ASPECTS OF THE BIOLOGY OF CAMPBELL ISLAND FERAL SHEEP (*Ovis aries* L.)

A thesis presented in partial fulfilment
of the requirements for the degree of
Master of Science in zoology
at Massey University.

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1985

FRONTISPIECE - field work, Campbell Island style.

ABSTRACT

The feral sheep population of Campbell Island was studied between April and August 1984. Data were collected from 2529 of the 4000 sheep killed in the south-east of the island, and the population described. Productivity and timing of lambing are examined. A survivorship curve and the age:sex characteristics are plotted to illustrate mortality and population structure. Changes in population size and lambing rates since 1895 are presented.

Attributes such as wool colour, occurrence of horns, body size and lambing dates are described. In several respects these differed significantly between localities, and the existence of distinct sub-populations is suggested. The presence of these sub-populations is related to home range behaviour.

Observations were made of 70 tagged sheep in the area around Menhir during April-June 1984, and it is suggested that they adhere to a home range, the mean size of which was 43.3 ha. Sheep were found associated in groups of up to 65, although mean size was 6.31. There was no constancy in group composition, although several hogget:dam associations were noted. Groups comprised both rams and ewes.

Time activity observations showed that in winter the sheep spent 70.2% of the time grazing, and 16.6% ruminating, with ruminating peaking around midday.

ACKNOWLEDGEMENTS

I would like to thank Ecology Division, DSIR who initiated and financed the study, and who arranged transport to the island.

I wish also to thank the Meteorological Service, Ministry of Transport, who provided accommodation on the island and transport aboard the MV Wairua, and the Department of Lands and Survey for providing permission and permits to work on the island.

I am indebted to Dr. John Skipworth, Massey University, for his supervision, advice and encouragement.

Many thanks also to my other supervisors: Prof. Brian Springett, Massey University; Dr. Mike Rudge, Ecology Division; and the late Dr. Francis Cockrem, Ministry of Agriculture and Fisheries.

A special acknowledgement is due Peter Wilson and Rowley Taylor of Ecology Division, Don Orwin of the Wool Research Institute of New Zealand, and Bill Regnault of the Wool Department, Massey University for their interest and encouragement.

Thanks to staff, technicians and fellow students in the Botany/Zoology Department, Massey University.

A thousand thank you's to my parents, Peter and Queenie Ballance, for their support and help in proof-reading.

Thank you, with whipped cream and cherries, are owing to Joyce Ballance, Jenny Waters and Murray Potter, who proof-read this for me.

To Alicia Warren : field assistant and sheep watcher of the highest order ! Your friendship, help and cheerfulness despite cold feet was invaluable.

To the members of the 1983-1984 Meteorological Service expedition to Campbell Island : Mark "Swampy" Crompton, Peter McCrostie, Grant "Unko" Unkovich, Robert Poole, Brian Hagan, Mark "Zeph" Revel, Bill Perry, Malcolm Saunders, and especially Grant "Harps" Harper and Mark Matthews. A thousand accolades for your cheerfulness, friendship, and above all, your supreme tolerance (especially of gory tales and jawbones !).

Many thanks and chocolate fish are due to Graeme Taylor for his friendship and help with many sheepy things.

A special award for Endurance Above and Beyond the Call of Duty is due to Nick Torr, Geordie Murman, Rick Thorpe and Leon Cooke, Wildlife Service, Department of Internal Affairs for the eradication of all those ungulates (17.2 tonnes thereof!), and the collection of ALL those jawbones ! For your unerring cheerfulness, help and friendship, I am eternally indebted.

To the woolly maggots whom this was all about, and to the Sammies and the Alberts for providing the light relief: a toast.

And finally, to Campbell Island itself: your magic made this all worthwhile.

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CHAPTER ONE

INTRODUCTION

1.1 FERAL SHEEP

1.1.1 POPULATIONS AND STUDIES

A feral animal is one whose lineage was once domesticated but which now exists in an unmanaged and self-sustaining state. Rudge (1984c) recognizes three classes of feral Caprinae : A. ancient populations, including the Soay sheep. B. recent populations dating from periods of exploration and settlement, or from changes in land use. These comprise the majority of feral populations. C. strays from domestic populations. These tend to mix with domestic animals and have a transient existence.

Rudge (1983, 1984a, 1984c) lists 39 known populations of feral sheep in the world, of which 21 are in the Pacific Basin. Of these, 11 are in New Zealand. Of the New Zealand populations the following have been the focus of various studies : Pitt Island (Rudge 1983); Arapawa Island (Ricketts 1977; Orwin and Whitaker 1984); Woodstock (Parsons 1980); and Campbell Island (refer section 1.2). Small captive populations of sheep from Campbell Island, Arapawa Island, Raglan, and Hokonui are held by the Ministry of Agriculture and Fisheries at the Whatawhata Hill Station (Cockrem 1980), and by the Wool Research Organisation of New Zealand at Lincoln.

The feral sheep of Mauna Kea on the island of Hawaii have been studied by Giffin (1976), while the Soay sheep on St. Kilda island in the New Hebrides, off northern Scotland, have been the focus of a number of studies (Boyd et al. 1964; Grubb and Jewell 1966; Grubb 1974; Jewell et al. 1974).The Scottish black-faced sheep of Boreray Island in the St. Kilda group have also been studied (Morton Boyd 1981), and Van Vuren (1981) has examined feral sheep on Santa Cruz Island off California.

Also relevant to studies on feral sheep is the resume by Geist (1971) on the bighorn sheep of Canada.

1.1.2 VALUE AND STATUS OF FERAL SHEEP

Although feral sheep have long been regarded as pests, with a large amount of effort put into eradication programmes, over the last ten to fifteen years there has been an upsurge of interest in them. The FAO of the United Nations has included feral farm animals in its programme on vanishing livestock, and the IUCN has included significant feral animals in its conservation programmes (Rudge 1982).

Various scientific, cultural, and economic values have been put forward to support the idea of conserving at least some feral populations (Ryder 1976; Whitaker 1976; Bowman 1981; Bigham and Cockrem 1982; Rudge 1982 and 1984; Wodzicki and Wright 1984).

A scientific reserve for feral sheep was created in 1981 on Pitt Island in the Chatham Group (Rudge 1983),

but none of the other feral populations in New Zealand have legal protection. The Campbell Island population is tolerated in a portion of the nature reserve, with a decision on the future of the remaining sheep expected by 1990 (Rudge 1983).

1.2 CAMPBELL ISLAND SHEEP

1.2.1 HISTORY

Farming began on Campbell Island in 1895 with the introduction of 300-400 sheep. Sheep previously liberated on the island between 1865 and 1895, in association with the Government castaway depots, failed to survive. The next introductions were of 2000 sheep in 1901, and 1000 in 1902. The breed of these founding flocks is uncertain. Kerr (1976) believed the 1901 introductions were Leicester-Merino and Lincoln-Merino crosses (Corriedales), while Wilson and Orwin (1964) thought the 1901 introductions were Merinos, and those of 1902 either Leicester-Merinos, half-bred Merinos and Romneys, or Corriedales. Thirty unidentified rams were introduced in 1923, and three Cheviot rams were released in 1953. Wilson and Orwin (1964) judged from appearance and wool that the sheep were a Merino-Longwool breed cross, with breed ranging from half to quarter bred types.

Sheep numbers peaked at 8540 in 1909-1910, and remained high until 1916 when the wool clip also peaked at 131 bales. During the 1920's sheep numbers dropped

rapidly, although this was due in part to the export of 2000 sheep in 1917-1918, and another 200 in 1923 and 1925 (Kerr 1976). As well, the shepherds were killing at least 30 sheep a year. When the farming venture was abandoned in 1931 sheep numbered about 4000.

During the farming era the sheep were not intensively managed. They were rounded up once a year for shearing, an operation which began in October or November and would take until March or April. On at least one occasion shearing had not been completed by August. Timms (Kerr and Judd 1978) describes four or five main musters of each of the main areas, with the shearing taking place next to the homestead in Tucker Cove.

A 1910 stock inspector reported that the ewes and rams ran together, and that lambing was taking place over six months of the year (Kerr 1976). Rams comprised "about 5%" of the population in 1911, and wethers a further 30%.

Sheep and wool were initially in good condition but they began to deteriorate after about 1904. This decline may have been due, in part, to the regrowth of less palatable species in the burnt-off vegetation. By 1931 some of the sheep were already described as double-fleeced with hairy wool, and Spence (1969) estimated there were more than 1000 'wild' sheep. The death and loss rate of stock was high, particularly after shearing and lambing. Lambing percentages for the whole island were in the range 20-24%.

After the farming era the number of sheep continued to decline. From 1941 onwards approximately 50 sheep a year were shot for meat, a factor contributing further to the decline. Wilson and Orwin (1964) recorded a low of 907 sheep in 1961, with a lambing percentage of only 11. The rate of decline was thus approximately 3% per annum (cf. Wilson and Orwin's figure of 5% which fails to take into account the export of at least 2000 sheep from the population). By 1969 the population trend had reversed, and the population count was about 3000 (Taylor et al. 1970).

A decision was then made to eradicate sheep from half of the island (Wilson and Orwin 1964; Taylor 1968), and Kenworthy (1980) has detailed the circumstances involved. The conflicting pressures from plant and animal ecologists on the one hand, and from the Meteorological Station, for whom the sheep were of value as a source of meat, on the other, were therefore partially resolved. In addition, several scientists had been interested in preserving the herd for genetic and agricultural values. In January and February 1970 a fence was erected across the middle of the island (figure 1.1), and 1281 sheep were shot from the northern portion. A further 105 sheep were shot in the succeeding year (Bell and Taylor 1970; Rudge in prep.).

Since 1975 population censuses have been carried out by Ecology Division, DSIR (Dilks and Dunn 1978;

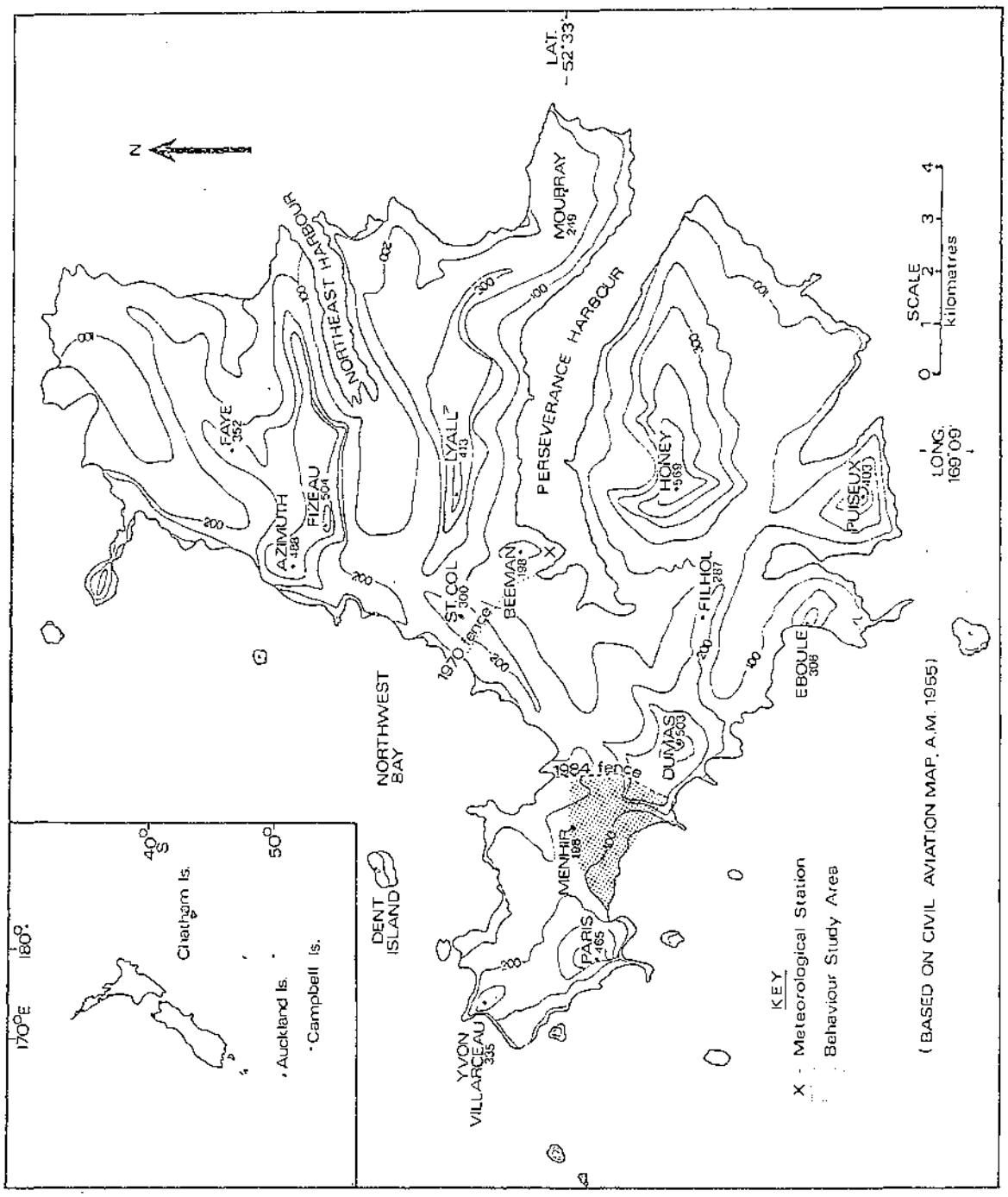

FIGURE 1.1 - map of Campbell Island.

Dilks and Wilson 1979; Wilson 1980; Wilson and Elliot 1981; Dilks and Grindell 1983; Wilson and Gaze 1983).

The sheep population and vegetation changes since the exclusion have also been studied in several summer expeditions : 1975-1976 (New Zealand Department of Lands and Survey 1980), and 1984 (Orwin 1984).

In 1983 a decision was made by the Outlying Islands Reserve Committee to further limit the numbers of sheep on the island. The numbers of sheep were increasing rapidly, and vegetation to the south of the fence was deteriorating further. In January-February 1984 a Department of Lands and Survey team erected a new fence across the south-western corner of the island (figure 1.1), an idea first proposed by Taylor (1980). A population of approximately 700-800 sheep was left in this area, which comprises about 10% of the island's total area. The sheep in the south-eastern corner of the island, between the two fences, were shot in June and July 1984.

1.2.2 PREVIOUS STUDIES

Data from the previous cull are being analysed with a view to determining reasons for the decline and subsequent rapid increase in sheep numbers to 1969 (Rudge 1984b, Rudge in prep.). Members of the 1975-1976 summer expedition looked at the disease status of the population (Hutton 1976, 1980), and at ectoparasites (Heath 1976, 1979). Holmes (1976) made comments on behaviour,

and Cockrem and Clarke (1976) remarked on physiology. Regnault (1976, 1980) examined wool and made some general observations. Bigham and Cockrem (1982,1984) looked at skin and wool in one of the captive populations, and Orwin (1984) looked at wool during the 1984 summer expedition. Both Regnault and Orwin currently hold wool and skin samples collected during the 1984 cull. General works concerned with the future of the sheep population on Campbell Island include Wilson (1979), Taylor (1980), and Wilson and Rudge (1982).

1.2.3 RATIONALE FOR PRESENT STUDY

With the construction of the fence in 1970 a research programme was adopted with the aims of studying the status of, and changes in, the flora and fauna (Wilson 1979, Taylor 1980, Rudge 1982). Aim 4 reads :"to allow further study of the biology, population ecology and agricultural value of the long isolated feral sheep and cattle".

Management policy 3.2 of the Management Plan for Campbell Island (New Zealand Department of Lands and Survey 1983) suggested the limiting of sheep to a small area, and encouraged research relating to the sheep.

Although work carried out to date goes some way to meeting these aims, the present study was instigated to allow a more intensive ecologically oriented study, which could take advantage of the amount of data that was expected from the large number of sheep.

1.3 CAMPBELL ISLAND

1.3.1 LOCATION AND STATUS

Campbell Island is New Zealand's southernmost island territory, lying 663 kilometres south of Bluff at latitude 52°33'S, longitude 169°09'E (figure 1.1).

The island covers an area of 114 square kilometres. Its greatest length from north to south is 14 kilometres, and from east to west is 14 kilometres.

Since 1954 Campbell Island and its outlying stacks have been gazetted as a Flora and Fauna Reserve, with a change of classification under the 1977 Reserves Act to Nature Reserve. They are all administered by the New Zealand Department of Lands and Survey, and entry to the reserve is by permit only.

1.3.2 GEOLOGY AND TOPOGRAPHY

The geology of Campbell Island has been described by various workers beginning with Filhol in 1885. A fairly complete geological survey carried out by R.L. Oliver in 1944 was published as "The Geology of Campbell Island" (Oliver 1950) as part of the Cape Expedition Series. Fleming (1980) presents the most recent summary of the known geology. A simple geological map is included in the management plan (New Zealand Department of Lands and Survey 1983), but a detailed map is still being prepared.

Campbell Island is the dissected remnant of a basaltic volcanic dome some 6-8 million years old (Adams 1981), which had its centre to the north of North-west

Bay. Most of the western half of the original island has been removed by marine erosion, resulting in a coastline characterised by steep precipitous cliffs up to 300m in height. The island slopes more gently to the east, and the "drowning" of radial valleys has created several large inlets, the most prominent being North-east Harbour and Perseverance Harbour. The volcanic rocks overlie mudstone, sandstone and limestone, with a basement of metamorphic schist.

The present topography of the island is the result of the interacting processes of glacial erosion, sea erosion and eustatic sea-level changes. The topography is rugged, with 15 peaks higher than 200m. Mount Honey is the highest peak at 569m.

The only maps of the island available prior to the time of the study result from a topographical survey by Clifton in 1942-1943. I used two maps - one produced by the Civil Aviation Department, Ministry of Transport, and the other obtained from Ecology Division, DSIR. Whilst largely comparable, these and other maps published in various books contain slight differences in the citation of heights. For example, Beeman is given a height of 198m on the Civil Aviation map, and 189m on the Ecology Division map. Other workers (Given 1980, Morris 1980) have bemoaned the lack of an accurate base map, and cast doubt upon the validity of some of the contours. Judd (1980) points out that Mt. Fizeau would appear to be

actually lower than Mt. Azimuth, although Mt. Fizeau's height is usually given as 16m higher than Mt. Azimuth. A small map obtained from the Royal New Zealand Air Force gives Mt. Fizeau's height as 475m (cf. the more usual 504m), which would align with Judd's comment.

A problem is the citation of all heights in imperial measurements. To maintain consistency throughout this study I have converted all figures to metric measurements, and have approximated contour lines from the nearest imperial equivalent (figure 1.1).

1.3.3 SOILS

Soils have been described by Campbell (1980). Soil formation has a strong relationship to topography, with deep peat deposits forming on flat and gently sloping surfaces. On moderate to steeply sloping land the peat mantle is shallower and generally less than 2m thick due to natural erosion processes. This thin peat at high altitudes has an increased mineral content.

The mass movement of peat is common, as evidenced by old slip scars. These slips are facilitated by the presence of impervious rocks providing a shear plane, and are triggered by periodic exceptional rainfall which causes soils to become saturated. Such slips are more prevalent in the lower and middle altitudinal zones where the accumulation of peat is most rapid. The most recent slips, which are a striking feature of the landscape, date from 23 May 1982 (Dilks and Grindell 1983).

1.3.4 VEGETATION

Campbell Island's vegetation is predominantly tussock grassland, shrubland and herbfield (Oliver and Sorenson 1951; Sorenson 1955; Given and Meurk 1980; Meurk 1982; New Zealand Department of Lands and Survey 1983). The subantarctic vegetation has been severely modified by burning, sheep grazing and the introduction of various herbs and grasses, since it was described by Hooker in 1844, Kirk in 1890, Cockayne in 1903, and Cheeseman in 1909. Two hundred and eighteen species of vascular plant have been recorded for the island (Meurk 1975; Given 1980). Of these, 81 are adventive species (Meurk 1977).

The original vegetation could be divided into 13 main formations (Meurk 1980), segregated by altitude, exposure, water table characteristics and/or proximity to maritime influences.

Meurk (1977, 1980) divides the island into two broad altitudinal zones, lower and upper. The lower alpine zone includes the following associations:

1. a dwarf forest of Dracophyllum scoparium and D. longifolium, attaining a height of 5m in sheltered places. This association includes Coprosma spp., Myrsine spp. and Polystichum vestitum, and reaches to 180m altitude.

2. Chionochloa antarctica tall tussock grasslands. Formerly widespread, but highly susceptible to grazing.

3. Poa litorosa-Bulbinella rossi meadows. This is

now the dominant mid-altitudinal formation. In a few places B. rossi exists in almost pure stands.

The dominant higher alpine zone association is:

4. a tall Marsippospermum rush-herbfield association.

The megaherbs, which include Pleurophyllum spp., Anisotome spp. and Stilbocarpa sp., were found in high altitude associations and in a tall tussock herb field with Poa foliosa. They had their range much restricted by sheep grazing, but have made a spectacular recovery in the north of the island since the exclusion of the sheep.

1.3.5 WILDLIFE

Campbell Island is an important breeding location for a number of marine mammals and seabirds. Hooker's sealion (Phocartos hookeri), fur seal (Arctocephalus forsteri), and sea elephants (Mirounga leonina) all breed on the island, although they have major breeding grounds on other subantarctic islands. The southern right whale (Eubalaena australis) congregates around Campbell Island from June to October to calve and mate (Bailey and Sorenson 1962).

About 62 species of birds have been recorded from Campbell Island, but only 29 are known to breed there (New Zealand Department of Lands and Survey 1983). It is the major breeding ground of the southern royal albatross (Diomedea e.epomophora) with an estimated population of 4243 birds (Dilks and Grindell 1983). Light-mantled

sooty albatrosses (Phoebetria palpebrata) breed on coastal cliffs and offshore islets.

Campbell Island is also the main breeding ground for the endemic New Zealand black-browed mollymawk (Diomedea melanophris impavida) with numbers for the 1975-1976 summer estimated at 74 825 pairs (Robertson 1980). The estimated 11 530 breeding pairs of grey-headed mollymawk (Diomedea chrysostoma) on Campbell Island may represent up to 40% of the world population for this species.

An estimated 2-3 million rockhopper penguins (Eudyptes crestatus) breed on Campbell Island (Westerkov 1960), with smaller numbers of erect-crested penguins (Eudyptes sclateri) and yellow-eyed penguins (Megadyptes antipodes). There are 8 breeding prion and petrel species, and a total population of 8000 endemic Campbell Island shag (Phalacrocorax campbelli) (Van Tets 1980).

Other breeding species include 4 gulls, 8 terns, 8 passerines and 2 ducks. The rare Campbell Island teal (Anas aucklandica nesiotis) is confined to Dent Island.

For a comprehensive outline of the island's fauna see Bailey and Sorenson (1962).

There are three species of introduced mammals in addition to the sheep. Thirty cattle abandoned in 1931 are now in the process of being eradicated, and are believed to number only two or three individuals. Norway rats (Rattus norvegicus) are abundant, and were the target of an Ecology Division, DSIR study from April

1984 - April 1985. Feral cats are present but not often seen.

The stream fauna is of low diversity, with mayflies and snails absent, but with a high number of isopods. There is one galaxiid fish (Galaxis brevipinnis) (New Zealand Department of Lands and Survey 1983). Six Foot Lake and the tarns have predominantly chironomid midges and worms (Crosby 1980).

Gressit (1964) described 300 species of terrestrial insects from the island, and more have been recorded since then (New Zealand Department of Lands and Survey 1983). Up to 200 of these may be endemic. Forster (1964) described 16 spiders and 1 harvestman. Climo (pers comm.) lists 7 species of land snail, and 1 endemic slug (Climo 1980). Other invertebrate groups have been poorly studied, if at all.

1.3.6 WEATHER

Campbell Island lies in a zone of strong prevailing westerly winds. The climate is dictated largely by the passage (at 6-7 day intervals) of a succession of anticyclones, each separated by a trough of relatively low pressure (New Zealand Department of Lands and Survey 1983). Each trough develops a number of cold fronts which are preceeded by gale force winds and a period of rain.

The following statistics come from Meteorological Service data for the years 1941-1980. Readings are taken at the Meteorological Base at sea level, and thus

represent minimum windspeeds and maximum temperatures for the island. (see Appendix A for mean monthly weather recordings for 1941-1980, and for daily weather recordings and monthly summaries for the duration of this study).

Average annual rainfall is 1361 mm spread over 246 raindays (1.0 mm or more of precipitation) throughout the year. Maximum 2-day rainfall recorded was 104 mm. Snow falls on an average of 42 days per annum, but it is usually light and lies on the ground for only a few days. Mean number of sunshine hours per year is low at 659 hours. The lowest number of sunshine hours ever recorded in one month is 1.1 hours in June 1984.

Mean annual air temperature is 6.9°C, and mean annual grass temperature is 3.2°C. Temperature variations are small with an average daily range of 4.7°C. Relative humidity is high averaging 85%.

The dominant climatic element is the wind. The mean hourly windspeed per annum is 32 kilometres per hour. There are 280 days per year when wind gusts are above 63 kilometres per hour, and 106 days when gusts are above 96 kilometres per hour. There are 60 days a year classed as having gale force winds, that is, average wind speed is greater than 62 kilometres per hour.

1.3.7 HUMAN HISTORY

Campbell Island was discovered in January 1810. From then until about 1830 it was visited by sealers, but

these visits ceased once fur seal populations declined almost to extinction. From then until the 1890's it was visited by several scientific and exploratory expeditions (Redwood 1950, Kerr 1976). The first of the two major expeditions was the British James Clark Ross expedition of 1840-1842, during which Lyall and Hooker compiled the first plant and animal inventories for the island. In 1874 a French expedition visited Campbell Island to observe the transit of Venus, and work was carried out by Filhol on the geology. Many of the French placenames on the island date from this expedition.

The island was visited periodically between 1868 and 1923 by Government vessels servicing the castaway depots, but, unlike the Auckland Islands which lay on the main shipping routes and have a history of shipwrecks, no shipwrecks have been found on Campbell Island (Eden 1955).

Throughout this period whalers were also visiting the island, and the last of the shorebased whaling stations at North-west Bay operated from 1909-1916 (Kerr and Judd 1978).

In 1864 the island was leased as a Government Pastoral Run, and farming began the following year with the introduction of 300-400 sheep. Farming continued until 1931 when the project was abandoned due to difficulties inherent in the climate and isolation from markets.

Since 1941 the island has been continuously occupied, beginning with the coast watching station during World War II, and continuing since 1945 by Meteorological Service staff.

Kerr (1976) gives a detailed history of the island, and Judd (1980) a list of historic sites.

1.4 AIMS

1. To describe the status of the Campbell Island sheep population in the south-east of the island at June-July 1984.

2. To consider the possibility that sub-populations have become established.

3. To investigate home range, movements and social groupings.

4. To examine daily activities.