ARCTIC
INSECT
NEWS

No. 2
1991

IN THIS ISSUE:

EDITOR'S COMMENTS

The first issue of *Arctic Insect News* elicited a very favourable response, and many comments and ideas as well as several articles for the newsletter have been received. Thank you all for your interest.

This issue contains two new occasional elements: *Feature locality*, for articles that will summarize the setting and general nature of particular field sites of biological interest; and *Feature species*, providing details about particular species of arctic arthropods that have been studied in enough detail to discover interesting biologies, adaptations or taxonomic affinities. Further contributions for these feature series are welcome.

The Biological Survey's arctic project is proceeding well, as indicated by some of the ongoing field work described in this issue. Copies of the Survey's brief "Arctic invertebrate biology: action required" are still available from the Biological Survey on request. As a basis for further efforts, a paper entitled "Arctic insects as indicators of environmental change" has also been prepared and is now in press in the journal *Arctic*.

H.V.D.

Arctic Insect News, distributed free of charge, is available on request from the Secretariat, Biological Survey of Canada (Terrestrial Arthropods), Canadian Museum of Nature, P.O. Box 3443, Station D, Ottawa, Ontario, K1P 6P4.

ADAPTATIONS AND ECOLOGY OF ARCTIC INSECTS

The marked reduction of arctic compared to temperate insect faunas (outlined in *Arctic Insect News* 1: 3-5) suggests that the arctic fauna has been rigorously selected for survival in difficult climatic conditions, and indeed many characteristics of arctic insects appear to be adaptive to short cold summers and long cold winters. For example, most species live in warm microhabitats, taking advantage of solar warming at the ground surface. Various species show also melanism, basking behaviour, activity at low temperatures, and opportunistic activity at any time of day provided only that it is warm enough. Aerial mating behaviour may be curtailed, diminishing contact with cool above-ground conditions.

The shortness of the summer is reflected by prolonged life cycles in many species, which overwinter more than once in the larval stage. Two- or three-year life cycles are common, several species take even longer, and the life cycle of the high arctic lymantriid moth *Gynaephora groenlandica* lasts for 14 years. Nevertheless, other species (including mosquitoes and bumble bees) are univoltine. Most species continue to grow and develop at lower temperatures than in temperate relatives. Adults typically emerge as early as possible in the short season, permitting reproduction to take place before winter returns. Winter conditions are met by cold-hardiness, including tolerance of freezing, and selection of particular sites for overwintering. Dormancy seems to be closely controlled in some species, though by no means in all.

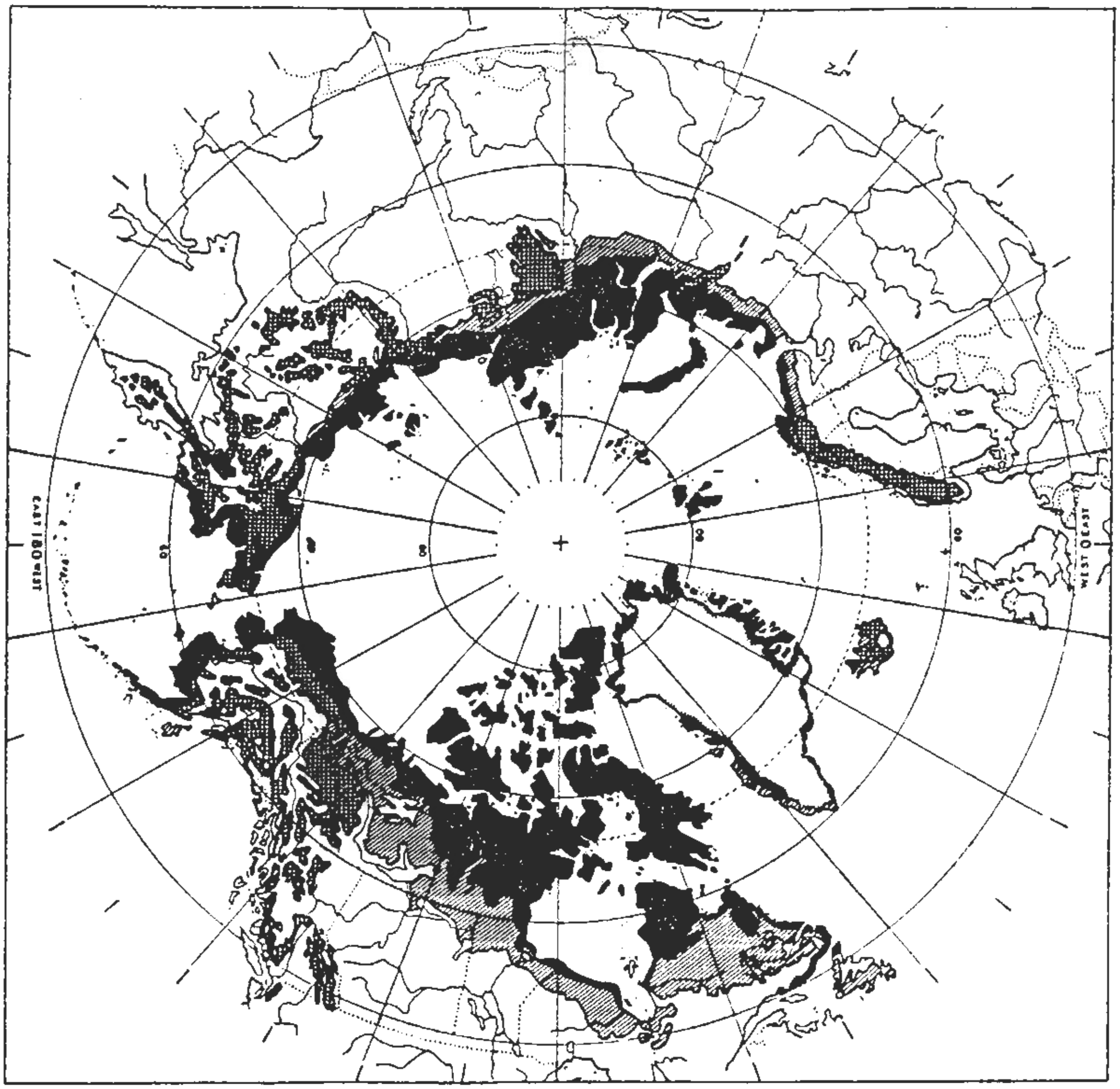
Some species appear to be adapted to shortage of resources of food by using a wider range of foods than in temperate relatives. At least a few species can resist temporary starvation. In some arctic biting flies the blood-feeding habit has been lost. Genetic systems of some arctic species may be adapted to retain variability and fix genotypes, especially by parthenogenesis which is relatively more common among insects in the arctic regions.

None of these types of adaptations is unique to arthropods of the arctic, though they are more frequent and more strongly developed there than in temperate regions. Several features such as precipitate emergence, prolonged life cycles, resistance to shortage of resources, and buffered genotypes reflect various forms of insurance against unpredictable risks, and are best developed in the high arctic.

Both faunal composition and ecological adaptation in the arctic therefore are closely related to the constraints of habitats and resources. Certain general food sources are prevalent, notably detritus and associated microflora, other arthropods, and vertebrates and their products. This favours particular kinds of arthropods, and most northern forms in fact are saprophages, predators, and ectoparasites of vertebrates, whereas the fraction of species that eat vascular plants is much lower than in temperate regions. These trophic features are allied with habitat characteristics: most species are confined to the relatively warm habitats of superficial soil and water – in which insolation raises temperatures – and to the skin of warm-blooded hosts.

Despite the "simplification" of arctic habitat structure and food supply, there are many cross links within the system, not only among habitats, but also between arthropods and vertebrates (through dung and carrion, ectoparasitism, and vertebrate predation), arthropods and microorganisms (especially in the decomposer complex), insects and flowers, insects and parasitoids, and various arthropods and their invertebrate predators. Thus the arctic ecosystem is not the simple system sometimes believed, despite the reduced numbers of species.

In summary, the nature of the arctic insect fauna is known in broad outline, but many questions remain about this characteristic life-zone in Canada. Most striking about what we know is (1) the apparent correspondence of the ecological valency and taxonomic



composition of the fauna with known ecological pressures; (2) the complexity of interactions among arthropods, other organisms of all sorts, and climate, in the supposedly "simple" arctic system.

Most striking about what we do not know, is (1) the lack of basic knowledge of taxonomy, distribution and variation; (2) the lack of understanding of the functioning of arctic systems except through crude measures of energy flow or diversity. This understanding would be favoured by studies that are more detailed and of longer term than most temporary expeditions to the arctic have hitherto allowed.

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H.V.D.

ARCTIC SPRINGTAILS - COLLEMBOLA

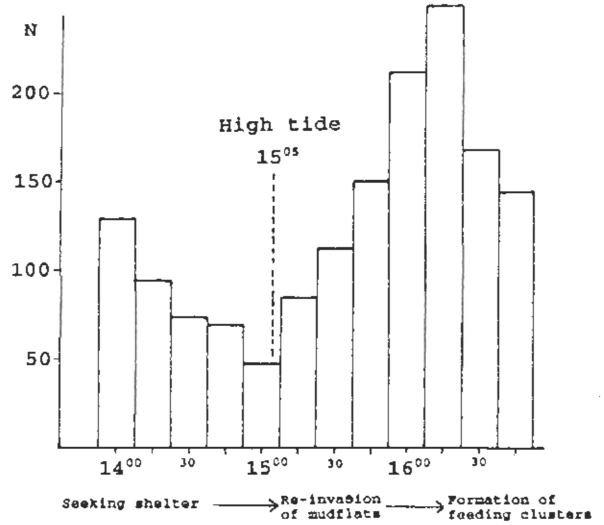
While low temperatures and short summers may limit the occurrence of tender butterflies and clumsy beetles in the arctic tundra, this adverse environment is a favourite playground for a great many species of Collembola which are well adapted to severe climate. Springtails - an early offshoot from the evolutionary line which produced the insects - never had wings to lift them out of the relatively warm and protected environment of the soil and plant cover, and their physiology enables them to remain active at around zero temperatures. A short activity season is compensated by long life cycles. Some arctic species spend 3-5 years as juveniles before they reproduce. Others probably speed up and reproduce the same summer as they hatch from the eggs. The tiny members of the genus *Sphaeridia* will hatch and grow to egg-laying adults within a week in warm environments. They also occur in arctic tundra, but so far we have no information about their life cycle there.

Low winter temperatures are met with supercooling. In the laboratory Collembola may cool to -40°C before body fluid freezes. In natural conditions they probably tolerate even lower temperatures. Low winter temperatures are often associated with desiccation, in particular on exposed sites with sparse snow cover. So far we do not know if arctic Collembola have special drought adaptations. However, anhydrobiosis is common in species living in arid environments in the south. *Sphaeridia* and other forms from the semideserts on the Canary Islands survived - dry as dust - in sand and plant litter in an open jar in a museum office for 15 months. After wetting of the substrate, they "refueled" their cells and became active after a few hours. We should probably collect winter samples from the "polar deserts", give them an extra freeze-dry and see what comes out after rewetting.The long life cycles may account for the accumulation of individuals and generations which gives unusually high population densities in certain tundra types. In mesic moss tundra in Spitsbergen 200 000 - 300 000 inds./m^2 is not unusual, corresponding to a biomass of several grams per m^2. The standing crop is high, but turnover is low. In temperate and tropical soils it is usually the other way around, though densities are often less than 10% of the above figures.

A few species of Collembola are predators on other small soil invertebrates, but most are phytophagous or saprophagous, feeding on lichens, algae, fungi and decaying plant material. The actual sources of energy and nutrients of the saprophages are probably fungi and bacteria which are ingested with the detritus. By chewing and ingestion of plant fragments, Collembola produce fecal pellets consisting of small particles with a great surface area. Such fecal pellets are more easily decomposed by fungi and bacteria than the original substrate. In this way the Collembola catalyze the microbial mineralisation process. In arctic soils, with generally low microbial activity and lack of earthworms and larger invertebrates, the role of Collembola as primary decomposers and producers of humus is probably more prominent than in temperate soils.

In the arctic food-web Collembola are on the menu of predatory mites, spiders and beetles. Birds also have a taste for these small, fleshy animals. Snow bunting and Lapland bunting may feed exclusively on snow-surface Collembola (at a rate of 1-2 per second!) when they arrive in Greenland during May. Several species of waders selectively pick Collembola from tidal mudflats and the shores of lakes, ponds and streams. An individual of the purple sandpiper, shot on Spitsbergen, had more than 900 Collembola in the stomach.

The success of Collembola in the arctic is reflected in their relatively high species diversity. While only 9 species of beetles occur in Spitsbergen (more than 3 000 in mainland Norway), 46 species of Collembola are present (about 300 in mainland Norway). A handful of soil from the North Slope of Alaska may contain more than 20 species of Collembola.

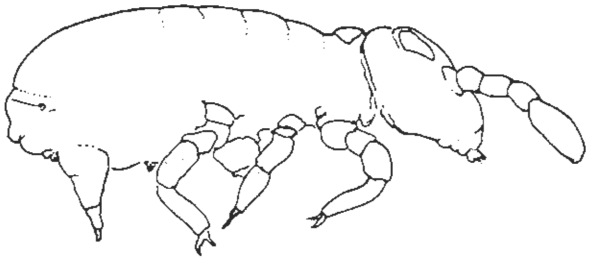


Tidal rythmicity in feeding behaviour of *Archisotoma polaris* grazing algae on mudflats at Alexandria Fiord, Ellesmere Island, 29th July 1983. 15-minute catches in a pitfall trap with 22 mm opening.

Most of the time animals sit in feeding clusters on spots particularly rich in green algae, without moving much around. When high tide approaches, clusters dissolve and animals move around to find suitable stones under which they shelter until tide falls again. They then re-invade the mudflats and form new feeding clusters. The trap was placed in a "migratory area" between feeding clusters. Minimum activity is precisely timed with onset of maximum high tide (15.05 h). At this particular spot the tide stopped 3-4 m away, so animals could just as well have kept on grazing. However, the tidal rythmicity of about 12.5 hours has "locked" the behaviour of the species.

High arctic sites have a large proportion of circumpolar Collembola. The arctic islands of Norway have 55 species, of which 80% are holarctic. The Queen Elizabeth Islands of Canada have 50 species, 75% holarctic. There is no modern survey of Greenland Collembola, but 90% of the about 50 known species are holarctic. The overall uniformity of high arctic faunas probably reflects a combination of short geographical distances and good dispersal capacity of the Collembola. Dry (anhydrobiotic) specimens – if they are present – may easily get blown around by the wind. Running waters (meltwater, streams, sea currents) carry a lot of Collembola on their surface. Another possibility is transpolar dispersal with ice-drift. During the violent spring thaw, large amounts of terrestrial material are washed away from the arctic shores. If a chunk of a Siberian river bank is stranded on an ice floe and enters the ice drift, it can theoretically reach the waters between Greenland and Spitsbergen in 2 years time. Collembola and other terrestrial invertebrates will no doubt survive if there is enough in situ organic substance to feed on during the short periods of above-zero temperatures. Searching the offshore sea ice for material of terrestrial origin would be most interesting!

In low arctic tundra and the northern taiga zone the proportion of endemic species increases rapidly – in particular where mountains provide a variety of exposures and altitudinal gradients. All of Alaska probably



Mackenziella psocoides Hammer. Two specimens of this peculiar and minute (0.3 mm) Collembola were discovered by the Danish zoologist Marie Hammer in the Mackenzie River delta in 1948. It was placed in a new family, Mackenziellidae, with such obscure affinities that various authors pushed it from the one end of the classification system to the other. It was not until the males were discovered on the Canary Islands in 1987, that its position could be fixed to near Sminthurididae where its closest relative – *Sphaeridia* – belongs. In the meantime there had been a few records from southern Germany and north Norway. Like *Sphaeridia* it probably has drought resistant eggs which may experience long-distance wind dispersal. This may explain the unusual geographical distribution of the species.

has some 300-400 species of Collembola, of which 20-30% are undescribed. In northeast Siberia, on the other side of the Bering Strait, the number of undescribed species appears to be even higher. However, the currently low level of precision of the systematics of these faunas makes judgements about endemism and biogeography rather speculative.

The importance of Collembola in tundra ecosystems is now being acknowledged in various research groups in the north, and efforts are being made to improve the systematic knowledge of the faunas. In 1988 an identification key to collembole genera of the entire Soviet Union was published. A team of Russian soil zoologists - operating in close contact with West European taxonomists - is preparing keys to all known species of the territory. In the North American arctic nobody works with Collembola systematics, apart from a single European now and then.

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A.F.

ELLESMERE ISLAND REVISITED

For two summers (1990, 1991) I have been preparing an inventory of insects and related arthropods at Hot Weather Creek on the Fosheim Peninsula, Ellesmere Island. This site is one of several selected by the Geological Survey of Canada to monitor global change. Extensive collections by entomologists in the early 60's at Lake Hazen, Ellesmere Island, and the resultant publications, are making my task easier.

1990 was a good collecting year. The quantity of organisms that my pan, pitfall, and Malaise traps caught was amazing, especially considering the vegetation was no more than ankle high in most places. Except for the ubiquitous mosquitoes and a few of the more glamorous insects, the other researchers (mostly geographers) had never noticed the insects under their boots.

1991 was quite different. The small amount of snow that had fallen was swept away in a windstorm, long before snow-melt time. Consequently, at Hot Weather Creek, the arctic spring was unusually dry. (Water comes from snow, rain or permafrost melt; there are no glaciers here.) All water bodies shrank and many completely disappeared. However, in early August the rains came, making a mockery of the notion of an arctic desert here.

In 1990 I discovered that the conspicuous, irregular networks of tracks in the mud bordering most water bodies were made by crane fly larvae (*Tipula besselsi*). These larvae, probably detritus feeders, tunnel along just beneath the mud surface, usually submerged under water. The adults were among the commonest insects on the wing. In 1991, however, larval tracks were almost nonexistent and the adults were correspondingly scarce. My guess is that the larvae suffered both from desiccation and heavier predation because the wading birds (Ruddy Turnstones mostly) could more easily reach their prey.

Similarly, in 1990 it was easy to find *Isochnus arcticus*, a little weevil making blotch mines on *Salix arctica*, the dominant plant of this region. While monitoring the progress of weevil metamorphosis, I discovered a chalcid parasite on almost 50% of these weevils. In

1991, by comparison, almost no blotch mines appeared on the new crop of willow leaves yet I readily found adult beetles and chalcid pupae within last year's leaf mines where they had overwintered. The drastic reduction of a new generation of weevils and chalcids may have been caused by a lack of snow cover leaving the overwintering stages vulnerable to mechanical injury.

The dramatic differences between my first two years on Ellesmere underscores the necessity for continual monitoring of a site to establish norms of variation so that long-term trends, should they develop, can be recognized and distinguished from yearly perturbations.

F.B.

FEATURE LOCALITY: POLAR BEAR PASS

BATHURST ISLAND

Polar Bear Pass, Bathurst Island, N.W.T.

Mean July temperature: 5°C (approx.)

Vegetation zone: High arctic

Habitats: Barrens, sedge meadow/marsh, shallow lakes, ponds, river, creeks, other special habitats

Arthropod fauna: Partly known; impoverished (approx. 120 species reported)

Vertebrate fauna and flora: Well known

75°43'N, 98°25'W

Current status: Research station (Canadian Museum of Nature); National wildlife area

Sample points of interest: Arctic oasis; substantial background information on the site; composition and relationships of an impoverished arthropod fauna; adaptations to severe conditions

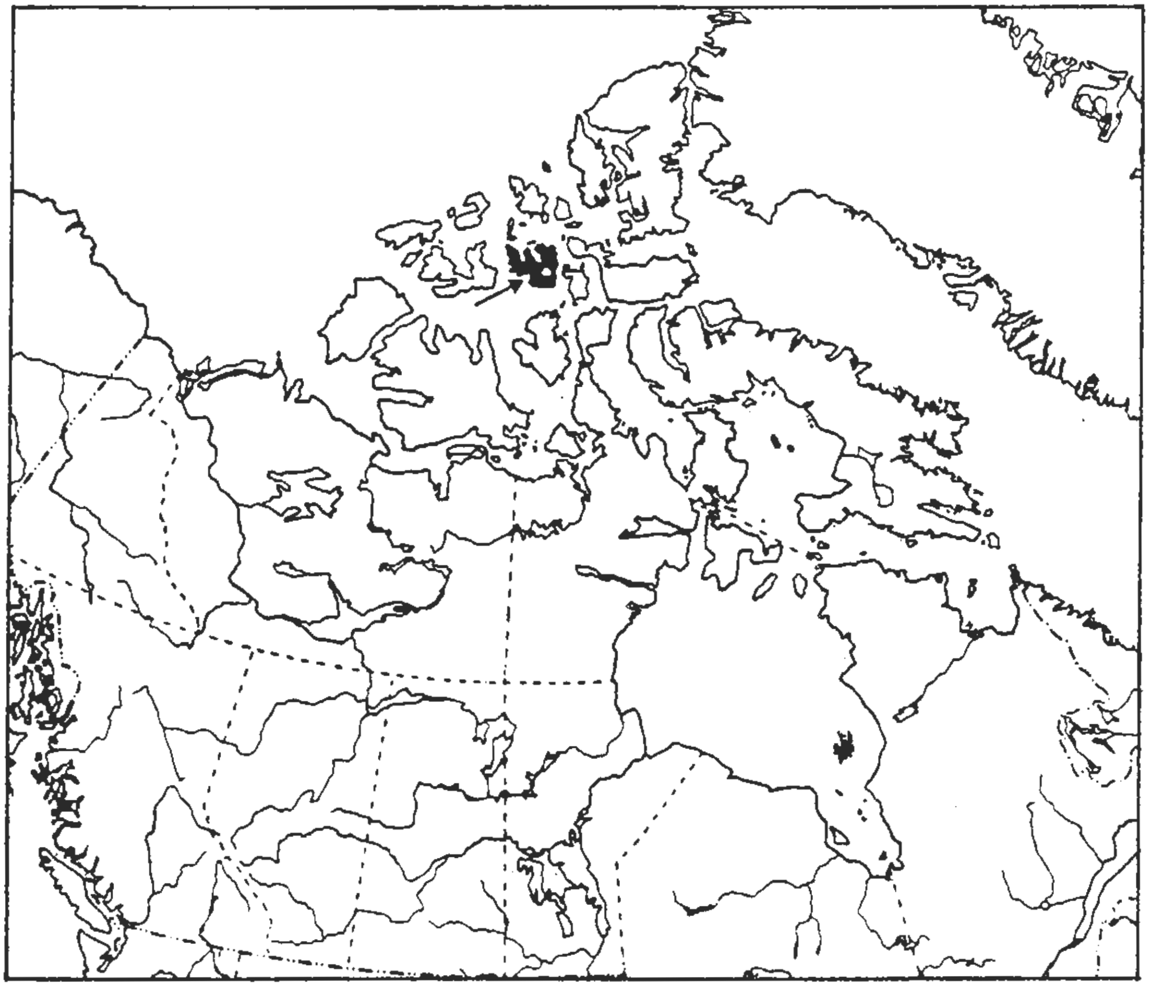
Sample references: Danks and Byers 1972; Danks 1980; Hayes and Murray 1987; Sheard and Geale 1983a, 1983b.

The Bathurst Island complex (18 000 km^2), 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. Bathurst Island itself comprises about 16 380 km^2; its coastline is much dissected and no part is more than 24 km from the Arctic Ocean.

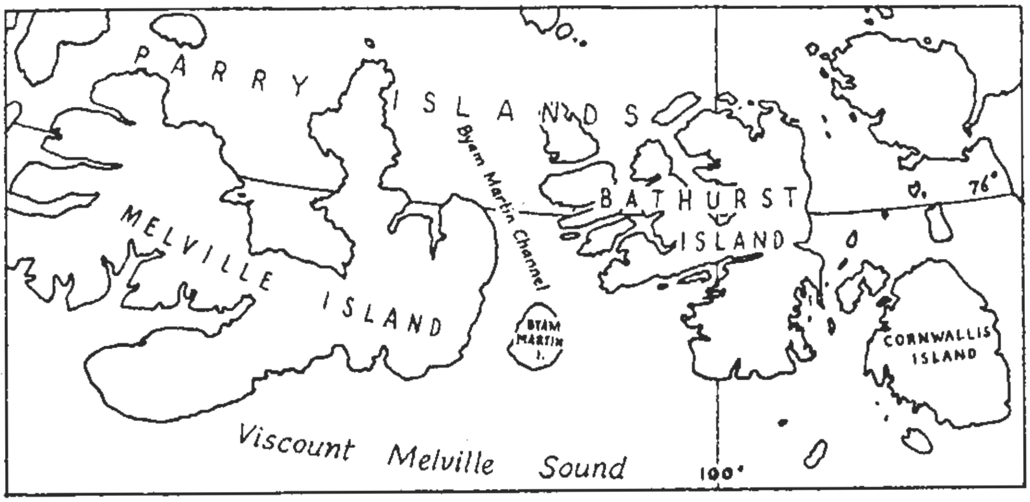
The topography is predominantly rolling, of sedimentary rocks folded into a series of uplands and valleys. Generally the relief does not exceed 365 m, but some uplands reach 460m in elevation. Bathurst Island was undoubtedly glaciated during Wisconsinan time, but mainly by local ice caps and not by the Laurentide (continental) ice sheet. Rapid glacial rebound seems to have taken place since deglaciation, which was extensive by 9000 years ago.

The climate is high arctic, and similar to, though probably slightly colder than, that of nearby Cornwallis Island. Bathurst is in a cloudy area of the arctic, and reduced insolation reduces summer temperatures.

Polar Bear Pass lies in a valley between two inlets of the sea in central Bathurst Island. A research station is located here, on a ridge overlooking the Goodsir River and the rich network of marsh and thermokarst ponds which support most of the local species. A variety of other habitats occur in this locality. Dry to very dry uplands, composed of



Location of Polar Bear Pass, Bathurst Island, in the Canadian Arctic



Bathurst Island and adjacent islands

shattered limestone, are relatively barren because they are well drained, and are characterized by *Saxifraga* and *Dryas*; *Salix arctica* and many other plants occur on less exposed sites; sedges dominate the wet lowlands. At least 42 species of birds feed on Bathurst Island and 26 species nest there, many of them exploiting insects. Eight species of terrestrial mammals have been recorded.

The arthropod fauna is impoverished, in accordance with the conditions in this cold, cloudy part of the arctic, which has been referred to as the "northwestern gap" or the "barren wedge". Some species dependent on a relatively warm growing season for development, or dependent on sunshine for activity, and present elsewhere in the high arctic, such as butterflies, bumble bees and mosquitoes, appear to be missing. Species characteristic of the harshest high arctic sites, such as chironomid midges and the geometrid moth *Psychophora sabini*, are most conspicuous. Only about 120 terrestrial arthropod species have so far been reported from Bathurst Island, including about 75 species of insects (more than half of them chironomids) and nearly 40 species of mites, most of which (together with spiders and springtails) live in relatively warm microsites at the soil surface. The climatic severity of this site, coupled with its diverse and rich habitats, make it potentially valuable for the study of species at the limits of their range and of various kinds of adaptations to short, cold seasons.

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H.V.D.

CURRENT ARCTIC RESEARCH

ENTOMOLOGISTS IN THE NORTH THIS SUMMER (1991)

Field parties from the University of Victoria (UVic) were in the North from 6 June until 14 August, 1991. During the peak period in late July, 8 people were present in field camp, involved to a greater or lesser extent in one or more of the research projects summarized in the following subsection.

Dr. *Olga Kukal* (O.K.) and *Tom Allen* (T.A.) set up base camp at Alexandra Fiord at 80° North on the East coast of Ellesmere Island (via Polar Continental Shelf Project, Resolute Bay) on 6 June, 1991 and were followed in sequence by:

Dr. *Lynn Gillespie*, botanist, Smithsonian Institution, Washington, D.C. (L.G.)
Mr. *Dean Morewood*, graduate student, UVic. (D.M.)
Dr. *Tanya Rossolimo*, visiting scientist, USSR Academy of Sciences, Moscow (T.R.)
Mr. *Jeff Lemieux*, honours student, UVic. (J.L.)
Dr. *Richard A. Ring*, project leader, UVic. (R.A.R.), and
Mr. *Adrian De Bruyn*, graduate student, UVic. (A.D.)

Later, Ring, Kukal, Allen, De Bruyn and Rossolimo moved to the western arctic where they collected and made observations at the Inuvik Scientific Resources Centre (Science Institute of the NWT) on the Tuktoyaktuk Peninsula (Polar Continental Shelf Project Station), and in the Richardson Mountains (from the PCSP station, Tuktoyaktuk).

Dr. *Fenja Brodo* completed another entomology-related contract for the Geological Survey of Canada at Hot Weather Creek near Eureka on western Ellesmere Island. The report of this work will concentrate on Chironomidae and should be available soon. An overview of the 1990 and 1991 work appears elsewhere in this newsletter.

Ms. *Sharron Meier*, M.Sc. student with Dr. *Joe Shorthouse* at Laurentian University, Sudbury, Ontario, completed the field work for her thesis on the ecology of endophytophagous insects of *Pedicularis* in the high arctic at Princess Marie Bay on eastern Ellesmere Island. Congratulations to Sharron on her marriage to Jim Godden, Base Manager of the PCSP station at Eureka, Ellesmere Is.

SYNOPSIS OF SOME CURRENT PROJECTS

Cold adaptations of arctic invertebrates: mechanisms mediating freezing tolerance (O.K., T.R., R.A.R., and A.D.)

The aim of this research is to elucidate the life cycles and overwintering stages of several species of invertebrates, as well as their behavioural thermoregulation and overwintering strategies. The species studied include *Gynaephora groenlandica* and *G. rossii* (Lymantriidae), *Colias hecla* (Pieridae), *Clossiana [Boloria] polaris* (Nymphalidae), *Hydroporus polaris* and *H. morio* (Dytiscidae), *Exorista* sp. (Tachinidae), *Tarentula exasperans* (Araneae), and several other species of Carabidae, spiders, tardigrades and mites.

Live specimens were collected and shipped to the University of Victoria for further studies where cryomicroscopy, nuclear magnetic resonance spectroscopy (NMR), differential scanning calorimetry (DSC), high pressure liquid chromatography (HPLC), etc. will be used to compare the cryoprotective systems in freezing tolerant and freezing intolerant animals. Our preliminary results indicate variation among the freezing temperatures and the supercooling points of the different species, but consistent values for the melting points have been determined for the different taxa. Melting and freezing points appear to be independent of the cooling/warming rates below 1°C/min and are similar in different tissue types (e.g., fat body, brain, hemolymph). The freezing and thawing profiles are strictly species-dependent in whole, live animals.

Behaviours of the arctic woolly-bear (*Gynaephora groenlandica*) and of *Clossiana [Boloria] polaris* (Nymphalidae) were observed in the field, and laboratory studies made of the thermal regulatory behaviour of *Clossiana.* Following the disappearance of *G. groenlandica* from the surface of the tundra at the end of July, much to our surprise the congener, *G. rossii*, "resurfaced" and commenced feeding during mid-August (communication with Dr. Fenja Brodo; Hot Weather Creek, W. Ellesmere Is.).

Influence of biotic and abiotic factors on the emergence and feeding activities of aquatic dytiscids (A.D.)

The physical environment and the invertebrate inhabitants were studied in three shallow ponds located on raised ocean beaches in Alexandra Fiord. We found that high winds have a cooling effect on the pond water; winds of 20 knots can cause the water temperature to drop nearly 10°C at 10cm depth. Insolation is crucial in warming up the pond water to almost 20°C during the warmest part of July. Rapid daily fluctuations were observed and were correlated with peaks of nematoceran emergence and feeding activity by predatory dystiscid larvae.

Prey range and preference, intraspecific aggression/cannibalism and their relationship to predator and prey density and predator hunger were investigated in the laboratory using larvae of *Hydroporus morio* and *H. polaris*. Field observations were made of possible basking and spacing behaviour. At Tuktoyaktuk, two species of dystiscids were collected from several somewhat deeper ponds. A brackish lagoon was also sampled for dytiscid species and preliminary cryobiological analysis by DSC indicates moderate supercooling ability and some degree of thermal hysteresis in at least one of these species. Future studies at both of these locations will include a more complete aquatic arthropod inventory, life histories of the predaceous beetles, identification of predator-prey relationships, and a more thorough investigation of physiological and biochemical adaptations to cold. A.D. hopes to extend understanding of insect predation in the arctic and to provide benchmarks for future investigations.

Thermoregulatory behaviour of *Clossiana [Boloria] polaris* (Nymphalidae) (T.A.)

A detailed study was completed of the minimum flight temperature, temperature in flight, minimum activity temperature, and the temperatures of the onset and termination of stupor for *C. polaris*. Data were collected establishing the ability of *Clossiana* to control its body temperature during basking to fractions of 1°C.

The sequential behaviour of feeding preference, basking and flight patterns of *Clossiana [Boloria] polaris* (Nymphalidae) (T.A.)

Studies were undertaken to establish the feeding preference (host plant) of *Clossiana* in both the adult and larval stages. Three distinct flight patterns were documented associated with three different activities: feeding, basking, and evasion of potential predators. The sequential behaviour pattern during peak activity periods was recorded. Initial findings relating to its life cycle indicate that *Clossiana* overwinters as a first-instar larva and that it is univoltine.

Clossiana [Boloria] polaris (Nymphalidae): a freezing-sensitive high arctic lepidopteran with an extremely low supercooling point and large thermal hysteresis (T.A., O.K., R.A.R.)

Whole-organism studies employing differential scanning calorimetry (DSC) on cold-adapted first-instar larvae have established that *Clossiana* is freezing intolerant, has an extremely low supercooling point, and has a large thermal hysteresis. First-instar larvae were reared in the laboratory from eggs collected from adults in the field that mated in captivity. Results from DSC indicate that this species needs to be studied for cryoprotectant composition.

Comparison of invertebrate communities in the dry hummock tundra and wet sedge-meadow (J.L. and T.R.)

Composition and seasonal phenology were compared for invertebrates sampled in the two primary habitats at Alexandra Fiord lowland. The lowland tundra of the area can be divided into two major ecosystems: dry hummock and wetland sedge-meadows. Two Malaise traps, one in each of the ecosystems, were set up and augmented with two series of yellow pan traps, originally intending to sample dolichopodid populations. Samples from the Malaise and pan traps are being sorted and identified, yielding an Honours B.Sc. thesis topic in which guilds of arthropods in the two ecosystems will be analyzed. In addition, weather patterns from microclimatic stations in each of the two areas will be used to explain frequency patterns observed for different insect groups.

Invertebrate recolonization of areas exposed by a retreating glacier (O.K., T.A., R.A.R.)

All the glaciers which move into the Alexandra Fiord lowland have been retreating at a rate of approximately 10m/yr. over the past 10 years. Invertebrate communities were sampled along a transect tracing the retreating glacial front. Vegetation samples were also taken. These were primarily moss and *Dryas integrifolia*; pitfall traps set up in a grid were used to capture mobile invertebrates.

Survey of the vascular plants of the Alexandra Fiord lowland with particular attention to arthropod-plant relationships (L.G., D.M.)

With the expert help of a Smithsonian Institution plant taxonomist, Dr. Lynn Gillespie, we were able to identify plant species not previously collected at Alexandra Fiord. Several host plants for gall-making mites were identified. Experiments were conducted investigating the thermal conditions within microhabitats created by cushion-forming plants, including *Dryas integrifolia*, *Silene acaulis*, *Cassiope tetragona*, and several species of dark-coloured mosses. Particular attention was paid to the changes in temperature over a 24-hour period during sunny and/or cloudy weather. In addition, several species of plants were sampled using Berlese funnels and the arthropods extracted were sorted. Mites were crudely sorted into groups representing sub-orders and possible families. Only a single phytoseiid specimen was collected, identified as an adult female *Amblyseius arcticus* Chant and Hansell; this specimen has been sent to Dr. D.A. Chant at the University of Toronto. Other mites collected represent four suborders (Astigmata, Prostigmata, Mesostigmata, and Oribatida) and several families, some of which were quite abundant; specimens have been sent to Dr. V.M. Behan-Pelletier.

Behavioural thermoregulation and dispersal capabilities of terrestrial invertebrates (T.R.)

This project was one of two undertaken by the visiting scientist from the USSR Academy of Sciences in Moscow. Dr. Tanya Rossolimo sampled invertebrate fauna using a gridwork of pitfall traps and consequently was able to compare statistically the faunal composition of different habitats. The two major habitat types of the lowland (i.e., tundra hummocks and sedge meadows) were compared and contrasted, as well as an altitudinal transect from the bottom of the lowland to the plateau recently exposed by retreating glaciers.

Other specimens have, at this point, been sent to:

Dr. D. Larson, aquatic beetles
Drs. D. Kathman and H. Dastych, tardigrades
Dr. J. Shorthouse, rose galls
Dr. D. Strongman, insects infested by fungus
Dr. R. Anderson, weevils
Dr. K. Coates, enchytraeids.

POTENTIAL PROJECTS FOR THE SUMMER OF 1992

Studies on cold hardiness and other topics will continue at Tuktoyaktuk, and in the Richardson Mountains, by the group at the University of Victoria. Depending on the results of various funding applications, *Richard Ring* may be joined by others including *Dean Morewood* and *Jeff Lemieux*, University of Victoria, Dr. *Roman Hanzal*, as an NSERC International Fellow from Czechoslovakia, and Dr. *Andrew Pullin*, University of Keele, England, who is interested especially in diapause and cold tolerance in Pieridae.

Dr. *Olga Kukal* and *Tom Allen* will continue their research, chiefly on Lepidoptera, at Alexandra Fiord, Ellesmere Island, and will probably be joined by *Adrian De Bruyn*, continuing his studies on aquatic beetles.

Still being planned is the continuation of successful Soviet-Canadian cooperation, with a visit by *Richard Ring*, *Olga Kukal* and *Tom Allen* to selected sites in the USSR as guests of Dr. *Yuri Chernov* and Dr. *Tanya Rossolimo*, USSR Academy of Sciences, Moscow. These sites may include Kamchatka in the far east, the Taimyr peninsula on the northernmost mainland, and the Urals, the apparent centre of diversity for *Gynaephora* spp.

R.A.R., O.K.

OTHER ITEMS OF INTEREST

The *U.K. Arctic Ecology* programme has completed a field season in entomological studies on Spitzbergen. I hope that more information from Dr. W. Block, British Antarctic Survey, and Dr. J. Bale, University of Leeds, will be presented in future issues of *Arctic Insect News*.

Dr. *Jens Böcher*, Zoological Museum, University of Copenhagen, visited Dr. *Richard Ring's* laboratory on 1-9 May, 1991, to discuss the potential for future cooperation between Canada and Denmark (in Greenland) in arctic invertebrate biology. Many possibilities and opportunities already exist for collaborative ventures or are coming into existence, for example, the year-round field station that is being proposed for north east Greenland at Zackenberg.

Another visit to Dr. Richard Ring's laboratory from Dr. *Dolf Harmson*, Biology Department, Queens University, provides a reminder that cooperative research can take place not only among northern entomologists, but also among northern biologists in other scientific disciplines and in other circumpolar nations.

Olga Kukal and *Richard Ring* presented a lecture on Arctic insects and their adaptations at the Inuvik Scientific Resource Centre in August, 1991. This was only one lecture in a series organized by Mr. *Gary White*, the new, young and energetic manager at the IRC, Science Institute of the NWT. It was on a Friday afternoon in the shining arctic sun, and held during the Northern Games. Despite the competition, about 30 people turned out to hear the presentation. Congratulations are due to Gary on a rejuvenated laboratory in Inuvik and to the many people involved in the Science Institute of the NWT.

Richard Ring also participated in a CBC North interview while in the arctic. This broadcast appears to have reached a wide audience: two personal letters were received at UVic, both supporting the arctic research!

R.A.R.

BOOK REVIEW

Lantzov, V.I., and Yu. I. Chernov. 1987. Tipuliform Diptera of the Tundra Zone. Nauka, Moscow. 176 pp. (in Russian)

At the International Congress of Dipterology in Bratislava last year Dr. V.I. Lantzov presented me with a copy of the valuable and comprehensive Memoir on the tipuliform Diptera of the Arctic, written in collaboration with Dr. Yu. I. Chernov. The authors recognise 102 species characteristic of the tundra life-zone of the Palaearctic; 13 Trichoceridae, 48 Tipulidae, and 41 Limoniidae. This is almost twice as many species as the corresponding Nearctic fauna recorded by Danks (1981); however, the balance between the three families is much the same in the two areas, and many of the same genera and subgenera are represented.

Chapter 1 begins with the listing of these 102 species, with individual annotations brief or extensive according to the information available. This is followed by a considerable discussion of the nature, content, and geography of the arctic fauna, and includes maps of the locality records and ranges of 22 selected species or subspecies. The maps cover the full range of each species, whether it is known in the Palaearctic region only or has been found also in the Nearctic. The two following chapters discuss the ecology of arctic tipuloids, first in relation to the landscape and vegetation of the tundra and of the small mammals that live there. The authors then discuss tipuloids as the hosts of parasites – gregarines and mermithids internally and mites externally – and also as the prey of larger animals, especially birds. The work of Dahl on *Trichocera* and of MacLean on Alaskan tipulids is referred to repeatedly; but the greater part of the material derives from Soviet studies, particularly the extensive work of Chernov. The last chapter deals with the special adaptations of arctic tipuloids, with Lantzov's work on *Tipula carinifrons* figuring prominently. *T. carinifrons* is a highly modified species with a strongly brachypterous and heavy-bodied female that emerges from the pupa with the eggs already ripe for laying. There is a set of interesting photographs showing the winged male discovering a female in the process of emerging from the pupa, and of the ensuing mating. *T. carinifrons* exists in at least four races, one occurring almost across arctic Eurasia, two others known from Chukotka and the Kurile Islands respectively, and one in Alaska (i.e. in East Beringia). The predominant theme of this chapter, however, relates to adaptations of the larval biology, or of the life cycle as a whole, both in *T. carinifrons* and in *Trichocera*.

Last, but not least, there is an extensive literature list of over 400 items covering many aspects of the biology of arctic tipuloids. About one-third of these are in Russian, the remainder being in the languages of western Europe. All in all, this is a most useful Memoir; would that we could have it also in English.

J.A.D.

FEATURE SPECIES: THE MOSQUITO *AEDES IMPIGER*

Aedes impiger (Walker)
Diptera: Culicidae

Range: Arctic, high boreal, and alpine; holarctic, including Greenland; transcontinental in North America
Larval habitat: Spring melt water pools
Food: Bacteria (larva), nectar (adults), blood (adult female)
Features of special interest: Precise oviposition site selection; facultative autogeny; longevity
Sample references: Corbet 1967; Corbet and Danks 1973, 1975; Danks and Corbet 1973.

Aedes impiger is one of two species of mosquitoes that occur commonly in the high arctic. The following observations are based on studies there.

The species is univoltine. Eggs are laid near pond margins in summer and hatch when submerged at snowmelt the following spring. The eggs are deposited 5 - 20 mm below the surface in narrow crevices (usually more or less lined with moss) in moist but surface drying soil, up to a few metres away from the current water level. Adult females chose sites sheltered from the wind, and deposit in the warmest sites during the mid-afternoon when the superficial soil layers are warmest. This results in the concentration of eggs in limited areas. These are the areas that first become free of snow in spring, facilitating the earliest possible hatch and development.

Larvae develop rapidly, even at low temperatures - the developmental threshold is only about 1°C - and adults emerge only 3-4 weeks after hatch. Some fail to complete development, pupation and emergence before ponds become dry, and this results in a greater production of females, apparently because the males survive less well in the adverse conditions of drying ponds.

In the high arctic, most of the seasonal emergence takes place over only 7–10 days, but the seasonal position and duration of emergence depend on year-to-year differences in weather. Flight activity of adults is greatest soon after the period of greatest emergence, but some adults, especially females, persist for more than one month after emergence has ended. Both sexes depend heavily on nectar from local plants.

Each ovarian cycle takes over one week in the high arctic, but even so some females complete at least three gonotrophic cycles. Varied reproductive options are available to females. Some females are autogenous in the first cycle, that is they can complete ovarian development without a blood meal. Some females are obligately autogenous - they mature eggs immediately, which are mature in about 10 days. However, in at least some females autogeny is facultative – individuals mature eggs with or without blood, depending on the circumstances. In these individuals, autogenous egg development begins only after about 10 days of blood deprivation. Autogenous egg development, however, results in the production of only about 5 (1–10), rather than about 50 (22–78) eggs. It has been attributed to the uncertain supply of hosts, and provides an individual with the option of perhaps producing many eggs if a host is found, but certainly producing a few if no host is found. There is wide variation in the number of eggs produced, and some individuals retain a few of their eggs ("relict eggs").

The adaptations described for *Aedes impiger* accord with the short cold season, restricted flight activity, and limited supply of hosts in cold arctic environments.

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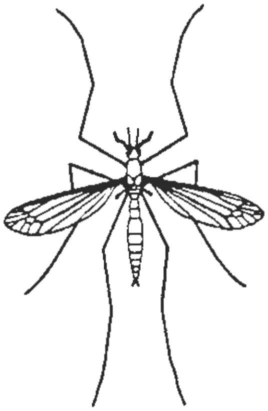
H.V.D.



Crane flies are characteristic of many arctic sites. Several dozen species occur in the Canadian arctic. The larvae of many species are associated with organically enriched sites (including garbage heaps). The large larvae and adults of some species are important foods for tundra birds.

HISTORY CORNER

Only one species of insect was collected during Captain William E. Parry's attempt to reach the north pole in 1827. J.C. Ross (1828) reported the find as follows:

> I am indebted to the friendship of Mr. J. Curtis for the following description of the only insect that was obtained during the voyage; and am most happy to have it in my power to avail myself of the authority of so eminent an entomologist.
>
> "Order, HEMIPTERA, Linn., &c. OMOPTERA, Leach.
> Fam. APHIDAE, Lat. Leach.
> Genus, APHIS, Linn., &c.
> A. Borealis, *Curtis's* MSS.
> Corpus magnum, atrum, hirsutum, femoribus basi ferrugineis: alis magnis, subfuscis, ad costam atris.
>
> "At first sight this insect might be mistaken for *A. Piceae* of *Panzer*, which it resembles in size and colour. Upon a closer examination, however, it will be seen that the whole surface, excepting the wings, is covered with rather long and somewhat hoary tomentum or pubescence; and the base only of the thighs is ferruginous; whereas, in *A. Piceae*, the whole insect is naked, and the antennae, thighs, and tibiae are ferruginous or reddish at their base."
>
> The circumstance of the *Aphis Borealis* having been found on floating floes of ice in the Polar Sea, at one hundred miles distance from the nearest known land, and as far north as 82°3/4, renders it in a more than ordinary degree interesting. Its very near resemblance to the *Aphis Piceae*, which feeds on the silver fir (*Pinus Picea*, Linn.), whence it derives its name, would induce the belief that the floating trees of fir, that are to be found so abundantly on the shores and to the northward of Spitzbergen, might possibly be the means by which this insect has been transported to the northern regions. It was never seen on the wing, and the few specimens that were obtained were in a very languid state, but revived by the heat of the hand.

Nearly 100 years later, Charles Elton (1925) reported large scale dispersal of aphids, syrphids, and other species observed on Spitzbergen in 1924: "The aphids are winged females, and have been identified by Mr. Laing as *Dilachnus piceae Pz* (*nec* Walker, the food-plant being the spruce *Picea* (P. exelsa, etc.)." Consequently, he concluded (Elton 1929) that Ross' "*Aphis borealis* Curtis" in fact was the spruce aphid *Dilachnus piceae*.

More than 20 years elapsed. Then Hottes (1950), apparently unaware of Elton's (1929) conclusion, referred to Curtis' description of "A. Borealis Curtis" and came to the less likely conclusion that this species was the pine aphid *Schizolachnus pineti* (Fab.) = (*Aphis (tomentosa) pini* DeGeer).

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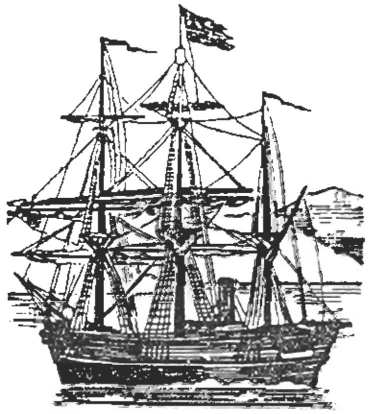
H.V.D.



CONTRIBUTORS TO THIS ISSUE

F.B.	Fenja Brodo is a Research Associate at the Canadian Museum of Nature in Ottawa. In addition to current work on Ellesmere Island, she has particular interests in crane flies, and her recent publications include a review of the genus *Prionocera*, and an account of the crane flies of the Canadian arctic islands.
H.V.D.	Hugh V. Danks is Head of the Secretariat for the Biological Survey of Canada (Terrestrial Arthropods) in Ottawa. He has broad interests in the Canadian and arctic insect faunas, and in modes of seasonal adaptation in insects, such as diapause.
J.A.D.	Antony Downes, formerly of the Biosystematics Research Institute, is a research associate of the Canadian Museum of Nature and of the Lyman Entomological Museum and Research Laboratory, McGill University. His interests include the behaviour, biogeography and evolution of insects, especially of the arctic and of Diptera generally.
A.F.	Arne Fjellberg, Dr. philos., is Curator of Entomology and Head of the Zoological Department at Tromsø Museum, University in Tromsø, Norway. He has broad interests in Collembola systematics and has several field seasons in Alaska, Canada and Siberia. He spent a sabbatical year on the Canary Islands in 1987-1988, and is now writing a monograph of the collembole fauna of the islands while he takes care of a couple of twins resulting from an unusual breeding success in the southern climate.
O.K.	Olga Kukal is an adjunct Professor in the Department of Biology at the University of Victoria, British Columbia. She is interested in several aspects of arctic biology, and in particular has studied the life cycle, many elements of cold hardiness, and other features of the lymantriid moth *Gynaephora groenlandica.*
R.A.R.	Richard A. Ring is a professor in the Department of Biology at the University of Victoria, British Columbia, and is the chairman of the subcommittee for the Biological Survey's arctic project. He has particular interests in insect cold hardiness, and he and several students have worked on features of insect biology, especially in the western arctic.

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