sanc[illegible]es in South Eastern South Australia.

FIGURE 2: MOVEMENT OF SOUTHERN ROCK LOBSTER - CAPE JAFFA

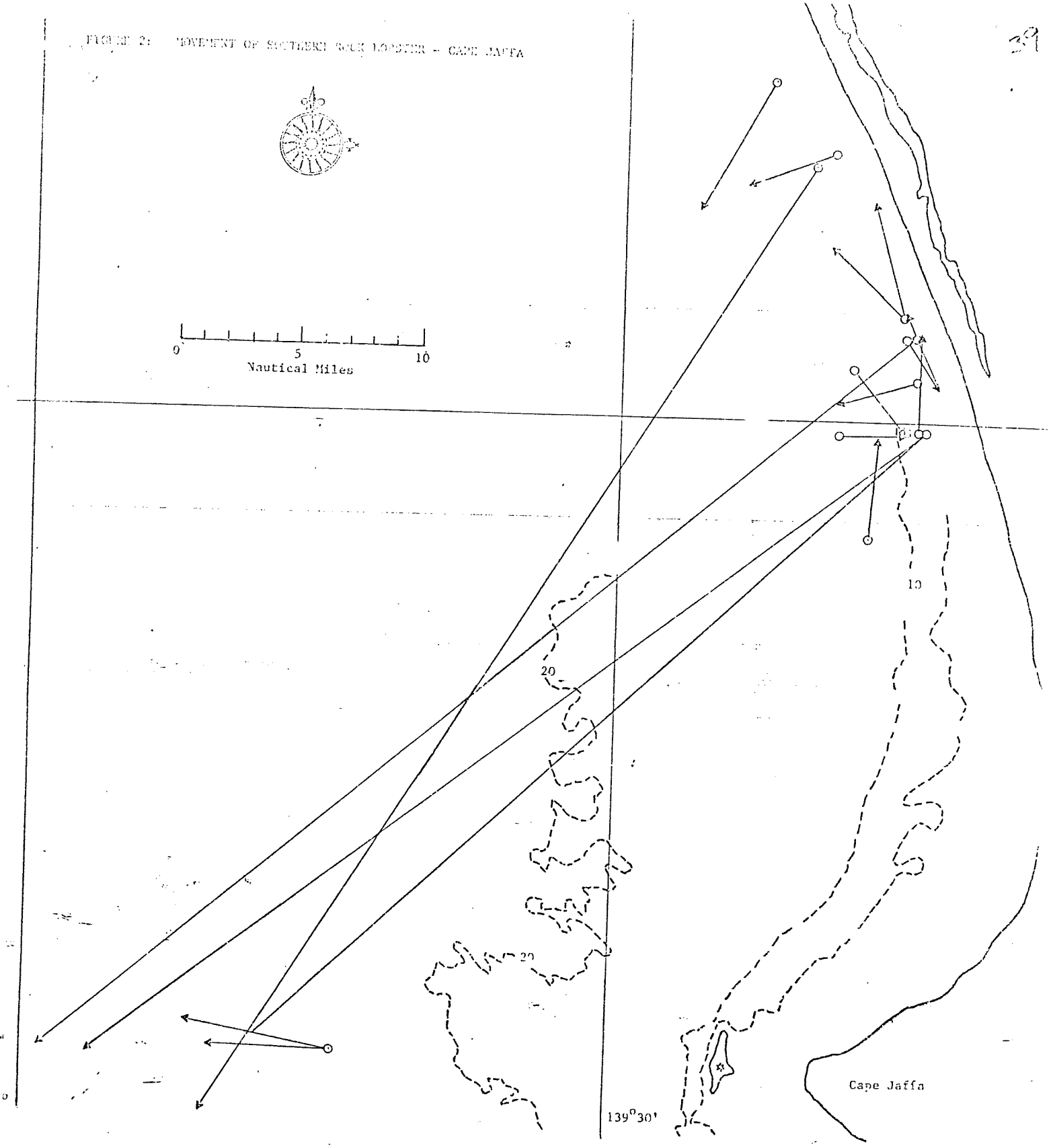

FIGURE 3: MOVEMENT OF SOUTHERN ROCK LOBSTER - CAPE JAFFA

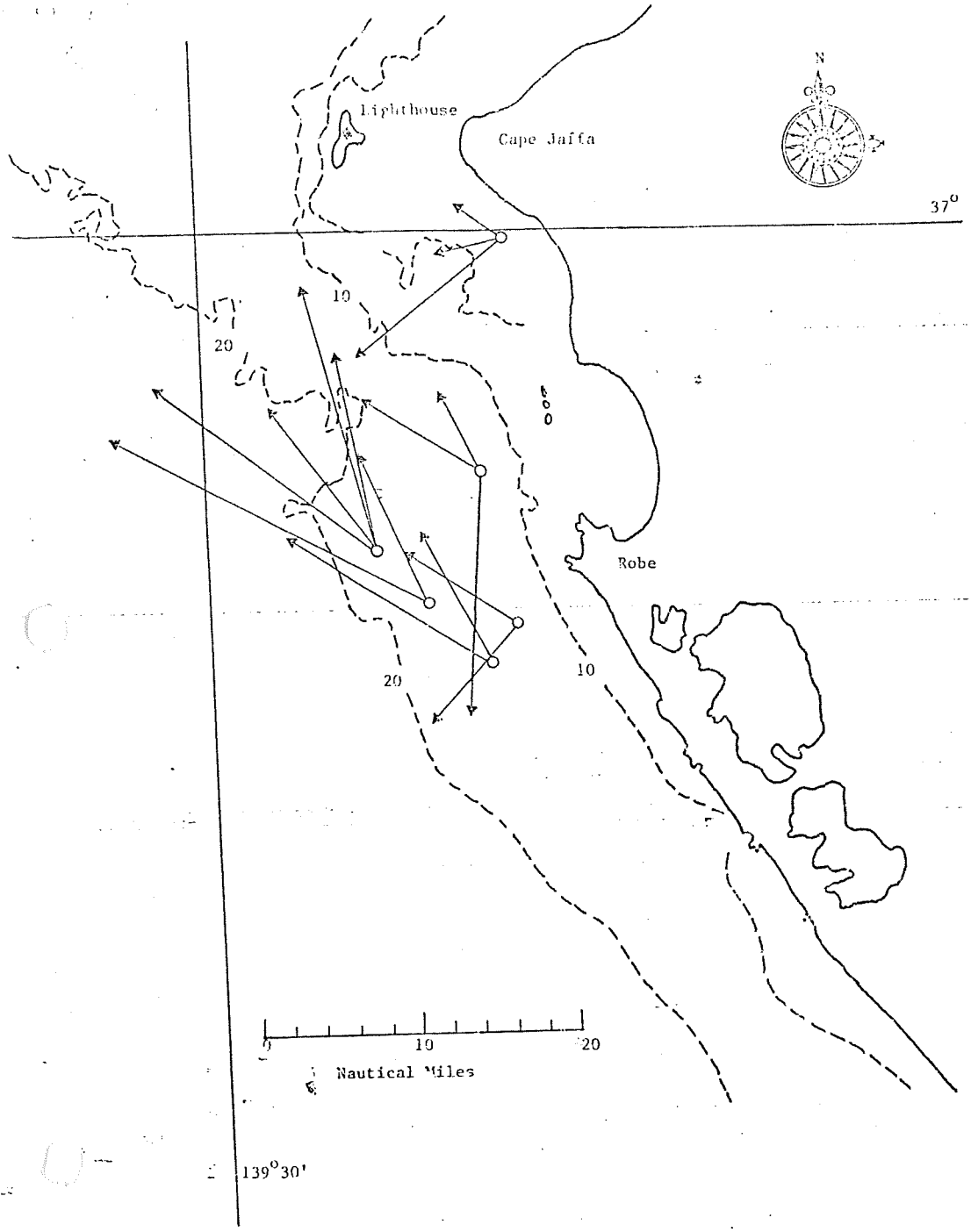

FIGURE 7 MOVEMENT OF SOUTHERN ROCK LOBSTER - BEACHPORT/SOUTHEND

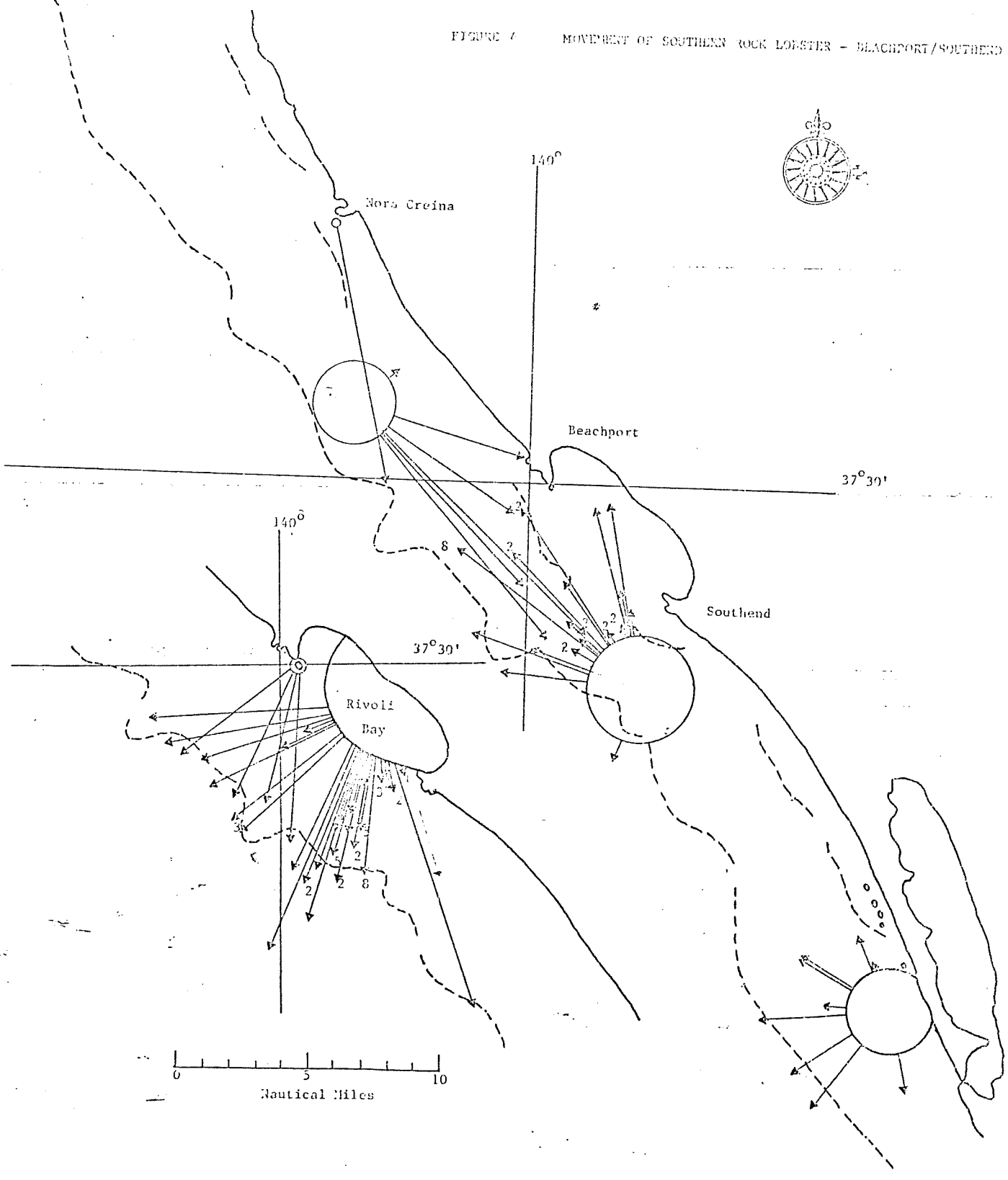

FIGURE 5 MOVEMENT OF SOUTHERN ROCK LOBSTER - PORT MACDONNELL