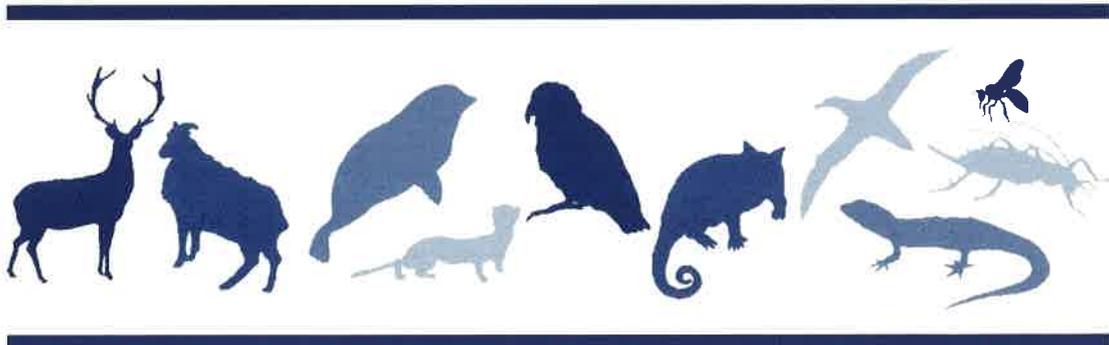




A radio tracking study of the movements
and foraging ecology of female New Zealand
fur seals (*Arctocephalus forsteri*)
at Cape Fowlwind

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Canterbury, New Zealand



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1.0 BACKGROUND.

The New Zealand fur seal, (*Arctocephalus forsteri*), occurs around most coastal areas of New Zealand. Breeding grounds are now primarily found along the west and southern coasts of the South Island, as well as on Stewart Island and the Chatham and sub-Antarctic Islands (Wilson, 1981).

Breeding takes place over the summer months, usually between mid-November and mid-January (Crawley & Wilson, 1976). The male fur seals occupy territories on the breeding colonies from November to January. Breeding females give birth to a pup, conceived during the previous breeding season, mid-November to late-December. Females normally mate again about 10 days after the birth of their pup (McNab & Crawley, 1975). After the breeding season most of the males disperse to non-breeding colonies around the country. Females however, remain and suckle their pups until weaning which, takes place between July and November (Miller, 1975). During the time females are suckling their pup, they engage in foraging trips. Before this study nothing was known about the frequency, duration or distances covered during these foraging trips.

At present there is concern over the by-catch of fur seals by the west coast hoki fishery. The west coast hoki season is normally between June and August so mature females caught during this time are likely to be pregnant with most having dependant pups ashore. As fur seals are polygamous and females produce only one pup each year the fur seal population is likely to decline with even low losses of females. The breeding colonies which are closest to the west coast hoki grounds, are those at Cape Foulwind and Charleston which between them have only a few hundred breeding females. Both colonies are approximately 100 kilometres away from the main hoki grounds (Wilson, 1992).

2.0 AIMS AND OBJECTIVES

AIM: To use radio tracking to determine where female New Zealand fur seals, from Cape Foulwind, travel in relation to behavioural and ecological factors.

OBJECTIVES:

- To find out where female New Zealand fur seals travel to when they leave the Cape Foulwind colony
- To relate the positions of female fur seals at sea to ecological factors (e.g. distribution of major prey species, fish stocks, salinity, water depth, ocean currents, distance from shore).
- To characterise the behaviours of female fur seals at sea.

3.0 METHODS

The major component of this study involved the radio tagging and tracking of fifteen presumed breeding female New Zealand fur seals. This was achieved using two stage transmitters with a signal transmitting distance of approximately 100kms and an assumed transmission life of around 10 months. The transmitters were built by SIRTRACK in Havelock North. A single transmitter was attached to the back of each seal's neck using an epoxy glue (Araldite K268). This method of attachment was chosen so that the transmitters would be shed in the next annual moult. The fur seals were caught and tagged in late March immediately after their annual moult.

The seals were tracked from two fixed stations one being located near Westport, on Mt. Rochfort (1038m), and the second station being located near Greymouth on Paparoa Peak (831m). The criteria for choosing these stations were primarily road access, altitude, an unobstructed line of sight seawards. Tracking was carried out over four two week periods during the expected 10 month transmission life of the transmitters. The tracking sessions were in April, July and November 1993 and January 1994. During these times both tracking stations were occupied and in radio contact with one another so as to allow seal positions to be determined by triangulation. The antennae consisted of two five element Yagi antennae mounted in parallel array. Radio-tracking information was analyzed and represented using the "ARCinfo" computer package. Location and movement data were related to water depth and environmental conditions near Cape Foulwind.

4.0 RESULTS

4.1 RADIO-TRACKING

Two key objectives of the radio tracking were firstly to determine the locations and distances of seals from the colony during each of the four tracking periods. Secondly to estimate the minimum trip durations and distances of foraging trips using individual seal movements at sea.

Transmitter loss was considered to be unavoidable and had an important impact on the results, especially in the later tracking periods.

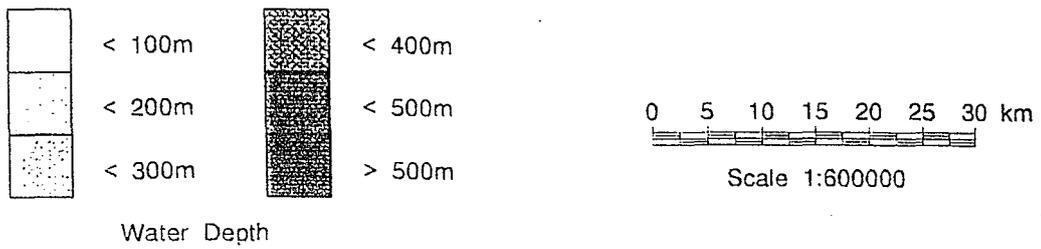
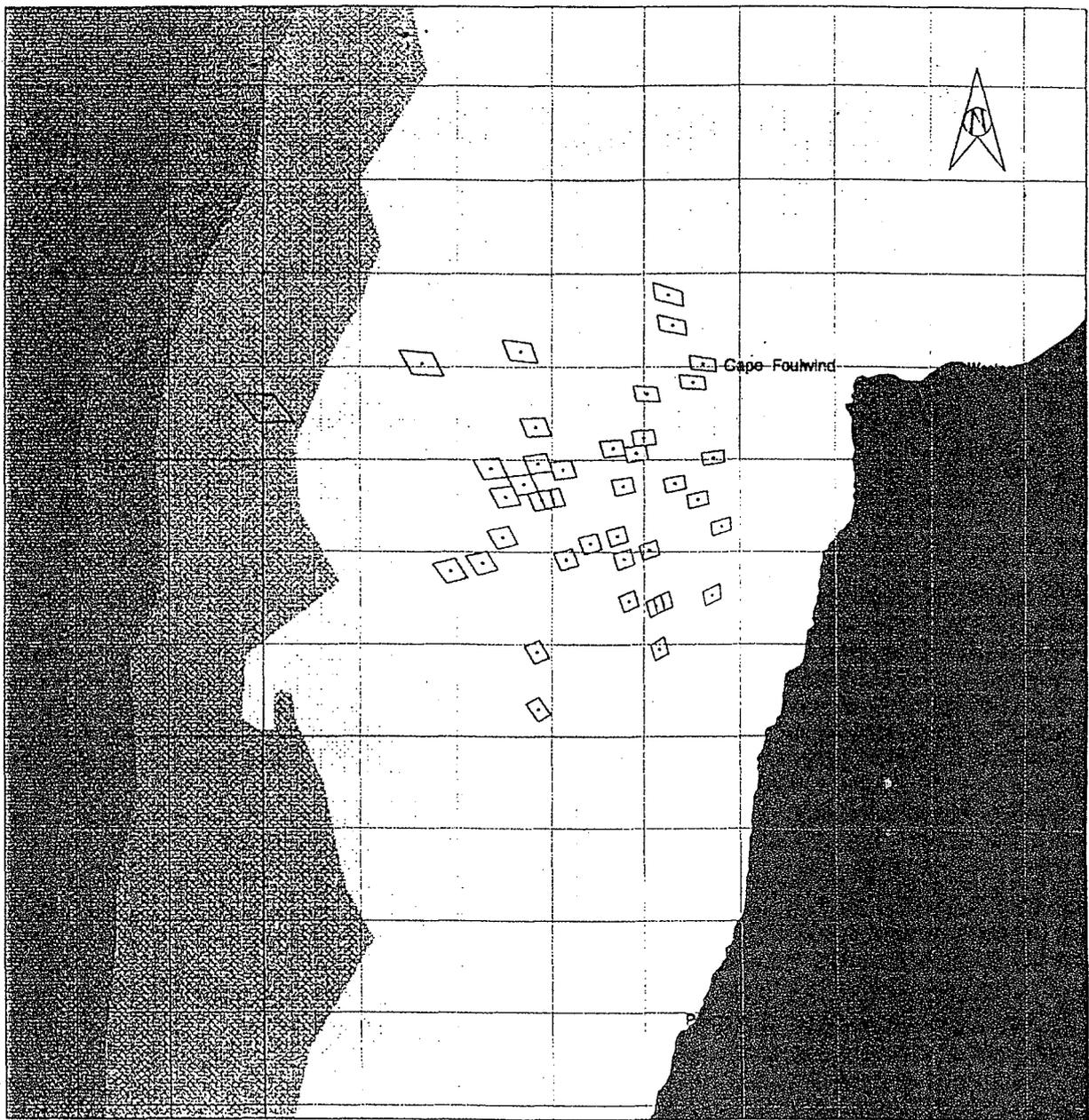


Figure 1: Locations of radio tagged seals during April 1993

At both tracking stations mountain ranges limited the area over which they could receive bearings. The potential area for triangulation was however, the best that we were able to achieve using fixed tracking stations. Because we wished to determine if females that breed at Cape Foulwind visit the west coast hoki fishery area we chose a southerly tracking station, this meant we were unable to triangulate seals very far north of the colony. Thus a southerly bias in the triangulated results is likely. Aerial tracking would have allowed triangulation over a larger area, however due to the size of the potential search area aerial tracking was prohibitively expensive.

Seasonal Variations in Foraging

The results from April indicated a tendency for the seals to travel south of the colony (figure 1). Although this may reflect the southerly bias of our potential triangulation area only four single bearings were recorded north of Mt. Rochfort suggesting that the southerly tendency was real. The positions and movements of seals during April suggest that some, but not all, of the tagged seals were foraging in a relatively restricted area southwest of the colony. Although most positions were close to the coastline the likelihood of triangulating a transmitter decreased as distance from a receiving station increased due to reduced signal strength.

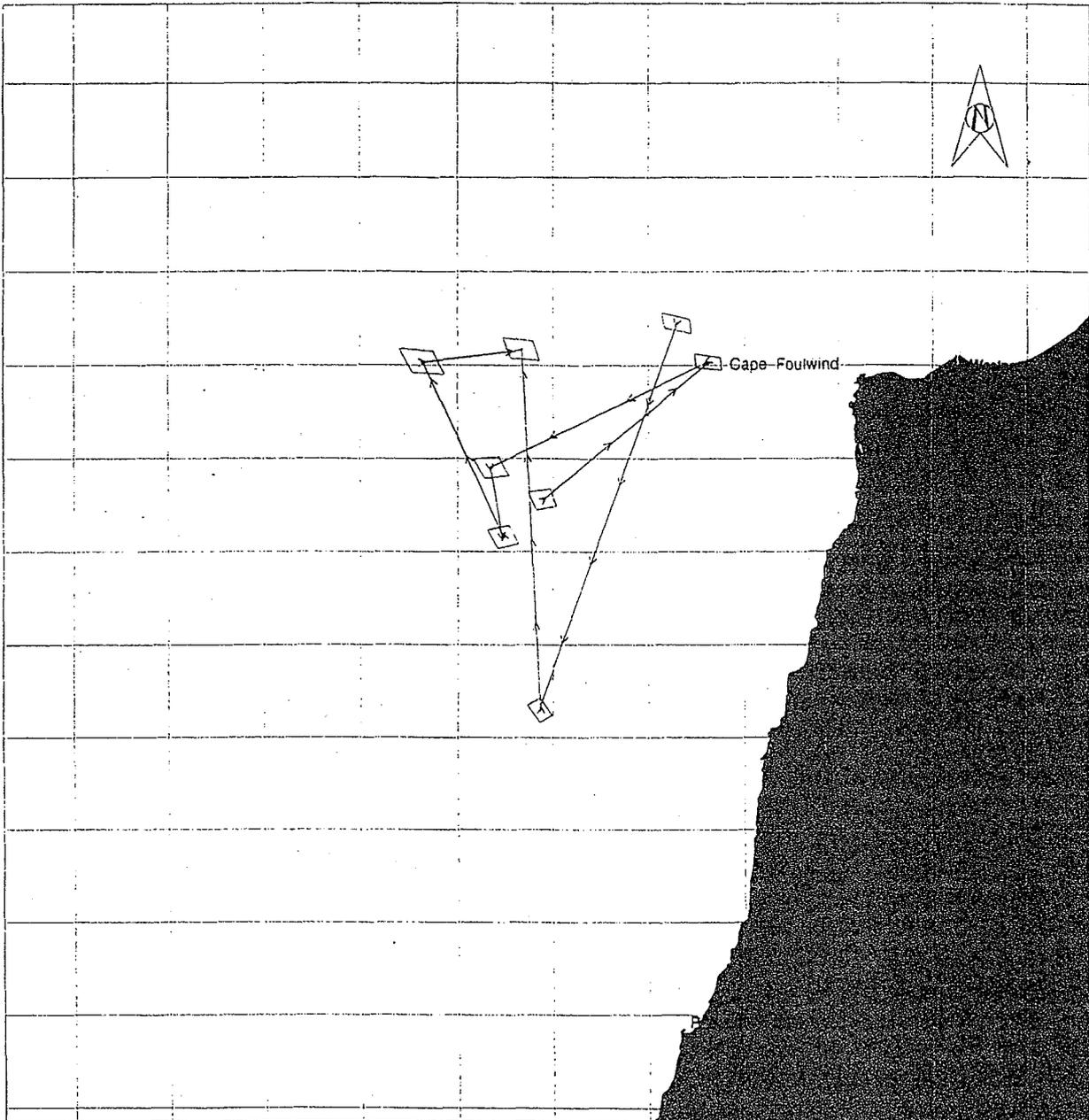
Triangulated positions during July suggested a change in the foraging areas used from those in April. It appeared that during July the tagged seals were travelling beyond our reception range to feed beyond the continental slope. During November only seven signals were received each from a different seal. No signals were received during January. The absence of signals in January indicates that most if not all of the transmitters had fallen off or been disabled by this time.

April was the only time when sufficient locations were recorded to study seal movements. The mean minimum duration of seal trips to sea during April was 2 days 14 hours while they remained on the colony for a minimum average duration of 23 hours.

Minimum total trip length was calculated using the straight line distance between triangulated locations plus the distance of the first and last location from the colony. The mean minimum distance was 100.8km with a range of 48.4km to 157.7km. The average distance that seals travelled during the day (24.1km) was twice that travelled at night (11.1km). Using a two sample t-test the mean distance travelled during the day varied significantly between day ($24.1 \pm 5.2SE$) and night ($11.1 \pm 1.9SE$, $t=2.74$, $p=0.012$) for log transformed data.

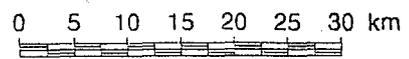
Individual Seal Movements

The movements of individual seals from the colony during April showed relatively wide variation, however most were within 30km of the coast. The movements of seal 2 (Figure 2) demonstrates that some seals were foraging within a relatively restricted area rather than moving from one foraging area to another.



→ Trip 1: 82.7kms, 1day 14hours.

→ Trip 2: 86.3kms, 2days 5hours.



Scale 1:600000

Figure 2: Movements and positions of seal number 2 on two foraging trips in April 1993

4.2 ENVIRONMENTAL FACTORS

Most seals apparently foraged in 100-200m depths in April with only a few going beyond the continental shelf. In July it appeared that more seals fed in the deeper waters beyond the continental shelf. Females of breeding age were caught in the west coast hoki fishery in 1990 (Mattlin, 1994) so it is possible that females from Cape Foulwind are attracted to fishing vessels. Although females from Cape Foulwind may be attracted to fishing boats our data did not provide evidence of this.

4.3 BEHAVIOURS AT SEA

Speed

Seals probably travel less distance when they are feeding than when travelling between the colony and feeding grounds. The estimates of speed can only be considered minimums because they were calculated using straight line distances between triangulated locations. As New Zealand fur seals are thought to feed primarily during the night (Street, 1964) lower speeds and shorter distances travelled at night would be expected. Loughlin *et al.* (1987) estimated a mean speed at sea of 6.5km/hr for female Northern fur seals whereas we calculated a mean minimum speed of 2km/hr. The maximum speed recorded by Loughlin *et al.* (1987), 10.8km/hr, was very similar to our estimate (10.4km/hr).

5.0 DISCUSSION

Foraging

The movements of female New Zealand fur seals that pupped at Cape Foulwind are likely to vary between seasons depending on prey dispersions (e.g. spawning aggregations of arrow squid), past experience at foraging, and the presence of fishing boats. The area where seals foraged appeared to change between April and July. Signals were received from most transmitters during July, but the low number of triangulations suggested that the seals were foraging in areas different to those used during April.

No statistically significant correlation could be demonstrated between any of the environmental factors and seal positions during any of the tracking periods. It is very difficult to relate environmental factors to the foraging locations of seals as there is little detailed information on marine conditions and prey distribution off the west coast.

The estimates of minimum distances travelled are likely to greatly underestimate the actual distances covered during foraging trips however they do provide an indication of the scale of fur seal movements. Fur seals tend to feed predominantly at night (Street, 1964) and this was reflected by our radio tagged seals tending to travel less distance at night. Seals appeared to dive and feed actively at night while moving between feeding areas during the day. Many species of fish with swim bladders rise into shallower waters at night which would make them easier to catch (Longhurst, 1976).

Fishing Boats

Hooker's sea lions (*Phocarctos hookeri*) are thought to be attracted to squid fishing boats lights, winch noises and offal (Public Discussion Paper, 1991). It is therefore possible that New Zealand fur seals are also

attracted to fishing boats. It has been suggested that fur seals may be attracted to vessels fishing in the Hokitika trench (Wilson 1992). However, we found no evidence to indicate that our tagged seals from Cape Foulwind were travelling to the Hokitika trench. The origins of the females of breeding age caught by vessels trawling the Hokitika trench remain unclear.

The use of fixed station radio-tracking has limitations, especially when the tagged animals are far from the tracking stations. However, given the available funding, fixed station VHF tracking was the best means we had of studying seal movements. Our radio-tracking methods achieved the objectives of the study in April and July but not in November and January. In these months the paucity of signals meant we could not determine seal movements. This lack of signals was most likely due to transmitter damage and loss.

6.0 CONCLUSIONS

- In April most seals fed about 30km southwest from the colony although some were recorded further north and south of the colony.
- In general radio-tagged seals foraged close to the coast during April and further offshore in July.
- A diurnal pattern of seal foraging behaviour was identified suggesting that they fed most at night and generally travelled between feeding grounds by day.
- Seasonal variations in environmental factors showed no obvious connection with the positions and movements of seals at sea.
- No seals were tracked to the hoki grounds.

7.0 ACKNOWLEDGEMENTS

This study was financed by grants from the Pacific Development and Conservation Trust and the Lottery Grants Board. Money from Lincoln University allowed us to purchase equipment which has been used in this and other studies.

Equally essential to the success of this project was the logistic and field support provided by Broadcast Communications Limited, the Department of Conservation (DoC) and Lincoln University. Broadcast Communications Limited allowed us to use their repeater stations on Mount Rochfort and Paparoa Peak free of charge. The use of their facilities provided comforts not usually enjoyed in remote field situations and considerably reduced the cost of mounting a tracking study such as this. John van Dissel, DoC Hokitika, installed the radio link between our two tracking stations. John Green and staff from DoC Westport provided valuable support. Motueka Nets donated the netting we used for catching seals.

We are grateful to Alastair Freeman for his weeks spent tracking seals and the computer wizardry of Russel McAuliffe and Andrew Harrington. Special thanks to the seal catching team of Alastair Freeman, Christine Ryan, Lisa Street, Amber and Lloyd Robbins who had courage enough to help us catch and tag those seals.

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