A Study of the Relationship between the starling *Sturnus vulgaris* and the Haematophagus mite *Ornithonyssus bursa*

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Frontispiece: Fifteen day old starling nestling with several individuals of the mite *Ornithonyssus bursa* located around the beak and below the eye.

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ABSTRACT

A description is given of a study of starlings breeding in 160 nest boxes over the two breeding seasons 1974-75 and 1975-76, aimed at determining productivity and some factors which possibly affect it. Changes in productivity through the season and between seasons are discussed, with particular reference to the influence of the mite Ornithonyssus bursa on nestling growth rate, weight at 15 days, mortality, blood characteristics, and lipid stores. Also the effect of mite infestations on the mean weight of nestlings from different brood sizes is discussed.

The starling nestling period is described, including changes in feeding activity, growth rates, sanitation measures and behaviour patterns. Factors possibly contributing to the death of late hatching nestlings are discussed.

The life cycle of O. bursa is outlined with particular emphasis on feeding methods and their effects on the host. The behaviour of mites in response to some environmental variables is discussed briefly in relation to the effects of mites on nestlings.

The seasonal pattern of O. bursa infestation over the starling breeding season is described with particular emphasis on the proportion of nest sites infested and the degree of infestation at each of three periods in the breeding season. Several methods of mite dispersal are considered and their importance in infesting other nest sites are discussed.

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1. Introduction

The common starling *Sturnus vulgaris*, a member of the Family Sturnidae was introduced into New Zealand from Europe in 1862 (Wilson, 1975). Its introduction was encouraged by farmers who believed it to be a valuable consumer of pasture pests. Starlings dispersed rapidly after their introduction and are now distributed widely over the country wherever the habitat is suitable for feeding. They are not found in dense native forests, or often above the snowline, but tend to be restricted to cleared and cultivated land created by farming activities. The starling is essentially an omnivore, its diet consisting largely of soil and sward-inhabiting organisms, with grain and fruit being eaten to a lesser extent (East, 1972).

Although starlings are cosmopolitan their abundance is thought to be controlled to a large extent by the availability of suitable nest sites (von Haartman,1957; Kessel, 1957). Such a situation has occurred in many areas of New Zealand, with a substantial increase in the number of breeding pairs when artifical nest sites have been erected (Bull, 1973). Also in areas where the common myna *Acridotheres tristis*, is found (north of latitude 40°S) competition for nest sites is evident. The myna is the more aggressive of the two and not only drives starlings from the nest-sites but destroys their eggs and nestlings. To overcome this competition and preferentially increase starling numbers, nest boxes with a 45mm entrance hole have been erected (Wilson, 1975) which allows starlings but not mynas to enter and breed. Thus farmers wishing to build-up local starling populations around their farms in the hope of encouraging consumption of pasture pests have often erected nest boxes in efforts to overcome any lack of natural nest sites.

Several studies have been carried out in New Zealand in recent years to investigate the value of starlings as biological control agents on pasture pests. East (1972) studied starling predation on grass-grub *Costelytra zealandica* populations while Coleman (1972) examined the feeding ecology and management of starlings; both of these studies being carried out in the

Canterbury Province. Current studies being carried out in Ecology Division, D.S.I.R. are directed towards finding how starling numbers can be increased by the erection of nest boxes; what the best design of nest box is; what eventually checks the population and how the increased population affects grass-grubs and orchards (Bull, 1973).

Some authors writing about the breeding biology of the starling noticed that the nests were often infested with parasitic mites. Royall (1966) in Central Arizona and De Haven and Guarino (1970) at Denver, Colorado found that the nest boxes were heavily infested with the red fowl mite Dermanyssus gallinae. Also several workers in New Zealand (e.g. Wilson, 1971; Drs.P.C. Bull, J.E.C. Flux and P. Purchas pers. comm) have commented that starling nestlings and nest boxes are often infested with large populations of parasitic mites. The feeding activities of these mites have been suspected as being partly responsible for the death of heavily infested nestlings. Wilson (1971) studied the ecology of the myna in Hawkes Bay and found that both myna and starling broods were often infested by the mite Ornithonyssus sylviarum. He concluded that this mite imposed "a strain on the --myna-- nestlings by sucking lymph, causing irritation and weight loss and in severe cases, causing the female to desert from the nest at night --- with obvious serious consequences".

In the Manawatu district, the bloodsucking mite found in starling nest boxes is O. bursa which has sometimes been called the "starling mite" (Dr. G.W. Ramsay, pers. comm.). Ornithonyssus bursa was first recorded in New Zealand in January 1950 (Murray, 1950) from specimens found on children; the original source of the infection being a deserted starling nest in the ceiling of a house. Since then it has been found in this country on a variety of avian hosts with the domestic fowl Gallus gallus, house sparrow Passer domesticus and starling being the most common.

Moss and Camin (1971) investigated the influence of the mite D. prognephilus on productivity and clutch size in purple martin Progne subis colonies but no similar study has yet been made here or elsewhere on the effects of O. bursa on productivity of starlings. Thus the objectives of this study were to examine the relationship between starlings and populations of O. bursa and in particular to look closely at the effect of mites on nestling growth and survival.

2. STUDY AREAS

2.1 Description

The study areas chosen (Fig.1) were selected because of ready accessibility from Palmerston North and because starlings were already known to breed there. The chief characteristics of each area are now detailed.

(1) Te Matai Road

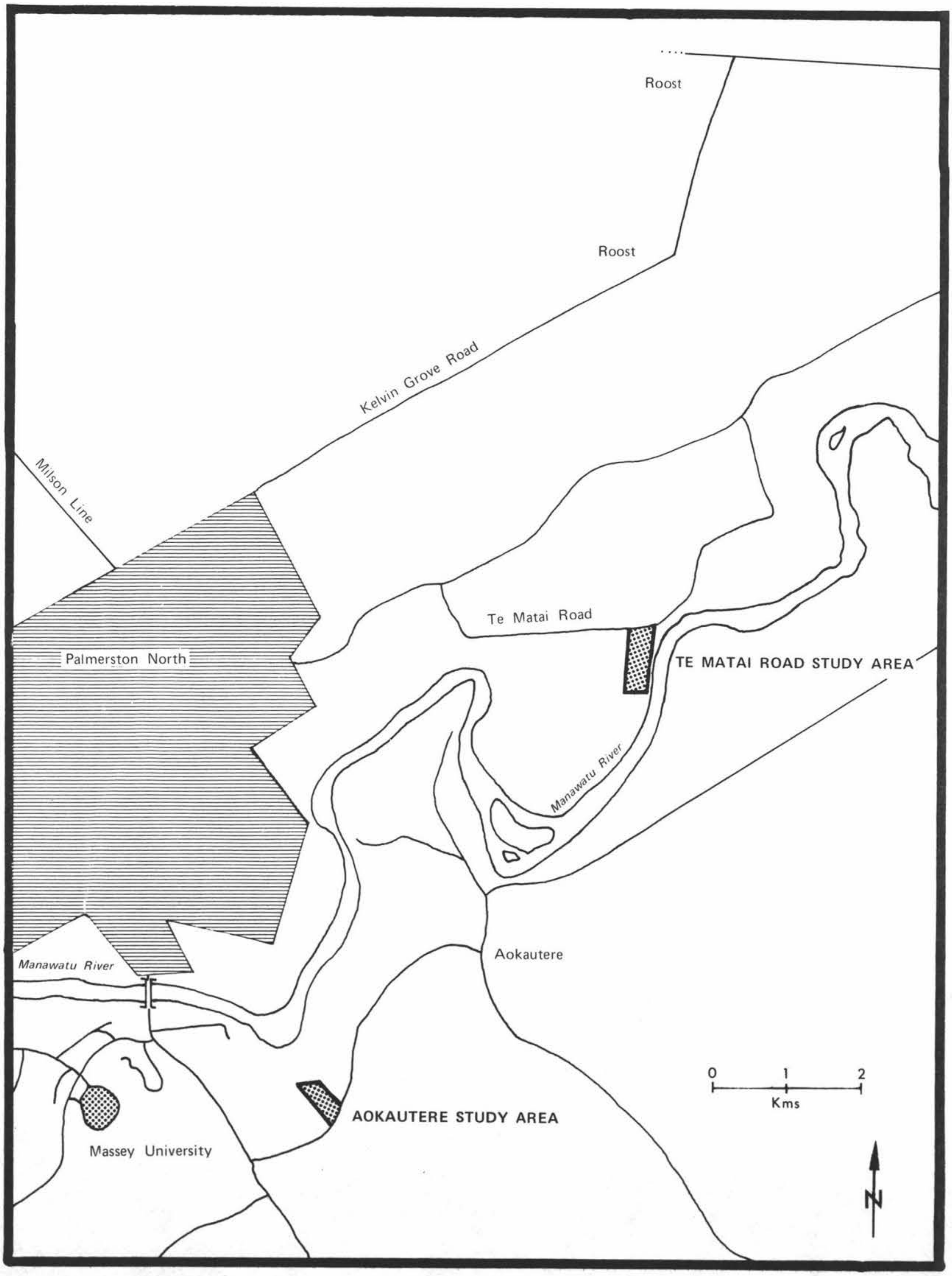
This area, about eight kilometres from Palmerston North, is part of the property of Dr. H. Wenham and is bordered on the eastern side by the Manawatu River (Fig.2). The study area covered approximately 12 ha. of flood-derived alluvial soils, now guarded by stop-banks. The land is flat with macrocarpas, Cupressus macrocarpa willows, Salix babylonica blue gums, Eucalyptus globulus and poplars Populus nigra being the only barriers to prevailing nor-westerly and easterly winds. The farm carries a flock of Coopworth sheep, but most of the property is maintained in pasture with about three hectares of lucerne for grazing and hay production. Each year three or four crops of hay are taken off the two paddocks of lucerne after which these are available for grazing sheep. In spring about two hectares are sown in potatoes, and after harvesting this crop in late summer the area is sown in pasture once more.

The land within a five kilometre radius of the study area is used mainly for pasture production, and there are small areas of commercial vegetables, grain and fodder crops.

Nest boxes were first introduced into the study area in the winter of 1972 when Dr. Wenham erected 12 boxes on trees and buildings. During winter 1973 a further 40 boxes were erected by Dr.Wenham on four fence-lines, followed by another 17 during the next breeding season. In May and June 1974 I set up 43 boxes so that in the 1974-75 and 1975-76 breeding seasons a total of 100 nest boxes on fence-lines were available to starlings.

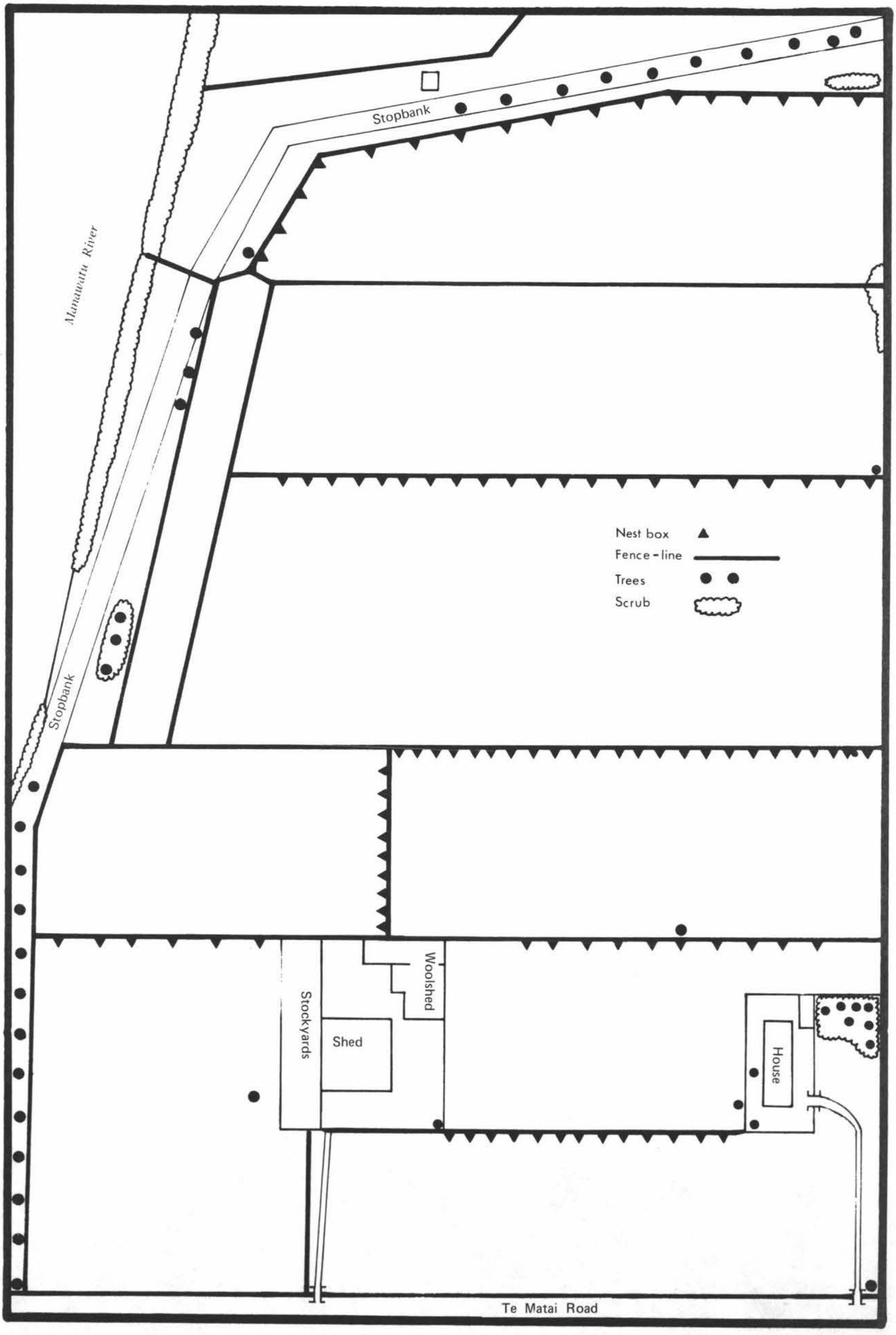
The nest boxes were all made to the same pattern from 17cm by 1.3cm timber. Internal measurements were 14cm x 14cm square at the base and c. 30cm deep. The lid sloped down

Figure 1: Map showing the Study Areas and their relation to Palmerston North.



Roost
Roost
Kelvin Grove Road
Milson Line
Palmerston North
Te Matai Road
TE MATAI ROAD STUDY AREA
Manawatu River
Manawatu River
Aokautere
AOKAUTERE STUDY AREA
Massey University
0
1
2
Kms
N

Figure 2: Map of the Te Matai Study Area.



Manawatu River
Stopbank
Stopbank
Nest box
Fence-line
Trees
Scrub
Stockyards
Woolshed
Shed
House
Te Matai Road

towards the rear with the entrance hole and a perch 10cm from the top. All nest boxes were stapled to the top two wires of the fence so that the entrance holes were approximately 1.25m from the ground. On average the nest boxes were 9.5m apart (maximum 15.0m;minimum 6.8m). Ninety-three nest boxes faced in a NNW direction, while the remaining seven faced NE.

(2) Aokautere

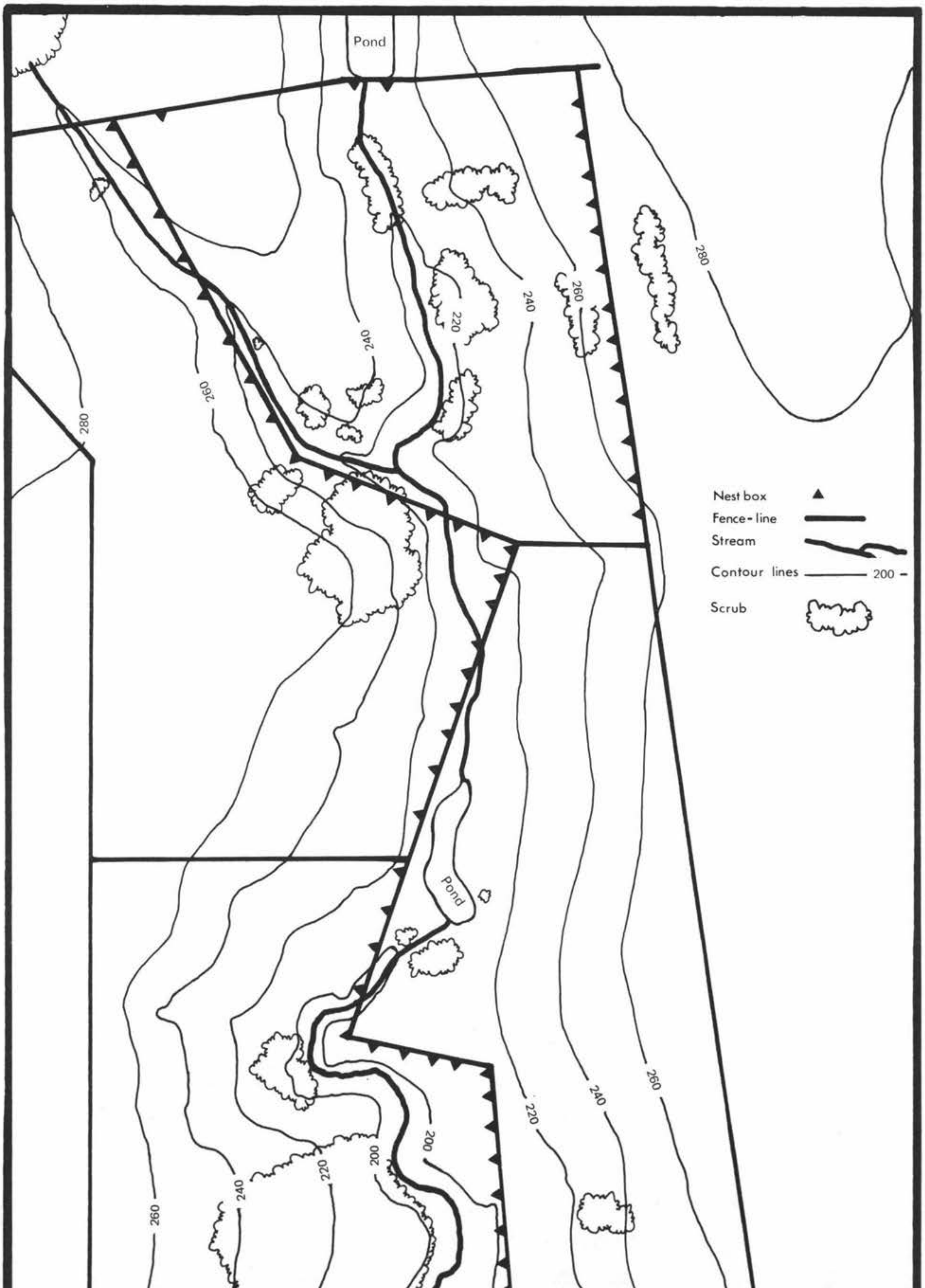
The Aokautere study area, on Mr.K.L. Lowe's property, is four kilometres from Palmerston North, and differed from the Te Matai Road area in topography (Fig.3). It is situated in a valley of about 10 ha with a soil comprising yellow-grey earth and loess.. A stream meanders down the valley and above this the valley sides rise some 120m. to substantial areas of flat land. These areas are utilized equally for pasture production and crops such as barley *Hordeum vulgare* and maize *Zea mays*. Willows grow by parts of the stream and considerable areas of the valley sides are covered in gorse *Ulex europaeus* and hawthorn *Crataegus monogyna*. A small flock of sheep and a few steers graze in the valley.

Prior to the 1974-75 breeding season, Mr.H. Robertson erected 51 nest boxes on fence-lines in the study area and I put up a further nine bringing the total number of nest boxes in the study area to 60. All the boxes were attached to the tops of fence posts, which made the entrance holes about 1.5m from the ground. On average the nest boxes were 10.8m apart (maximum 17.6; minimum 4.8m), and they faced in a NNE-NE direction.

(3) Massey University

Prior to the 1975-76 breeding season it was decided that destructive analysis of some nest boxes was essential to obtain total numbers of mites present (rather than indices of numbers present) at various times of the breeding season. So as to avoid draining the main study areas of Te Matai Rd and Aokautere, 28 additional boxes were erected on Massey University No. 3 Sheep Farm and on No.2 Dairy Farm. These boxes were identical to those already in use in the other study areas, however to facilitate quick and efficient dismantling they were not nailed together but instead were braced tightly with wire. They were then nailed to the top of suitable wooden fence posts, but were spaced far apart to enduce a high rate of occupancy. Twenty-one

Figure 3: Map of the Aokautere Study Area.
Conour-lines are in metres.



Pond
Pond
280
260
240
220
200
Nest box
Fence-line
Stream
Contour lines 200
Scrub

faced in a NE direction while the remaining seven faced W. The land surrounding the nest boxes was mainly flat pasture with a small area cultivated for cropping and trial-pasture plots.

2.2 Meteorology

It has been established elsewhere that climate influences breeding success in starlings. For instance, Dunnet (1955) showed that in Scotland during the breeding season about 95% of the food taken by foraging starlings lived just below the soil surface, in the region most influenced by weather. Drying of the soil surface, due to drought conditions, can result in a decrease in the availability of food to the foraging parent starlings. Studies carried out on irrigated pastures (Lobb and Wood,1971) and non-irrigated pastures (Coleman,1972) on the Canterbury Plains showed that starlings consumed animal material when it was available. However, when drying of the sward occurred they were "forced to consume cereals from stubble fields to supplement their insect diet" (East,1972). Taitt (1973) has shown in feeding studies with starlings that vegetable material has a lower energy value and digestive efficiency when compared to animal material. Therefore nestlings with a high proportion of vegetable material in their diet would be expected to have a reduced growth rate and less chance of survival. Thus weather over the breeding season (September to January in New Zealand) is an important influence on breeding starlings and the climate in the study areas for this period is now considered.

Meteorological records used were those obtained by Grasslands Division, D.S.I.R. at Station 19, which is situated next to Massey University. These measurements were considered reasonable accurate for the two main study areas because both are within 10km of the station. Meteorological records for the five breeding seasons prior to 1974-75 (see Appendix 1) show that as the breeding season progresses there is generally a decrease in monthly total rainfall, and a rise in mean temperature (= half the sum of the maximum and minimum monthly temperatures) but the amount of wind remains fairly constant. Therefore during the breeding season the potential for evaporation of surface water increases, which contributes to a drying of the soil surface and this in turn impedes probing by starlings in the grassy sward. Lobb and Wood (1971) found from faecal analyses that most of the major foods of starlings were insect pests and worms that inhabit the sward and the upper two centimetres of soil. In 1969, between mid-June and late August they found that when the weather was dry with frequent frosts, very few grass-grub (Costelytra zealandica) fragments were recovered but they were found throughout this period in 1970 when rainfall was closer to normal. Therefore because a major portion of starling food is usually obtained from this stratum of the soil it may be inferred that nestlings could suffer when excessive drying occurs.

Weather records are now given for the two breeding seasons studied — 1974-75 and 1975-76.

Table 1.

Some Meteorological Records for the 1974-75 Starling Breeding Season.

	Rainfall (mm) (Total Monthly)	Mean temp. (°C) = (½ max. + min.)	Wind (Total Run.km)	Evaporation (0.1mm)
Sep.	115.9	12.2	6994.0	636.0
Oct.	128.0	13.0	8617.0	788.0
Nov.	50.6	16.0	9663.0	1334.0
Dec.	75.7	18.1	7715.0	1551.0
Jan.	37.9	20.2	7504.0	1919.0

Table 1 shows that the total monthly rainfall decreased from September to January while the mean temperature and potential for evaporation increased. The data suggest that drying of the soil surface would occur during November and December and this was supported by casual observation. In addition, during early summer several districts in the immediate vicinity of Palmerston North were classified by the Ministry of Agriculture and Fisheries as being under drought conditions. Any marked drying of the soil surface would have restricted the foraging activities of the parents and this was reflected in the high mortality and low fledging weights of late nestlings. (see Section 9) In addition hot weather seemed in some cases to influence the nestlings directly by apparently inducing physiological stress. Often young were found 'panting' in the heat of the nest boxes, which suggested that a few nestlings may have suffered from the effects of dessication.

The weather conditions that prevailed for the 1975-76 breeding season were remarkably unlike those of the previous season (Table 2).

Table 2.

Some Meteorological Records for the 1975-76 Starling Breeding Season

	Rainfall (mm) (Total Monthly)	Mean temp. (°C) = (½ max. + min.)	Wind (Total Run.km)	Evaporation (0.1mm)
Sep.	54.0	10.7	9686.0	712.0
Oct.	82.7	13.3	10678.0	1160.0
Nov.	53.1	13.3	10398.0	1154.0
Dec.	103.3	15.2	12338.0	1564.0
Jan.	90.1	17.7	9472.0	1837.0

Instead of a dry spell occuring towards the end of the season, heavy rain fell which resulted in moist soils and abundant growth of pasture. Although the wind run was high, and the potential for evaporation about the same as for 1974-75, the soil surface did not become dry because of the low temperatures and high rainfall. The overall result of these conditions was that starlings were able to feed in pasture throughout the season and the ample food available was reflected in the weights and survival of the late nestlings.