

PATTERNS OF SEASONAL ACTIVITY AND
HOST-PARASITE RELATIONSHIPS FOR
FLEAS ASSOCIATED WITH
RICHARDSON'S GROUND SQUIRRELS,
SPERMOPHILUS RICHARDSONII, IN SOUTHERN
MANITOBA, CANADA

A Thesis

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of

Graduate Studies

The University of Manitoba

by

Leslie Robbin Lindsay

In Partial Fulfilment of the

Requirements for the Degree

of

Masters of Science

Department of Entomology

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RELATIONSHIPS FOR FLEAS ASSOCIATED WITH RICHARDSON'S GROUND SQUIRRELS,
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BY

LESLIE ROBBIN LINDSAY

A thesis submitted to the Faculty of Graduate Studies of
the University of Manitoba in partial fulfillment of the requirements
of the degree of

MASTER OF SCIENCE

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ABSTRACT

The host-parasite relationships between several flea species and their host, Richardson's ground squirrel, Spermophilus richardsonii (Sabine), were evaluated at three localities in Manitoba during a three year study. Ground squirrels captured near Darlingford, Manitoba were infested with Neopsylla inopina (Rothschild), Opisocrostitis bruneri (Baker), Oropsylla rupestris (Jordan) and Rhadinopsylla fraterna (Baker). Opisocrostitis bruneri was the only one of these species infesting squirrels at the two sites near Winnipeg, Manitoba (designated Perimeter and St. Norbert).

Adult ground squirrels emerged during late March and early April, males approximately seven days before females. Juveniles first appeared above ground in late May and early June. Adult male squirrels immersed to hibernate from mid-June to early July; adult females from late July to mid-August; female juveniles before male juveniles. The last juveniles were captured in early September to mid-October.

At Darlingford, 268 individual squirrels were captured 2308 times during 1987-1989. At the two sites near Winnipeg, 184 individuals were captured 1689 times during the same period. Juvenile squirrels constituted 64.7% to 92.9% of the total captures and were the most frequently

recaptured stage in 1987 and 1988.

At Darlingford, 1,446 N. inopina, 4,657 O. bruneri, 12,506 O. rupestris and 379 R. fraterna were taken from S. richardsonii during 1987-1989. At the two sites near Winnipeg, 6,212 O. bruneri were collected from squirrels during the same period. Female fleas were usually collected more often than males for all flea species and the observed biweekly sex ratio (M/F) generally favoured females for all flea species.

With the exception of two weeks in April, N. inopina was present on less than 50% of the squirrels. There was one peak in observed mean intensity in April during 1988 and 1989. There were two peaks of prevalence and mean intensity for O. bruneri during May and August at Darlingford and near Winnipeg. During early April, early July and September there were peaks in the prevalence and mean intensity of O. rupestris. The prevalence of R. fraterna adults on Richardson's ground squirrels was generally below 10% and squirrels were rarely infested with more than one or two R. fraterna adults, except during early April and from mid-August to the end of the trapping season.

Nulliparous N. inopina predominated only during April and early May, when the majority of teneral individuals were also collected. Immatures and nulliparous O. bruneri adults predominated throughout April and May. At all sites, the

majority of teneral O. bruneri were taken from squirrels in July. Nulliparous O. rupestris females predominated in early June and occurred sporadically throughout the season. Parous females were numerous during most trapping intervals. Teneral O. rupestris adults were collected in large numbers in August (1987) and June (1988). Nulliparous R. fraterna were abundant only in April of 1988 and 1989 and teneral R. fraterna adults were collected only during April in 1989. The percentage of mated females varied over the season and was usually directly correlated with per cent parity for all flea species. Parous, mated females from all species were collected from squirrels throughout the entire season. Egg development in the different flea species was therefore not dependent on the estrous cycle of female S. richardsonii.

The seasonal activity of O. bruneri adults was not markedly different when this species shared its host with several other flea species compared to when O. bruneri was the only flea species infesting the squirrels.

Chapter I
INTRODUCTION

Several different flea species are associated with Spermophilus richardsonii (Sabine) (Richardson's ground squirrel) in Canada and the United States. Oropsylla rupestris (Jordan) is the most common flea of the Richardson's ground squirrel (Jellison 1947). While O. rupestris has been removed from a variety of other scuirid spp. and certain other mammalian hosts (i.e. Mustela, Canis and Lepus spp.) (Smit 1983), it has rarely been recorded outside the range of the Richardson's ground squirrel (Holland 1949, 1985) (Figs. 1,2). Opisocrostis bruneri (Baker) is found on Richardson's ground squirrels throughout most of the host's geographic distribution (Fig. 3). This flea species is also associated with the thirteen-lined and Franklin's ground squirrel (S. tridecemlineatus (Mitchill) and S. franklinii (Sabine), respectively) (Holland 1985; Smit 1983). Opisocrostis bruneri occurs within the range of these three species and where host distributions overlap, O. bruneri infests all three (Holland 1944). Neopsylla inopina (Rothschild) has been recorded from Richardson's ground squirrels in Alberta, Saskatchewan (Holland 1985), Manitoba

Figure 1. Geographic distribution of Spermophilus richardsonii (adapted from Hall 1981).

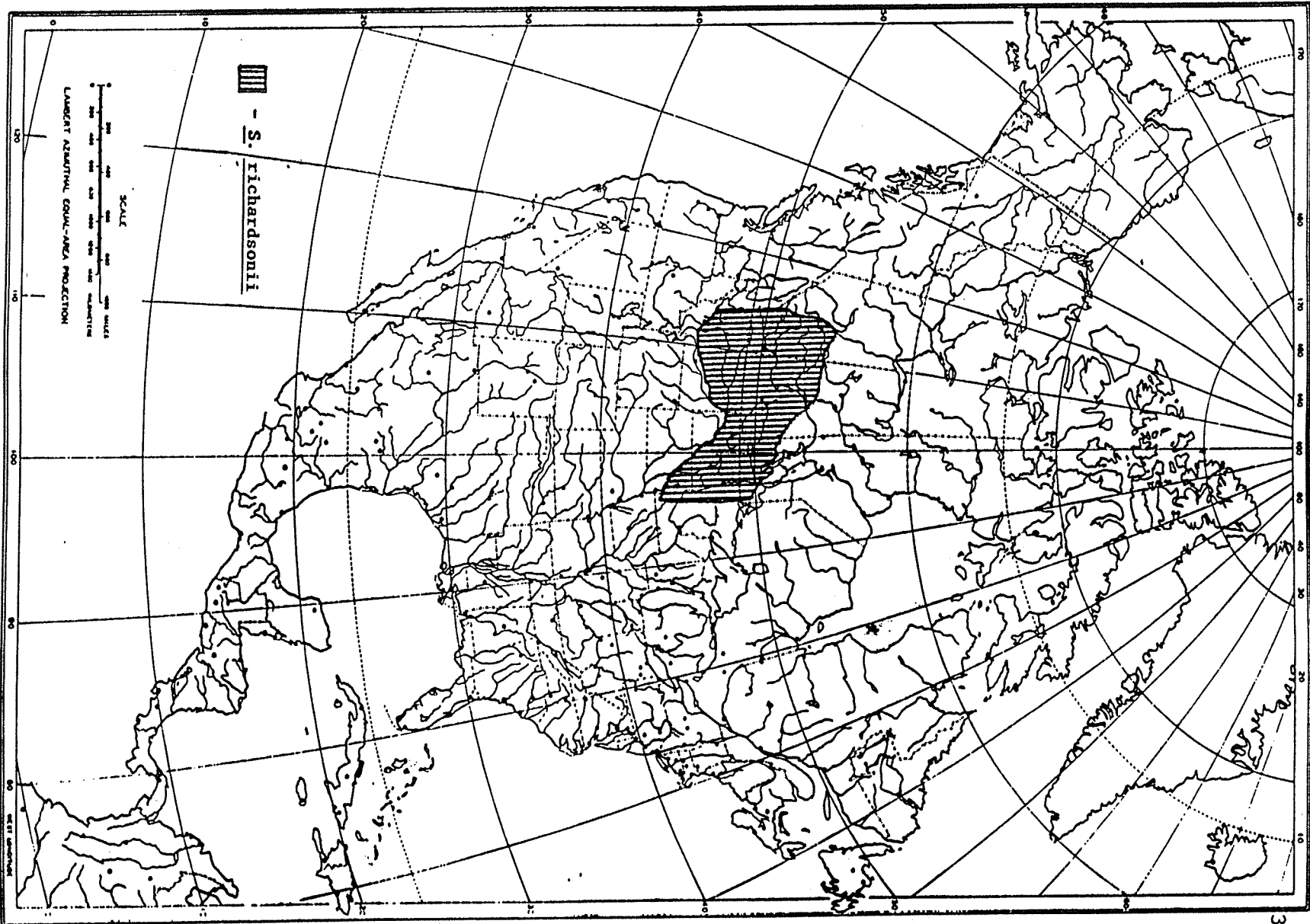


Figure 2. Geographic distribution of Oropsylla rupestris and its primary host, Spermophilus richardsonii (Adapted from Hall 1981, Holland 1985, Smit 1983).

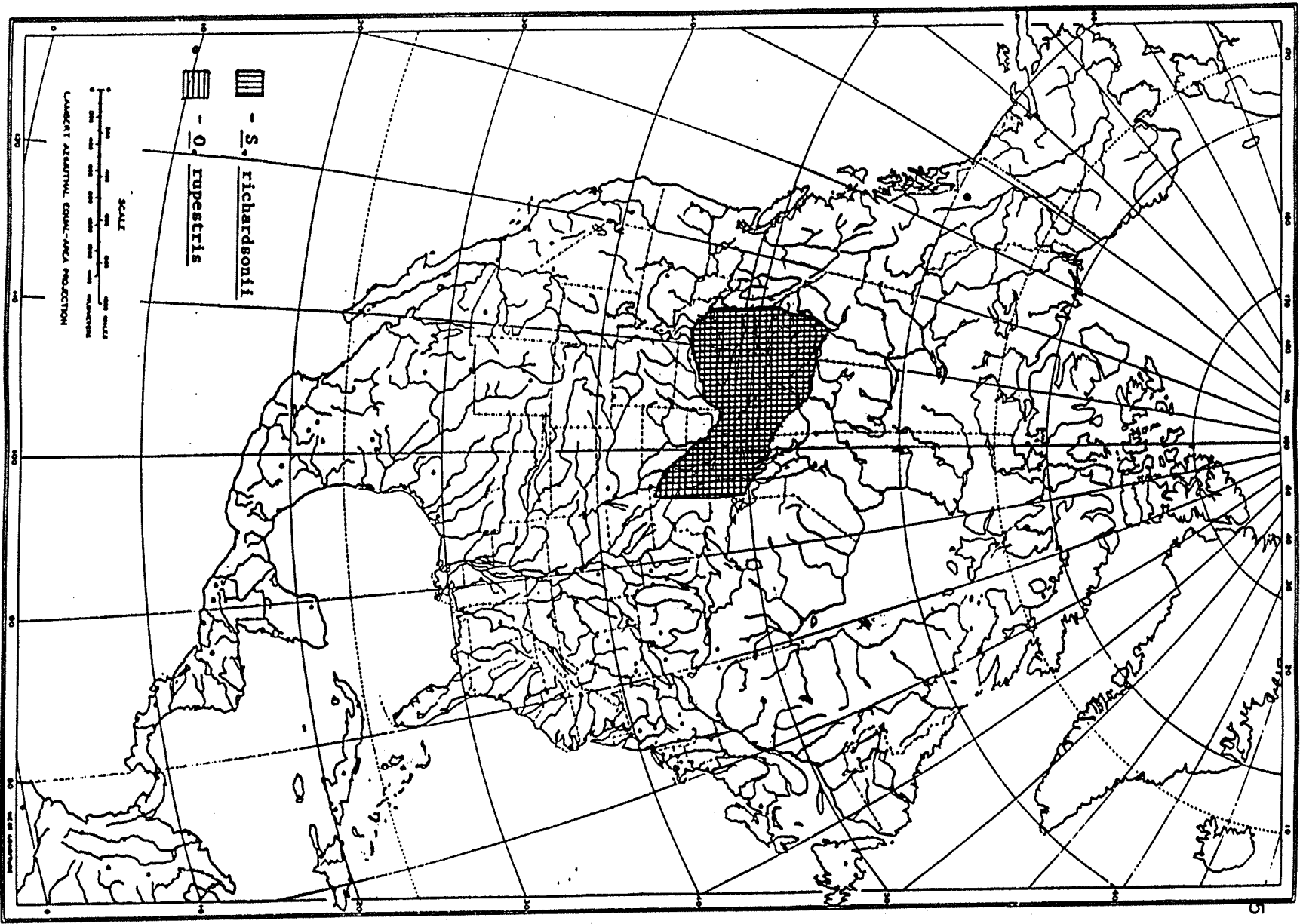
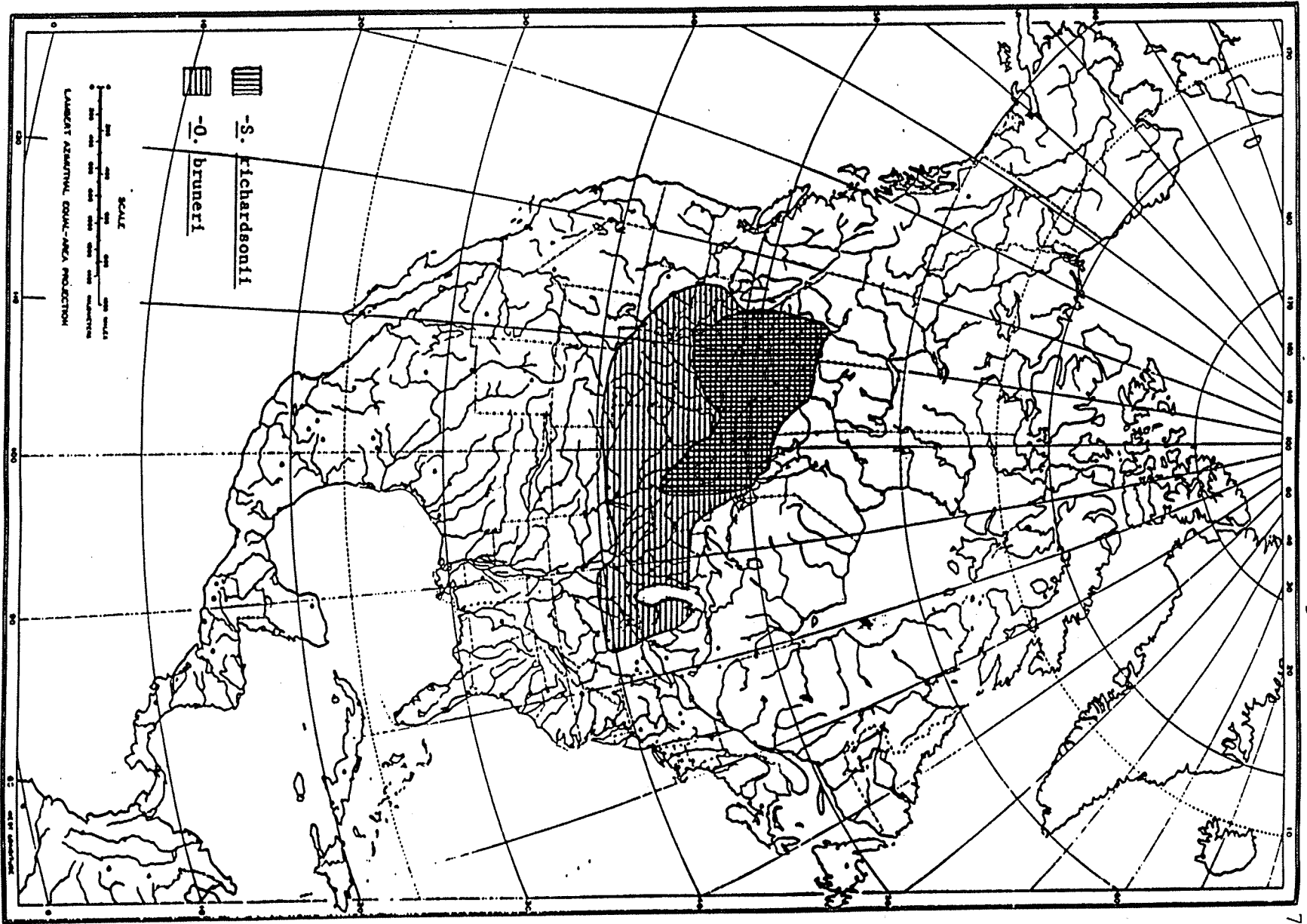


Figure 3. Geographic distribution of Opisocrostitis
bruneri and the host, Spermophilus
richardsonii (Adapted from Hall 1981, Holland
1981, Perdue 1980).



(Galloway and Christie unpublished) and Montana (Hubbard 1947). This species has been recorded from a variety of host species but is considered primarily associated with S. richardsonii (Holland 1985). Richardson's ground squirrels in Montana, Alberta, Saskatchewan and Manitoba are occasionally infested with Rhadinopsylla fraterna (Baker) (Galloway and Christie unpublished; Holland 1949; Hubbard 1947). This species has been collected from several rodent hosts but S. richardsonii is considered its primary host (Holland 1985). At certain localities, Richardson's ground squirrel can be concurrently infested with each of these flea species (Hilton and Mahrt 1971; Galloway and Christie unpublished).

Richardson's ground squirrels form colonies within a common habitat, though all members of the colony have their own burrows (Armitage 1981). Adult and yearling males emerge from hibernation in breeding condition in late March to early April in Saskatchewan (Michener 1984a). The monoestrous females emerge 7-10 days after males and most females are mated within a week (Michener 1985). Gestation is typically 22.5 days and parturition occurs 25-27 days after female emergence (Michener 1980b). Juvenile emergence occurs during the last week of May or early June in Saskatchewan (Michener 1974). Adult males generally immerge to hibernation in the first half of July followed by

nonreproductive and reproductive females, respectively (Michener 1984a). Juvenile females enter hibernation before juvenile males (Michener 1981). Above ground activity ceases during September or October in Saskatchewan (Michener 1974). The annual cycle of Spermophilus richardsonii has not been examined in Manitoba since the early 1900's (Seton 1909).

Five seasonal activity studies have been performed on O. bruneri from thirteen-lined, Richardson's and Franklin's ground squirrels. Hendricks (1967) reported the mean intensity (number of fleas/infested host) of O. bruneri adults collected from S. tridecemlineatus. The highest intensity of adult O. bruneri occurred during October and June. Kinzel and Larson (1973) examined the geographic distribution and relative abundance of O. bruneri and Thrassis bacchi bacchi (Rothschild) infesting S. tridecemlineatus in North Dakota. Regional differences in the abundance of these two species were attributed to geographic and climatic variation. Baesler (1975) collected O. bruneri from Richardson's ground squirrels in North Dakota. Peak numbers of O. bruneri adults were correlated with seasonal changes in rainfall. In each of these studies, the authors suggested that changes in flea activity were dependent on abiotic conditions. However, the data from each of these studies was collected from a number

of different locations, during different periods of the season. Variation in sampling locations may have confounded conclusions concerning flea seasonal activity and the proximate factors controlling flea activity.

Burachynsky and Galloway (1980) and Reichardt (1989) examined the seasonal changes in mean intensity and prevalence of O. bruneri adults on S. franklinii from a single sampling location near Birds Hill Park, Manitoba. Two peaks in observed mean intensity of O. bruneri occurred in May and early September, respectively. During June and July, juvenile emergence resulted in a depression of the number of adult O. bruneri/host.

Reichardt (1989) investigated the dependence of O. bruneri oogenesis on the estrous cycle of S. franklinii. Since the first peak of adult O. bruneri occurred during the breeding season of S. franklinii and was followed by a single peak later in the season, it was hypothesized that O. bruneri ovarian development was initiated by the levels of reproductive hormones of female hosts. Examples of this type of reproductive interdependence have been documented for the fleas, Spilopsyllus cuniculi Dale and Cediopsylla simplex (Baker) from various lagomorph hosts (Rothschild and Ford 1973). Reichardt (1989) also speculated that since O. bruneri is found almost exclusively on S. franklinii that "the high degree of association may have resulted in the