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FOOD OF THE SOUTHERN BOOBOOK
NINOX NOVAESEELANDIAE

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A series of regurgitated pellets and sundry loose material comprising the undigested remains of prey species taken by Southern Boobooks were collected by Mr Peter Duckworth from beneath two diurnal roost sites on the east coast of Tasmania: Mayfield, 20km south of Swansea and Rostrevor at Triabunna. The Mayfield site was in an old derelict farm building where two boobooks were roosting and where, in six visits, 64 pellets were collected between June 1979 and January 1981. The Rostrevor site was in an old machinery shed where one boobook roosted and where, in nine visits, 25 pellets were collected between July 1978 and February 1980. The material has been lodged with the Queen Victoria Museum, photographed, measured and analysed to determine the species taken. The results are given in Table 1. In determining the numbers of mammals and birds, cranial material only was counted; in frogs, paired pelvic bones and in spiders, pairs of chelicerae.

Insect remains were numerous in all the pellets. These were mainly from medium sized (1-3cm long) nocturnal beetles. One pellet from Mayfield collected on 24 August 1980 contained the remains of about 50 specimens of

Table 1. Analysis of 90 pellets and other such loose material regurgitated by the Southern Boobook *Ninox novaeseelandiae* at Mayfield and Rostrevor. Column 1 gives the percentage of pellets in which a species was found; 2, the number of individuals found in pellets; 3, the number of individuals found in loose material; 4, total number of individuals in the pellets and loose material. *From Mayfield samples only.

Prey Species	1	2	3	4
Bat *Eptesicus* sp.	-	-	2	2
House Mouse *Mus musculus*	8	8	15	23
Rat (Juvenile)* *(Rattus)* sp.	-	-	1	1
Rabbit (Juvenile)* *Oryctolagus cuniculus*	-	-	1	1
House Sparrow *Passer domesticus*	1	1	7	8
Common Starling *Sturnus vulgaris*	2	1	7	8
European Goldfinch *Cardeulis cardeulis*	7	5	2	7
Striated Pardalote* *Pardalotus striatus*	-	-	1	1
Golden Whistler *Pachycephala pectoralis*	-	-	3	3
Small Bird	7	-	-	2
Brown Tree Frog* *Litoria ewingi*	18	26	31	57
Shore Crab* (fam. Grapsidae)	1	1	-	1
Trapdoor Spider (fam. Ctenizidae)	61	113	253	366
Insects (mainly Coleoptera, see text)	100		numerous	

Xylonychus piliger - a rare endemic scarabaeid beetle known to form mating swarms on late winter evenings. Other scarabaeoid beetles recovered from pellets included *Elephastomus proboscideus* (8 pellets), *Pharochilus politus* (2 pellets), *Aphodius tasmaniae* (2 pellets), and *Heteronyx* sp. (5 pellets). Cerambycid beetles were well represented, including *Phoracantha fallax* (3 pellets), *P. synonyma* (1 pellet), *Coptocercus rubripes* (1 pellet), *Phylctaenodes pustulosus* and *Tessaromma sericans* (2 pellets each). Together with chrysomelid beetles, *Paropsis* spp. (5 pellets), elaterids (1 pellet) and cryptorhynchine weevils (2 pellets), these beetles tend to be active on tree trunks at night.

Trap-door spiders (fam. Ctenizidae) were abundant in samples collected at both sites in summer. These are presumably captured as they wander over open ground at night. Dried fibrous grassy material in some pellets may have been accidentally consumed when taking ground-dwelling prey such as spiders.

Pellets, the average size of which was 24mm x 14mm, did not reflect any significant difference in prey selection at the two collecting sites except for tree-frogs in the Mayfield sample and their complete absence from the Rostrevor sample. Frogs were not found in pellets collected during the summer months, probably because they were not active and abroad in the warmer weather. All pellets contained the remains of more than one species and reflected the rather varied diet of an opportunistic predator.

Nick Mooney (pers. comm.) found the gut of one Southern Boobook to contain 10 Tasmanian Froglets *Ranidella tasmaniensis,* 1 Brown Froglet *R. signifera* and 2 Brown Tree Frogs *Litoria ewingi.* An examination of a series of alcohol preserved gut contents of Southern Boobooks in the museum's collections was found to include remains of Pigmy Possum *Cercartetus nanus,* Grey Fantail *Rhipidura fuliginosa,* some undetermined small birds, scorpions, mole crickets, insects, spiders and earthworms.

Opportunistic feeding by the Masked Owl *Tyto novaehollandiae* also is suggested by Green and Rainbird (1985), but whereas that predator was found to feed almost exclusively on small mammals and birds, the Southern Boobook was found to take mostly insects and spiders. Though there is some overlap of prey species such as the House Mouse and small birds, the analyses of pellet composition from these two nocturnal predators, which both live in sclerophyll forest and woodland, illustrate predatory activities and prey selection relative to their body size. The Masked Owl ranges in body weight from 1100g in females to 450g in males whereas the Southern Boobook ranges from 290g to 140g.

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A SUBSTANTIAL DECLINE IN NUMBERS OF THE SOUTHERN ELEPHANT SEAL AT HEARD ISLAND

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Introduction

The 1985 Australian National Antarctic Research Expedition (ANARE) to the Australian Territory of Heard Island had, as one of its major goals, the task of censusing the population of the Southern Elephant Seal *(Mirounga leonina* L.) on the island over the pupping period, as part of an international program aimed at monitoring the total population of these seals. Monitoring of the Southern Ocean marine ecosystem has the purpose of making sure that changes to all parts of the ecosystem, induced by harvesting certain species, can be discerned before permanent damage is done to significant elements of that ecosystem by continued overharvesting. Effective and economically feasible monitoring is a most difficult thing to do, and many years are certain to pass before the "health" of even portions of the Southern Ocean ecosystem can be reliably checked from one year to the next. Regular censusing of island populations of birds and mammals that are important consumers within the pelagic food chain is one likely way of doing this.

The period on the island was originally scheduled to have been the whole of October. However, when the relief ship, the "Nella Dan", became beset in ice at Amundsen Bay, Antarctica, the time at Heard Island was extended to 56 days, October 1 to November 25, before the substitute relief ship, the "Icebird", arrived to remove the members of the expedition from the island. The extra time allowed more work to be done on all programs, and also allowed a survey of sealer's relics on the island to be completed.

Choice of Elephant Seal for Censusing

Elephant Seals breeding at Heard Island were selected for censusing for several reasons. They are known to range widely at sea and principally feed on fish and squid south of the Antarctic Convergence. Their large size and presence ashore on exposed beaches makes censusing readily possible and accurate; and they are numerous enough to reach a sizeable biomass (40,000 tonnes, McCann 1985) and so make the results of any census relevant to a considerable part of the food chain.

The importance of Elephant Seals has been appreciated in some general sense for many years. For a century these seals and whales were the one part of the Antarctic food chain that could be significantly exploited. Oil production from Heard Island did not cease until the 1930's, although by that time the scale of operation was much reduced compared to earlier days. The very first ANARE to Heard Island in 1948 counted the Elephant Seals in the Four Bays area close to the camp and this remained an important task for succeeding expeditions until the close of the camp in 1955. Unfortunately not much of this work was published, but enough was written up for it to be clear that the breeding cows that had come ashore to pup during October approximately numbered 30,000 animals for the whole island during the early fifties.

Since that time several researchers, principally South African, have shown that fluctuations in the numbers of Elephant Seals have occurred; and that in the last decade all trends have been negative in those islands (Marion, Crozet, Kerguelen) censused in the Indian Ocean. The Elephant Seals on Heard Island are more numerous than on any other island in the region excepting Iles Kerguelen, and the question of how the population has altered in the past 30 years is therefore of importance.

Methods of Censusing

A census of the whole island, by counting seals hauled out on beaches, necessitated two parties, one at Atlas Cove and the other at Spit Bay (see Fig. 1). Daily counts of all seals hauled ashore in selected study sites (including Four Bays, which was censused between 1948 and 1955) were made between October 3 and November 24, 1985. This period of 52 days overlapped the peak in seal cow numbers (for example, see Fig. 2, which gives the counts made at West Bay) and provides sufficient data to estimate Elephant Seal populations on Heard Island in the future if the census is done on any day between October 1 and November 3. This is the period in which sufficient relevant age classes of seals exist on shore for acceptable accuracy in a census.

Aerial photography of all the island beaches, that was planned to coincide with ground truth counts, was not possible as the "Nella Dan" failed to return to Heard Island. The helicopters with specially modified camera mounts were only used on one day with the Linhof camera (October 2) for a seal census flight along the northern beaches of Heard Island during the initial landing.

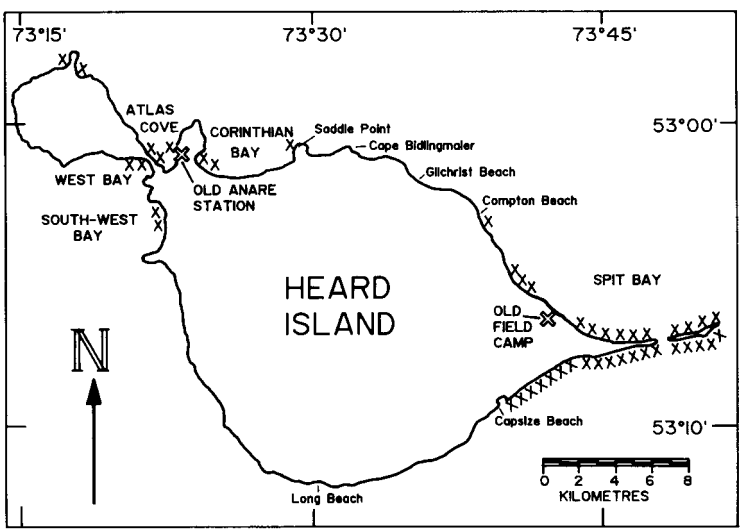

Figure 1. Map of Heard Island, showing elephant seal concentrations on beaches examined in 1985.

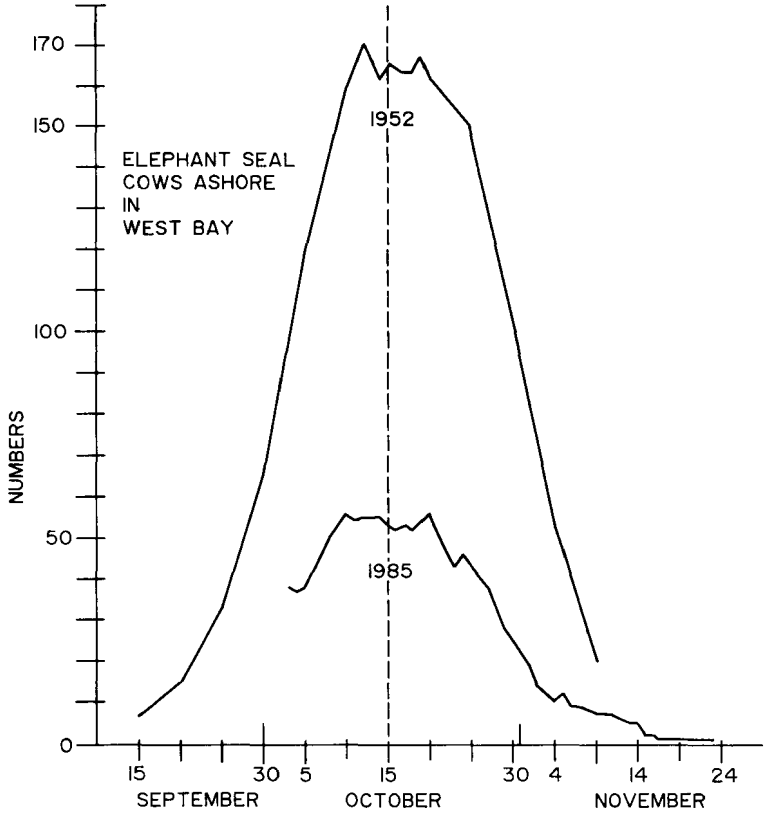

Figure 2. Population numbers of elephant seal cows ashore at West Bay in 1952 and 1985.

Some hand held 35mm photography was also done of the small island at the tip of the Spit on October 5. Twenty-four large Elephant Seal harems were seen; cow numbers will be counted from the photographs. Unfortunately time was not given for scientific flying following the relief of the party by "Icebird" on November 25; and so Long Beach was never counted. This was the only beach omitted from the census. The nonavailability of the "Nella Dan" helicopters to census northern beaches such as Church Rock, Saddle Point, Cape Bidlingmaier and Gilchrist and Compton Beaches was compensated to a large extent by the use of LARCs as sea transport. By this means the census was completed on all the northern and eastern beaches that were not reached by foot.

During the census, all Elephant Seals were classified into the following categories, reflecting factors such as age, sex and reproductive status, viz. adult bulls, bachelors, challengers, beachmasters, subadults, yearlings, cows, black pups and weaned pups. Dead pups were also recorded. Thus the population structure of the seals was censused as well as the total numbers.

Beach type was recorded and significant changes to beaches, particularly between Capsize Beach and the Spit have evidently occurred in the thirty years since the last census. The once eight kilometre long spit was broken by a wave washed and channeled section about two kilometres across which isolated the final two kilometres of the Spit and made it an island. Although substantial areas of beach had been thus lost to the Spit itself, new sandy beaches had been created between Capsize Beach and the Southern Spit Coast which at least equalled the lost area.

Results and Discussion

October 15 was the day of maximum numbers of cows ashore, averaged over all study sites. This same date is also applicable on Iles Kerguelen (Angot 1954, van Aarde 1980). The new coastline that was created between Capsize Beach and the Southern Spit Coast was well used by the seals; 2804 cows were found on it in 28 harems. An estimate has been made for Long Beach on the basis of adjusted counts from earlier years, and although the confidence limits are wide, the conclusion is unarguable.

The number of Elephant Seals on Heard Island has dropped dramatically between 1948-55 and 1985. An estimate of Elephant Seal numbers on Heard Island in the early 1950s was that of Carrick and Ingham (1960). They used a whole island count of pups and a composite of cow counts on several dates to obtain a figure of 23,000 breeding cows, 17,688 of them on the Spit. However, the count of animals on the Spit was done on the 27, 28, 29 October 1949. These dates were, on average, 13 days past the day of maximum numbers (October 15) which has now been established by this present work. The 1985 data allow a more accurate estimate than was possible in the 1950s because it is now known that 65 per cent of the cows were present on October 28 compared to October 15.

Thus, assuming a similar haulout pattern in 1949, the 17,688 cows on October 28 would be equivalent to 27,212 cows on October 15. This 27,212 becomes 30,236 for a whole island cow total (the Spit is 90 per cent of the whole island, Carrick and Ingham 1962) and increases to 31,827 for a pup production figure (total cows on maximum day equal 95 per cent of pup production).

The pup production in 1985 (13,111) was only approximately 40 per cent of that in 1949 (31,827). A population decrease of 60 per cent in a long-lived (20 years maximum known) species like the Elephant Seal is a very significant change. There is no doubt that some changes must have occurred in the seal's environment to bring this about. As there have not been any changes recognised during the terrestrial period of the Elephant Seal's existence on any of the islands studied where the population decrease has been shown, it is likely that the unknown factors controlling the seal population belong to that period of life spent in the marine environment. Whether increased predation is an effective factor (Van Aarde, 1980) or whether food is limiting the seal numbers is now known. Both are possible but evidence is scant.

However, it is relevant to note that at least some aspects of the atmospheric circulation at Heard Island have altered between 1950 and 1980, in that cyclones tracked significantly further north (Radok and Watts, 1975; Allison and Keage, in press). Ocean temperatures at the island also significantly increased (Allison and Keage, in press). It is likely that these changes in more readily measured parameters indicate that other parameters of the ocean environment have altered in many ways which are not yet appreciated.

Phytoplankton and zooplankton are dependent on water currents for their location of course, as well as being dependent on factors such as temperature for their growth rates and thus competitive abundance. If these food sources for fish and squid changed in any of several ways (abundance, timing, location), then the fish and squid populations, upon which the Elephant Seals substantially rely for food, would adjust in response.

The decades since 1950 have seen the Kerguelen Shelf change from a non-existent fishery to one where very substantial catches are now taken annually by far-ranging east European fishing fleets. Elephant Seals and fishing boats are, at first sight, likely to be competitive, but the degree of competition is extremely difficult to assess. It may be that inexperienced weaned pups in their first year of life, feeding within the island shelf waters, have suffered an increased mortality as a consequence of the operation of this relatively new fishery.

Further monitoring will be necessary to confirm the trend of population decrease and to measure it on a one to three yearly basis. Has the population now stabilised, for example, or is it continuing to fall? The Elephant Seal census on Heard Island has picked up a very significant signal, indicating some major ecosystem adjustment in the marine environment. The interpretation of that signal must wait on further information.

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