SYLLOGEUS

NATIONAL MUSEUM OF NATURAL SCIENCES

MUSÉE NATIONAL DES SCIENCES NATURELLES

ΣΥΛΛΟΓΕΥΣ

No. 25

H. V. Danks

ARTHROPODS OF POLAR BEAR PASS, BATHURST ISLAND, ARCTIC CANADA

MUSÉES NATIONAUX DU CANADA

OTTAWA

NATIONAL MUSEUMS OF CANADA

SYLLOGEUS is a publication of the National Museum of Natural Sciences, National Museums of Canada, designed to permit the rapid dissemination of information pertaining to those disciplines and educational functions for which the National Museum of Natural Sciences is responsible. In the interests of making information available quickly, normal publishing procedures have been abbreviated.

Articles are published in English, in French, or in both languages, and the issues appear at irregular intervals. A complete list of the titles issued since the beginning of the series (1972) and individual copies of this number are available by mail from the National Museum of Natural Sciences, Ottawa, Canada. K1A 0M8

La collection SYLLOGEUS, publiée par le Musée national des sciences naturelles, Musées nationaux du Canada, a pour but de diffuser rapidement le résultat des travaux dans les domaines scientifique et éducatif qui sont sous la direction du Musée national des sciences naturelles. Pour assurer la prompte distribution de cette publication, on a abregé les étapes de la rédaction.

Les articles sont publiées en français, en anglais ou dans les deux langues, et ils paraissent irrégulièrement. On peut obtenir par commande postale la liste des titres de tous les articles publiés depuis le début de la collection (1972) et des copies individuelles de ce numéro, au Musée national des sciences naturelles, Ottawa, Canada. K1A 0M8

Syllogeus series No. 25

Printed in Canada
ISSN 0704-576X

Série Syllogeus N^{O} 25

Imprimé au Canada

ARTHROPODS OF POLAR BEAR PASS, BATHURST ISLAND, ARCTIC CANADA

H. V. Danks

Biological Survey Project
Entomological Society of Canada
202 - 1316 Carling Avenue
Ottawa, Ontario
K1Z 7L1

Syllogeus No. 25

National Museum of Natural Sciences
National Museums of Canada

Musée national des sciences naturelles
Musées nationaux du Canada

Ottawa 1980

TABLE OF CONTENTS

ABSTRACT

An annotated checklist is provided of the arthropod fauna of Bathurst Island, where the National Museum of Natural Sciences has operated a high arctic research station (75°43'N, 98°25'W) since 1968.

Collections are currently incomplete, but the fauna is clearly impoverished, reflecting the particular climatic severity of this area of the arctic archipelago. Widespread, especially circumpolar, arctic species predominate. The fauna of 112 known species comprises 37 mites, 4 spiders, 6 springtails, and 65 insects. Chironomids constitute half of the insects.

Few species eat living vascular plants; most are saprovores, but many (including species expected but not yet collected) parasitize vertebrates. Many saprovores depend on vertebrates through organic matter derived from dung or carrion. Some birds in turn depend heavily on arthropods for food. The members of this arctic ecosystem are evidently highly inter-related, though the detailed habits and habitats of many of the arthropods are unknown.

The research station area would be valuable for research on arthropods: because a variety of habitats, including rich marshes very productive of chironomids and other insects, occur there; because this particular high arctic site favours study of arthropod adaptations at high latitudes; and because study of the demonstrated links to vertebrates would be facilitated by long term studies already in progress at the research station.

These unique values for the study of arthropods, together with the considerable importance of the area for wildlife, suggest that the research station site and a large area surrounding it be protected from future environmental damage: Ecological Reserve status is highly desirable.

RÉSUMÉ

Cet ouvrage consiste en une liste annotée des arthropodes de l'île Bathurst, dans la partie septentrionale de l'Arctique canadien, où le Musée national des Sciences naturelles exploite depuis 1968 une station de recherches (75°43' latitude nord, 98°25' longitude ouest).

La récolte des arthropodes n'est pas encore complète, mais on note que la faune est peu diversifiée ce qui reflète la rigueur remarquable du climat dans cette région de l'Archipel arctique. On note une prédominance d'espèces circumpolaires. Parmi les 112 espèces dénombrées, on compte 37 mites, 4 araignées, 6 collemboles et 65 insectes. La moitié des insectes sont des chironomidés.

Peu d'espèces se nourrissent de plantes vasculaires; saprophages pour la plupart, bon nombre (y compris des espèces dont on n'a pas encore fait la récolte) sont des parasites de vertébrés. En effet, beaucoup de saprophages tirent les matières organiques dont ils ont besoin des fientes ou des charognes de vertébrés. Certains oiseaux, en revanche, dépendent surtout des arthropodes. Bien que les moeurs de beaucoup d'arthropodes ne soient pas connues en détail, les espèces de cet écosystème arctique sont sans doute interdépendantes.

La zone de la station de recherches serait précieuse pour faire des recherches sur les arthropodes en raison de la diversité des habitats, y compris d'abondants marécages qui donnent naissance à une multitude de chironomides et à d'autres insectes. De plus, l'endroit lui-même favorise l'étude de l'adaption des arthropodes à hautes latitudes. Enfin, l'étude des relations avec les vertébrés serait facilitée par des recherches à long terme déjà en cours à la station de recherches.

Ces avantages exceptionnels qui favorisent l'étude des arthropodes, ainsi que la richesse de la faune de cette région, démontrent que l'emplacement de la station de recherches, entourée d'une vaste zone, doit être protégé de l'empiètement humain et de la détérioration qui s'en suit. Il est donc important de constituer, au plus tôt, une réserve écologique dans cette région.

INTRODUCTION

The National Museum of Natural Sciences, National Museums of Canada, has operated a high arctic research station in Polar Bear Pass, Bathurst Island, N.W.T., for several years. Most of the research conducted there has concerned vertebrates, and the importance of the site for wildlife is well recognized (e.g. Nettleship and Smith 1975). This paper presents an annotated checklist of the arthropod fauna of Bathurst Island, and considers thereby other values of the area surrounding the Museum's research station.

The Bathurst Island complex, consisting of Bathurst Island and several closely adjacent smaller islands and islets, lies between 74°59'N and 76°45'N and 97°16'W and 104°30'W in the Queen Elizabeth Islands of the Canadian Arctic Archipelago (Fig. 1). This high arctic complex has an area of about 18 000 km^2 (7,000 sq. mi). Bathurst Island itself comprises about 16 380 km^2 (6,400 sq. mi.); its coastline is much dissected and no part is more than 24 km from the Arctic Ocean.

Geology and physiography have been described by Taylor (1956), Roots (in Fortier *et al*. 1963), Kerr (1974), Bird (1967), and others. The topography is predominantly rolling, of sedimentary rocks folded into a series of uplands and valleys. Generally the relief does not exceed 365 m, but some uplands reach 460 m in elevation. Most of the island is composed of Devonian and Silurian sandstone, limestone and shale. Items of particular geological interest include a disjunction between adjacent regional structures in eastern Bathurst Island (McNair 1961), remnants of eroded reef knolls on the central uplands, and several raised beaches.

Blake (1970) considered the glacial geology. Bathurst Island was undoubtedly glaciated during Wisconsinan time, but mainly by local ice caps and not by the Laurentide (continental) ice sheet. Rapid glacial rebound seems to have taken place since deglaciation, which was extensive by 9,000 years ago.

The climate is high arctic, and similar to, though probably slightly colder than, that of nearby Cornwallis Island. Bathurst Island is in a cloudy area of the arctic (Gavrilova 1966), and all island sites are close to the sea. Mean temperatures during July, the warmest month, are below 4.5°C,

Fig. 1 Map of the Queen Elizabeth Islands

though of course insolated surfaces and shallow water bodies become much warmer than this. Records for Resolute (Thompson 1967) suggest that precipitation averages about 13 cm per year, of which just over half falls as snow. Wind is predominantly from the north-west, with an average speed in summer of about 20km/h.

The vegetation has not been fully described. Mosses were listed by Brassard and Steere (1968), but data have not been published on the vascular plants (studies are in progress). Current collections suggest that nearly 80 plant species occur on Bathurst Island: *Saxifraga* and *Dryas* characterize the dry uplands, which are relatively barren because the sedimentary rocks are well drained; *Salix arctica* and many other plants occur on less exposed sites; sedges dominate the wet lowlands.

The vertebrate fauna is quite well known; at least 42 species of birds feed on Bathurst Island and 26 species nest there (Nettleship and Smith 1975, p. 17): King Eider (*Somateria spectabilis*), Greater Snow Goose (*Chen caerulescens*), gulls, jaegers and shorebirds are most in evidence. Eight species of terrestrial mammals have been recorded. Collared Lemming (*Dicrostonyx torquatus*), Arctic Fox *(Alopex lagopus)*, Muskox (*Ovibos moschatus*) and Peary Caribou (*Rangifer tarandus*) are most common.

THE ARTHROPOD FAUNA

Introduction

The arthropod fauna of Bathurst Island has not been fully explored.

Several spiders were collected on the island by early geological survey parties, and these records were cited by Leech (1966).

Danks and Byers (1972) collected material in 1969 by searching in various habitats, by operating pan-traps and stream-nets in several locations and emergence traps in one pond, and by inspecting a few birds and mammals for parasites, but they left before the end of July. This material was identified by various specialists (see Danks and Byers 1972), and is in the Canadian National Collection (CNC).

Gill and Strandtmann (1977) identified species (mostly ectoparasitic mites) secured by routine brushing from collared lemmings (*Dicrostonyx torquatus*). This material is also in the CNC.

Danks (1971b) mentioned additional chironomid species from the island. He also (1971a) recorded, from the stomachs of birds collected there, two of the species noted by Danks and Byers (1972). S.D. MacDonald secured additional material from bird stomachs in 1970, which was identified by H.V. Danks.

R.W. Strandtmann (University of Texas, Lubbock) secured some free-living as well as parasitic mites in 1974, including several species not collected by Danks and Byers (1972). H.L. Dickson collected mite samples in 1975. Free-living mites in the 1974 and and 1975 samples were identified and reported upon by Behan (1978). This material is in the Lyman Entomological Museum, Macdonald College of McGill University.

I. Sutherland (National Museum of Natural Sciences) collected benthos from a variety of freshwater habitats in 1974, and a few chironomid larvae were taken. This material (mostly crustaceans) has not yet been fully sorted or identified, though it is in National Museum of Natural Sciences collections.

J.D. Bissett (Agriculture Canada, Ottawa) collected some arthropods in 1977. These were collected in August, so that several species not found by Danks and Byers (1972) were obtained. The material is in the CNC. Except for most mites and for chironomids, it was reported on by Bissett (1977).

As a result of these investigations, 112 arthropod species (4 spiders, 37 mites, 6 springtails and 65 insects) are known from the island. These are shown by family in Table I, and listed in the following section (and in Appendix I).

Annotated checklist of the fauna

Class ARACHNIDA

Order ARANEAE

Spiders are very common on Bathurst Island, especially on the ridges, where they are eaten by birds (Danks 1971a; stomach contents from additional bird species collected by S.D. MacDonald).

family Thomisidae

Xysticus deichmanni Soerensen

This crab spider was recorded from Bathurst Island by Turnbull *et al*. (1965) and Leech (1966). It has a wide Nearctic distribution (Alaska to Greenland: Turnbull *et al*. 1965 - see Leech 1966, p. 197 for a map), but does not occur in Iceland (Braendegaard 1958). Oliver (1963) found it on Ellesmere Island, and Turnbull *et al*. (1965) also recorded it from Baffin and Victoria Islands.

Leech (1966) provided some notes on the habits, including courtship and mating, for which males tie the females down with silk. Members of this species live mostly on the ground in or near plant clumps, mainly of *Dryas*, and sometimes in flowers (cf. Kevan 1973, p. 671). Apparently they eat mainly small Diptera - captured by ambush - especially Chironomidae and (at Hazen Camp, Ellesmere Island) Culicidae; they have also been found feeding on newly hatched moth (*Gynaephora*) larvae. Fertilized adults can overwinter, and lay eggs

Table I. *Known families of the arthropod fauna of Bathurst Island, N.W.T.*

(no. of species in parentheses)

Class Arachnida (41)

Order Araneae (4)

- Thomisidae (1)
- Erigonidae (3)

subclass Acari (37)

Order Parasitiformes

Suborder Mesostigmata

- Ascidae (5)
- Phytoseiidae (1)
- Laelapidae (4)

Order Acariformes

Suborder Prostigmata

- Nanorchestidae (1)
- Terpnacaridae (1)
- Eupodidae (4)
- Penthalodidae (1)
- Rhagidiidae (3)
- Tydeidae (4)
- Bdellidae (1)
- Pygmephoridae (1)
- Myobiidae (1)
- Stigmaeidae (2)

Suborder Acaridiae

- Glycyphagidae (1)
- Myocoptidae (1)

Suborder Oribatei

- Brachychthoniidae (1)
- Damaeidae (1)
- Tectocepheidae (1)
- Suctobelbidae (1)
- Ceratozetidae (2)

Class Collembola (6)

- Poduridae (2)
- Isotomidae (3)
- Onychiuridae (1)

Class Insecta (65)

Order Phthiraptera

Suborder Mallophaga (3)

Suborder Anoplura (1)

Order Diptera (54)

- Trichoceridae (2)
- Chironomidae (32)
- Mycetophilidae (3)
- Sciaridae (3)
- Cecidomyiidae (1)
- Piophilidae (1)
- Anthomyiidae (1)
- Muscidae (10)
- Calliphoridae (1)

Order Lepidoptera (2)

- Geometridae (1)
- Lymantriidae (1)

Order Hymenoptera (5)

- Tenthredinidae (1)
- Ichneumonidae (4)

the following year. Leech (1966) recorded one instance of mermithid parasitism, and many cases of cannibalism, in this species. He also found fragments of these spiders in the crop and gizzard of snow buntings (*Plectrophenax nivalis*).

family Erigonidae

Collinsia spetsbergensis (Thorell)

This is a circumpolar arctic-alpine species (Braendegaard 1958, 1960; see map in Leech 1966, p. 177; also recorded in McAlpine 1965a; Danks and Byers 1972; Ryan 1977).

It is one of the commonest spiders under high arctic conditions, occurring under stones and in moss on saxifrage barrens (feldmark) as well as in moister habitats (Braendegaard 1958; Holm 1958). Leech (1966) found specimens only in wet or damp areas (by river deltas); they retreated to cracks in the ground if it dried out. He therefore considered that *C. spetsbergensis* is a member of the humid arctic faunal element. However, it is evidently a eurytopic species: over 500 specimens were collected on Bathurst Island from a variety of habitats; nearly 2/3 of the material came from dry ridges, the rest from lower-lying ground (unpubl. [The citation "unpubl." throughout this paper refers to unpublished data of Danks or of Danks and Byers.]).

Erigone psychrophila (Thorell)

This is a circumpolar arctic-alpine species (Braendegaard 1958, 1960; Hurd and Lindquist 1958), recorded in the arctic archipelago from Ellesmere, Ellef Ringnes, Prince Patrick, Melville, Bathurst, Devon and Cornwallis Islands (Oliver 1963; McAlpine 1965a; Leech 1966; Danks and Byers 1972; Ryan 1977). Leech (1966, p. 183) and McAlpine (1965a, p. 78) map the distribution.

This is a very common high arctic species. Holm (1958) and Braendegaard (1960, p. 13) found it in both dry and wet localities, McAlpine (1965a) found it in all principal habitats, and Danks and Byers (unpubl.) collected over 1,000 specimens from both dry and humid localities. Leech (1966), however, regarded it as a species primarily of damp habitats, occurring at the edges of quiet ponds, etc.

The species overwinters in vegetation (Leech 1966); it is active at very low temperatures (McAlpine 1965a).

Apparently this is the species most commonly eaten by birds on

Bathurst Island (Danks 1971a); Braendegaard (1960, p. 13) noted that these spiders were particularly pursued by small wading birds.

Holm (1958) figured the egg cocoon, which is distinct from that of other species of the genus.

Diplocephalus barbatus (Koch)

This spider is a high-arctic holarctic species (Leech 1966, as *Savignya barbata* (map, p. 193); Danks and Byers 1972; Ryan 1977), but it has seldom been collected in large numbers.

It lives in damp situations, e.g. gravelly sections of river deltas with scattered surface vegetation, building its webs in cracks and overwintering on or near the surface under rocks or vegetation (Leech 1966). On Bathurst Island, nearly all specimens were collected in or near the marsh (unpubl.).

subclass ACARI

Mites are well-represented in both arctic and antarctic habitats. Although the taxonomy of many groups is inadequately known, studies of mite faunas of arctic soils have been greatly assisted by the recent synthesis of Behan (1978). Behan showed that species of Prostigmata, generally small mites, are more prevalent in polar regions than they are farther south, whereas the larger oribatid mites dominate temperate soil faunas.

A major feature governing mite occurrence in the arctic appears to be humidity, and accordingly Behan (1978, pp. 162-164) recognized species of moist habitats, wet habitats, dry habitats, and eurytypic species. Species found in moist habitats were most numerous.

As in temperate-region soils, mites are undoubtedly important in decomposition and energy transfer in the arctic, and perhaps more so because earthworms, for example, are absent at high latitudes. But although arctic mites are often numerous, difficulties of sampling and identification, and the small size of individuals of most species, have so far prevented adequate analysis of their roles in northern ecosystems.

Order PARASITIFORMES

Suborder Mesostigmata

family Ascidae

This is a large family with members in a wide variety of habitats. Most species are believed to be predaceous.

Arctoseius spp.

Species of this characteristic arctic genus were considered by

Lindquist (1961). These free-living mites are frequent in soil and humus. They are reported by some authors to be predators (Binns 1975), but the food habits of most species are unknown. Lindquist (1961) reported that spores (parasitic or symbiotic Sporozoa or possibly fungi) are common in these mites. He noted the observation of Hurd *et al.* (unpubl.) that population fluctuations in these and other mites and Collembola result from lemming cycles: the drastic disturbance of vegetation during lemming peaks causes lower populations of soil arthropods the following year.

Arctoseius ornatus Evans

This species was originally known only from Alaska (Evans 1955, 1958; Hurd and Lindquist 1958; etc.), and later from Bathurst Island (Danks and Byers 1972), and Devon Island (Ryan 1977), but Behan (1978) recorded it from the northern mainland, and various other sites in the archipelago. Lindquist (1961) indicated that individuals of this species occur on lower lying (and hence moister) sites than those of other species of the genus he studied in Alaska, while Behan (1978, p. 116) noted that the species occurs in wet habitats.

Arctoseius minor Lindquist

Behan (1978, p. 115) recorded this species from Bathurst Island, and from several other arctic areas, where it occurred in damp tundra sites, usually in enriched areas as near lemming burrows and bird perches. Lindquist (1961) reported it from Alaska.

Arctoseius weberi Evans

Behan (1978, p. 115) recorded this species from Bathurst Island and other high and low arctic areas, where it occurred in moist habitats in moss, lichens, or the edges of dried up pools. It was described from Alaska (Evans 1955), and has since been recorded there several times (e.g. Lindquist 1961; Douce and Crossley 1977). Lindquist found it chiefly in higher, drier, sites.

Arctoseius multidentatus Evans

A species of moist habitats, recorded from Bathurst Island and other Canadian arctic areas, especially on the mainland (Ryan 1977; Behan 1978, p. 116). It occurs also in Alaska (Evans 1955 and many later records).

Arctoseius sp. nr *robustus* Lindquist

This species from Bathurst Island (Danks and Byers 1972) is perhaps the same as that collected by McAlpine (1965a, p. 77) from an occupied nest of *Dicrostonyx* *torquatus* on Ellef Ringnes Island. On Bathurst Island, specimens were taken only near a garbage heap (unpubl.).

family Phytoseiidae

Phytoseiids are mainly predators of free-living phytophagous mites, but some species are supposed to feed also on pollen, nectar, fungi, etc. (Krantz 1978; Krantz and Lindquist 1979).

Amblyseius sp. nr *atsak* Chant and Hansell

Bissett collected a single specimen of this mite from Bathurst Island (E.E. Lindquist, pers. comm.). *Amblyseius* spp. are predaceous on other mites and small insects (e.g. Chant and Hansell 1971). *A. atsac* is known only from a single locality of the Northwest Territories.

family Laelapidae

The best known members of this family are nest-associates or ectoparasites of vertebrates, though several other modes of life occur.

Laelaps alaskensis Grant

This is a common parasite of myomorph rodents (e.g. *Microtus, Peromyscus)* in the United States (in both east and west, including Alaska), and it has been recorded from *Dicrostonyx* (Tipton 1960; Whittaker and Wilson 1974). Gill and Strandtmann (1977) recorded it from collared lemmings (*Dicrostonyx torquatus*) on Bathurst Island; McAlpine (1965a) collected it from this host on Ellef Ringnes Island on several occasions. Ryan (1977) reported it from the same host on Devon Island. Harper (1956) recorded it from *Dicrostonyx* on the northern mainland (Keewatin).

Haemogamasus ambulans (Thorell)

Recorded from Bathurst Island by Gill and Strandtmann (1977), and Behan (1978), the species is widely distributed in the eastern and western United States, including Alaska, and in Canada (Nfld, northern mainland and arctic islands) (Whittaker and Wilson 1974; Ryan 1977; Behan 1978, p. 114), as well as in Eurasia (Keegan 1951; Otakulov 1977; Williams *et al.* 1978). It parasitizes a very wide range of rodent hosts, and also *Lepus* and *Sorex,* as well as some birds (Keegan 1951; Whittaker and Wilson 1974). In the Canadian arctic, adult female and nymphal mites were reported from *Dicrostonyx torquatus* hosts on Bathurst Island, and McAlpine (1965a) recorded *H. ambulans* (as *H. alaskensis* Ewing) in an occupied nest of *D. torquatus* on Ellef

Ringnes Island.

Hirstionyssus isabellinus (Oudemans)

This nest parasite of small mammals occurs widely in northern Canada, as well as in the United States, including Alaska, and in Eurasia (Herrin 1970; Otakulov 1977). In the arctic it has been recorded from *Dicrostonyx torquatus* by McAlpine (1965a) and by Gill and Strandtmann (1977). Herrin (1970) reported it from "*Lemmus*" on Prince Patrick Island although that host does not occur on the island according to Banfield (1974), who shows Banks Island as the northern range limit. Some of the hosts, especially young animals, are heavily infested (McAlpine 1965a; Gill and Strandtmann 1977).

Members of the species occur on a wide range of rodent hosts (e.g. *Microtus*), and on some other hosts including carnivores (Strandtmann and Morlan 1953; Herrin 1970; Whittaker and Wilson 1974).

Hypoaspis sp. nr *nolli* Karg

This undescribed species was reported by Behan (1978, p. 147) from a variety of habitats in several arctic localities, including Bathurst and Baffin Islands, the Yukon Territory, Mackenzie delta and Keewatin areas of the mainland, and Alaska. There are several soil-inhabiting species of this genus.

Order ACARIFORMES

Suborder Prostigmata

family Nanorchestidae

These mites occur worldwide, including Antarctica, in moss, humus, and soil.

Nanorchestes collinus Hirst

This holarctic species occurs widely in Canada and Alaska, and on Banks, Baffin, Bathurst, Devon, Ellef Ringnes, Ellesmere, Somerset, Victoria and some smaller islands (Hurd and Lindquist 1958; McAlpine 1965a; Behan 1978, p. 117). Behan (1978) found it very abundant in dry habitats of various types, and common in moist habitats. On Bathurst Island in 1977, Bissett also found a species of *Nanorchestes* commonly (E.E. Lindquist, pers. comm.), probably this species.

Nanorchestes spp. have generally been considered predaceous, but they probably feed in fact on algae (Schuster and Schuster 1977; see Krantz and Lindquist 1979).

family Terpnacaridae

This is a fairly small but widely distributed group of mites known from dry vegetable material and soil. Except in the genus *Alycosmesis* (not arctic), the hind tibia is modified for jumping.

Terpnacarus bouvieri Grandjean

Another holarctic species, recorded in the Canadian arctic from both wet and dry habitats on Banks, Bathurst, Devon and Ellesmere Islands and on the northwest mainland, and in Alaska and the Aleutian Islands (Behan 1978, p. 117; also recorded by Hurd and Lindquist 1958).

family Eupodidae

Representatives of three genera of these soft-bodied mites were collected on Bathurst Island by Danks and Byers (1972), all in the moist situation beneath muskox dung (unpubl.). A fourth species was recorded by Behan (1978). Some authors believe that members of this family are predominantly fungivorous.

Eupodes spp.

Species of *Eupodes* are widely distributed especially in temperate regions (Krantz 1978). The hind tibia of these small, fast-moving, and fragile mites is enlarged for jumping. The mites occur in grasses, lichens, mosses, damp soil, humus, etc. (Baker and Wharton 1952; Strandtmann 1971; Krantz 1978). In the arctic, Weber (1950a) recorded a species of *Eupodes* from turfy ground and lemming runways. They probably eat lower plant forms such as lichens, algae and fungi according to Strandtmann (1971).

Eupodes sp.

An unidentified species of *Eupodes* was recorded on Bathurst Island by Danks and Byers (1972), collected under muskox dung (unpubl.).

Eupodes wisei Strandtmann

This species, which apparently occurs also in the antarctic (cf Strandtmann 1971), was recorded from mosses, lichens and vegetation on Banks, Bathurst, Devon, Ellesmere, King Christian and Igloolik Islands by Behan (1978, p. 118).

Protereunetes boerneri Thor

These small to very small, delicate mites occurred in duff, moss, and in a bird's nest on Ellef Ringnes Island (McAlpine 1965a). Strandtmann (1971) reported them from lemming (*Lemmus*) nests as well as from tundra in Alaska, from which they had previously been reported by Hurd and Lindquist (1958). Behan (1978) recorded the species also from the northwest mainland. A single specimen was collected by Danks and Byers (1972) on Bathurst Island, under muskox dung on a grassy hummock (unpubl.). Both Bissett (E.E. Lindquist, pers. comm.), and Behan (1978: in moist moss, sedge and lichens) later found these mites commonly on the island. Douce and Crossley (1977) showed that this was a dominant species in wet communities in Alaska. The species was described from Spitzbergen.

Cocceupodes curviclava Thor

C. curviclava occurs in Europe (Strandtmann 1971) as well as Alaska (Hurd and Lindquist 1958) and the Canadian high arctic (McAlpine 1965a; Danks and Byers 1972; Ryan 1977; Behan 1978), but Strandtmann (1971) believed that there is some uncertainty as to the identity of specimens assigned to this species.

Thor and Willmann (1941) stated that *C. curviclava* occurs in moss and other vegetation. On Ellef Ringnes Island it was common in a variety of sites sampled by Berlese extraction (McAlpine 1965a). Behan (1978, p. 118) reported that it occurred in wet areas.

family Penthalodidae

Representatives of this family are widespread in moss, leaf mould, etc., and though previously thought to be predaceous (Baker and Wharton 1952; Krantz 1978), some species may feed on lichens, primitive algae, and perhaps mosses (Krantz and Lindquist, 1979).

Penthalodes ovalis (Dugès)

These small, delicately sclerotized mites are probably circumpolar (Strandtmann 1971). Danks and Byers (1972) and Behan (1978, p. 118) recorded the species from Bathurst Island, in both wet and dry habitats.

family Rhagidiidae

Rhagidiids are fast-moving predaceous mites that are light-sensitive and generally occur under stones or debris, in soil or moss, etc., and in caves (Baker and Wharton 1952; Strandtmann 1971; Krantz 1978). Though soft-bodied, they possess chelate, often powerfully developed, chelicerae well suited for predation.

Rhagidia spelaea (Wankel)

Danks and Byers (1972) recorded this species on Bathurst Island, under stones near a river (unpubl.).

Strandtmann (1971) recorded *R. spelaea* only "from caves of central Europe". The taxonomy may therefore be confused, but if the species is holarctic, perhaps it occurs only in cool climates or situations.

Rhagidia uniseta Thor

Specimens on Bathurst Island collected by Danks and Byers (1972) were taken under stones, in both moist situations near a river and dry localities on ridges (unpubl.). Behan (1978) found them in more or less dry habitats such as litter, and reported the species also from Alaska and the northwestern mainland as well as Banks, Baffin, King Christian, Somerset, Seymour and Igloolik Islands. Strandtmann (1971) noted that the species occurs in Norway. It is also known in Siberia according to Behan (1978), and is probably circumpolar.

Coccorhagidia clavifrons Canestrini

This widely distributed species is known from western Europe, Japan, and Africa, as well as several North American arctic sites including Bathurst Island (Behan 1978, p. 120). Behan (1978) found specimens in mixed vegetation and near bird perches.

family Tydeidae

This is a large cosmopolitan family. Its members have a wide variety of habits and habitats.

Tydeus spp.

Some species of this worldwide genus of rathr small mites are cosmopolitan (Baker 1965), but habits are uncertain. The mites may be predators, fungivores, pollen feeders, phytophages, or perhaps a combination of these (Baker 1965; Krantz and Lindquist 1979).

Behan (1978, p. 151) recorded two undetermined species of Tydeus from Bathurst Island (as well as many other arctic areas). A species of *Tydeus* was also collected by Bissett in 1977 (E.E. Lindquist, pers. comm.).

Tydeus interruptus Thor

A single specimen *T. interruptus* was collected on Bathurst Island by Danks and Byers (1972). Specimens collected by Weber (1950a) in Alaska were in turfy ground and lemming runways.

Microtydeus sp.

An undescribed species of this genus was recorded from moss by Behan (1978, p. 151) from Bathurst Island, the Mackenzie delta, and the northern coastal plain.

family Bdellidae

These so-called "snout mites" apparently prey on small arthropods (such as Collembola) or on arthropod eggs (Atyeo 1960). They are well represented in arctic regions.

Bdella muscorum Ewing

This species has been recorded commonly in Canada and the United States (Calif. to Md., north to Alaska, south to Tenn.) as well as in Europe and Greenland (Atyeo 1960; Behan 1978). There are arctic records from Bathurst Island (Danks and Byers 1972; Behan 1978), and from Axel Heiberg, Banks, Baffin, Devon, Ellesmere, Melville and Victoria Islands (Ryan 1977; Behan 1978). The species is evidently circumpolar.

Atyeo (1960) recorded specimens from moss. On Bathurst Island, Danks and Byers found the mites only in relatively dry areas (ridges, hummocks), but they were within litter, under stones, and in other protected sites there (unpubl.). Behan (1978) reported them also only from dry habitats.

family Pygmephoridae

Species of this diverse family are associated with nests of vertebrates or with insects, though some are free-living. The habits of most species are unknown, but some have been found to be fungivorous (Krantz and Lindquist 1979).

Bakerdania sp.

An undescribed species, widespread in the arctic, and collected in moist moss and lichens, was taken from Bathurst Island by Behan (1978, p. 154: "*Bakerdania* sp. 5").

family Myobiidae

Myobiids are exclusively ectoparasites of certain mammals, to which they cling by means of the highly modified anterior legs.

Radfordia macdonaldi
Gill and Strandtmann

This ectoparasite was described from specimens from collared lemmings (*Dicrostonyx torquatus*) on Bathurst Island, the only known locality, by Gill and Strandtmann (1977). Other species of the genus occur throughout North America on a wide range of rodent hosts (Whittaker and Wilson 1974), but have not previously been recorded from lemmings.

family Stigmaeidae

Most members of this large and widely distributed family (except for *Eustigmaeus*, see below) are thought to be predators of other arthropods (Krantz 1978). Nevertheless, predatory habits have been observed in members of only 2 stigmaeid genera, and Krantz and Lindquist (1979) cautioned against assuming predation to be the habit of most species.

Stigmaeus sp. nr *sphagneti* (Hull)

Behan (1978, p. 151) reported this mite from moss and lichens in moist well-drained areas from Alaska, eastern U.S.S.R. and Bathurst Island.

Eustigmaeus sp. nr *lacuna* (Summers)

Bissett (1977) took a single

specimen of this bright red mite from the moss *Drepanocladus brevifolia* on Bathurst Island. *Eustigmaeus* spp. (which are strongly sclerotized and globate mites) typically feed on mosses, from which they suck out the cell contents (Gerson 1972). *Eustigmaeus lacuna* is known only from Alaska (Watson *et. al.* 1966), and from the Sierra Nevada of California.

suborder Acaridiae

family Glycyphagidae

The family Glycyphagidae includes species that live in stored products and in the nests of wild mammals.

Dermacarus hypudaei (Koch)

Mites of the genus *Dermacarus*, except while in the non-feeding hypopal stage, are scavengers or detritus feeders in the nests of mammals. The hypopal instar of *D. hypudaei* was reported on collared lemmings (*Dicrostonyx torquatus*) on Bathurst Island by Gill and Strandtmann (1977). Fain and Whittaker (1973) listed many small mammal species, including rodents, insectivores and one carnivore, from which hypopi of this species have been recovered. The adult is unknown. The species is widely distributed in the United States (Texas to Minn., N.Y.), and has been reported from *Spermophilus* in Alberta (Fain and Whittaker 1973).

family Myocoptidae

Representatives of the cosmopolitan family Myocoptidae occur in the fur of mainly rodent hosts.

Myocoptes japonensis canadensis Radford

Three females of this ectoparasite were recovered from *Dicrostonyx torquatus* by Gill and Strandtmann (1977). The species appears to be widely distributed in Canada and the eastern U.S., and occurs on *Clethrionomys*, *Marmota* and *Microtus* (Whittaker and Wilson 1974), as well as on *Dicrostonyx* (Fain and Hyland 1970; Whittaker and Wilson 1974).

suborder Oribatei

Most oribatid mites are soil associates involved in processes of decomposition, feeding either on decaying higher plants, or on the micro-flora and -fauna associated with decaying plant matter. A few have other habits. The precise roles of most species are unknown. Behan (1978) suggested, from analysis of gut contents, that more than half of arctic oribatids are non-specialized feeders ("panphytophages"), eating both decaying higher plant material and microphytes.

family Brachychthoniidae

Liochthonius scalaris Forsslund

This is a very widely distributed northern holarctic species (Hammer 1952, 1954; Watson *et al*. 1966; Douce and Crossley 1977; Maclean *et al*. 1978), recorded by Behan (1978, p. 125) from more or less well drained sites in many of the arctic islands. On Bathurst Island, it was one of the species most frequently encountered by Behan (1978, p. 215). Douce and Crossley (1977) found that it was a dominant species of dry communities in Alaska. Apparently it does not occur in wet sites (Maclean *et al*. 1977).

family Damaeidae

Epidamaeus longitarsalis (Hammer)

Recorded from Bathurst Island by Behan (1978) (and probably earlier by Danks and Byers 1972, as *E*. sp.). Mites of this group live in litter, humus, moss, etc., and are, perhaps, microbrowsers on fungi, yeasts and algae (Krantz 1978). Danks and Byers found a single specimen under muskox dung. Behan (1978, p. 129) noted that *E. longitarsalis* occurred mainly in dry sites, but also in moist areas. She reported it also from the northern Mackenzie district, Yukon and Alaska (cf Hammer 1952).

family Tectocepheidae

Tectocepheus velatus Michael

A very widely distributed holarctic species (Hammer 1952, 1954; Watson *et al*. 1966; Maclean *et al*. 1978), reported by Behan (1978, p. 133; map p. 214) from Bathurst Island and many other arctic and subarctic sites, in a variety of habitats but not from 'polar desert' sites. The species is microphytophagous (references cited by Behan 1978, p. 171).

family Suctobelbidae

Suctobelbella setosoclavata (Hammer)

This species occurs fairly widely on the northwestern mainland, including the Yukon, Alaska, and the Aleutian Islands, and on Bathurst and Devon Islands (Behan 1978, p. 135: Hammer 1952; Watson *et al*. 1966). Hammer (1952) and Behan (1978) found it mainly in moss and lichen. Mites of this group are apparently microphytophagous (Luxton 1972).

family Ceratozetidae

Trichoribates polaris Hammer

This species has been reported from Alaska, Ellesmere Island, Bathurst Island, and Devon Island (Hurd and Lindquist 1958; Hammer 1954, p. 27; Danks and Byers 1972; Ryan 1977). Recently, Behan (1978, p. 140) recorded it also from the northern mainland, and from Banks and Victoria Islands. On Bathurst Island, Danks and Byers found specimens in litter, low vegetation on marsh edges and in marsh outcrops (unpubl.). Behan (1978) stated that it occurred mainly in moist sites. Allred (1954) noted that some species of this genus are intermediate hosts for tapeworms.

Iugoribates gracilis Sellnick

Reported from Greenland (Hammer 1944, 1952, 1954) and more recently in the North American arctic (Danks and Byers 1972; Ryan 1977; Behan 1978). *I. gracilis* occurs in a wide variety of wet and dry habitats. Hammer (1954) found it especially in mosses and lichens, particularly associated with snow patches, though also on stony barrens. On Bathurst Island it occurred under stones and muskox dung, in litter, and on leaves, and one specimen was even recovered from lemming fur (unpubl.). Behan (1978, p. 140) found it in humus in an Ivory Gull nest (as well as in other dry and moist areas). She therefore suggested that birds may passively disperse these widely distributed mites. The mites appear to feed mainly on fungi and algae (Behan 1978), though they eat other materials. This was the species of mite encountered most frequently on Bathurst Island by Behan (1978, p. 215).

Class COLLEMBOLA

Most springtails are small, soil; or humus inhabitants. The group is very widely distributed even in Antarctica and the highest arctic. Many species are supposed to feed chiefly on fungal hyphae, but the detailed habits of most collembolans are unknown.

Collembola outnumber Acari in high arctic and polar desert regions, unlike temperate regions where mites normally predominate (Behan 1978, and references cited there). Further collections should therefore greatly increase the number of species known from

Bathurst Island, even though some of the species already known occur in very large numbers in many sites.

family Poduridae

Hypogastrura trybomi group

This represents a taxonomically complex species-group (see Gisin 1960; note in McAlpine 1965a). It has been reported from arctic Siberia and Northern Canada (Gisin 1960; McAlpine 1965a; Danks and Byers 1972; Ryan 1977). On Bathurst Island, specimens were collected quite commonly in stream nets in creeks, in pan traps on ridges, and by sweeping and searching vegetation in the marsh (unpubl.).

Podura aquatica (Linn.)

This very common species occurs from Scandinavia to Spain, in Russia and China (Gisin 1960) and in the United States from Alaska and Washington to Texas, and from New York to Tennessee (Maynard 1951; Hurd and Lindquist 1958). In northern Canada it is known from the Mackenzie district, Ellesmere Island, Bathurst Island, and Devon Island (Hammer 1953b, table 3; Oliver 1963; Danks and Byers 1972; Ryan 1977).

Individuals occur in masses on still and running water and on debris on the shore (Maynard 1951; Gisin 1960); *P. aquatica* has structural adaptations for semi-aquatic life. It has therefore been recorded only from wet or moist habitats (e.g. Hammer 1953b; unpubl.). Gisin stated that it overwinters in the soil.

family Onychiuridae

Onychiurus groenlandicus (Tullb.)

This is a holarctic species ranging from Alaska through Greenland, Jan Mayen Island and Spitzbergen to Siberia (Hammer 1944, 1953b table 3, 1954; Gisin 1960; McAlpine 1965a; Valpas 1967, who maps the distribution, p. 38, though he terms it "nearctic"). In Canada, *O. groenlandicus* has been taken on the northern mainland (Hammer 1953b), and on Ellesmere, Ellef Ringnes, Bathurst, and Devon Islands (Hammer 1953a, 1954; McAlpine 1965a; Danks and Byers 1972; Ryan 1977).

These springtails live in various arctic habitats, including soil, vegetation, moss and abandoned lemming nests (Hammer 1953b; McAlpine 1965a; Valpas 1967). They occurred in most terrestrial habitats on Bathurst Island (unpubl.).

family Isotomidae

Isotomurus palustris (Müll.)

A truly cosmopolitan species, occurring in North America from the high arctic to Texas and Florida, in Mexico, and in Algeria, Australia, etc. (Folsom 1937; Maynard 1951; Gisin 1960). Folsom (1937) recorded it from Greenland, though Hammer (1953b, 1954) did not report it there. Northern records include Alaska (Weber 1950a; Hammer 1953b; Hurd and Lindquist 1958); Northwest Territories (Hammer 1953b; Mills and Richards 1953), Ellesmere Island (Folsom 1937; Hammer 1954; Oliver 1963), Bathurst Island (Danks and Byers 1972), and Devon Island (Ryan 1977).

This species was by far the most common collembolan on Bathurst Island: over 2,600 specimens (of about 3,500 total collembolans) were collected there from various habitats (unpubl.). The species is, however, most abundant on or near water (Maynard 1951; Gisin 1960), and even on snow (Folsom 1937), though it occurs also in soil and moss in wet habitats (Hammer 1953b). MacNamara (1924) stated that on the water surface, in a temperate area, it fed on wind-borne conifer pollen (that would not be available in the arctic), and on desmids and diatoms.

Isotoma violacea (Tullb.)

A species widely distributed in north and middle Europe and Asia, and in North America south to New York and north to Ellesmere, Ellef Ringnes, Bathurst and Devon Islands (Folsom 1937; Hammer 1944, 1953b table 3, 1954; Maynard 1951; Gisin 1960; Oliver 1963; McAlpine 1965a (map, p. 78); Danks and Byers 1972; Ryan 1977).

Hammer (1953b) found specimens commonly in various habitats, such as vegetation and moss; Maynard (1951) in sphagnum moss near a pond; and McAlpine (1965a) in duff. On Bathurst Island specimens were taken by a variety of methods, including pan-traps, stream-nets, sweeping, and searching under stones (unpubl.).

Folsomia quadrioculata (Tullb.)

This is another circumpolar species, that extends south to middle Europe, and its known range includes Greenland, Iceland and Spitzbergen (Folsom 1937; Hammer 1944, 1953b, 1954; Gisin 1960; Stach 1962; Valpas 1967).

In northern North America it has been reported from Alaska (Hurd and Lindquist 1958), the northern mainland of Canada (Hammer 1953b; Mills and Richards 1953), Ellesmere Island (Hammer 1953a, 1954), Bathurst Island (Danks and Byers 1972), and Devon Island (Ryan 1977).

Though found in a variety of habitats, such as under stones, and in moss and litter (Folsom 1937; Mills and Richards 1953; Hammer 1954; Stach 1962), it does not occur in very wet sites according to Hammer (1953b). Valpas (1967) found it in all of his soil samples from Spitzbergen. On Bathurst Island only about 20 specimens were taken, all in stream nets in creeks (unpubl.). Addison (1977, table 1) found it only in moister sites. According to MacLean *et al.* (1977), it is a dominant or co-dominant species in Alaska and other areas.

class INSECTA

order PHTHIRAPTERA

suborder Mallophaga

Three species of chewing lice have been recorded from Bathurst Island, but undoubtedly many more occur there on different or even on the same bird hosts. An indication of these additional species can be obtained from the list of bird hosts of Mallophaga prepared by Emerson (1972, part IV).

Strigiphilus ceblebrachys Denny

This ectoparasite has been recorded only from snowy owls *(Nyctea scandiaca),* and is the only mallophagan species recorded from that host (Emerson 1972). It has been found widely in Canada (Quebec to B.C.: Canadian National Collection), including the arctic and subarctic (Danks and Byers 1972; Peters 1934). Probably it is found throughout the range of the host, which is a circumpolar species (Godfrey 1966).

Lagopoecus affinis (Children)

This is an ectoparasite of ptarmigans (*Lagopus* spp.) (Emerson 1972), though it has been recorded from foxes (*Vulpes*) (Canadian National Collection), presumably after transfer from the prey. The species has been recorded in northern Canada and Alaska, and on several arctic islands (Emerson 1950 (Baffin); Danks and Byers 1972 (Bathurst); Canadian National Collection (Ellesmere, Prince Patrick)). Undoubtedly it is circumpolar like the host (Godfrey 1966).

Anatoecus sp.

The species found on snow geese (*Chen caerulescens atlantica*) on Bathurst Island (Danks and Byers 1972) cannot be named with certainty, because the limits of the species in this genus are uncertain: many subspecies and several species have been named, especially in a study by Keler (1960), who erected subspecies partly on the basis of their hosts. It is more likely that there are a small number of species some of which attack a wide range of Anseriform hosts (cf Emerson 1972).

suborder Anoplura

Only one species of sucking louse has been recorded so far on Bathurst Island, from lemmings, though up to a few more probably occur there on hosts such as muskox, caribou, wolf and arctic fox that are seldom collected and very rarely inspected for ectoparasites.

Hoplopleura acanthopus Burmeister

This parasite of *Microtus* and several other rodents occurs widely in the U.S., and in Eurasia and Alaska (Ferris 1951), and has been recorded several times from lemmings *(Dicrostonyx* and *Lemmus)* in the arctic (McAlpine 1965a; Danks and Byers 1972; Gill and Strandtmann 1977).

McAlpine (1965a) reported that it occurred only on adult hosts. Danks (unpubl.) secured specimens from a young snowy owl *(Nyctea scandiaca)* chick from a nest to which dead lemmings had been brought by the adult to feed the young birds.

Cook and Beer (1959) described the early stages.

order DIPTERA

Family Trichoceridae

These, known as winter craneflies in the south, are a characteristic element of arctic and subarctic faunas. For a general summary of distribution, phenology and adaptation in arctic trichocerids see Dahl (1970). Larvae of most species are saprovores.

Trichocera borealis Lackschewitz

This highly variable circumpolar arctic species, originally described from Spitzbergen, has been collected commonly in many arctic and subarctic localities (Oliver 1963; McAlpine 1964; Dahl 1967 (map, p. 70); Danks and Byers 1972; Ryan 1977). Adults appear from June to September, depending on locality (Dahl 1970).

Danks and Byers (1972) reported that the species overwintered in various larval instars (II-IV). McAlpine (1965a) noted readily disturbed mating swarms (less than 1 m above the ground) over depressions in bare soil usually in the lee of banks, etc.

The larvae live in the soil, apparently in moist and organically enriched sites: larvae on Bathurst Island were collected from owl mounds, a garbage pile, beneath a Muskox carcass, and under damp stones (unpubl.).

Trichocera columbiana Alexander

This is a widely distributed nearctic species, found from the Pacific coast and boreal regions to the high arctic (see the map of Dahl 1970, p. 75).

Danks and Byers (1972) found adults on Bathurst Island. These were associated with burrows of the Collared Lemming (*D. torquatus*) (unpubl.). McAlpine (1965a) stated that all stages of this species (as *T.* sp. nr. *arctica*, identified as *T. columbiana* by Dahl 1967) were found only in lemming burrows; that the adults mated near burrow entrances; and that eggs appear to be laid only near lemming droppings, which are probably the larval food source. The larva was described by Dahl (1967).

family Chironomidae

Non-biting midges are a major component of the fauna in high arctic localities (Oliver 1968), but they are difficult to identify, and the specific classification in many genera has not been fully worked out. Fortunately, the high arctic species share many features; their habits are therefore discussed collectively, allowing an abbreviated subsequent treatment of each species.

Arctic chironomids live mainly in freshwater, though a few species occur in moist (semi-terrestrial) habitats, in marshy ground, at the periphery of ponds, beneath dung or stones on lower lying ground, or in leaf litter under *Salix* clumps, for example. Larvae of many species in the subfamily Tanypodinae are free-living predators (only *Procladius* in the known Bathurst Island fauna). Most other larvae feed on detritus or algae; many build more or less robust cases of cemented substrate particles (see Oliver 1971).

Some aspects of the habits of high arctic species from ponds are well known from studies at Hazen Camp, Ellesmere Island (Oliver 1968; Danks and Oliver 1972a, b; Oliver and Danks 1972).

All species in a given pond habitat will emerge only after spending the winter as fully fed larvae and hence they emerge as early as possible in the season. Larvae that have not quite completed growth and must feed in spring, even if only a little, evidently enter diapause and do not emerge in the same year (Danks and Oliver 1972a). Individuals that do emerge therefore have the maximum period available for reproduction and early larval development during the short high arctic summer.

Although this leads to early synchronized emergence at similar depths in a given pond, temperature differences between different depths and ponds, slight differences in developmental time between species, and the life span of adults of two weeks or so, mean that adult chironomids are encountered throughout the arctic summer. This prolonged period of availability is undoubtedly important for the birds and spiders, for example, that eat adult chironomids. However, even fully grown larvae will not emerge if the habitat remains too cold, so that emergence is severely curtailed or prevented in unusually cold (="late") years. Males normally emerge slightly before the females.

The life cycles of all of the species appear to last for more than one year, and larvae overwinter in any instar except the first (Danks 1971b). This, and failures to emerge in a given year (larvae that become fully fed after the beginning of summer, or that experience unusually cold conditions), means that large or fully grown larvae in shallow ponds are always available to avian predators throughout the summer, and they too are a major food source for many arctic birds during the breeding season (e.g. Holmes 1966; Mayfield 1978; stomach contents of Bathurst Island birds collected by MacDonald).

Deep water lake species appear to develop at very low temperatures and, like the pond species, have life cycles of 2 or more years (Welch 1976). Some continue to develop under the ice during winter according to Andersen (1946). Some species emerge through the candled lake ice of the summer in cool years (Oliver 1968; Welch 1973). Other species live only at the lake edges, which thaw earlier and are warmer in summer, though they are frozen in winter (Andersen 1946); many of these species occur also in ponds.

Little is known about the species of arctic streams, which show tremendous seasonal changes in flow rate.

High arctic chironomids emerge near solar noon, when the air is warmest (Oliver 1968; Danks and Oliver 1972b). In some species there is a preponderance of females that may reflect facultative parthenogenetic reproduction (Oliver and Danks 1972); some species or populations are known to be parthenogenetic (Lindeberg 1971).

Other aspects of the life cycle of arctic chironomids were discussed by Danks (1971b). All species overwinter in the larval stage, and are freezing-tolerant; mechanical protection against surrounding ice may be assisted by the construction of special sealed "winter cocoons", within which the larvae are tightly folded in various characteristic ways.

Oliver (1968) observed mating in many species at Hazen Camp and showed that mating was normally initiated in swarms, as in most species from temperate latitudes, but that several species initiated mating on the ground. Eggs matured within a few days of emergence (from reserves accumulated during the larval stage), and some species could complete a second ovarian cycle in a further 5 or 6 days.

Adults of at least some arctic species imbibe nectar (McAlpine 1965b; Hocking 1968), though Oliver (1968, p. 116) does not consider this to be an important feature of adult habits in most species. However, temperate chironomids feed commonly on honeydew (Downes 1974).

Many of the high arctic species are circumpolar; synonymy with European names of others that currently appear to be nearctic might be expected to increase the number of known circumpolar species, when the systematics of this family is better known.

Bathurst Island species recorded here for the first time were determined by D.R. Oliver from material in the Canadian National Collection collected by Danks and Byers in 1969, and by Bissett in 1977.

subfamily Tanypodinae

Larvae of most species of this subfamily are more or less predaceous (e.g. on other chironomids); all are free living.

Procladius culiciformis (Linn.)

P. culiciformis occurs in the Nearctic from the high Arctic (Danks 1971b, p. 1878; Danks and Oliver 1972a; Ryan 1977) to Michigan and Wisconsin (Roback 1971), and is recorded from Siberia, central Europe, etc. (Fittkau and Reiss 1978). The species is probably circumpolar. In the southern parts of its range, e.g. Southern England, there are at least two generations per year, as in shallow lakes or reservoirs (Mundie 1957 [as *P. choreus* and *P. crassinervis*, see Roback 1971]). Mundie (1957) illustrated seasonal emergence patterns in detail. These can be compared with similar information for an arctic pond population given by Danks and Oliver (1972a).

Larvae curl up for winter, overwintering frozen in instars II-IV (Danks 1971b). Temperature sums to first emergence of this species after the thaw in a shallow pond on Bathurst Island were given by Danks and Oliver (1972a, p. 672).

Subfamily Diamesinae

This is a cold-adapted group of running water (a few species occur in still water), frequent in arctic and antarctic lands, and in mountain ranges.

Diamesa spp.

Two species of *Diamesa* are known from Bathurst Island; one species was reared from a small creek (unpubl.). There are many known Nearctic species (Hansen and Cook 1976).

Pseudokiefferiella sp.

One species was found on Bathurst Island by Danks and Byers (unpubl.).

Subfamily Orthocladiinae

This is the most widely distributed group of Chironomids, found in many habitats including still and running water and semi-terrestrial situations, and dominant in colder arctic regions (Oliver 1968).

Corynoneura sp.

Collected from Bathurst Island by Bissett in 1977.

Chaetocladius sp.

Occurred in a shallow pond on Bathurst Island (unpubl.)

Cricotopus (Isocladius) laricomalis Edw.

Recorded from a pond on Bathurst Island (Danks 1971b), and distributed widely in Northern Canada, Greenland, Fennoscandia and Europe, including central sections (Hirvenoja 1973; Fittkau and Reiss 1978). This still water species was recorded by Andersen (1946: as *C. glacialis*, see Hirvenoja 1973), who found it in lakes only in shallow, winter frozen areas.

In Ellesmere Island ponds, the species is protandrous, with a predominance of females (Danks and Oliver 1972a; Oliver and Danks 1972). Danks (1971b, p. 1885) reported that the larvae overwinter in cocoons.

Diplocladius sp.

Adults of one species of this genus were collected from the marsh on Bathurst Island (unpubl.).

Limnophyes spp.

At least 2 species of *Limnophyes* occur on Bathurst Island; larvae were found in shallow ponds and in melt pools at the edge of the marsh (unpubl.). These small midges occur commonly in the high arctic (Oliver 1963; McAlpine 1965a).

Metriocnemus ursinus (Holmgr.)

This species was reared from a small melt pool in the marsh on Bathurst Island (unpubl.). Thienemann (1941, p. 47; 1954) showed that the larvae inhabit springs or terrestrial habitats.

Apparently, *M. ursinus* is a circumpolar arctic species (Fittkau and Reiss 1978; Thienemann 1941, p. 148; Oliver 1962), though Hirvenoja (1967) believed that more than one species may have to be recognized.

Metriocnemus spp.

Specimens of 2 species of *Metriocnemus* that are probably not *M. ursinus* have been reared from temporary pools, and from a small stream, on Bathurst Island (unpubl.).

Orthocladius (Eudactylocladius) sp.

Adults of this species were taken in the marsh on Bathurst Island (unpubl.).

Orthocladius (Euorthocladius) sp.

Collected from Bathurst Island by Bissett in 1977.

Orthocladius (Pogonocladius) consobrinus (Holmgr.)

This is a circumpolar species (Fittkau and Reiss 1978 (as *Pogonocladius*); Hirvenoja 1967; Oliver 1963) that has been recorded from shallow ponds on Bathurst Island (unpubl.). Although Thienemann (1954, p. 291) noted that the larvae are freezing tolerant, *O. consobrinus* occurs south to latitudes in Europe where this tolerance would not be needed.

This is not a fully typical arctic species: daily emergence from shallow ponds on Ellesmere Island was bimodal and unusually widely spread through the day in both sexes (Danks and Oliver 1972b, p. 913); also, *O. consobrinus* is one of the few arctic orthoclads studied by Oliver and Danks (1972) that has a sex ratio close to unity at emergence. The seasonal emergence is nevertheless typical (Danks and Oliver 1972a, pp. 667, 681).

Paraphaenocladius despectus (Kieff.)

Recorded by Danks (1971b, table XI) from a pond on Bathurst Island, by Oliver (1963) from Ellesmere Island, and by Ryan (1977) from Devon Island, this is one of the earliest species to emerge from arctic ponds (Danks and Oliver 1972a, p. 671). Females predominate on emergence (Oliver and Danks 1972).

Prosmittia nanseni (Kieff.)

Described from Ellesmere Island

(as *Camptocladius nanseni), P. nanseni* occurs widely in the Canadian High Arctic (Oliver 1963; McAlpine 1965a; Danks 1971b, table XI).

On Bathurst Island, adults of this species were trapped from a shallow pond (unpubl.).

Psectrocladius polaris (Kieff.)

This appears to be a high arctic-Nearctic form, described from Ellesmere Island. On Bathurst Island (Danks 1971b, table XI), it was taken in emergence traps and reared from a shallow pond (unpubl.).

Psectrocladius spp.

Two other species of this genus occurred in the same pond on Bathurst Island as *P. polaris*. The larval winter cocoon of one of these was described and figured by Danks (1971b, p. 1887).

Smittia spp.

At least 2 species of this genus of small chironomids were taken in the marsh on Bathurst Island (unpubl.). Some of the species feed on nectar (Oliver 1968).

Genus unknown

Many adults of one species of orthocladiine taken from Bathurst Island by sweeping in the marsh appear to belong to an obscure or undescribed genus (unpubl.).

Subfamily Chironominae

Members of this subfamily typically live in warm lentic habitats, and they are most common in the tropics and warm temperate regions. Nevertheless, there are several lotic and arctic representatives. Larvae of nearly all of the species build firm cases of cemented particles; the cases are especially robust in the tribe Tanytarsini.

tribe Chironomini

Chironomus spp.

Larvae and adults of one species were recovered commonly from a shallow pond on Bathurst Island: larvae spend the winter folded in half within the cocoon and winter larvae are dehydrated relative to active larvae (Danks 1971b: "*Chironomus* "sp. 2""). A second species of this diverse genus occurred in the same pond.

Phaenopsectra sp.

Found in general collections from the Bathurst Island marsh (unpubl.).

Stictochironomus unguiculatus (Malloch)

Apparently a Nearctic species (Townes 1945 [Southampton Island];

Danks 1971b; Danks and Oliver 1972b) that may, however, be represented in the Palaearctic Region under a synonym. As in other arctic species, daily emergence takes place near solar noon; but in *S. unguiculatus* the initial emergence of males before the females is particularly striking, and there is a second emergence peak, of females only, in the afternoon (Danks and Oliver 1972b, p. 908).

Danks (1971b) figured the winter cocoon and normal overwintering position of the larva, and showed that individuals were dehydrated in winter as in *Chironomus* "sp.2".

tribe Tanytarsini

Paratanytarsus sp.

Adults of a hitherto undescribed species of this genus were taken from a pond emergence trap on Bathurst Island (unpubl.).

Tanytarsus gracilentus (Holmgr.)

This circumpolar species (Lindeberg 1968, p. 89, who summarized and mapped known records; Fittkau and Reiss 1978) occurs from the high arctic south in Europe to Germany. It is a common species in northern areas (Oliver 1963; McAlpine 1965a; Lindeberg 1968; Danks 1971b, table XI).

McAlpine (1965a) reared it from a pupa collected in a seepage pool; elsewhere it has been found in ponds.

Lindeberg (1968) described structural variations among 4 populations from different areas. There was a slight preponderance of females (56%) at emergence in a population from Ellesmere Island (Oliver and Danks 1972).

Tanytarsus norvegicus (Kieff.)

This species is probably circumpolar, occurring in northern Canada, Fennoscandia, and in Europe south to the British Isles and Germany (Fittkau and Reiss 1978; Thienemann 1954, p. 484).

Palmén (1961) reported a parthenogenetic race. Other populations contain males (e.g. Lindeberg 1970), but often the proportion of males is low (12-16%: Lindeberg 1971; 38%: Oliver and Danks 1972).

Danks (1971b, p. 1887) figured the overwintering position and winter cocoons of the larvae of this species from a pond on Bathurst Island. Like *Chironomus* "sp. 2", larvae were dehydrated in winter.

Some aspects of the seasonal emergence of *T. norvegicus* are figured by Danks and Oliver (1972a). Like *S. unguiculatus*, this species shows a bimodal daily emergence from shallow ponds (Danks and Oliver 1972b, p. 908), though initial emergence of males before the females was not detected.

Tanytarsus sp.

A species of *Tanytarsus*, probably distinct from those above, was reared from the marsh on Bathurst Island (unpubl.).

family Mycetophilidae

Mycetophilids (fungus gnats) are normally associated with fungi and hence with damp or decaying vegetation, but the detailed life-histories of most species are little understood.

Exechia frigida (Holmgr.)

This is a common species of the arctic and subarctic (Landrock 1927; Hurd and Lindquist 1958; Oliver 1963; Danks and Byers 1972; Ryan 1977); it appears to be circumpolar, though there is some doubt whether it is really a single species across this range (Tuomikoski 1967, and references cited there).

On Bathurst Island, specimens were secured both on ridges under stones and in the marsh (unpubl.).

Sciophila sp.

Several specimens of a species of *Sciophila* were taken on Bathurst Island (in the marsh) by Danks and Byers (1972).

Species of this genus have been collected previously in high arctic localities (e.g. Oliver 1963), but no biological information is available.

Bolitophila sp.

A few specimens of a previously undescribed species of *Bolitophila* were taken on Bathurst Island by Bissett (1977). Other specimens of undescribed species have been collected on Ellesmere Island (Oliver 1963), and elsewhere in the arctic.

family Sciaridae

These small flies are common, especially in the arctic, but they are very difficult to identify. Species known from Bathurst Island all belong to the very inadequately understood genus *Bradysia*.

Different sciarid species appear to occupy a very wide range of larval habitats, but most species are probably more or less saprophagous. Some species show interesting peculiarities such as wing dimorphism and varying degrees of wing reduction, though these features have not been investigated in arctic species.

Bradysia spp.

Danks and Byers (1972) recorded 3 species of *Bradysia* from Bathurst Island; 3 species are known also from Ellef Ringnes Island (McAlpine 1965a); 4 or 5 species from Devon Island (Ryan 1977); 7 from Alaska (Hurd and Lindquist 1958); and 9 from Ellesmere Island (Oliver 1963). This material was collected from a variety of situations, including lemming burrows, a possible larval habitat; adults appear to feed on nectar (McAlpine 1965a, b). All of the specimens from Bathurst Island were taken in the marsh (unpubl.).

family Cecidomyiidae

This family of mostly minute (0.5-2 mm) flies is very inadequately known taxonomically. Consequently, the species (3 specimens) found on Bathurst Island have not been identified even to genus. Similar problems in identification of arctic cecidomyiids were encountered by Hurd and Lindquist (1958: to family); Oliver (1963: to subfamily); McAlpine (1965a: to genus); and others.

Primitive members of the family are mycophagous, but the many more advanced species form galls on vascular plants.

MacLean and Pitelka (1971, p. 29) noted that, unlike other flies, the gall-midges are evidently too small to be used as food by birds, and they separated their data on these "micro-Nematocera" from data on larger flies.

family Piophilidae

The "carrion flies" are a cool-adapted group most common in northern areas (McAlpine 1977).

Arctopiophila arctica (Holmgr.)

This is a northern holarctic species (Hurd and Lindquist 1958; Oliver 1963; and others [as *Piophila* or *Allopiophila arctica*]; see McAlpine 1977).

Larvae feed on carrion, and were taken and reared on Bathurst Island from carcasses of muskoxen (unpubl.). McAlpine (1977, p. 47) reported adults also around faeces. The adults feed on *Dryas* nectar (McAlpine 1965b).

Overwintering takes place in the larval stage, including the final instar, and some larvae are ready to pupate immediately with the advent of spring (Danks and Byers 1972). Similar rapid spring emergence was noted by Weber (1950a) for an Alaskan piophilid. McAlpine (1977, p. 25) figured part of the larva.

family Anthomyiidae

Fucellia pictipennis Becker

This is an arctic species found from Alaska to Greenland (Hurd and Lindquist 1958; Oliver 1963; Huckett 1965; Hennig 1966; Danks and Byers

1972; Ryan 1977). The larvae of the flies in this genus ("kelp flies") live in rotting seaweed, carcasses, etc., thrown up by the tide on the shore (cf. Aldrich 1918). McAlpine (1965b) reported an adult female of this species taking nectar from a flower of *Dryas*. Hocking (1968) reported nectar-feeding from saxifrage flowers.

family Muscidae

The muscid flies are well represented in arctic areas, especially by members of the genus *Spilogona*. The larvae of most species (but not of *Spilogona*) are saprophagous. Adults commonly visit flowers for nectar.

Spilogona spp.

These characteristic arctic muscids evidently live in more or less moist situations during the larval stage, where they are predaceous on chironomid larvae (D.M. Wood, pers. comm.; Downes 1964, p. 292). Adults visit flowers very commonly (McAlpine 1965b; Mosquin and Martin 1967), and also prey on adult chironomids (J.A. Downes, pers. comm.).

Nearly all of the material collected on Bathurst Island by Danks and Byers was taken in the marsh (unpubl.), usually on hummocks or mounds. Emergence did not begin until nearly mid-July in 1969 (Danks and Byers 1972); later emerging species of *Spilogona* were therefore missed (compare *S. dorsata* below), and Bissett (1977) collected four additional species during August in 1977.

Spilogona almquistii (Holmgr.)

This species has been recorded from Swedish Lapland, Novaya Zemlya and W. Taimyr (Hennig 1959), and in Greenland and northern Canada (Keewatin) as well as Ellesmere, Bathurst, Prince Patrick, Cornwallis and Devon Islands (Huckett 1965; Oliver 1963; Danks and Byers 1972; Ryan 1977).

Only 2 males (July 16) and 1 female (July 17) were captured on Bathurst Island (unpubl.).

Spilogona latilamina (Collin)

Widely distributed in northern Canada, the arctic islands and Alaska (Hurd and Lindquist 1958; Oliver 1963; Huckett 1965; Danks and Byers 1972; Bissett 1977; Ryan 1977), this species may occur also across the palaearctic region (Hennig 1959, p. 361, suggested that *S. latilamina* might be a synonym of *S. zaitzeri* Schnabl.).

This was the species of *Spilogona* captured most commonly on Bathurst Island during July 1969 (unpubl.).

Spilogona obsoleta (Malloch)

This is probably a circumpolar species (Hennig 1959 [as *S. hirticauda*]; McAlpine 1965a [map of nearctic range, p. 86]; Hurd and Lindquist 1958; Oliver 1963; Huckett 1965; Danks and Byers 1972; Bissett 1977; Ryan 1977).

McAlpine (1965a) reported the larvae around burrows of the collared lemming (*D. torquatus*), and the adults mainly in low, wet habitats, as near marshes, and on flowers of *Papaver* and other plants.

Spilogona sanctipauli (Malloch)

This is a widespread circumpolar arctic species (Hurd and Lindquist 1958; Hennig 1959; Oliver 1963; Huckett 1965; McAlpine 1965a (who mapped the New World distribution, p. 86); Danks and Byers 1972; Bissett 1977).

McAlpine (1965a) reported that adults are found on higher drained land and are strongly attracted to saxifrage flowers.

Spilogona dorsata (Zett.)

Another arctic species, occurring from Greenland to Alaska in the Nearctic Region (Huckett 1965; Oliver 1963; Danks and Byers 1972; Ryan 1977), and in Eurasia including Spitzbergen (Hennig 1959).

Only two specimens were collected on Bathurst Island in 1969, one of them a very teneral specimen on the last day of sampling (July 17), and the other a dead specimen from the previous year's emergence (unpubl.). Adults of *S. dorsata* may therefore emerge slightly later in the season than some other species of the genus, and indeed Bissett (1977) collected many specimens in early August.

Spilogona melanosoma (Huckett)

This arctic and subarctic species is widely distributed in the Nearctic Region from Alaska to Greenland (Huckett 1965); it closely resembles (and perhaps is synonymous with) *S. brunneifrons* Ringdahl from western Europe (see Huckett 1965). Bissett (1977) reported it from Bathurst Island. Mosquin and Martin (1967) observed it visiting flowers on Melville Island.

Spilogona extensa (Malloch)

This arctic nearctic species is known from Greenland and Keewatin, and from Ellesmere, Baffin and Bathurst Islands (Oliver 1963; Huckett 1965; Bissett 1977). Bissett's (1977) specimens were all pan-trapped near *Papaver* in bloom, from which the flies might have been seeking nectar.

Spilogona micans (Ringdahl)

Bissett (1977) secured specimens probably of this species from

Bathurst Island. This is an arctic and subarctic species known from Greenland, the northern mainland of Canada, and Baffin Island (Huckett 1965) as well as western Eurasia (Hennig 1959).

Spilogona tundrae Schnabl.

This circumpolar arctic and subarctic species (Huckett 1965; Hennig 1959) is known in the Canadian high arctic only from Ellesmere (Oliver 1963), Baffin (Huckett 1965), Devon (Ryan 1977) and Bathurst Islands (Bissett 1977). It was the most abundant insect (235 specimens) collected by Bissett in 1977.

Pogonomyioides segnis (Holmgr.)

This species occurs from Alaska and the Yukon to the arctic islands, N.E. mainland of Canada, and Greenland (Huckett 1965; Oliver 1963; Danks and Byers 1972), but has been recorded only from Novaya Zemlya, the type locality, in the Palaearctic Region (Hennig 1962).

The larval habits are unknown; a single adult specimen was captured on Bathurst Island, by a stream net (unpubl.). Elsewhere, adults of this species have been reported as frequent flower visitors (e.g. Mosquin and Martin 1967); both sexes imbibe nectar, and females eat pollen (McAlpine 1965b; Kevan 1973, p. 670).

family Calliphoridae

Boreellus atriceps (Zetterstedt)

The only blowfly known from Bathurst Island (Danks and Byers 1972), this characteristic high arctic species has a circumpolar distribution (Hall 1948; Zumpt 1956; see McAlpine 1965a, p. 78, for a map).

In Finland, Nuorteva (1964) found that the species occurred only at higher elevations, in the harshest tundra zones. This habit appears to be possible because unlike related species, larvae of *B. atriceps* pupate exposed, rather than in protected situations such as the soil, so that they occupy the warmest (insolated) sites (McAlpine 1965a).

B. atriceps larvae eat carrion; on Bathurst Island most records are from several Muskox (*Ovibos moschatus*) carcasses (unpubl.). McAlpine (1965a) recovered material chiefly from dead lemmings (*Dicrostonyx*), reporting that once over 1,800 flies emerged from a single lemming carcass. Kalela *et al.* (1961) and Tsernov (1961, cited by Nuorteva 1964) found the fly associated only with lemming (*Lemmus*) burrows. Weber (1950a) recorded puparia from the carcass of an Eskimo dog and McAlpine (1965a) found all stages of the fly on the same host.

At least some individuals overwinter in the adult stage; adults appear very early in the season and (in 1969) were laying eggs soon after mid June (Danks and Byers 1972). McAlpine's (1965a) observations suggest that other stages probably overwinter also. Both sexes visit flowers (especially of *Potentilla*) for nectar (McAlpine 1965b; Mosquin and Martin 1967) and, females especially, are frequently heavily dusted with pollen (McAlpine 1965b).

Larvae and puparia of this species occurred in bird stomachs collected by S.D. MacDonald in 1970 (unpubl.).

order LEPIDOPTERA

family Geometridae

Psychophora sabini Kirby

This circumpolar arctic species has been reported from many of the Queen Elizabeth Islands (Bruggemann 1958; Oliver 1963; McAlpine 1965a; Ryan 1977), including the more severe arctic sites such as Bathurst Island (Danks 1971a; Danks and Byers 1972), Ellef Ringnes Island (McAlpine 1965a), and Ward Hunt Island (Crary 1958). It occurs widely in the non-Canadian arctic (e.g. Nordstrom *et al.* 1941; Wolff 1964).

This is a characteristic species of arctic barrens. It appears to be polyphagous, for Danks and Byers (1972) found that larvae ate all three common plants (*Saxifraga oppositifolia*, *Dryas integrifolia*, *Papaver radicatum*) offered to them.

The life cycle evidently lasts more than one year, and larval instars II-IV overwinter, under flat stones on ridges for example, each moulting to the next instar in spring. The ichneumonid parasite *Meloboris* sp. (undescribed species) has been reared from this moth (Danks and Byers 1972). Early in the year, before arctic pools melt, larvae are eaten by Purple Sandpipers (*Erolia maritima*), Long-tailed Jaegers (*Stercorarius longicaudus*), and probably other birds (Danks 1971a).

P. sabini appears to belong to a pleomorphic complex (Munroe in McAlpine 1965a); the form from Ellef Ringnes Island is smaller, paler and lacks the faint pattern of the typical form (Downes 1964, p. 297); and apparently some elements from Ellesmere Island have somewhat reduced wings (Downes 1964, p. 299).

family Lymantriidae

Gynaephora sp.

A species of *Gynaephora (=Byrdia)*

apparently occurs on Bathurst Island, for R.W. Strandtmann, in a brief report to the National Museum of Natural Sciences in 1974, recorded two types of caterpillars from the island. One was evidently the larva of *Psychophora sabini*, but the other was a "hairy" species, *G. groenlandica* (Hom.) or *G. rossii* Curtis.

G. groenlandica occurs in Greenland, in the Yukon Territory, and on Cornwallis, Devon, Ellesmere, Melville, Prince Patrick and Victoria Islands (Bruggemann 1958; Oliver 1963; Wolff 1964; Ryan 1977; Ryan and Hergert 1977, fig. 1 [the symbols for *G. groenlandica* and *G. rossii* are reversed in the key to this figure]; Ferguson 1978). It appears to be a high arctic endemic (Downes 1964), but does not occur in Siberia (Wolff 1964).

G. rossii occurs from Labrador to Alaska, in Siberia and Japan, and also in the Rocky Mountains and on Appalachian peaks; it is perhaps more southern than *G. groenlandica*, though both species occur together in Ellesmere and Devon Island sites, for example (Ferguson 1978). In the archipelago, it has also been reported from Baffin, Devon, Melville, Somerset and Victoria Islands (Ryan and Hergert 1977, fig. 1 [the symbols for *G. groenlandica* and *G. rossii* are reversed in the key to this figure]; Ferguson 1978). *G. rossii* is not known from Greenland.

The larvae of both species normally feed on *Salix* (Wolff 1964), though Ryan and Hergert (1977) report that they feed also on *Saxifraga* and *Dryas*, and, in the laboratory, on *Prunus*. Larvae are much more commonly collected than the adults (Bruggemann 1958; Wolff 1964). These larvae are highly freezing tolerant, and are often found exposed in winter on the feldmark: they inhabit drier habitats. Larvae appear to overwinter several times, and for the final time in a late instar (Oliver *et al*. 1964). They are often heavily parasitized, especially by the tachinid *Chetogena (= Spoggosia) gelida* (Coq.). Ryan and Hergert (1977) summarized the biology of the species. They concluded that the life cycle lasts about 10 years, though some of the data used to derive this estimate were based on relatively few larvae.

Bruggemann (1958, p. 698) believed that females do not fly, and he found one female of *G. groenlandica* that had deposited eggs on the cocoon from which it had emerged.

order HYMENOPTERA

suborder Symphyta

family Tenthredinidae

Amauronematus sp. nr *articola* Dalla Torre

A few adults of this undescribed species of sawfly were captured by Danks and Byers (1972), mostly close to the marsh in early July (unpubl.). Larvae of related species feed on willow (*Salix*), and *S. arctica* is almost certainly the foodplant of the species on Bathurst Island.

suborder Apocrita

family Ichneumonidae

This very diverse family of exclusively parasitic insects undoubtedly has several species that are represented on Bathurst Island but have not yet been collected. These would be expected to parasitize sciarids and other dipterans, as well as lepidopterans, for example.

Ichneumon sp.

An extensive series of females of this undescribed species was collected on Bathurst Island by Danks and Byers (1972). Females overwintered under larger flat stones on ridges, and remained there until mid-June in 1969. These adults were eaten by Purple Sandpipers (*Erolia maritima*) early in the year (Danks 1971a).

Overwintering as adult females is universal in species of this diverse genus (Heinrich 1961, p. 214; Rasnitsyn 1964; Dasch 1971), which attack lepidopterous pupae, chiefly macrolepidoptera.

Meloboris sp.

A single specimen was reared from a larva of the moth *Psychophora sabini* Kirby collected in spring on Bathurst Island (Danks and Byers 1972). The parasite must therefore overwinter inside its host. This undescribed species appears to be distinct from a species of *Meloboris* known from Ellesmere Island (W.R.M. Mason, pers. comm.).

Atractodes sp.

Recorded from Bathurst Island by Bissett (1977), who noted that it was a parasite of *Spilogona* spp. Species of *Atractodes* occur commonly in arctic localities (e.g. Bruggemann 1958; Hurd and Lindquist 1958). Oliver (1963), for example, recorded 6 species from Lake Hazen, Ellesmere Island. The taxonomy of the genus is, however, inadequately known.

Stenomacrus sp.

Species of this genus have often been found in the high arctic, even on Ellef Ringnes Island (McAlpine 1965a), but the taxonomy is no better known than in *Atractodes*. Oliver (1963) found 4 species on Ellesmere Island, and Ryan (1977) recorded 3 species from Devon Island. Bissett (1977), who reported a species of *Stenomacrus* from Bathurst Island, supposed that the hosts were mycetophilids, though McAlpine (1965a) inferred that they might be sciarids.

General discussion of the fauna

1. Composition

The checklist and Table I show that the arthropod fauna of Bathurst Island is depauperate (cf Danks and Byers 1972, discussion). Few species are represented there relative to some other areas of the high arctic such as Ellesmere Island (cf Downes 1964), and the composition of the fauna reflects attenuation by harsh conditions. Most of the species are those common and widespread in the arctic (see 'distribution' below). Many groups are represented only by species that occur also in the bleak northern outpost of Ellef Ringnes Island (McAlpine 1965a), such as the geometrid *Psychophora sabini*, the trichocerids *Trichocera borealis* and *T. columbiana*, and the blowfly *Boreellus atriceps*. This attenuation appears to reflect the cooler cloudier climate of the central Queen Elizabeth Islands, and is mirrored by the distribution of plant species (Danks and Byers 1972; the figure from which is reproduced here as Fig. 2).

The faunal list is nevertheless incomplete. Species would have been missed by the relatively limited collecting so far carried out, especially species emerging later in the season, e.g. some chironomids from lakes. Collecting of Collembola has also been deficient, and undoubtedly more species remain to be discovered. Again, many more species of bird ectoparasites, especially Mallophaga and Acari, would be expected, for 42 species of birds occur on Bathurst Island (Nettleship and Smith 1975). Sutton's collection from Southampton Island (Peters 1934), for example, contained many species of Mallophaga because a large number of birds had been examined for parasites. Finally, additional species of parasitic Hymenoptera would be expected.

2. Distribution

The types of distribution shown by species of arthropods reported from Bathurst Island are summarized in Table II. The prevalence of circumpolar and holarctic species -

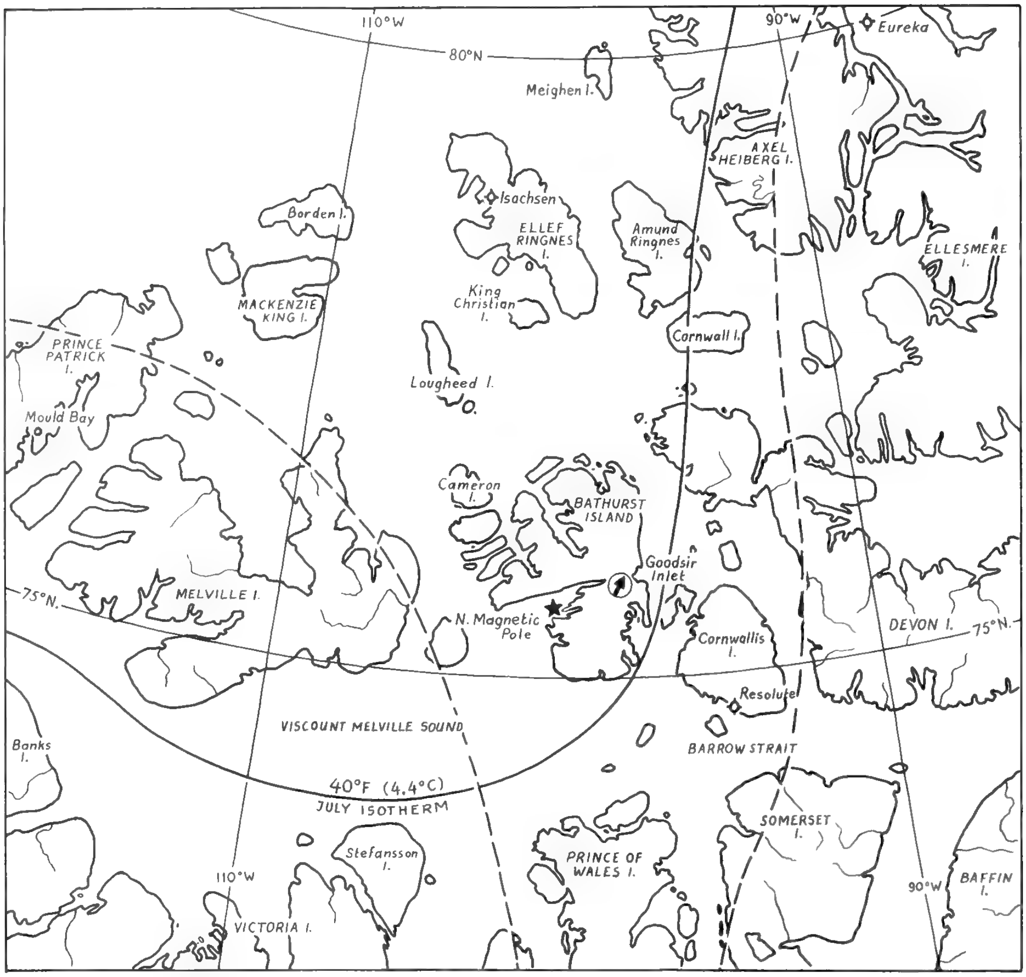

Fig. 2 Map of Bathurst and surrounding islands, to show 4.4°C July isotherm (solid line) (Thompson 1967), 80-species insotaxis of vascular plants (dashed line) (Beschel 1969), and site of High Arctic Research Station of the National Museum (arrow) (from Danks and Byers 1972).

two thirds of those with adequately known ranges - is very striking. This parallels the predominance of circumpolarity in arctic species of birds (Godfrey 1966), butterflies (Freeman 1958), Collembola (Hammer 1944, p. 61), and other groups.

Many holarctic distributions of insects may reflect incompletely documented circumpolar ranges; records from the northern U.S.S.R. are both deficient and difficult of access. In some groups, future taxonomic work would be expected to

Table II. *Provisional summary of distribution of Bathurst Island arthropods.*

Distribution type	number of species
circumpolar, arctic	15
circumpolar, also S.	10
circumpolar, unknown	1
holarctic, arctic	9
holarctic, also S.	6
holarctic, unknown	3
nearctic, arctic	17
nearctic, also S.	4
nearctic, unknown	1
unknown, but arctic	2
cosmopolitan	1
unknown	43
total	112

	number of species	combined	% of total	combined	% of known	combined
circumpolar	26	44	23	39	39	66
holarctic	18		16		27	
nearctic	22		20		33	
cosmopolitan	1		1		1	
unknown	45		40			
arctic only	43		38		67	
also southern	21		19		33	
unknown	48		43			

"circumpolar" species have been recorded more or less throughout the Nearctic and Palaearctic Regions.

"holarctic" species have been recorded in both Nearctic and Palaearctic Regions, but the known range in one or both of these regions is restricted.

modify somewhat the figures in Table II. Some nearctic chironomid species may belong to species known from the Palaearctic Region under a different name. On the other hand, North American and European populations of some species currently listed as "Holarctic" may prove to be specifically distinct, as suggested by the reservations expressed by Hirvenoja (1967) about the chironomid *Metriocnemus ursinus*, by Tuomikoski (1967) about the mycetophilid *Exechia frigida*, and by Strandtmann (1971) about the mite *Cocceupodes curviclava*.

About two thirds of adequately known Bathurst Island species are confined to the arctic (Table II); most of the rest range southwards at least to middle Europe or the northern United States.

Both the circumpolarity and arctic restriction of most of the Bathurst Island fauna appear to be somewhat higher than in arctic localities with a richer fauna. This is an additional reflection of the relatively severe high arctic regime of Bathurst Island (compare McAlpine 1964).

3. Habitats

Arthropods are well represented in both terrestrial and aquatic habitats (the diversity of chironomids largely accounts for the latter), but a significant proportion are parasitic (Table III). Many more ectoparasites of vertebrates (see above) would be expected in the fauna, so that probably about equal numbers of species in fact occur in each of the three main types of habitat shown in Table III: soil and water (because of insolational warming) and vertebrate skin (because of host homoiothermy) are the least severe arctic habitats for arthropods.

Most terrestrial species are restricted to microhabitats that offer them relatively favourable conditions for survival, growth, or nutrition, but factors influencing these restrictions are not known in detail.

4. Feeding habits

The majority of known arthropods on Bathurst Island are saprovores or are associated with vertebrates (see below). There is, however, a significant number of known predators or parasites of invertebrates (Table IV).

Although few species of insects feed on vascular plants, at least some mites and dipterans probably eat lower plants such as algae and fungi, and fungal decomposition is certainly important to saprovores such as some mycetophilids and mites.

Table III. *Provisional summary of habitats of Bathurst Island arthropods.*

Habitat	no. of species		%
terrestrial, restricted	53	59	53
terrestrial, widespread	6		
aquatic or semi-aquatic	39		35
parasitic on vertebrates	10		9
parasitic on invertebrates	4		3

Table IV. *Provisional summary of food type of Bathurst Island arthropods.*

Food type	no. of species	% of total	% of known
herbivores	5	4	5
predators/parasites of invertebrates	31	28	29
ectoparasites of vertebrates	10	9	10
saprovores/particle feeders (in aquatic species)	59	53	56
unknown	7	6	

5. Associations with vertebrates

Many species of arthropods on Bathurst Island are closely linked with vertebrates (Table V). Many mites and lice are ectoparasitic. Other species eat vertebrate carcasses (*Boreellus atriceps*, *Arctopiophila arctica*, etc.), or dung. *Trichocera columbiana* seems to be an obligate lemming associate in both adult and larval stages. Some mites and other forms occur only in sites organically enriched by carrion or dung. Several mite species and at least one species of chironomid occur beneath muskox dung, for example.

The relationships of vertebrates to insects as food sources are no less clear. Most of the larger arthropods are used as food, especially by birds. Chironomid adults and larvae, blowfly larvae and pupae, moth larvae, ichneumonid adults, etc., are all characteristic food sources at different times of

Table V. *Provisional summary of associations with vertebrates of Bathurst Island arthropods*

Association	no. of species
parasitizes vertebrates	10
uses vertebrate products as food	8+
vertebrates use species as food	39+
probably none	12
unknown	40

year (e.g. Danks 1971a; Mayfield 1978; contents of bird stomachs collected by MacDonald). Feeding Red Phalaropes typically agitate the water in ponds to stir up insect (chironomid) larvae. Taylor (1974) showed that females of the Long-tailed Jaeger ate many arthropods during summer (males ate mainly lemmings), with specific hunting behaviour. Consumption of arthropods by jaegers appeared to be related to arthropod abundance, especially following emergence of chironomids from the marsh.

6. Arthropods and the arctic ecosystem

The climatic rigour and relatively low biotic diversity on Bathurst Island highlights the integration of arthropods into the high arctic ecosystem. Fig. 3 shows a simplified example based on available information for Bathurst Island.

A key position in this system is occupied by the lemming (*D. torquatus*), because its population cycles not only influence breeding patterns in other vertebrates (such as the Snowy Owl), but also modify the soil and vegetation by feeding and disturbance, and thereby influence the arthropod fauna in subsequent years (cf notes above on *Arctoseius* spp.; Weber 1950b). Because of their size, muskoxen and caribou must also be important to insect and mite saprovores. The supply of dung and carrion for insects, as well as lemming prey for vertebrates some of which use arthropods as an alternative food supply, consequently fluctuates from season to season.

This interacts with season to season variations in weather, which are marked on Bathurst Island (e.g.

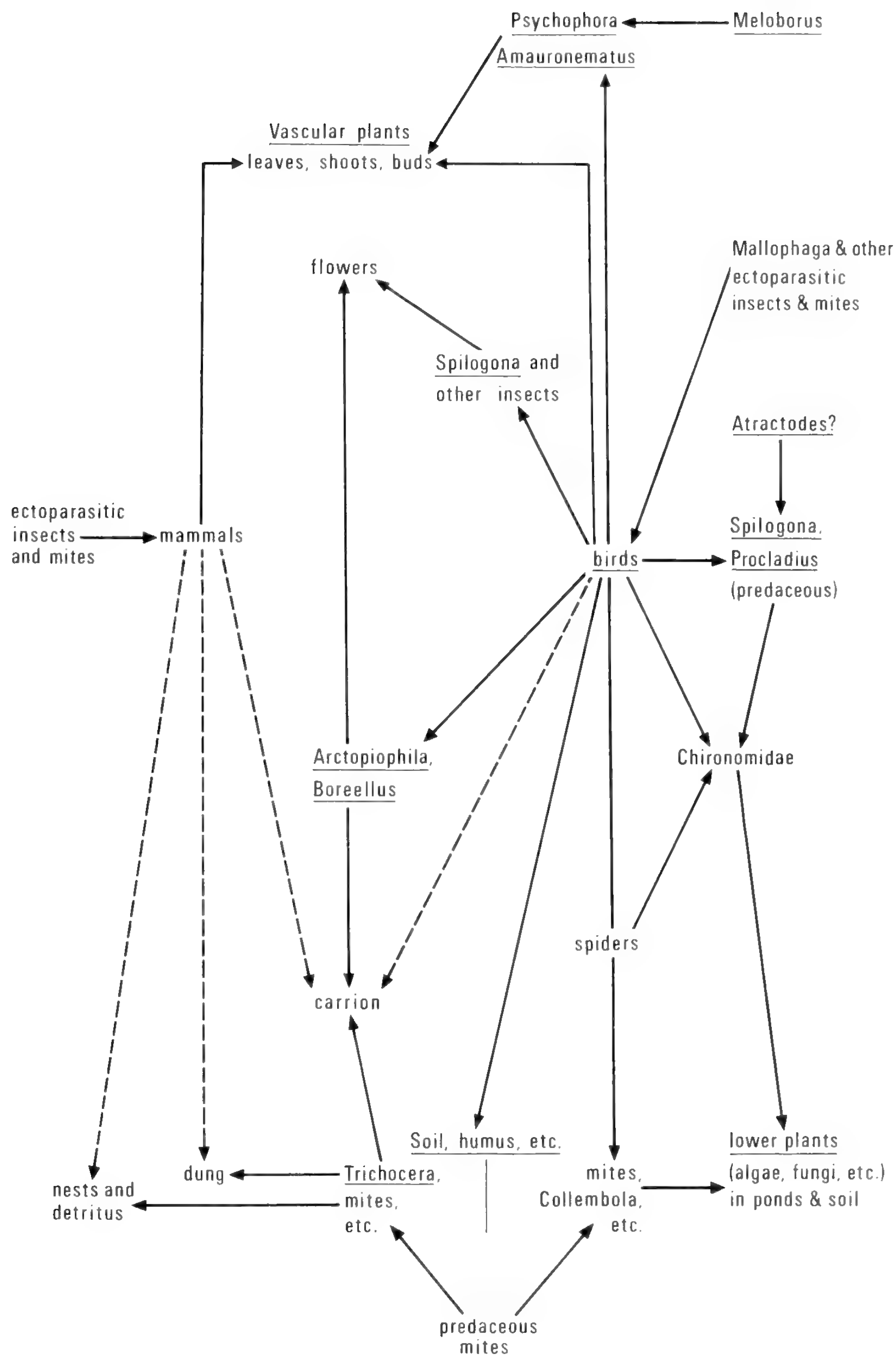

Fig. 3 Simplified scheme of relationships of arthropod fauna of Bathurst Island with some of the other biota (and see text; interactions among vertebrates, and some links in saprovore food chains, are omitted for clarity).

Taylor 1974), as in other high arctic sites. Such variations, especially of temperature, close to the limits for activity are particularly important to arctic poikilotherms.

Some insect species, including chironomids, defer emergence in exceptionally poor years, and this determines the availability of adults (though not of larvae) in a given season. Some birds on Bathurst Island also defer reproduction if the spring thaw is late (MacDonald, pers. comm.). Deferred emergence in insects can lead to diminished adult populations not only in the current year, but also in a subsequent year if the life cycle lasts for several years and few progeny are produced in a particular year. Such effects from one year to the next, through the influence of weather on adult activity, have been indicated for mosquitoes on Ellesmere Island (Corbet and Danks 1973).

Need for research on arthropods

From a purely entomological viewpoint, there are many outstanding questions to be answered about modes of adaptation to arctic climate and the sorts of season-to-season variation just discussed.

Patterns of morphological variation in high arctic insects such as *Trichocera borealis*, *Psychophora sabini*, and *Tanytarsus gracilentus* could also usefully be studied on Bathurst Island, where populations would have been selected by harsh local conditions.

But in addition, the notations in the arthropod checklist strongly suggest that collaborative studies of *both* invertebrate and vertebrate life on Bathurst Island would be fruitful. The breeding success of shore-birds, for example, is partly dependent on the summer supply of arthropod food (cf Holmes 1966). Because this supply might depend on conditions up to several years previously, and because season-to-season variations are so marked, these collaborative studies should be of long duration.

An excellent start has been made in long-term studies of the vertebrates (see below). Continued studies of the vertebrates *with* insects could therefore provide an unparalleled understanding of this high arctic system.

THE HIGH ARCTIC RESEARCH STATION

Introduction

The Research Station on Bathurst Island was established in 1968 by the National Museum of Natural Sciences, with the support of the Polar Continental Shelf Project. Field studies have been conducted every year since then (see Advisory Committee on Northern Development, annual reports).

The station itself is located on a ridge at 75°43'N. 98°25'W., overlooking the Goodsir river valley and the lowlands of Polar Bear Pass (see Fig. 4 below). The Station now comprises a wooden laboratory building and four Parcoll huts. One of these is used for storage and one as a kitchen and dining facility. Two lodging huts can accommodate up to a dozen scientists at one time.

Since 1968, the biota of the camp area has been investigated extensively. Results of the many studies are not summarized here, but the following list indicates the wide scope of the work undertaken on Bathurst Island. Salient references to work at the station are given, when available, in parentheses.

General

Soil reconnaissance and pedology

Meteorology

Micrometeorology (Danks 1971c: pond temperatures)

Archaeology

Birds (cf Macdonald 1975). [Ecology and behaviour of Ivory Gull (*Pagophilea eburnea*) was studied on nearby Seymour Island (MacDonald 1976a), and of White Gyrfalcon (*Falco rusticolus*) on Ellesmere Island (MacDonald 1976b).]

Breeding bird census and banding program (partial list of species in Taylor 1974, appendix I).

Ecology of Rock Ptarmigan (*Lagopus mutus*) (MacDonald 1970a, b).

Behaviour and annual cycle of Sanderling (*Calidris alba*) (Parmelee 1970; Parmelee and Payne 1973).

Ecology and Life history of Red Phalarope (*Phalaropus fulicarius*) (Mayfield 1978).

Ecology and life history of King Eider (*Somateria spectabilis*) (Lamothe 1973; Palmer 1977).

Ecology, behaviour and use of food resources by jaegers, esp. Long-tailed Jaeger (*Stercorarius* *longicaudus*) (Taylor 1974).

Ecology and behaviour of Snowy Owl (*Nyctea scandiaca*) (Taylor 1973, 1974; Parmelee 1972).

Breeding behaviour of Red-throated Loon (*Gavia stellata*)

Nesting behaviour of Black-bellied Plover (*Pluvialis squatarola*) (Mayfield 1973).

Recording of arctic bird sounds.

Mammals

Behaviour, ecology, populations, reproductive biology, and food preferences of Muskox (*Ovibos moschatos*) (Gray 1969, 1970, 1972, 1973, 1974a, b, 1977; Gray and Cockerton 1974; Gray and Rowell 1976; Jonkel *et al*. 1975; Parker *et al*. 1975).

Ecology, life history and behaviour of Collared Lemming (*Dicrostonyx torquatus*).

Life history, behaviour and food preferences of Arctic Hare (*Lepus arcticus*).

Behaviour, ecology, food preferences and populations of Peary Caribou (*Rangifer tarandus*) (Gray 1977; Parker *et al*. 1975; Sutcliffe 1977.)

Behaviour and ecology of Arctic Fox (*Alopex lagopus*).

Behaviour of Wolf (*Canis lupus*) and Peary Caribou.

Postglacial Walrus (*Odobenus rosmarus*) (Harington 1975).

Mammalian parasites (see below).

Plants

Botanical studies, including utilization, classification and mapping of plant communities (and bird-nesting habitats) (Van Eyk and Sheard 1976).

Ecology and distributional studies of bryophytes (Miller and Ambrose 1976; Miller and Ireland 1978; cf Brassard and Steere 1968).

Soil lichen ecology.

Collection and identification of fungi (Bissett 1977), and lichens (Brodo 1978).

Freshwater plankton.

Invertebrates

Inventory of insects and related terrestrial arthropods (Danks and Byers 1972; Bissett 1977).

Overwintering of arctic insects (Danks 1971b; Danks and Byers 1972).

Studies of free-living and parasitic mites (Behan 1978).

Ectoparasites (mainly mites) of Collared Lemming (Gill and Strandtmann 1977).

Freshwater invertebrates, especially crustaceans.

Endoparasites of vertebrates

(Webster 1974; Samuel and Gray 1975; Duszynski *et al*. 1977).

Values of the station for research on arthropods

1. General

The Research Station is well-placed from several standpoints. It is relatively accessible for a high arctic site (close to the Resolute airstrip on neighbouring Cornwallis Island). It is near extensive nesting or feeding grounds of a variety of birds and mammals. Bathurst Island is interesting geologically (see Introduction). Disturbance has been minimal because there is no permanent Inuit settlement on the island and arctic wolves therefore persist, for example, although recently exploration for oil has taken place in several island sites. The research station has several more specific values for insect research.

2. Range of habitats

The research station is close to a wide variety of habitats, each with characteristic arthropod species. The major ones are:

Upland barrens: These are characterized by classical high arctic "feldmark" species, such as the moth *Psychophora sabini*, some of which persist at very low density; individuals of some other species, such as spiders and Collembola, are very abundant. The environmental relationships and adaptations of both types are especially interesting.

Marsh and thermokarst pond network: These are colonized by a complex of species. Chironomid midges occur in the ponds and in semi-terrestrial marsh habitats. Their populations are very high, and would allow interesting measures of productivity. Some characteristic arctic flies (such as *Spilogona* spp.) occur here abundantly and could readily be studied; their life histories are little known.

Creeks: Creeks are inhabited by a particular assemblage of chironomid species, the population dynamics of which is not understood (largely because of marked seasonal changes in stream-flow), although emerging flies are often numerous.

Rivers: Larger arctic rivers probably have a chironomid assemblage that differs from both still water and creeks, but this has scarcely been investigated.

Lakes: The chironomid species of large lakes differ from those of marshes and ponds, and emerge later in the season. Perhaps, therefore, they are important to the ecosystem in late summer, but the actual numbers of emerging individuals have seldom been compared in the arctic with the production of marshes such as those near the research station.

General habitats: General habitats (in the sense of Elton and Miller 1954), especially enriched sites associated with mammal droppings or carrion, support locally high insect populations.

3. Richness of certain habitats

The marsh has a very rich biota (especially insects) because of the closed vegetation, and the continuous summer supply of moisture resulting from the poor drainage above permafrost. The marsh is undoubtedly one of the most productive sites for arthropods on the island.

4. Representation of the high arctic

Bathurst Island lies in a region of the Queen Elizabeth Islands characterized by a depauperate fauna (see above). The composition of this fauna presumably reflects climatic conditions that would make studies of adaptations to arctic life especially worthwhile. These adaptations include cold-hardiness, seasonal control of the life cycle, polyphagy, adjustments of fecundity, parthenogenesis, behavioural adaptations, and so on (Downes 1965; Oliver 1968; Danks 1971b). The composition of the fauna also reflects colonization since deglaciation, presumably mainly by dispersal from the larger richer islands to the east and north (cf McAlpine 1965a for Ellef Ringnes Island), in ways that have not yet been analysed.

5. Availability of background data

The insect fauna has been generally though incompletely surveyed. Many interactions of insects with other organisms have already been noted. Extensive pertinent data already gathered for several years on many of these organisms in the research station area would facilitate work on the arthropods. For example, lemmings and other mammals (important host, dung and carrion sources for insects), birds (many of which feed extensively on insects), and vegetation, have been studied. Freshwater crustaceans have been collected, and are involved in the dynamics of habitats that produce considerable numbers of chironomids.

THE POLAR BEAR PASS AREA AS AN ECOLOGICAL RESERVE

I.B.P. Ecological Sites

The International Biological Program (1964-1974), a cooperative program to study the biological productivity of the earth's ecosystems in relation to human adaptability and welfare, was concerned also with the preservation of unique or valuable ecosystems, including the conservation of terrestrial biological communities.

The Canadian Committee for the International Biological Program, Conservation, Terrestrial (CCIBP/CT) (Fuller 1973) divided the country into 10 operational zones, each with a consulting panel to coordinate the identification and characterization of ecological sites. These were areas of particular biological interest that should be protected from environmental damage (because the biological values of the site might outweigh all other values), subjected to special management, or used as a basis for the scientific understanding of typical Canadian biological communities.

About 1,400 sites have so far been identified (LaRoi *et al.* 1976; Nettleship and Smith 1975). Seventy-one arctic sites were described by Nettleship and Smith (1975) (CCIBP/CT Panel 9), and one of the 27 high arctic sites is the area of Bathurst Island around the National Museums research station.

The Bathurst Island site

The site proposed on Bathurst Island (Fig. 4) encompasses a strip 30-40 km wide across the full width of south-central Bathurst Island, and a peninsula on the east coast (Brooman point). Its total area is 2,960 km^2 (1,150 sq. mi.).

Desirability of ecological reserve status for the Polar Bear Pass site

The Bathurst Island site is an

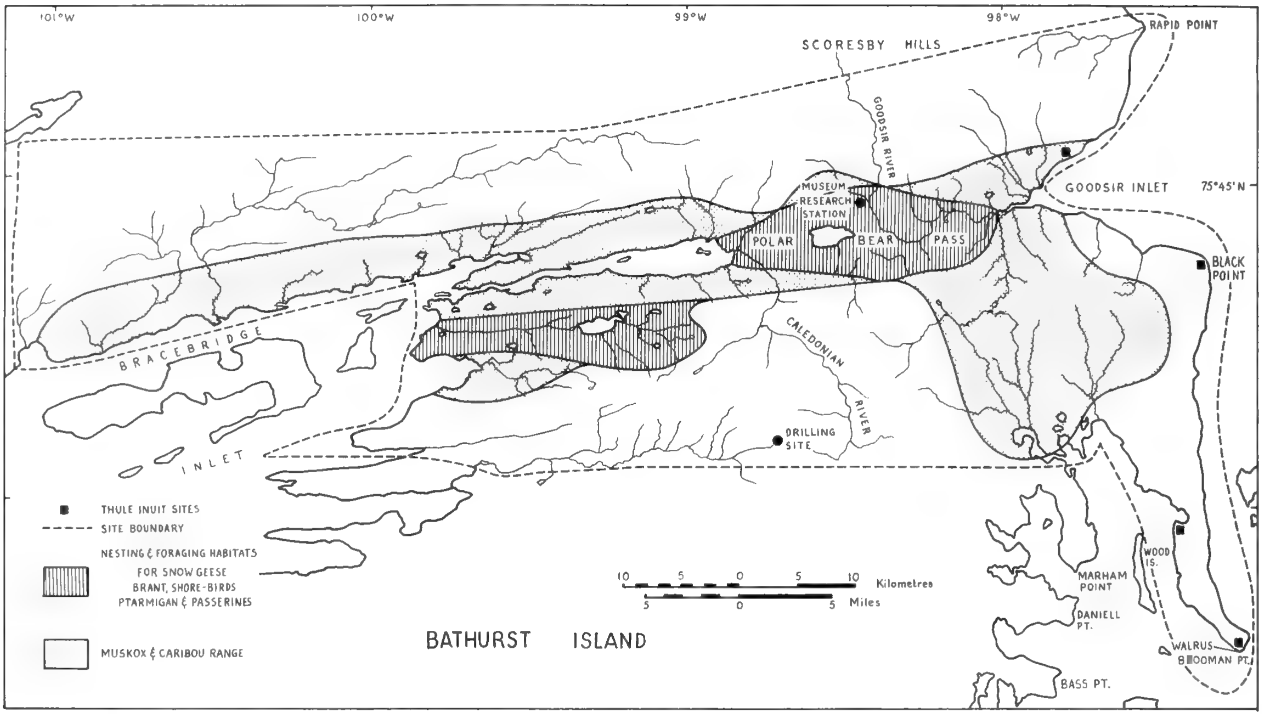

Fig. 4 Proposed ecological site on Bathurst Island (from Nettleship and Smith 1975).

especially valuable high arctic ecsystem because it includes: the variety of important insect habitats noted above; major nesting and foraging grounds of several dozen species of birds; important calving and wintering grounds for muskoxen; seasonal migration routes for Peary Caribou; and sea ice access routes (and occasionally denning sites) for Polar Bear. Interrelationships among many of these organisms have already been pointed out by reference to the arthropods. Rich marsh (sedge meadow) sites of this sort are limited in the high arctic (Bliss 1977, fig. 1). Brooman Point is noted for populations of Walrus; and there are many Inuit archaeological sites on the island. At least 15 sites are known from the Polar Bear Pass area alone (some as old as 4,000 years), and a similar number of sites, 500-4,000 years old, occurs in the Brooman Point area. Included there are several large sites from about 1,200 A.D. that are of considerable archaeological importance.

The continued existence of the National Museums' Research Station (and data thereby accumulated) greatly enhances the scientific value of the area.

As pointed out by Nettleship and Smith (1975) and by MacDonald (1977a, b), protection to be effective must often involve sizeable areas of land in the north, where biological productivity is low. Moreover, these northern ecosystems are relatively simple, life processes are slow in plants and cold-blooded animals (life cycles of some of the insects on Bathurst Island certainly take at least several years), and major disturbances are long-lasting or irreversible.

For all these reasons, and in the present context because of the exciting possibilities for exploration and understanding of arctic arthropods and their ecological roles provided by the Polar Bear Pass area, the recent withdrawal of the site from further development for two years, and planned consultations with an I.B.P. working group to develop recommendations for future status (IANA 1978), is an important step towards permanent protected status. Application on behalf of the National Museum has also been made for a Land Use Reservation of this area. Work by the Land Management Division of IANA is now proceeding towards a proposal for permanent protection of the area, and public consultations are expected to begin during 1979.

ACKNOWLEDGMENTS

This paper results from a 1978 contract between the Entomological Society of Canada and the National Museum of Natural Sciences, and is a slightly modified version of the contract report submitted to the Museum. I thank C.D. Dondale, J.A. Downes, E.E. Lindquist, S.D. MacDonald, W.R.M. Mason, J.F. McAlpine, E.G. Munroe, D.R. Oliver, W.R. Richards and D.M. Wood for their helpful comments on various sections of the manuscript.

REFERENCES CITED

Addison, J.A. 1977. Population dynamics and biology of Collembola on Truelove lowland. pp. 363-382 *in* L.C. Bliss (Ed.), Truelove lowland, Devon Island, Canada: A high arctic ecosystem. U. Alta. Press, Edmonton. 714 pp.

Advisory Committee on Northern Development. 1970-1977. Annual Reports. Government activities in the North. Information Canada/Supply and Services Canada, Ottawa.

Aldrich, J.M. 1918. The kelp flies of North America (genus *Fucellia,* family Anthomyiidae). *Calif. Acad. Sci. Proc.* ser. 4, 8: 157-179.

Allred, D.M. 1954. Mites as intermediate hosts of tapeworms. *Proc. Utah Acad. Arts Letters* 31: 44-51.

Andersen, F.S. 1946. East Greenland lakes as habitats for chironomid larvae. *Meddr Grønland* 100 (10). 65 pp.

Atyeo, W.T. 1960. A revision of the mite family Bdellidae in North and Central America. *Kans. Univ. Sci. Bull.* 40: 345-499.

Baker, E.W. 1965. A review of the genera of the family Tydeidae (Acarina). *Advances in Acarology* 2: 95-133.

Baker, E.W. and G.W. Wharton. 1952. An introduction to Acarology. MacMillan, N.Y. 465 pp.

Banfield, A.W.F. 1974. The mammals of Canada. National Museum of Natural Sciences, U. Toronto Press. 438 pp.

Behan, V.M. 1978. Diversity, distribution and feeding habits of North American arctic soil Acari. PhD. thesis, Dept. of Entomology, Macdonald College of McGill University. 428 pp.

Beschel, R.E. 1969. [Floristic relations of the nearctic islands.] (In Russian, English summary) *Bot. Zh. SSSR* 54: 872-891.

Binns, E.S. 1975. Notes on the biology of *Arctoseius cetratus* (Sellnick) (Mesostigmata: Ascidae). *Acarologia* 16 (1974): 577-582.

Bird, J.B. 1967. The physiography of arctic Canada. John Hopkins, Baltimore. 336 pp.

Bissett, J. 1977. Preliminary observations on the vascular plants, fungi, and insects of Polar Bear Pass, Bathurst Island, N.W.T. Unpub. report to National Museums of Canada. 39 pp. (mimeo).

Blake, W., jr. 1970. Preliminary account of the glacial history of Bathurst Island, arctic archipelago. *Geol. Surv. Can. Pap.* 64-30. 8 pp.

Bliss, L.C. 1977. Introduction. pp. 1-11 *in* L.C. Bliss (Ed.), Truelove lowland, Devon Island, Canada: A high arctic ecosystem. U. Alta. Press, Edmonton. 714 pp.

Braendegaard, J. 1958. Araneida. *Zool. Iceland* III (54). 113 pp.

__________ 1960. The spiders (Araneida) of Peary land, north Greenland. *Meddr Grønland* 159(6). 24 pp.

Brassard, G.R. and W.C. Steere. 1968. The mosses of Bathurst Island, N.W.T., Canada. *Can. J. Bot.* 46(4): 377-383.

Brodo, I.M. 1978. Preliminary checklist of the lichens of Bathurst Island, N.W.T. Unpubl. report, National Museum of Natural Sciences, 12 pp.

Bruggemann, P.R. 1958. Insects and environments of the high arctic. *Proc. Xth Int. Congr. Ent.* 1: 695-702.

Chant, D.A. and R.I.C. Hansell. 1971. The genus *Amblyseius* (Acarina: Phytoseiidae) in Canada and Alaska. *Can. J. Zool.* 49: 703-758.

Cook, E.F. and J.R. Beer. 1959. The immature stages of the genus *Hoplopleura* (Anoplura: Hoplopleuridae) in North America, with descriptions of two new species. *J. Parasit.* 45: 405-416.

Corbet, P.S. and H.V. Danks. 1973. Seasonal emergence and activity of mosquitoes (Diptera: Culicidae) in a high arctic locality. *Can. Ent.* 105: 837-872.

Crary, A.P. 1958. Arctic ice island and ice shelf studies. Part I. *Arctic* 11: 3-42.

Dahl, C. 1967. Notes on the taxonomy and distribution of arctic and subarctic Trichoceridae (Dipt. Nem.) from Canada, Alaska and Greenland. *Opusc. Ent.* 32: 49-78.

__________ 1970. Distribution, phenology and adaptation to arctic environment in Trichoceridae (Diptera). *Oikos* 21: 185-202.

Danks, H.V. 1971a. A note on the early season food of arctic migrants. *Can. Field-Nat.* 85: 71-72.

__________ 1971b. Overwintering of some north temperate and arctic Chironomidae. II. Chironomid biology. *Can. Ent.* 103: 1875-1910.

__________ 1971c. Spring and early summer temperatures in a shallow arctic pond. *Arctic* 24: 113-123.

Danks, H.V. and J.R. Byers. 1972. Insects and arachnids of Bathurst Island, Canadian arctic archipelago. *Can. Ent.* 104: 81-88.

Danks, H.V. and D.R. Oliver. 1972a. Seasonal emergence of some high arctic Chironomidae (Diptera). *Can. Ent.* 104: 661-686.

__________ 1972b. Diel periodicities of emergence of some high arctic Chironomidae (Diptera). *Can. Ent.* 104: 903-916.

Dasch, C.E. 1971. Hibernating Ichneumonidae of Ohio. *Ohio J. Sci.* 71: 270-283.

Douce, G.K. and D.A. Crossley, jr. 1977. Acarina abundance and community structure of an arctic coastal tundra. *Pedobiol.* 17: 32-42.

Downes, J.A. 1964. Arctic insects and their environment. *Can. Ent.* 96: 280-307.

__________ 1965. Adaptations of insects in the arctic. *A. Rev. Ent.* 10: 257-274.

__________ 1974. The feeding habits of adult Chironomidae. *Ent. Tidskr. 95 Suppl.* : 84-90.

Duszynski, S.W., W.M. Samuel, and D.R. Gray. 1977. Three new *Eimeria* spp. (Protozoa, Eimeriidae) from muskoxen, *Ovibos moschatus*, with redescriptions of *E. faurei, E. granulosa* and *E. ovina* from muskoxen and from a Rocky Mountain bighorn sheep, *Ovis canadensis*. *Can. J. Zool.* 55(6): 990-999.

Elton, C.S. and R.S. Miller. 1954. The ecological survey of animal communities with a practical system of classifying habitats by structural characters. *J. ecol.* 42: 460-496.

Emerson, K.C. 1950. The genus *Lagopoecus* (Philopteridae: Mallophaga) in North America. *J. Kans. ent. Soc.* 23(3): 97-101.

__________ 1972. Checklist of the Mallophaga of North America (North of Mexico). Desert Test Center, Dugway, Utah. Parts I-IV. 200, 118, 28, 216 pp.

Evans, G.O. 1955. A collection of mesostigmatid mites from Alaska. *Bull. Brit. Mus. Nat. Hist. (Zool.)* 2(9): 287-307.

______ 1958. A revision of the British Aceosejinae (Acarina: Mesostigmata). *Proc. Zool. Soc. Lond.* 131: 177-229.

Fain, A. and K. Hyland. 1970. Notes on the Mycoptidae of North America, with description of a new species on the eastern chipmunk. *Jl N.Y. ent. Soc.* 78: 80-87.

Fain, A. and J.O. Whittaker, jr. 1973. Phoretic hypopi of North American mammals (Glycyphagidae). *Acarologia* 15: 144-170.

Ferguson, D.C. 1978. Noctuoidea Lymantriidae. fasc. 22.2 *in* R.B. Dominick *et al*. The moths of America North of Mexico. E.W. Classey and Wedge Entomological Research Foundation, London. 110 pp., 8 pl.

Ferris, G.F. 1951. The sucking lice. *Mem. Pacific Coast ent. Soc*. 1. 320 pp.

Fittkau, E.J. and F. Reiss. 1978. Chironomidae. *In* J. Illies (*Ed*.) Limnofauna Europaea. Gustav Fischer, Stuttgart. pp. 404-440.

Folsom, J.W. 1937. Nearctic collembola or springtails, of the family Isotomidae. *Bull. U.S. Nat. Mus*. 168. 144 pp.

Fortier, Y.O. *et al*. 1963. Geology of the north-central part of the Arctic Archipelago, Northwest Territories (Operation Franklin). *Geol. Surv. Can. Mem*. 320. 671 pp.

Freeman, T.N. 1958. The distribution of arctic and subarctic butterflies. *Proc. Xth Int. Congr. Ent*. 1: 659-671.

Fuller, W.A. 1973. The conservation of terrestrial communities program in Canada. *Syesis* 6: 11-17.

Gavrilova, M.K. 1966 (1963). Radiation climate of the arctic. (Translated from the Russian). Israel Program for Scientific Translations Ltd., Jerusalem. (Available from U.S. Dept. of Commerce) 178 pp.

Gerson, U. 1972. A redescription of *Ledermuelleria frigida* Habeeb (Acarina: Prostigmata: Stigmaeidae). *Acta Arachnol*. 24: 15-28.

Gill, D. and R.W. Strandtmann. 1977. Ectoparasites of the collared lemming (*Dicrostonyx torquatus*) on Bathurst Island, N.W.T., Canada. *J. Med. Ent*. 14(1): 101-106.

Gisin, H. 1960. Collembolenfauna Europas. Museum d'Histoire Naturelle, Geneva. 312 pp.

Godfrey, W.E. 1966. The Birds of Canada. *Nat. Mus. Can. Bull*. 203. 428 pp.

Gray, D.R. 1969. Studies on the behaviour of the muskox (*Ovibox moschatus wardi*) on Bathurst Island, N.W.T. *Arctic Circular* 19(3): 55-57.

____________ 1970. The killing of a bull muskox by a single wolf. *Arctic* 23(3): 197-199.

____________ 1972. Winter research on the muskox (*Ovibos moschatus wardi*) on Bathurst Island 1970-71. *Arctic Circular* 21(3): 158-163.

____________ 1973. Social organization and behaviour of muskoxen (*Ovibos moschatus*) on Bathurst Island, N.W.T. Ph.D. thesis, University of Alberta, Edmonton. 212 pp.

____________ 1974a. The defence formation of the Muskox. *Muskox* 14: 25-29.

___________ 1974b. N.W.T. Council considers sport hunting for muskoxen. *Nature Canada* 3(1): 35.

___________ 1977. The status of the muskox and Peary caribou on Canada's arctic islands. *In* T. Mosquin and C. Suchal (Eds.), Canada's threatened species and habitats. Can. Nat. Fed. Sp. Publ. 6. 185 pp.

Gray, D.R. and D.F. Cockerton. 1974. Muskoxen at Bathurst Island. *Beaver* (winter 1974): 32-39.

Gray, D.R. and J. Rowell. 1976. A preliminary report on some aspects of social organization and behaviour of muskoxen in Polar Bear Pass, Bathurst Island, N.W.T. 1973-75. unpub. report, National Museum of Natural Sciences. 41 pp.

Hall, D.G. 1948. The blowflies of North America. Thomas Say Foundation (Ent. Soc. Am.) 477 pp.

Hammer, M. 1944. Studies on the oribatids and collemboles of Greenland. *Meddr Grønland* 141(3): 210 pp.

___________ 1952. Investigations on the microfauna of northern Canada, Part I. Oribatei. *Acta arctica* 4: 1-108.

___________ 1953a. Collemboles and oribatids from the Thule district (Northwest Greenland) and Ellesmere Island (Canada). *Meddr Grønland* 136(5): 2-16.

___________ 1953b. Investigations on the microfauna of northern Canada, part 2. Collembola. *Acta arctica* 6: 1-108.

___________ 1954. Collemboles and oribatids from Peary-land (North Greenland). *Meddr Grønland* 127(5): 1-28.

Hansen, D.C. and E.F. Cook. 1976. The systematics and morphology of the Nearctic species of *Diamesa*, Meigen, 1835 (Diptera: Chironomidae). *Mem. Am. ent. Soc.* 30. 203 pp.

Harington, C.R. 1975. A postglacial walrus (*Odobenus rosmarus*) from Bathurst Island, Northwest Territories. *Can. Field-Nat.* 89(3): 249-261.

Harper, F. 1956. Mammals of Keewatin. *Univ. Kans. Mus. Nat. Hist., Misc. Publ.* 12. 94 pp.

Heinrich, G.H. 1961. Synopsis of nearctic Ichneumoninae Stenopneusticae with particular reference to the Northeastern region (Hymenoptera). Part III. Synopsis of the Ichneumonini: Genera *Ichneumon* and *Thyrateles*. *Can. Ent. Suppl.* 21. 368 pp.

Hennig, W. 1959. 63b. Muscidae: Gattung *Spilogona* Schabl. *in* E. Lindner (Ed.), Die Fliegen der paläarktischen Region.

__________ 1962. 63b. Muscidae. *In* E. Lindner (Ed.), Die Fliegen der paläarkischen Region. pp. 673-720.

__________ 1966. 63a. Anthomyiidae. *In* E. Lindner (Ed.), Die Fliegen der paläarkischen Region.

Herrin, C.S. 1970. A systematic revision of the genus *Hirstionyssus* (Acari: Mesostigmata) of the nearctic region. *J. Med. ent.* 7: 391-437.

Hirvenoja, M. 1967. 7. Chironomidae and Culicidae (Dipt.) from Spitzbergen. pp. 52-61 *in* J. Kaisila. Notes on the arthropod fauna of Spitzbergen I. *Ann. ent. Fenn.* 33: 13-64.

__________ 1973. Revision der Gattung *Cricotopus* van der Wulp und ihrer Verwandten (Diptera, Chironomidae). *Ann. Zool. Fenn.* 10: 1-363.

Hocking, B. 1968. Insect-flower associations in the high arctic with special reference to nectar. *Oikos* 19: 359-387.

Holm, A. 1958. The spiders of the Isfjord region of Spitsbergen. *Zool. Bidrag fran Uppsala* 33.

Holmes, R.T. 1966. Feeding ecology of the red-backed sandpiper (*Calidris alpina*) in arctic Alaska. *Ecology* 47: 32-45.

Huckett, H.C. 1965. The Muscidae of Northern Canada, Alaska, and Greenland (Diptera). *Mem. ent. Soc. Can.* 42. 369 pp.

Hurd, P.D. Jr. and E.E. Lindquist. 1958. Analysis of soil invertebrate samples from Barrow, Alaska. Final Report, Arctic Inst. N. Am. project ONR-173 and ONR-193. 24 pp. (mimeo)

IANA. 1978. Polar Bear Pass I.B.P. site to receive federal protection. Indian and Northern Affairs Press Release, Feb. 20, 1978. 6 pp. (mimeo)

Jonkel, C.J., D.R. Gray, and B. Hubert. 1975. Immobilizing and marking wild muskoxen in arctic Canada. *J. Wildlife Man.* 39(1): 112-117.

Kalela, O., T. Koponen, E.A. Lind, J. Skarén, and J. Tast. 1961. Seasonal change of habitat in the Norwegian lemming, *Lemmus lemmus* (L.). *Ann. Acad. Sci. Fenn.* A, IV, 55: 1-72.

Keegan, H.L. 1951. The mites of the subfamily Haemogamasinae (Acari: Laelaptidae). *Proc. U.S. Nat. Mus.* 101: 203-268.

Keler, S. 1960. Uber die dualistische Differenzierung der Gattung *Anatoecus* Cummings (Mallophaga). *Zeits. Parasitenkunde* 20: 207-316.

Kerr, J.W. 1974. Geology of Bathurst Island Group and Byam Martin Island, arctic Canada (Operation Bathurst Island). *Geol. Surv. Can. Mem.* 378. 152 pp.

Kevan, P.G. 1973. Flowers, insects and pollination ecology in the Canadian high arctic. *Polar Record* 16: 667-674.

Krantz, G.W. 1978. A manual of Acarology. Oregon State U., Corvallis, Oregon. 2nd edn. 509 pp.

Krantz, G.W. and E.E. Lindquist. 1979. Evolution of phytophagous mites (Acari). *A. Rev. Ent. 24: 121-158.*

Lamothe, P. 1973. Biology of the King Eider (*Somateria spectabilis*) in a freshwater breeding area on Bathurst Island, N.W.T. M. Sc. thesis, University of Alberta, Edmonton. 125 pp.

Landrock, K. 1927. 8. Fungivoridae (Mycetophilidae). *In* E. Lindner (Ed.), Die Fliegen der Paläarktischen Region.

LaRoi, G.H., T.A. Babb, and C.E. Perley. 1976. Canadian National Directory of I.B.P. Areas, 1968-1975. 2nd edn. Univ. Alberta, Edmonton. 7 vols.

Leech, R.E. 1966. The spiders (Araneida) of Hazen Camp 81°49'N, 71°18'W. *Quaest. ent.* 2: 153-212.

Lindeberg, B. 1968. Population differences in *Tanytarsus gracilentus* (Holmgr.) (Dipt., Chironomidae). *Ann. Zool. Fenn.* 5: 88-91.

__________ 1970. Tanytarsini (Diptera) from northern Fennoscandia. *Ann. Zool. Fenn.* 7: 303-312.

__________ 1971. Parthenogenetic strains and unbalanced sex ratios in Tanytarsini (Diptera). *Ann. Zool. Fenn.* 8: 310-317.

Lindquist, E.E. 1961. Taxonomic and biological studies of mites of the genus *Arctoseius* Thor from Barrow, Alaska (Acari: Aceosejidae). *Hilgardia* 30 (11): 301-350.

Luxton, M. 1972. Studies on the oribatid mites of a Danish beech wood soil. 1. Nutritional biology. *Pedobiol.* 12: 434-463.

MacDonald, S.D. 1970a. The breeding behaviour of the Rock Ptarmigan. *Living Bird* 9: 195-238.

__________ 1970b. Life history of Rock Ptarmigan on Bathurst Island, N.W.T. *Arctic Circular* 20 (2): 44-48.

__________ 1975. A new bird sanctuary in the High Arctic. *Nature Canada* 4 (4): 28.

__________ 1976a. Phantoms of the polar pack ice. *Audubon* 78(3): 2-19.

___________ 1976b. Gyr! *Audubon* 78 (4): 76-79.

___________ 1977a. An arctic oasis. *Nature Canada* July/Sept: 4-6.

___________ 1977b. An Arctic Oasis. Brochure to accompany N.M.N.S. travelling exhibit. 12 pp.

MacLean, S.F., jr., V. Behan, and A. Fjellberg. 1978. Soil Acari and Collembola from Chaun Bay, Northern Chukotka, USSR. *Arctic Alpine Res.* 10 (3): 559-568.

MacLean, S.F., jr., G.K. Douce, E.A. Morgan, and M.A. Skeel. 1977. Community organization in the soil invertebrates of Alaskan Arctic tundra. *In* Soil organisms as components of Ecosystems. *Ecol. Bull* (Stockholm) 25: 90-101.

MacLean, S.F., jr. and F.A. Pitelka. 1971. Seasonal patterns of abundance of tundra arthropods near Barrow. *Arctic* 24: 19-40.

MacNamara, C. 1924. The food of Collembola. *Can. Ent.* 56: 99-105.

Mayfield, H.T. 1973. Black-bellied Plover incubation and hatching. *Wilson Bull.* 85(1): 82-85.

___________ 1978. Undependable breeding conditions in the Red Phalarope. *Auk* 95: 590-592.

Maynard, E.A. 1951. A monograph of the Collembola or springtail insects of New York State. Ithaca, N.Y. Comstock Publ. Co. Inc. 339 pp.

McAlpine, J.F. 1964. Arthropods of the bleakest barren lands: composition and distribution of the arthropod fauna of the northwestern Queen Elizabeth Islands. *Can. Ent.* 96: 127-129.

___________ 1965a. Insects and related terrestrial invertebrates of Ellef Ringnes Island. *Arctic* 18(2): 73-103.

___________ 1965b. Observations on anthophilous Diptera at Lake Hazen, Ellesmere Island. *Can. Field-Nat.* 79: 247-252.

___________ 1977. A revised classification of the Piophilidae, including 'Neottiophilidae' and 'Thyreophoridae' (Diptera: Schizophora). *Mem. ent. Soc. Can.* 103. 66 pp.

McNair, A.H. 1961. Relations of the Parry Islands fold belt to the Cornwallis folds, eastern Bathurst Island, Canadian Archipelago. pp. 421-426 *in* G.O. Raasch (Ed.), The Geology of the Arctic (Proc. 1st Int. Symp. Arctic Geol., Calgary, Alberta, Jan. 1960). Univ. Toronto Press.

Miller, N.G. and L.J.H. Ambrose. 1976. Growth in Culture of Wind-blown Bryophyte Gametophyte fragments from Arctic Canada. *Bryologist* 79 (1): 55-63.

Miller, N.G. and R.R. Ireland. 1978. A floristic account of the bryophytes of Bathurst Island, Arctic Canada. *Occ. Pap. Farlow Herbarium Harvard Univ.* 13. 38 pp.

Mills, H.B. and W.R. Richards 1953. Collembola from arctic and boreal Canada. *J. Kans. ent. Soc.* 26: 53-59.

Mosquin, T. and J.E.H. Martin. 1967. Observations on the pollination biology of plants on Melville Island, N.W.T., Canada. *Can. Field-Nat.* 81: 201-205.

Mundie, J.H. 1957. The ecology of Chironomidae in storage reservoirs. *Trans. R. ent. Soc. Lond.* 109: 149-232. 36 figs.

Nettleship, D.N. and P.A. Smith (Eds.) 1975. Ecological sites in northern Canada. Can. Comm. I.B.P., Panel 9. 331 pp.

Nordström, F., E. Wahlgren, and A. Tullgren. 1941. Systematisk Bearbetning au Sveriges Storfjärilar Macrolepidoptera. Svenska Fjarilar 2. Nordisk Familjeboks, Stockholm. 353 pp.

Nuorteva, P. 1964. The zonal distribution of blowflies (Dipt., Calliphoridae) on the arctic hill Ailigas in Finland. *Ann. ent. Fenn.* 30: 218-226.

Oliver, D.R. 1962. A review of the subfamily Orthocladiinae (Chironomidae, Diptera) of Bear Island. *Astarte* 20: 1-19.

__________ 1963. Entomological studies in the Lake Hazen area, Ellesmere Island, including lists of species of Arachnida, Collembola and Insecta. *Arctic* 16: 175-180.

__________ 1968. Adaptations of arctic Chironomidae. *Ann. Zool. Fenn.* 5: 111-118.

__________ 1971. Life History of the Chironomidae. *A. Rev. Ent.* 16: 211-230.

Oliver, D.R., P.S. Corbet, and J.A. Downes. 1964. Studies on arctic insects: the Lake Hazen project. *Can. Ent.* 96: 138-139.

Oliver, D.R. and H.V. Danks. 1972. Sex ratios of some high arctic Chironomidae. *Can. Ent.* 104: 1413-1417.

Otakulov, T. 1977. [Gamasid mites of *Apodemus flavicollis*]. (In Russian). *Zool. Zh.* 56: 1792-1796.

Palmén, E. 1961. Eine parthenogenetische Rasse von *Tanytarsus norvegicus* (Kieff.) Brund. (Dipt., Chironomidae) aus dem oligohalinen Brackwasser des Finnischen Meerbusens. *Ann. ent. Fenn.* 27: 45-50.

Palmer, R.S. 1977. King Eider studies. *Brit. Birds* 70: 107-113.

Parker, G.R., D.C. Thomas, E. Broughton, and D.R. Gray. 1975. Crashes of muskox and Peary caribou populations in 1973-74 on the Parry Islands, Arctic Canada. Canadian Wildlife Service, Progress Note, No. 56. 10 pp.

Parmelee, D.F. 1970. Breeding behaviour of the sanderling in the Canadian High Arctic. *Living Bird* 9: 97-146.

____________ 1972. Canada's incredible arctic owls. *Beaver* (Summer 1972): 30-41.

Parmelee, D.F. and R.P. Payne. 1973. On multiple broods and the breeding strategy of arctic sanderlings. *Ibis* 15: 218-226.

Peters, H.S. 1934. V. Mallophaga from birds of Southampton Island, Hudson Bay. *Mem. Carnegie Mus.* 12(2), sect. 4: 35-37.

Rasnitsyn, A.P. 1964. [on hibernation of Ichneumon-flies (Hymenoptera Ichneumonidae)]. [In Russian, English summary]. *Ent. Obozr.* 43: 46-51. (Translation in *Ent. Rev.* 43(1): 24-26).

Roback, S.S. 1971. The adults of the subfamily Tanypodinae (=Pelopiinae) in North America (Diptera: Chironomidae). *Monogr. Acad. Nat. Sci. Phila.* 17. 410 pp.

Roots, E.F. 1963. Bathurst Island group - physiography. pp. 580-585 *in* Y.O. Fortier (Ed.), Geology of the north-central part of the Arctic Archipelago, Northwest Territories (Operation Franklin). *Geol. Surv. Can. Mem.* 320. 671 pp.

Ryan, J. 1977. Invertebrates of Truelove lowland. Appendix 7, pp. 699-703 *in* L.C. Bliss (Ed.), Truelove lowland, Devon Island, Canada: A high arctic ecosystem. U. Alta. Press, Edmonton. 714 pp.

Ryan, J.K. and C.R. Hergert. 1977. Energy budget for *Gynaephora groenlandica* (Homeyer) and *G. rossii* (Curtis) (Lepidoptera: Lymantriidae) on Truelove lowland. pp. 395-409 *in* L.C. Bliss (Ed.), Truelove lowland, Devon Island, Canada: A high arctic ecosystem. U. Alta. Press, Edmonton. 714 pp.

Samuel, W.M. and D.R. Gray. 1975. Parasitic infection in muskoxen. *J. Wildlife Man.* 38(4): 775-782.

Schuster, R. and I.T. Schuster. 1977. Ernährungs- und Fortpflanzungs-biologische Studien an der Milbenfamilie Nanorchestidae (Acari, Trombidiformes). *Zool. Anz.* 199: 88-94.

Stach, J. 1962. On the fauna of Collembola from Spitsbergen. *Acta. Zool. Cracoviensia* 7(1): 1-20, 5 pl.

Strandtmann, R.W. 1971. The eupodoid mites of Alaska (Acarina: Prostigmata). *Pacif. Insects* 13: 75-118.

Strandtmann, R.W. and H.B. Morlan. 1953. A new species of *Hirstionyssus* and a key to the known species of the world. *Tex. Rep. Biol. Med.* 11: 627-637.

Sutcliffe, A.J. 1977. Further notes on bones and antlers chewed by deer and other ungulates. *Deer* 4 (2): 73-82.

Taylor, A. 1956. Physical geography of the Queen Elizabeth Islands, Canada. American Geographical Society, New York. 12 vols.

Taylor, P.S. 1973. Breeding behaviour of the Snowy Owl. *Living Bird* 12: 137-154.

__________ 1974. Summer population and food ecology of jaegers and Snowy owls on Bathurst Island, N.W.T., emphasizing the Long-tailed Jaeger. M.Sc. thesis, University of Alberta, Edmonton. 168 pp.

Thienemann, A. 1941. Lapplandische Chironomiden und ihre Wohngewässer. *Arch. Hydrobiol. Suppl.* 17. 253 pp.

__________ 1954. *Chironomus.* Leben, Verbreitung und Wirtschaftliche Bedeutung der Chironomiden. *Binnengewässer* 20. 834 pp.

Thompson, H.A. 1967. The climate of the Canadian Arctic. Queen's Printer, Ottawa.

Thor, S. and C. Willman. 1941. Acarina Prostigmata 6-11 (Eupodidae, Penthalodidae, Penthaleidae, Rhagidiidae, Pachygnathidae, Cunaxidae). *Tierreich* 71: 1-186.

Tipton, V.J. 1960. The genus *Laelaps* with a review of the Laelaptinae and a new sub-family Alphalaelaptinae (Acarina: Laelaptidae). *Univ. Calif. Publs. Ent.* 16: 233-356.

Townes, H.K. 1945. The nearctic species of Tendipedini. *Am. Midl. Nat.* 34: 1-206.

Tuomikoski, R. 1967. 6. Mycetophilidae and Sciaridae from Spitsbergen, collected by Dr. J. Kaisila in 1965. pp. 43-51 *in* J. Kaisila, Notes on the arthropod fauna of Spitzbergen. I. *Ann. ent. Fenn.* 33: 13-64.

Turnbull, A.L., C.D. Dondale, and J.H. Redner. 1965. The spider genus *Xysticus* C.L. Koch (Araneae: Thomisidae) in Canada. *Can. Ent.* 97: 1233-1280.

Valpas, A. 1967. 4. Collemboles of Spitsbergen. pp. 28-40 *in* Kaisila, J. Notes on the arthropod fauna of Spitzbergen I. *Ann. ent. Fenn.* 33: 13-64.

Van Eyk, S.W. and J.W. Sheard. 1976. Plant ecological research in Polar Bear Pass, Bathurst Island, N.W.T. Unpub. report, University of Saskatchewan. 134 pp.

Watson, D.G., J.J. Davis, and W.C. Hanson. 1966. Terrestrial invertebrates. pp. 565-584 *in* N.J. Wilimovsky and J.N. Wolfe (Eds.), Environment of the Cape Thompson region, Alaska. U.S. Atomic Energy Commission.

Weber, N.A. 1950a. A survey of the insects and related arthropods of arctic Alaska. *Trans. Am. ent. Soc.* 76: 147-206.

__________ 1950b. The role of lemmings at Point Barrow, Alaska. *Science* 111: 552-553.

Webster, W.A. 1974. Records of cestodes in varying lemmings and arctic fox from Bathurst Island, N.W.T. *Can. J. Zool.* 52: 1425-1426.

Welch, H.E. 1973. Emergence of Chironomidae (Diptera) from Char Lake, Resolute, Northwest Territories. *Can. J. Zool.* 51: 1113-1123.

__________ 1976. Ecology of Chironomidae (Diptera) in a polar lake. *J. Fish. Res. Bd. Can.* 33: 227-247.

Whittaker J.O., Jr. and N. Wilson. 1974. Hosts and distribution lists of mites, parasitic and phoretic, in the hair of wild mammals of North America, North of Mexico. *Am. Midl. Nat.* 91: 1-67.

Williams, G.L., R.L. Smiley, and B.C. Redington. 1978. A taxonomic study of the genus *Haemogamasus* in North America, with descriptions of two new species (Acari: Mesostigmata: Laelapidae). *Int. J. Acarol.* 4: 235-273.

Wolff, N.L. 1964. The Lepidoptera of Greenland. *Meddr Grønland* 159(1). 74 pp.

Zumpt, F. 1956. Calliphorinae. 64.i. *In* E. Lindner (Ed.), Die Fliegen der Paläarktischen Region 190; 191; 193: 1-140. Stuttgart.

Appendix I. Preliminary analysis of some general features of the Bathurst Island arthropod fauna.

Species	Distribution		Habitat	Food	Vertebrate Association
Araneae					
Xysticus deichmanni	N	A	T	P	F
Collinsia spetsbergensis	C	A	W	P	F
Erigone psychrophila	C	A	W	P	F
Diplocephalus barbatus	H	A	T	P	F
Acari					
Arctoseius ornatus	N?	A	T	P?	O?
A. minor	N?	A	T	P?	O?
A. weberi	N?	?	T	P?	O?
A. multidentatus	N?	A	T	P?	O?
A. sp. nr *robustus*	?	A?	T	P?	O?
Amblyseius sp. nr *atsak*	?	?	T	P	O
Laelaps alaskensis	N	S	O	V	P
Haemogamasus ambulans	H	S	O	V	P
Hirstionyssus isabellinus	H	S	O	V	P
Hypoaspis sp. nr *nolli*	?	A	T	P?	?
Nanorchestes collinus	H	S	T	H?	?
Terpnacarus bouvieri	H	A	T	?	?
Eupodes sp.	?	?	T	S?	?
E. wisei	C?	(A)	T	S?	?
Protereunetes boerneri	H	A	T	S?	P?
Cocceupodes curviclava	H	?	T	S?	?
Penthalodes ovalis	C	?	T	?	?
Rhagidia spelaea	H?	?	T	P	O
R. uniseta	C	A	T	P	O
Coccorhagidia clavifrons	W?	S	T	P	O
Tydeus 2 spp.	?	?	T	?	?
T. interruptus	H	?	T	?	?
Microtydeus sp.	?	?	T	?	?
Bdella muscorum	C	A	T	P	O

Species	Distribution		Habitat	Food	Vertebrate Association
Bakerdania sp.	?	?	T	P	?
Radfordia macdonaldi	?	?	O	V	P
Stigmaeus sp. nr *sphagneti*	?	?	T	P	O
Eustigmaeus sp. nr *lacuna*	?	?	T	H	O
Dermacarus hypudaei	N	S	O	(V)	P
Myocoptes japonensis canadensis	N	S	O	V	P
Liochthonius scalaris	H	A	W	S	?
Epidamaeus longitarsalis	N	A	T	S	?
Tectocepheus velatus	H	S	T	S	?
Suctobelbella setosoclavata	N	A	T	S	?
Trichoribates polaris	N	A	T	S	?
Iugoribates gracilis	N	A	W	S	?
Collembola					
Hypogastrura sp. *trybomi* group	?	?	T	S	?
Podura aquatica	C	S	T-F	S	?
Onychiurus groenlandicus	H	A	T	S	?
Isotomurus palustris	W	(S)	W	S	F
Isotoma violacea	H	S	T	S	?
Folsomia quadrioculata	C	A	W	S	?
Phthiraptera					
Strigiphilus ceblebrachys	C	(S)	O	V	P
Lagopoecus affinis	C	(S)	O	V	P
Anatoecus sp.	C	S	O	V	P
Hoplopleura acanthopus	C	S	O	V	P
Diptera					
Trichocera borealis	C	A	T	S	?
T. columbiana	N	S	T	S	P
Procladius culiciformis	C	S	F	P	F
Diamesa 2 spp.	?	?	F	S	F
Pseudokiefferiella sp.	?	?	F	S	F
Corynoneura sp.	?	?	F	S	F

Species	Distribution		Habitat	Food	Vertebrate Association
Chaetocladius sp.	?	?	F	S	F
Cricotopus laricomalis	H	S	F	S	F
Diplocladius sp.	?	?	F	S	F
Limnophyes 2 spp.	?	?	F	S	?
Metriocnemus ursinus	C	A	F-T	S	F
Metriocnemus 2 spp.	?	?	F	S	F
Orthocladius 2 spp.	?	?	F	S	F
O. (P.) consobrinus	C	S	F	S	F
Paraphaenocladius despectus	N	A	F	S	F
Prosmittia nanseni	N	A	F	S	F
Psectrocladius polaris	N	A	F	S	F
Psectrocladius 2 spp.	?	?	F	S	F
Smittia 2 spp.	?	?	F-T	S	F
Unknown sp.	?	?	F	S	F
Chironomus 2 spp.	?	?	F	S	F
Phaenopsectra sp.	?	?	F	S	F
Stictochironomus unguiculatus	N	A	F	S	F
Paratanytarsus sp.	?	?	F	S	F
Tanytarsus gracilentus	C	S	F	S	F
T. norvegicus	C	S	F	S	F
T. sp.	?	?	F	S	F
Exechia frigida	C	A	T	S	?
Sciophila sp.	?	?	T	S	?
Bolitophila sp.	?	?	T	S	?
Bradysia 3 spp.	?	?	T	S	P?
Cecidomyiidae sp.	?	?	T	?	(?)
Arctopiophila arctica	H	A	T	S	P
Fucellia pictipennis	N	A	T	S	?
Spilogona almquistii	C	A	F-T	P	?
S. latilamina	N	A	F-T	P	?
S. obsoleta	C	A	F-T	P	P?
S. sanctipauli	C	A	F-T	P	?
S. dorsata	H	A	F-T	P	?
S. melanosoma	N	A	F-T	P	?

Species	Distribution		Habitat	Food	Vertebrate Association
S. extensa	N	A	T	P	?
S. micans	H	A	T	P	?
Spilogona tundrae	C	A	T	P	?
Pogonomyioides segnis	H	A	T	S?	?
Boreellus atriceps	C	A	T	S	P,F
Lepidoptera					
Psychophora sabini	C	A	T	H	F
Gynaephora sp.	N	A	T	H	F
Hymenoptera					
Amauronematus sp. nr *articola*	?	?	T	H	?
Ichneumon sp.	?	?	O	P	F
Meloboris sp.	?	?	O	P	?
Atractodes sp.	?	?	O	P	?
Stenomacrus sp.	?	?	O	P	?

Key

Distribution:
- C: Circumpolar
- H: Holarctic (circumpolarity not established)
- N: Nearctic
- W: Worldwide (cosmopolitan)

- A: Arctic only
- S: Arctic and southern (boreal forest southwards)

Habitat:
- F: Freshwater
- O: Other organisms
- T: Terrestrial
- W: Widespread in terrestrial habitats

Food (larval food in endopterygotes):
- H: Herbivores

P: Predators/parasitoids (of invertebrates)

S: Scavengers/saprovores (includes particle feeders in aquatic species, and fungivores, omnivores, etc., normally associated with decomposition processes in soil habitats)

V: Vertebrate parasites

?: Unknown

Vertebrate Association:

F: Vertebrates use the species as food

O: Probably none

P: Uses vertebrate products as food (includes nest associates, dung and carrion feeders, etc.); or parasitizes vertebrates

?: Unknown

RECENT SYLLOGEUS TITLES/TITRES RECENTS DANS LA COLLECTION SYLLOGEUS

No. 13 Jarzen, David M. (1977)
THE POLLEN AND SPORE REFERENCE COLLECTION AT THE NATIONAL MUSEUMS OF CANADA. 15 p.

No. 14 Argus, George W., and David J. White (1977)
THE RARE VASCULAR PLANTS OF ONTARIO./ LES PLANTES VASCULAIRES RARES DE L'ONTARIO. 63 p/66 p.

No. 15 Harington, C.R. (1978)
QUATERNARY VERTEBRATE FAUNAS OF CANADA AND ALASKA IN A SUGGESTED CHRONOLOGICAL SEQUENCE. i, 105 p.

No. 16 Jarzen, David M., and Gregory J. Whalen (1978)
CATALOGUE OF THE POLLEN AND SPORE EXCHANGE COLLECTIONS, NATIONAL MUSEUM OF NATURAL SCIENCES. 29 p.

No. 17 Argus, George W., and David J. White (1978)
THE RARE VASCULAR PLANTS OF ALBERTA./LES PLANTES VASCULAIRES RARES DE L'ALBERTA. 46 p./47 p.

No. 18 Maher, Robert V., David J. White, and George W. Argus (1978)
THE RARE VASCULAR PLANTS OF NOVA SCOTIA./LES PLANTES VASCULAIRES RARES DE LA NOUVELLE-ECOSSE. 37p./38p.

No. 19 Boullard, Bernard (1979)
CONSIDERATIONS SUR LA SYMBIOSE FONGIQUE CHEZ LES PTERIDOPHYTES. 59 p.

No. 20 Maher, Robert V., George W. Argus, Vernon L. Harms, and John H. Hudson (1979)
THE RARE VASCULAR PLANTS OF SASKATCHEWAN./LES PLANTES VASCULAIRES RARES DE LA SASKATCHEWAN. 55 p./57 p.

No. 21 Brunton, D.F. (1979)
THE VASCULAR PLANT COLLECTIONS OF JOHN MACOUN IN ALGONQUIN PROVINCIAL PARK, ONTARIO. 20 p.

No. 22 Warkentin, John (1979)
GEOLOGICAL LECTURES OF DR. JOHN RICHARDSON, 1825-26. 63 p.

No. 23 Cody, William J. (1979)
VASCULAR PLANTS OF RESTRICTED RANGE IN THE CONTINENTAL NORTHWEST TERRITORIES, CANADA. 57 p.

No. 24 Haber, Erich and James H. Soper (1979)
VASCULAR PLANTS OF GLACIER NATIONAL PARK, BRITISH COLUMBIA, CANADA.