SOLITARY WASPS FROM SUBARCTIC NORTH AMERICA – I. POMPILIDAE FROM THE NORTHWEST TERRITORIES AND YUKON, CANADA

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Spider wasps (Pompilidae) of 19 species were collected in the Northwest Territories during part of the summer in 1967 and 1968 and in Yukon, during part of the summer in 1968. Previous locality records of 6 species in the literature have been added to the list. A list of sample localities is given and discussed in relation to general and local geographical, physiographic, geological, and ecological features of the study areas and adjacent regions. Distribution and composition of this fauna are analyzed in the light of known zoogeography of spider wasps. Holarctic elements and elements with circumpolar distribution are well represented. The range of distribution of some transcontinental elements is surprisingly broad, including regions as far south as California, Arizona, New Mexico, Texas and Mexico. Some northern extensions reach the Arctic Coast area (on the Mackenzie Delta), at least within its subarctic portion in Northwest America, and along the favorable axis of dispersion of the Mackenzie River System.

Fossorial wasps thrive particularly in tropical, subtropical, and warm temperate climates, wherever soil, moisture, and vegetation are adequate. Northern and even Subarctic regions, however, are by no means devoid of hunting wasps; moreover, some species or groups are seen predominantly or exclusively in these areas. Some bees range to the Arctic and High Arctic, in North America to Ellesmere Island for instance (Hocking and Sharplin, 1964, 1965).

Therefore it seemed interesting to obtain some information – limited as it may be – on the northern distribution and composition of wasp faunas, Pompilidae in particular, and on some associated physiographic, geological and ecological features. All sampling localities visited by me are situated south of the Arctic Circle (see Fig. 1).

GENERAL PHYSIOGRAPHIC, GEOLOGICAL, AND ECOLOGICAL PROFILES

The boundaries of the Subarctic Region (see Fig. 1) are not always clear cut, especially the southern one. To the north, the tree-line is generally considered the approximate boundary with the Arctic Region. The interpenetration of trees and tundra, however, complicates the pattern.

Fossorial wasps were collected in two areas: the Great Slave Lake area (Northwest Territories) (Figs. 1:2 and 2) and the Southern Yukon Territory area (Figs. 1:3 and 3). The former only is generally included in the Subarctic Region, the latter being considered part of the Cordilleran Region and Intermontane Belt. At first view, the characteristic features of the regions considered and in particular the Subarctic Region do not look very favorable for solitary wasps.

Most of the area lies on the forest-tundra transition or is covered with the boreal forest and the taiga, characterized by the dominance of coniferous trees (mainly spruce and jack pine) in its climax communities. Often the conifers grow so close together that there is very little understory and the soil, covered with mossy vegetation, is not directly accessible to fossorial wasps. The muskeg and the general post glacial topography, characterized by many lakes, bogs, and poorly drained surfaces, does not seem to provide a very good habitat for fossorial wasps either. The situation seems more favorable for fossorial wasps in clear-

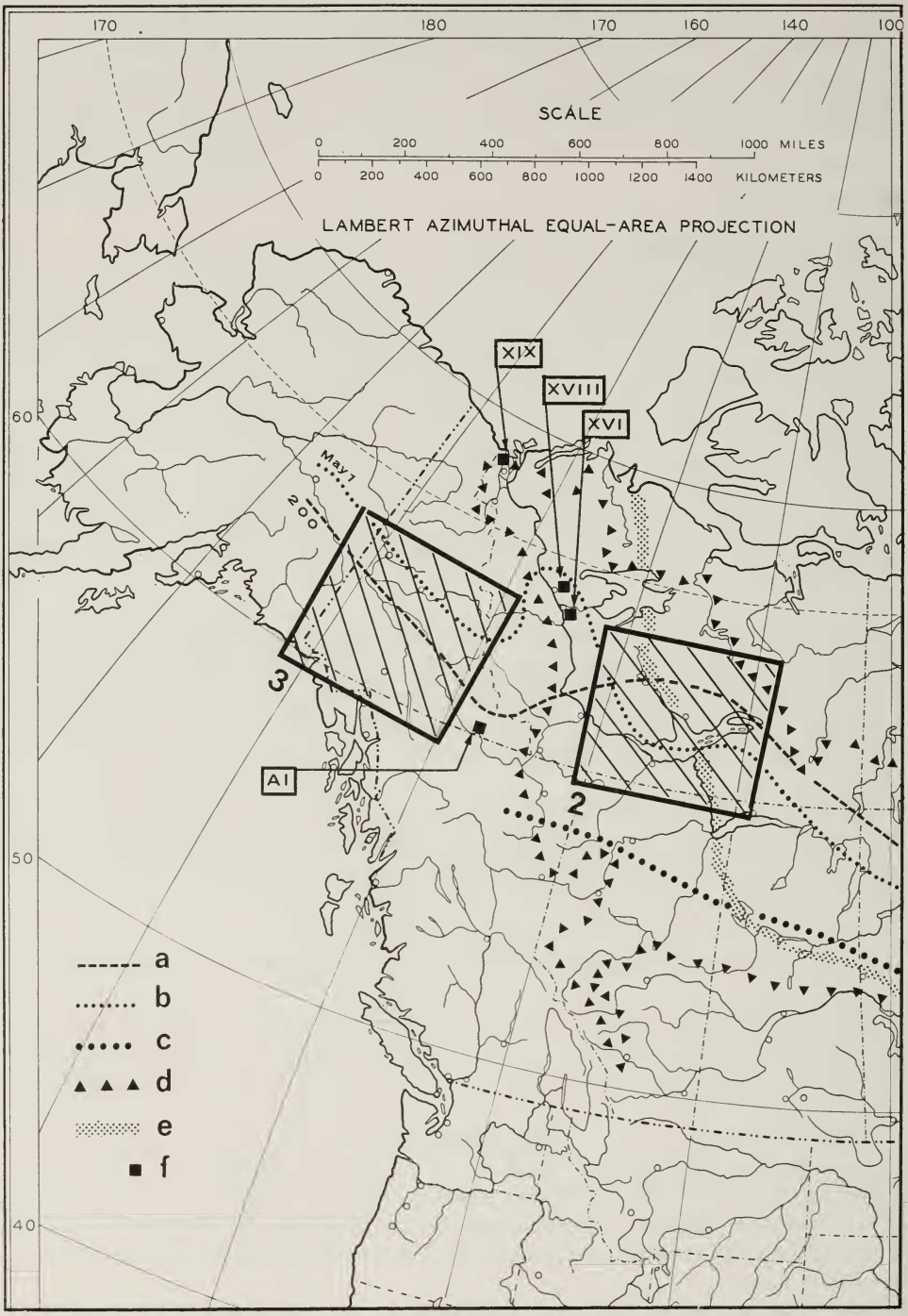

Fig. 1 Northwest America: Great Slave Lake (Fig. 2) and Yukon (Fig. 3) study areas hatched. *a*. mean annual number of days with snow cover one inch or more (adapted from Laycock, *in* Warkentin, 1968); *b*. average day on which mean daily temperature rises to 32°F (adapted from Laycock, *in* Warkentin, 1968); *c*. approximate southern limit of discontinuous permafrost (after Brown, *in* Wonders, 1968); *d*. approximate delimitation of "Subarctic Region" (adapted from Wonders, *in* Warkentin, 1968); *e*. approximate delimitation of western margin of the Canadian Shield (adapted from Wonders, *in* Warkentin, 1968); *f*. sample localities in previous literature (Evans, 1950-1951) and situated outside study areas 2 and 3; Northwest Territories: XVI = Fort Norman; XVII = Cameron Bay of Great Bear Lake (not represented); XVIII = Norman Wells; XIX = Reindeer Depot. Yukon Territory: A1 = Watson Lake.

ings, sand, gravel pits, along ridges, hillocks, roadsides, river banks, lake shores, fixed sand dunes, some old dugouts, and forest edges. The forest cover is locally interrupted or eliminated altogether in disturbed areas where early successional stages are found. Most of the wasps collected were found in such natural or man-made disturbed areas.

The climate, at first view, does not seem to provide a better picture than physiography: the long and severe winter in Subarctic Regions (at least in the northwest) is generally as cold as in the Arctic with even lower extreme temperatures. Discontinuous permafrost underlies much of the Subarctic (Warkentin *et al.*, 1968); the first study area (Great Slave Lake) lies entirely north of the southern limit of discontinuous permafrost. The growing season is short, varying from approximately 60 to 150 days, through the continental taiga. The summer, however, is often very hot, with long daylight hours, favorable to rapid development of plant and animal life. Insects, in general, are abundant. Favorable microclimates for solitary wasps are provided by river banks, lake shores, and sandy areas.

The mean daily temperature for the various months or mean daily minimum or maximum temperatures are often used to express the amount of energy in the environment available for the conversion of minerals and moisture into plant tissue. The length of the growing season is especially important for plant and animal life. A detailed study of climate and meteorological conditions is beyond the scope of this paper (see current literature). Some limited meteorological information is condensed in Figs. 1, 2 and 3. Exploitation of favorable microclimates (Hocking and Sharplin, 1965), the short favorable summer, and an efficient resting stage for overwintering, probably allow the wasps to cope with these severe conditions (see also Fuller, 1969).

Geological and soil conditions seem far from optimal. In the Subarctic Regions, much of the surface was totally stripped of regolith and soil by glaciation, leaving pockets of morainic debris, ponds, muskegs, and poorly drained soil. The last is typically a grey thin podzol usually cold (at least on the shield portion of the area). However one also finds in this region lighter, sandier soils of kame of lacustrine origin (Warkentin *et al.*, 1968) which probably are a more favorable habitat for fossorial wasps, particularly in the form of sand ridges, cleared areas, lake shores and river banks. The Great Slave Lake area lies partly on the podzol zone, in the east on the Canadian Shield, and partly on the grey wooded soil zone, which also is from a podzol type, west of the Shield. The soil conditions in the Yukon study area are more complex with considerable variety of slope, altitude, and cover.

THE GREAT SLAVE LAKE STUDY AREA (FIGS. 1:2 AND 2)

This area is subdivided geologically and physiographically into two distinct parts: the Canadian Shield and the circum-Shield plains and plateaus. Most of the sample localities are in the latter part, but localities XII, XIII, XV, (Fig. 2) are on the Shield.

The Canadian Shield, a vast expanse of Precambrian gneisses and granites has undergone a complex geomorphic evolution. In the shield region of the study area, north and northeast of Great Slave Lake, the Shield is included in the Kenoran orogenic region, whereas the eastern part (east of the Slave River) and a limited part of the north belong to the Hudsonian orogenic region. In this part of the study area, predominantly rocky, the soil cover is particularly restricted, both in depth and expanse. However, some "islands" of favorable soil, particularly around lake shores (localities XII and XIII, Fig. 2) have been found. Reduction of forest cover in many areas may also influence favorably colonisation by fossorial wasps. The vegetation in the Shield region of this study area is classified as "forest and barren", forest section 27 (Northwestern Transition Section, a subdivision of the Boreal Forest Region) (Rowe, 1959). "It is a zone of open subarctic woodland where unfavorable

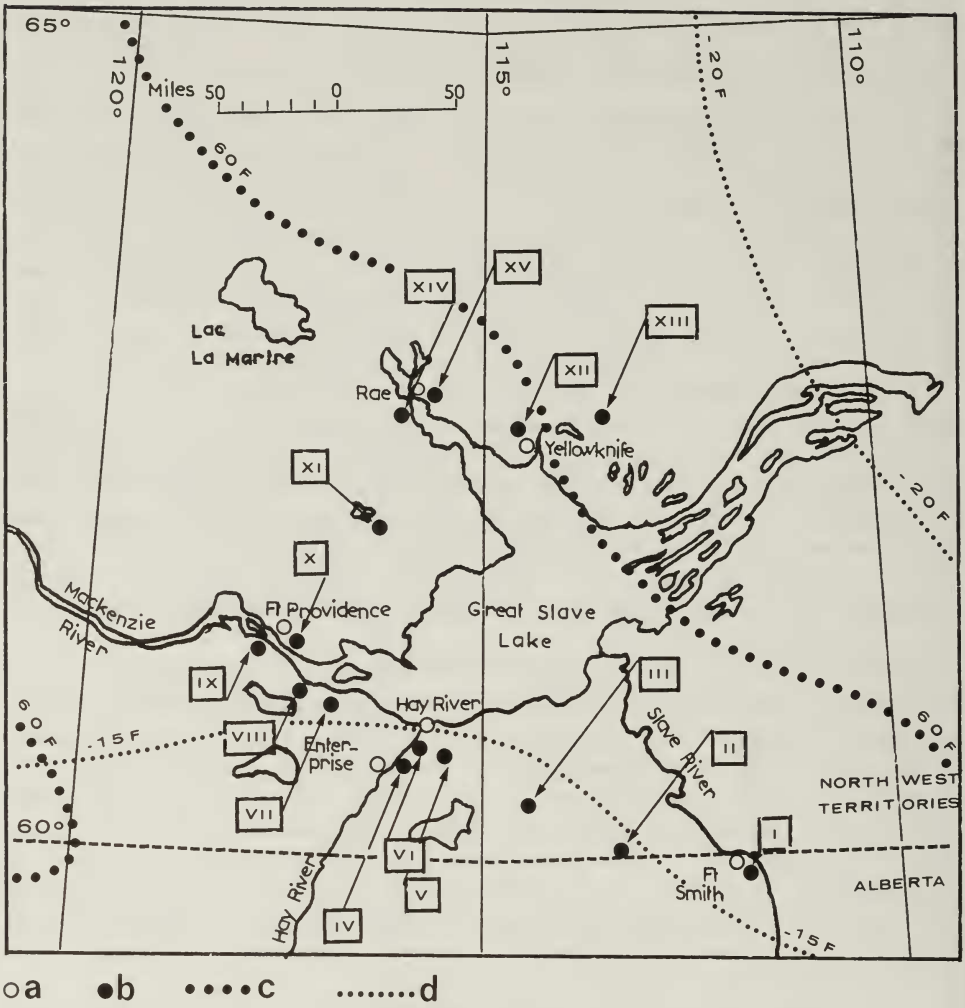

Fig. 2. Great Slave Lake study area. *a.* towns; *b.* sample localities visited; *c.* mean daily temperature for July; *d.* mean daily temperature for January (*c* and *d* adapted from "Yukon today", 1968; source: Meteorological Branch, Department of Transport). I = Fort Smith; II = Sass River; III = Wood Buffalo Park northern boundary; IV = Enterprise; V = Buffalo River; VI = Banks of the Hay River; VII = Heart Lake Biological Station; VIII = Kakisa River banks; IX = Fort Providence, South; X = Fort Providence, North; XI = Birch Lake; XII = Yellowknife; XIII = Yellowknife-Prelude Lake; XIV = Frank Channel; XV = Rae.

climatic conditions, thin soil, and frequent fires have combined to reduce distribution, abundance, and size of tree species; . . . open stands of dwarfed trees, with local patches of sheltered, deep, frost-free soil where density and high growth of forest patches can be surprisingly good;" . . . most abundant tree: black spruce (*Picea mariana* (Mill.) B. S. P.), sometimes white spruce (*P. glauca* (Moench) Voss) tamarack (*Larix laricina* (DuRoi) K. Koch) jack pine (*Pinus Banksiana* Lamb.); . . . southern parts: stunted aspen (*Populus tremuloides* Michr.) balsam poplar (*Populus balsamifera* L.). All in all (except for some species and locally), the Shield part seemed the less favorable.

The circum-Shield plains (western interior basin) part of the study area belongs to a sedimentary basin which fringes the Shield, on the west. The sedimentary cover varies in thickness, age, and landforms; Devonian reef structures can be found for instance on the southwest part of the Great Slave Lake area. More detailed information is provided in the list of sample localities. The banks of the Mackenzie River, near Fort Providence, seemed to offer particularly good soil, climate, (microclimate?), and vegetation cover. Therefore, these banks were searched intensively and successfully for fossorial wasps (sample localities IX and X). In the sedimentary part of the study area, the vegetation is classified as "Upper Mackenzie Section of the Boreal Forest" (Rowe, 1959, 23a): white spruce and balsam poplar form the main cover types on alluvial flats bordering rivers; large areas of sandy soils are occupied by pines (*Pinus Banksiana, P. contorta* Dougl. var. *latifolia* Engelm.), aspen, and in moist to wet positions, black spruce and tamarack. Alluvial flats are bordered by low benchlands and terraces giving way to undulating or rolling uplands with isolated ridges and low hills; there are large areas of swamp and peat.

In the following list, the localities sampled are arranged in a series of increasing latitude, to facilitate detection of possible impoverishment in number of species with latitude. Each locality is preceded by its identification numeral on the maps. The plus sign indicates localities not prospected by me, but found in previous literature. Species collected are represented by their identification number in list of species (the same applies to the list of localities from the Yukon study area, given later). Sources of geological information used are Brown, 1958, Geological Survey of Canada, 1955 and Jolliffe, 1942.

Characteristics of sample localities and conditions of sampling

I. *Fort Smith* (Mountain Portage-Slave River banks, 59° 58' N, 111° 45' W, 700-750' elevation).

Description. – Sandy banks, terraces, cutbanks, pits; many natural and man-made disturbed areas, with early successional stages.

Geology. – On sand, silt or drift covered area, probably contact between: west, Palaeozoic-Silurian (mainly sedimentary rocks: dolomite, limestone, etc.) and east, Archaean (Cambrian?): granodiorite, granite, etc.; mainly acid rocks.

Conditions of sampling. – 15 August 1967; clouded over, some sun, some rain. Sampling probably not very significant (weather, short duration).

Species collected. – 1 (numbers refer to species list below).

II. *Sass River (Wood Buffalo Park)* (road to Fort Smith, 60° 10' N, 113° 30' W, approx. 900-950' elevation).

Description. – Sandy roadside, early successional stages (man-made disturbed area); represents clearing in forest cover.

Geology. – On Palaeozoic – Middle Devonian (limestone, bituminous limestone, dolomite).

Conditions of sampling. – 14 August 1967; warm, sunny weather, wind moderate. Sampling probably not very significant (short duration).

Species collected. -- 3.

III. *Wood Buffalo Park northern boundary* (road to Fort Smith, 60° 28' N, 114° 35' W, approx. 900-950' elevation).

Description. – Same as II.

Geology. – Situated approximately on limit between geological areas described in II and IV.

Conditions of sampling. – 14 August 1967; warm, sunny, wind moderate.
Species collected. – None.

IV. *Enterprise* (about 20 miles north of Enterprise, on highway to Hay River, 60° 40' N, 116° W, approx. 850-900' elevation).
Description. – Clearing (man-made?) in wooded banks of the Hay River (aspen predominant); early successional stage, soil apparently favorable, soft, sandy, gravelly.
Geology. – On Palaeozoic – Upper Devonian (Simpson Formation, shale).
Conditions of sampling. – 28 July 1967; stormy weather threatened, but sunny at times – 11 August 1967; warm, cloudy, sunny at times, very strong wind. Sampling probably not very significant (weather, short duration, time of day).
Species collected. – 1.

V. *Buffalo River* (road to Pine Point, from Hay River, 60° 45' N, 115° 05' W, approx. 800-850' elevation).
Description. – Sandy clearing (man-made?) in wooded road sides; early successional stage.
Geology. – Same as IV.
Conditions of sampling. – 14 August 1967; warm, sunny, wind moderate. Sampling probably not very significant (short duration).
Species collected. – 15, 17.

VI. *Banks of the Hay River* (near Hay River, Pine Point road junction, 60° 45' N, 115° 50' W, approx. 500-550' elevation).
Description. – Sandy spots, banks; loose flat earth and compact cutbanks; variety of vegetation covers, ranging from densely forested (spruce, aspen, etc.) to sparsely covered with vegetation in early successional stages.
Geology. – Same as IV.
Conditions of sampling. – 29 July 1967; weather average – 12 August 1967; clouding over rapidly and becoming completely overcast; wind increasingly strong. Probably not very good sampling conditions.
Species collected. – 1, 12.

VII. *Heart Lake Biological Station area* (Hart Creek, road to Fort Providence, 60° 50' N, 116° 35' W, approx. 800-850' elevation).
Description. – Apparently favorable soft sandy earth, in open wooded banks of the creek; trees with important understory, shrub, herbaceous.
Geology. – Same as IV.
Conditions of sampling. – 10 August 1967; very hot, sunny, windy.
Species collected. – 5, 15, 22.

VIII. *Kakisa River Banks* (Mackenzie Highway, 61° N, 117° 15' W, approx. 650-700' elevation).
Description. – River banks, apparently not very favorable compact earth, although sparse vegetation (early successional stage) seems adequate.
Geology. – Same as IV.
Conditions of sampling (probably very unfavorable). – 10 August 1967; very hot, sunny, windy.
Species collected. – None.

IX. *Fort Providence* (South bank of Mackenzie River, 61° 17' N, 117° 36' W, approx. 500' elevation).

Description. – Rather compact earth, variety of vegetation cover conditions ranging from open forested areas (aspen mainly) to shrub and sparse herbaceous vegetation.

Geology. – Same as IV (but alluvial deposits).

Conditions of sampling (probably not very significant). – 1 August 1967; very good weather, hot, sunny, slight wind.

Species collected. – 7, 21, 24.

X. *Fort Providence* (North bank of Mackenzie River, 61° 17' N, 117° 30' W, approx. 500' elevation).

Description. – Apparently very favorable area, with a great variety of vegetation conditions; soil of various types and conformations: sandy spots, hillocks, small ridges, flats, etc.

Geology. – See IV and IX.

Conditions of sampling. – Probably the most complete sample of the study, with samplings taken frequently, on various days ("season") and at various times, weather conditions, etc. 21 July 1967 – 22 July 1967; overcast day, wind from W. – 25 July 1967 – 26 July 1967 – 31 July 1967; amelioration of weather, previously rather bad for one to two days – 9 August 1967; sunny, hot day – 11 July 1968; sunny, windy, very hot, a few clouds, hazy, intense activity of Hymenoptera recorded – 17 July 1968; excellent weather, sunny, warm, no wind.

Species collected. – 1, 4, 5, 7, 9, 12, 15, 17, 20, 25.

XI. *Birch Lake area* (roadside, Mackenzie Highway, about half way between Fort Providence and Rae, 62° N, 116° 17' W, 650-700' elevation).

Description. – Rather small gravel, sand pit (with some slated rocks), along the highway, in forested area (jack pine mainly?): sparse vegetation, herbaceous, shrubs.

Geology. – On Palaeozoic – Middle Devonian (limestone or dolomite).

Conditions of sampling (probably not very good). – 2 August 1967; very hot, sunny, moderate wind, some light clouds at high altitude, rain storm on nearby Great Slave Lake in the evening – 8 August 1967; clouding over rapidly but increasingly warm.

Species collected. – 5.

XII. *Yellowknife* (mostly shores of Long Lake, 62° 27' N, 114° 23' W, approx. 650. elevation).

Description. – Apparently one of the restricted favorable localities found on the Shield section of the study area, with spots of sandy soil covered with low, sparse vegetation (herbaceous and shrub, dwarfed trees); however flowers very scarce (in contrast to Mackenzie River localities: IX and X).

Geology. – Archaean (granodiorite, granite, etc.; also sand and silt, or drift covered areas).

Conditions of sampling. – Average to good, but perhaps affected by generally cold weather and strong wind. 4 August 1967; cool, windy, but sunny (cold, cloudy and windy the day before with short sunny periods) – 5 August 1967 – 7 August 1967; cold, strong wind, sunny – 29 July 1968; sunny, very hot, hazy, wind rather strong.

Species collected. – 7, 12, 16, 18, 23, 25.

XIII. *Yellowknife area* (shores of Prelude Lake, 62° 32' N, 113° 48' W, approx. 600-650' elevation).

Description. – One of the best spots found on the Shield section: local conditions apparently very favorable, as far as soil conditions (soft earth, sandy spots) and vegetation cover are concerned; the latter ranges from open woodland (jack pine predominant?) to sparse shrub and herbaceous vegetation; flats, hillocks, and sand pits provide a good variety of topographical microclimates.

Geology. – Archaean (Yellowknife group, mainly sedimentary and derived metamorphic rocks).

Conditions of sampling (apparently average to good). – 6 August 1967; sunny, cloudy periods, strong rather cold wind – 7 August 1967; weather better than previous day, mostly sunny, moderate wind.

Species collected. – 1, 6, 8, 12, 15, 16, 21, 22.

XIV. *Frank Channel* (shores of Great Slave Lake: northwestern arm, near Rae, 62° 43' N, 116° 03' W, approx. 600' elevation).

Description. – Sandy spots on shores of lake; apparently favorable area, flowers and vegetation varied; clearings, pits, etc.

Geology. – Palaeozoic – Ordovician (dolomite, red arenaceous limestone, sandstone, etc.).

Conditions of sampling (average to good). – 8 August 1967; weather good but increasing cloudiness – 26 July 1968; sunny, warm, clouding over.

Species collected. – 1, 3, 12, 15, 25.

XV. *Rae* (about 10 miles East, on the road to Yellowknife, 62° 46' N, 115° 50' W, approx. 500-550' elevation).

Description. – The northernmost sampling locality in the Great Slave Lake study area; transition between Shield and sedimentary sections; rather restricted pit, with flat sections, cutbanks, in rather compact and not sandy soil; man-made disturbed area, early successional stages; apparently not very favorable.

Geology. – Archaean.

Conditions of sampling. – 8 August 1967; sunny, windy.

Species collected. – 5, 22, 23.

The following localities have been found in previous literature: (Evans, 1950-1951); being not included in the study area (Fig. 2), they have been represented on the general map, Fig. 1. Species identification numbers preceded by + represent species which have not been found by me.

XVI. + *Fort Norman* (Mackenzie River, approx. 65° N, 125° 30' W).

Geology. – Cenozoic – Tertiary (shale, conglomerate, sandstone, limestone, coal).

Dates. – 6, 9, 15 August.

Species collected. – +10, +13, +14, 23, +26.

XVII. + *Cameron Bay* (Great Bear Lake? not represented on map).

Dates. – 1 July.

Species collected. – +10.

XVIII. + *Norman Wells* (Mackenzie River, approx. 65° 30' N?, 127° W).

Geology. – Palaeozoic – Upper Devonian (Imperial-Bosworth-formation; sandstone and shale).

Dates. – 12 July – 3 August; 20-28 July; 20-29 July 1949; 12-23 August.
Species collected. – 6, 9, +11, 15, +19.

XIX. + *Reindeer Depot* (Mackenzie Delta, approx. 67° 20' N?, 134° 20' W).
Geology. – Cenozoic – Pleistocene and recent (alluvium, glacial drift).
Dates. – 8 July 1948; 11 July; 12 July – 13 August.
Species collected. – 1, 12, 15, 17.

THE YUKON STUDY AREA (FIGS. 1:3 AND 3)

The climatic, geological, and ecological features of the Yukon study area are much more complex and varied than the preceding one. On the other hand, the sampling in this area has been limited and is probably less significant.

Most of the sampling localities are situated in one "geological province", characterized by intrusives, plateaus, rocks ranging in age from Precambrian to Recent (Anon., 1968). This area, of low to moderate altitude is part of the physiographic "Intermontane Belt" region of the Cordilleran Continental Façade. This belt is underlain largely by folded Jurassic strata and Tertiary volcanics and composed of low mountains, rolling hills, tablelands dissected by rivers, and flat glacial lake plains. No samples have been taken from the mountain regions, south, north and east in the Yukon Territory. The sampling area is situated mostly on the basin-like area known as the Yukon Plateau in the interior of the Territory. The average elevation is 2,000 to 3,000 feet. There is a certain lack of precipitation in this interior basin.

The climate is characterized by wide variations in temperature from year to year. One reason is the proximity of both the relatively warm Pacific and the cold Arctic Ocean. The climate thus depends on the frequency and duration of air mass invasions. The same applies to summer temperatures. These characteristics may affect the populations of fossorial wasps and may produce important year to year population fluctuations. On the average the last spring frost occurs in mid-June and the first autumn frost in mid-August. Annual precipitation is low in the Yukon, which is in the "rain shadow" of the mountains bordering the Pacific.

Forest types found in the study area are classified (Rowe, 1959) as Dawson, Central Yukon, Eastern Yukon, and Kluane sections of the Boreal Forest Region. Sample localities A, C, D (Fig. 3) are situated in the Central Yukon section (26b), where white spruce grows on the lower slopes of protected lowlands. On the uplands, it associates with alpine fir (*Abies lasiocarpa* (Hook.) Nutt.). On the mountain slopes are islands of park-like white spruce, willow and aspen interspersed with patches of grassland. In the valleys, on water modified tills and coarse terrace materials lodgepole pine (*Pinus contorta* var. *latifolia*) and white spruce are the dominant species, frequently associated with aspen. Black spruce occupies areas of high water table. Sample localities E, G, (Fig. 3) are included in the Eastern Yukon Forest section (26c) where forestless barrens are more common, and north and east slopes frequently non-forested. Flood plains are generally narrow in the sharply cut valleys with low representation of balsam poplar. Peaty soils are extensively developed. Sampling stations I, J (Fig. 3) belong to the Dawson Forest section (26a) comparable to the Central Yukon section but lodgepole pine has only a scattered distribution. Surface deposits are mainly residual, derived from breakdown of the underlying Precambrian and Tertiary rock. Sample localities A3, B, B2 (Fig. 3) are in the Kluane Forest section (26d) characterized by a dry cold climate, with park-like appearance vegetation. White spruce and poplar are abundant. There is no lodgepole pine and relatively little black spruce.

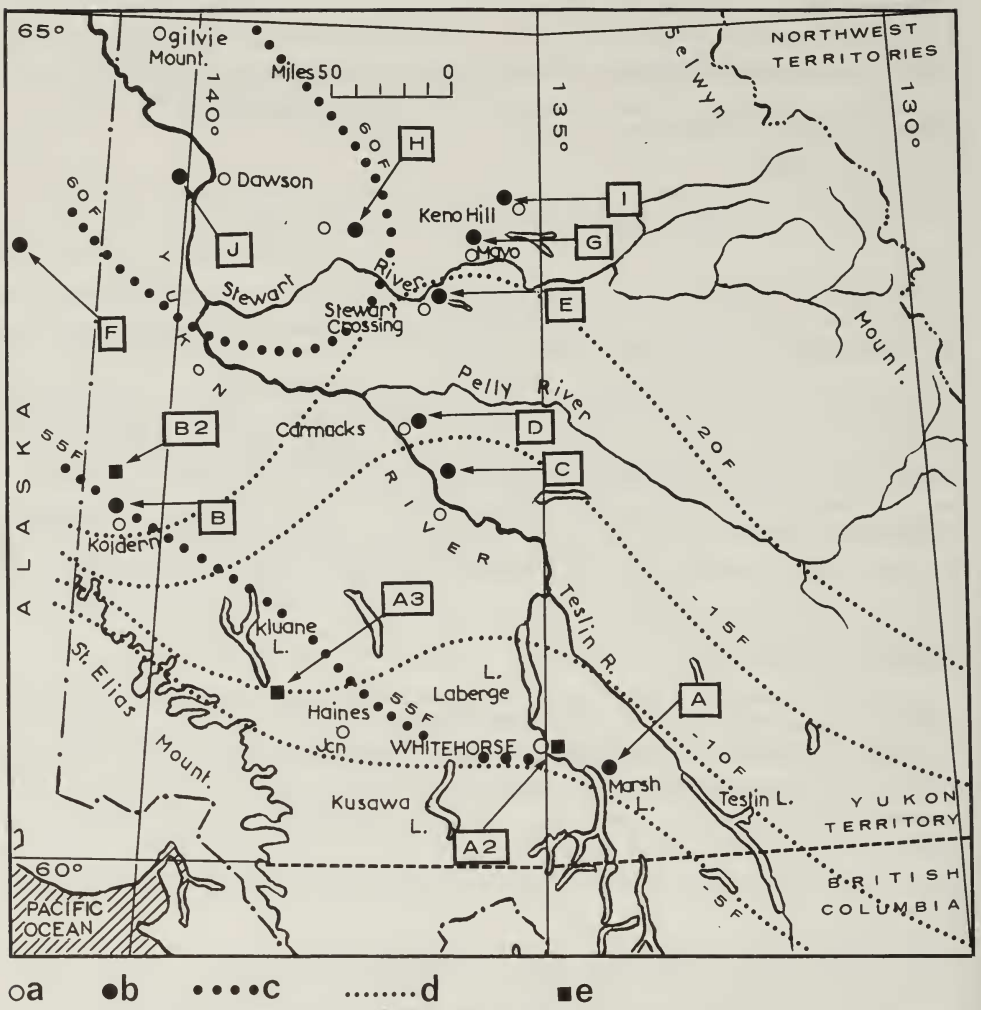

Fig. 3. Yukon study area. *a.* towns; *b.* sample localities visited; *c.* mean daily temperature for July; *d.* mean daily temperature for January (*c* and *d* adapted from "Yukon today", 1968; source: Meteorological Branch, Department of Transport); *e.* sample localities found in previous literature (Evans, 1950-1951). A = Marsh Lake; A2 = Whitehorse; A3 = Kluane; B = Pickhandle Lake; C = Tatchun Lake; B2 = Snag; D = Minto; E = Stewart River valley; F = Taylor Creek; G = Mayo; H = Gravel Lake; I = Keno Hill; J = Dawson City.

As in the Great Slave Lake study area, the spots which were the most favorable for fossorial wasps were clearings, roadsides, old sandpits, river banks, lake shores, ridges, cutbanks, and in general disturbed areas and early successional stages.

Characteristics of sample localities and conditions of sampling

Localities preceded by + in the following list, are those which have been found in previous literature (Evans, 1950-1951) and species numbers preceded by + correspond to species not found by me.

A1. + *Watson Lake* (see Fig. 1, 60° 04' N, 128° 49' W, 2,500-3,000' elevation).
Dates. – 17-24 June; 20-25 June; 25 June.
Species collected (not by me). – 6, 12, 15, +19, 23.

A. *Marsh Lake* (Mile 880, Alaska Highway, east of Whitehorse, 60° 30' N, 134° 18' W, approx. 2,300' elevation).
Description. – Old sand-gravel pit, rather compact soil, sparse low vegetation, apparently not very favorable.
Conditions of sampling (not very good). – 5 August 1968; cloudy, sunny at times, windy.
Species collected. – +10, 23.

A2. + *Whitehorse* (60° 43' N, 135° 03' W, approx. 2,500-3,000' elevation).
Dates. – June-July; 1 July; 3-4 July; 3 July – 1 August; 4-5 July; 9-11 July; 25 July 1948; July-August.
Species collected (not by me). – 1, 2, 3, 9, 15, 18, 21, 23, 24.

A3. + *Kluane* (South tip of Kluane Lake, 61° 02' N, 138° 23' W, approx. 2,500-3,000' elevation).
Dates. – 28 July.
Species collected (not by me). – 8.

B. *Pickhandle Lake* (near Koidern: Alaska Highway, near U. S. border, 61° 57' N, 140° 20' W, 2,500' elevation).
Description. – Narrow strip of earth in rock pit, with sparse low vegetation; apparently not very favorable (but some Sphecidae found, no Pompilidae).
Conditions of sampling (not very significant). – 15 August 1968; weather excellent, very hot.
Species collected. – None.

C. *Tatchun Lake area* (near Carmacks, Mile 122, Highway from Whitehorse to Dawson, 62° 20 N, 136° 17' W, approx. 1,700' elevation).
Description. – Series of pits and flats, with small hillocks and ridges; shrub and herbaceous vegetation, numerous flowers, some trees (aspen); soil rather compact.
Conditions of sampling (average to good). – 9 August 1968; sunny, windy – 10 August 1968; weather excellent, sunny, warm, slight wind.
Species collected. – 2, 12 23.

B2. + *Snag* (north of locality B, 62° 25' N, 140° 23' W, approx. 2,500-3,000' elevation).
Dates. – 24 July.
Species collected (not by me). – 1, 8, 9, +19.

D. *Minto* (Mile 147, Highway from Whitehorse to Dawson, 62° 37' N, 136° 52' W, approx. 1,700' elevation).
Description. – Fairly restricted sandy area, probably a very old small sand pit; small sand ridges.
Sampling conditions (not very significant). – 10 August 1968; good weather but windy.
Species collected. – None.

E. *Stewart River Valley* (Mile 223, Whitehorse to Mayo highway, 63° 26' N, 136° 27' W,

approx. 1,700' elevation).

Description. – Flats, terraces in the river valley and sand gravel pits, various soil and vegetation conditions, probably good variety of microclimates.

Conditions of sampling (too restricted although area probably favorable). – 10 August 1968; very hot.

Species collected. – 3, 15.

F. *Taylor Creek area* (Alaska, Mile 52, North of Tetlin Jctn., approx. 63° 30' N, 142° 25' W, 4,000?' elevation).

Description. – Pit and ridge of rather compact soil, bordering boggy area (black spruce); vegetation sparse, herbaceous, flowers numerous.

Conditions of sampling (fairly restricted). – 14 August 1968; hot, hazy.

Species collected. – 3.

G. *Mayo* (some Miles North of town, Mile 248, direction Keno Hill, 63° 38' N, 135° 53' W, approx. 1,700' elevation).

Description. – The area is described in tourist guides as "the hottest and coldest spot in the Yukon"; potential good areas (pits, clearings, etc.) appeared rather limited; several man-made disturbed areas (sand pits) were visited; soil rather compact, flowers scarce, (already outgrown).

Conditions of sampling. – 12 August 1968; very good weather, very hot, some clouds.

Species collected. – 3.

H. *Gravel Lake* (near McQuesten, Mile 52, Highway 3 to Dawson City, 63° 47' N, 137° 45' W, approx. 2,200' elevation).

Description. – Rather small sand/gravel pit, with many flowers.

Conditions of sampling (not very conclusive). – 12 August 1968; very good weather, very hot.

Species collected. – 1.

I. *Keno Hill* (63° 54' N, 135° 18' W, approx. 3,200' elevation).

Description. – Small areas of potentially good soil, in a generally rocky area; apparently not very favorable in general.

Conditions of sampling. – 11 August 1968; very hot, sunny, no wind.

Species collected. – None.

J. *Dawson City* (Mile 15, west of Dawson, 64° 10' N, 139° 40' W, approx. 3,500?' elevation).

Description. – The northernmost sample locality of this study; potentially good areas for fossorial wasps apparently fairly limited, at least as seen from the highway; some narrow strips of soil on the roadside and pits were visited; flowers relatively abundant (many bumblebees).

Conditions of sampling (probably not very significant). – 13 August 1968.

Species collected. – None.

DISTRIBUTION OF SAMPLES IN TIME (SEASONAL AND DAILY)

The total sampling time was about 54 hours for the Great Slave Lake study area and only 10 for the Yukon study area. Although these figures are very low, the sampling was

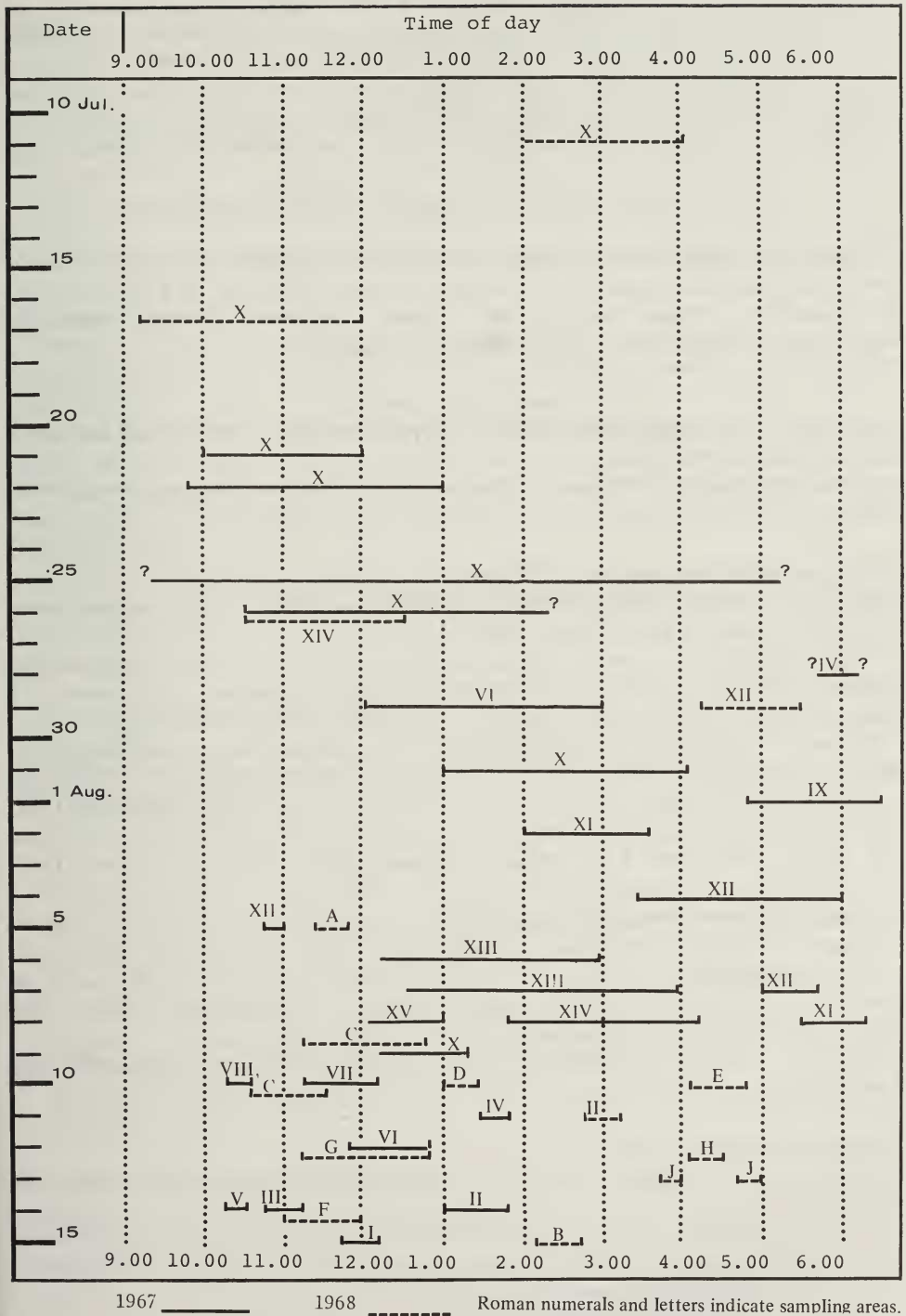

Fig. 4. Seasonal and daily distribution of samples of subarctic Pompilidae

distributed as efficiently as possible both in space – only the potentially "good spots" have been visited – and in time – only the best season (July, August) and best part of the day (between 9:00 a.m. and 6:00 p.m.) were used. Figure 4 represents diagrammatically the distribution of the samples in time (season and time of day) and shows that the samples cover a reasonable cross section. In the light of this limited sampling, conclusions must be drawn with prudence, particularly as to negative evidence concerning certain species and localities and the problem of possible impoverishment with increasing latitude. This is confirmed by the previous literature, which mentions many species not found in this study.

LIST OF SPECIES COLLECTED AND PREVIOUS INFORMATION

Species and sample localities found in the literature are preceded by the sign +. Species and localities have been given identification numbers, used on the maps. N.W.T. = Northwest Territories; Y.T. = Yukon Territory; C.N.C. = Canadian National Collections, Ottawa, Ontario; C.A.S. = California Academy of Sciences, San Francisco.

Genus *Evagetes* Lepeletier

Biology. – All social parasites of other Pompilini, destroying the host egg and laying their own (Evans, 1950-1951).

Known distribution. – Palaearctic, Nearctic, and Neotropical Regions (Evans, 1950-1951).

1. *Evagetes crassicornis crassicornis* Shuckard.

Biology. – In Europe, social parasite of several Pompilini. Inhabits sandy or gravelly areas, often in the vicinity of woods (Evans, 1950-1951).

Known distribution. – Widely distributed holarctic species. In Europe, throughout the northern part of the continent; in North America across the continent in Hudsonian and Canadian Zones, and to a limited extent the Transition Zone (Evans, 1950-1951).

Records. – NORTHWEST TERRITORIES. – I, ♀ 15 August 1967. IV, ♀ 28 July 1967. VI, ♀ 29 July 1967. X, ♀ 11 July 1968, ♀ 17 July 1968, ♀ 22 July 1967, 3 ♀♀ 26 July 1967, ♀, ♂ 31 July 1967, ♀ 9 August 1967. XIII, ♀ 6 August 1967. XIV, 2 ♀♀ 26 July 1968. +XIX, ♂, 9 ♀♀ 13 August (Evans, 1950: CNC). YUKON TERRITORY. – A2, ♂, 3 ♀♀ 3-4 July (Evans, 1950: CNC). B2, 2 ♀♀ 24 July (Evans, 1950: CNC). H, ♀ 12 August 1968.

2. *Evagetes crassicornis consimilis* Banks.

Biology. – Collected on sand and on flowers (Evans, 1950).

Known distribution. – Canadian and Transition faunas of western U. S. and Canada. In general occurs south of the range of typical *crassicornis*, but considerable overlap in range (found also in New Mexico, California, etc.) (Evans, 1950).

Records. – YUKON TERRITORY. – +A2, 2 ♀♀ 4-5 July (Evans, 1950: CNC). C, ♀ 9 August 1968.

3. *Evagetes subangulatus* Banks.

Biology. – Either in open country or in clearings in woodlands, is partial to sandy soil (Evans, 1950).

Known distribution. – Occurs transcontinentally from the Hudsonian to the Transition Zones, from Labrador and Yukon to Georgia in the Appalachians and to New Mexico, Arizona, etc. Not mentioned from N.W.T. (Evans, 1950).

Records. – NORTHWEST TERRITORIES. – II, ♀ 14 August 1967. XIV, ♀ 26 July

1968, ♀ 8 August 1967. YUKON TERRITORY. – +A2, 2 ♀♀ June, July (Evans, 1950: CNC, CAS). E, ♀ 10 August 1968. F, ♀ 14 August 1968. G, ♀ 12 August 1968.

4. *Evagetes bradleyi* Banks.

Records. – NORTHWEST TERRITORIES. – X, ♀ 11 July 1968.

5. *Evagetes hyacinthinus* Cresson (all individuals collected by me are of the very hairy form called "*scudderi*" by Banks: Evans, *personal communication*).

Known distribution. – Transcontinental, primarily in the Transition Zone. Not mentioned from N.W.T. in list of localities (Evans, 1950).

Records. – NORTHWEST TERRITORIES. – VII, 2 ♀♀ 11 August 1967. X, ♀ 25 July 1967, 4 ♀♀ 26 July 1967, 5 ♀♀ 31 July 1967. XI, ♀ 8 August 1967. XV, ♀ 8 August 1967.

6. *Evagetes parvus* Cresson.

Biology. – Frequents sand pits, waste places, gardens, occasionally clearings in woodlands. Occurs throughout the summer months, and may have several generations during this time (Evans, 1950).

Known distribution. – Transcontinental in Canadian, Transition, and Upper Austral Zones, but less common southward and westward. One of the commonest Pompilini in the northeastern and north central U. S. and eastern Canada; there are but few records from west of the Rocky Mountains (Evans, 1950). This species is also reported from Arizona, New Mexico, etc.

Records. – NORTHWEST TERRITORIES. – XIII, ♀ 6 August 1967. +XVIII, 6 ♂♂, 5 ♀♀ 20-28 July 1949 (Mason, *in* Evans, 1951). YUKON TERRITORY. – +A1, ♂, ♀ 25 June (Evans, 1950: CNC).

Genus *Priocnemis*

7. *Priocnemis notha alaskensis* Townes.

Reported from Alaska, Northwest Territories (Krombein *et al.*, 1958).

Records. – NORTHWEST TERRITORIES. – IX, ♀ 1 August 1967. X, ♀ 25 July 1967. XII, ♀ 5 August 1967.

Genus *Anoplius* Dufour

Known distribution. – Some species rather restricted ecologically and others very wide-ranging throughout the World (except Australia?). Well represented in the Nearctic and Neotropical regions (Evans, 1951).

Subgenus *Anoplius* Dufour

Biology. – Various in habits, none seems to be a strict psammophile. Some in restricted ecological niches, others: more wide-ranging (Evans, 1951).

Known distribution. – Species seen from Nearctic, Neotropical, Palaearctic, and Oriental regions (Evans, 1951).

8. *Anoplius (Anoplius) ithaca* Banks.

Biology. – Confined to stony stream sides. Appears to have several (perhaps 3) generations a year throughout its range (Evans, 1951).

Known distribution. – Transcontinental in Transitional and Upper Austral Zones (Muesebeck *et al.*, 1951). Exceedingly wide distribution, although rather local: Texas . . , etc. north to Yukon, Manitoba . . , etc. Not mentioned from N.W.T. (Evans, 1951).

Records. – NORTHWEST TERRITORIES. – XIII, ♀ 7 August 1967. YUKON TERRITORY. – +A3, 2 ♀♀ 28 July (Evans, 1951: CNC). +B2, 2 ♀♀ 24 July (Evans, 1951: CNC).

9. *Anoplius (Anoplius) imbellis* Banks.

Biology. – Taken along streams (cf *ithaca*); does not appear to be restricted to this habitat (Evans, 1951).

Known distribution. – Transcontinental, from the Hudsonian to the Upper Austral Zones, but appears to be most common in the Transition Zone (more common in the Pacific States?) (Evans, 1951).

Records. – NORTHWEST TERRITORIES. – X, ♀ 26 July 1967. XVIII, 22 ♂♂, 11 ♀♀ 12 July – 3 August (Evans, 1951: CNC). YUKON TERRITORY. – +A2, 3 ♂♂ 9-11 July (Evans, 1951: CNC). +B2, 2 ♂♂, ♀ 24 July (Evans, 1951: CNC).

Species not found by me but reported from previous literature in N.W.T. or Y.T. or both:

+10. *Anoplius (Anoplius, nigerrimus* (Scopoli) (*in* Evans, 1951).

Known distribution. – Holarctic species known from almost the whole of Europe; in North America it occurs transcontinentally in the Hudsonian and Canadian Zones, entering the Transition Zone sparingly (Evans, 1951).

Records. – NORTHWEST TERRITORIES. – +XVI, ♀ 9 August (Evans, 1951: CNC). +XVIII, ♀ 1 July (Evans, 1951: CNC). YUKON TERRITORY. – A, ♂ 10 July (Evans, 1951: CNC).

+11. *Anoplius (Anoplius) tenuicornis* Tournier (*basalis* Dreisbach, *in* Evans, 1951).

Known distribution. – Holarctic. Apparently uncommon species, transcontinental distribution in the Canadian Zone, south to New Brunswick, Vermont, Manitoba, and at high altitudes to New Mexico and California (Evans, 1951, 1956, 1966).

Records. – NORTHWEST TERRITORIES. – +XVIII, ♂, ♀ 20-29 July 1949 (Mason, *in* Evans, 1951 CNC).

Subgenus *Pompilinus* Ashmead

Predominantly inhabitants of sandy areas; remarkable unselectivity in prey selection (Evans, 1951).

12. *Anoplius (Pompilinus) tenebrosus* Cresson.

Biology. – Sandy places, especially vicinity of woods (Evans, 1951).

Known distribution. – Common across the continent from upper extremities of Upper Austral Zone far into the Hudsonian Zone; Canadian and Transition Zones (Evans, 1951).

Records. – NORTHWEST TERRITORIES. – VI, 2 ♂♂ 29 July 1967. X, ♀ 11 July 1968. XII, ♂ 5 August 1967. XIII, 6 ♂♂, ♀ 6 August 1967, 2 ♂♂ 7 August 1967. XIV, ♀ 26 July 1968, ♂ 8 August 1967. +XIX, ♀ 11 July (Evans, 1951: CNC). YUKON TERRITORY. – +A1, 12 ♀♀ 20-25 June (Evans, 1951: CNC). C, ♂ 9 August 1968.

Species not found by me but reported from previous literature in N.W.T. or Y.T. or both:

+13. *Anoplius (Pompilinus) cylindricus* (Cresson).

Known distribution. – Widely distributed species, Florida . . , Texas, etc., Ontario, N.W.T.

Records. – NORTHWEST TERRITORIES. – +XVI, ♂ 6 August (Evans, 1951: CNC).

+14. *Anoplius (Pompilinus) marginatus* (Say).

Known distribution. – Temperate North America, east of the Rockies, from Florida, Texas . . , etc. to Quebec, N.W.T. . , etc.

Records. – NORTHWEST TERRITORIES. – +XVI, ♀ 15 August (Evans, 1951: CNC).

Genus *Pompilus* Fabricius

Known distribution. – Cosmopolitan (Evans, 1951).

Subgenus *Ammosphex* Wilcke

Biology. – Variety of habitats, but seems particularly characteristic of wooded places (close to the ground, sunny spots) (Evans, 1951).

Known distribution. – Holarctic Region; eight species known in the Nearctic Region; (also in Europe), (Evans, 1951).

15. *Pompilus (Ammosphex) luctuosus* Cresson.

Known distribution. – Transcontinental in Hudsonian and Canadian Zones, sparingly entering the Transition Zone in western states; . . . Quebec . . . New Mexico, California . . . N.W.T., Y.T., etc. True *luctuosus* is apparently a common species only in the far north (Evans, 1951).

Records. – NORTHWEST TERRITORIES. – V, ♂ 14 August 1967. VII, ♀ 11 August 1967. X, 2 ♀♀ 25, 31 July 1967. XIII, ♀ 6 August 1967 (dragging paralyzed spider prey: *Tarentula* sp., immature; Fam. Lycosidae), ♀ 7 August 1967. XIV, ♀ 8 August 1967. +XVIII, ♂, ♀ 12-23 August (Evans, 1950-1951: CNC). +XIX, ♂, 8 ♀♀ 12 July – 13 August (Evans, 1951: CNC). YUKON TERRITORY. – +A1, ♂, ♀ 17-24 June (Evans, 1951: CNC). +A2, ♂, 4 ♀♀ 3 July – 1 August (Evans, 1951: CNC). E, ♀ 10 August 1968.

16. *Pompilus (Ammosphex) occidentalis* Dreisbach.

Known distribution. – Mountain forests of the west, apparently chiefly in the Transition Zone, ranging from Alberta and British Columbia south at high altitude to New Mexico, Arizona and California; not uncommon, western U. S., Canada. Not mentioned from N.W.T. and Y.T. (Evans, 1951). Mexico (Puebla, Mexico) (Krombein *et al.,* 1958).

Records. – NORTHWEST TERRITORIES. – XII, ♀ 29 July 1968. XIII, ♀ 6 August 1967.

17. *Pompilus (Ammosphex) imbecillus ojibwae* Evans.

Known distribution. – Across the continent, chiefly in Canadian Zone (north of the range of the nominate subspecies); also Hudsonian Zone, . . . north to N.W.T. (Evans, 1951).

Records. – NORTHWEST TERRITORIES. – V, ♀ 14 August 1967. X, 2 ♀♀ 21, 25 July 1967, ♂ 31 July 1967. +XIX, ♀ 8 July 1948 (Evans, 1951: CNC).

18. *Pompilus (Ammosphex) angularis* Banks.

Biology. – In sheltered sandy areas and open woodlands, where the soil is light (Evans, 1951).

Known distribution. – Transcontinental in Transition and Upper Austral Zones; occasional record from Canadian and Lower Austral Zones; . . Yukon . . California (San Diego, etc.) (Evans, 1951).

Records. – NORTHWEST TERRITORIES. – XII, 2 ♀♀ 4 August 1967, ♀ 5 August 1967. YUKON TERRITORY. – +A2, ♂ 3 July (Evans, 1951: CNC).

Species not found by me but reported from previous literature in N.W.T. or Y.T. or both:

+19. *Pompilus (Ammosphex) michiganensis michiganensis* Dreisbach.

Known distribution. – Hudsonian, Canadian, and Transition Zones, N.W.T. . New York . . . and at high elevations to Colorado and Georgia (Evans, 1951).

Records. – NORTHWEST TERRITORIES. – +XVIII, ♂ 20 July (Evans, 1951: CNC). YUKON TERRITORY. – +A1, 3 ♂♂, 2 ♀♀ 20-25 June (Evans, 1951: CNC). +B2 : 2 ♂♂ 24 July (Evans, 1951: CNC).

Subgenus *Anoplochares* Banks

Known distribution. – Holarctic (Europe) (Evans, 1951).

20. *Pompilus (Anoplochares) apicatus* Provancher.

Biology. – Not uncommon; chiefly in sheltered places, particularly sunny spots in woodlands; also open prairie country (Great Plains) (Evans, 1951).

Known distribution. – Very wide; most abundant in Transition Zone, where transcontinental in distribution; from the Great Plains eastward occurs also in Canadian, Upper and Lower Austral Zones, as far north as Labrador and far south as Alabama, Texas; not mentioned from N.W.T. and Y.T. (Evans, 1951).

Records. – NORTHWEST TERRITORIES. – X, ♂, ♀ 25 July 1967.

Subgenus *Arachnospila* Kincaid

Biology. – The three species found in the Nearctic Region are fairly common (Evans, 1951).

Known distribution. – Holarctic (Evans, 1951).

21. *Pompilus (Arachnospila) fumipennis fumipennis* Zetterstedt.

Known distribution. – Holarctic; the most boreal of our Pompilidae; circumpolar in distribution: northern Eurasia (. . Finland . .); in North America ranges transcontinentally in the Hudsonian and Canadian Zones, except British Columbia and Alberta southward in the Rockies and Coastal Ranges, where replaced by the subspecies *eureka* Banks; . . Labrador . . N.W.T., Y.T. . . Alaska . . (Evans, 1951).

Records. – NORTHWEST TERRITORIES. – IX, ♂, ♀ 1 August 1967. XIII, ♂ 7 August 1967, ♀ 10 August (Evans, 1951: CNC). YUKON TERRITORY. – +A2, ♂ 1 July (Evans, 1951: CNC).

22. *Pompilus (Arachnospila) scelestus* Cresson.

Biology. – The best known and possibly the most common species of *Pompilus* in our fauna; variety of habitats, including sand dunes, fields, gardens, open woodlands (Evans, 1951).

Known distribution. – Transcontinental in Upper Austral and Transition Zones, entering the Canadian Zone to a limited extent, especially in the West; peripheral localities: . . Quebec, Manitoba, Alberta, British Columbia . . . . California, Arizona, New Mexico . . Not mentioned from N.W.T. and Y.T. (Evans, 1951).

Records. – NORTHWEST TERRITORIES. – VII, ♀ 11 August 1967. XIII, ♀ 7 August 1967. XV, ♀ 8 August 1967 (dragging paralyzed spider prey: *Phidippus* sp., immature; Fam. Salticidae).

23. *Pompilus (Arachnospila) arctus* Cresson.

Biology. – One of the more common species of *Pompilus* within its range; most often encountered on or near the ground in open wooded areas or in parks; nests in soft earth; (Evans, 1951).

Known distribution. – Transcontinental in the Hudsonian, Canadian and Transition Zones; some peripheral localities: . . Labrador . . California, New Mexico . . (Evans, 1951).

Records. – NORTHWEST TERRITORIES. – XII, ♀ 5 August 1967. XV, ♀ 8 August 1967. +XVI, ♀ 6 August (Evans, 1951: CNC). YUKON TERRITORY. – A, ♀ 5 August 1968. +A1, 2 ♂♂ 24 June (Evans, 1951: CNC). +A2, 3 ♂♂ July, August (Evans, 1951: CNC). C, ♀ 9 August 1968.

Genus *Episyron* Schiødte

Biology. – Usually in sandy or gravelly areas, where the nest is in the earth (Evans, 1951).

Known distribution. – All the zoogeographic regions of the world, except apparently Australian; twelve species recorded in the Nearctic Region (Evans, 1951).

24. *Episyron oregon* Evans.

Known distribution. – Western U. S. and Canada, from Yukon and Alberta to Wyoming and California; principally a Transition Zone species; not mentioned from N.W.T. (Evans, 1951).

Records. – NORTHWEST TERRITORIES. – IX, ♀ 1 August 1967. YUKON TERRITORY. – +A2, ♀ 2 July 1948 (Mason, *in* Evans, 1950: CNC).

25. *Episyron quinquenotatus quinquenotatus* Say.

Known distribution. – Throughout the Canadian Alleghanian and Carolinian faunas of eastern U. S. and Canada; more common northward; ranges westward sparingly to Texas, Colorado, Montana, British Columbia. Not mentioned from N.W.T. or Y.T. (Evans, 1950).

Records. – NORTHWEST TERRITORIES. – X, 3 ♂♂, 2 ♀♀ 11 July 1968 (one ♀ digging in sandy soil), 3 ♂♂, 4 ♀♀ 25 July 1967 (one ♀ digging burrow in sandy hillock; another ♀ dragging paralyzed spider prey: *Araneus cornutus* Clerck; Fam. Araneidae), ♂, 3 ♀♀ 31 July 1967 (one ♀ dragging paralyzed spider prey: *Araneus,* immature; Fam. Araneidae), ♀ 9 August 1967 (dragging paralyzed spider prey: *Araneus patagiatus* Clerck; Fam. Araneidae). XII, 2 ♀♀ 29 July 1968. XIV, 2 ♀♀ 26 July 1968 (one on flowers, the other digging burrow in sandy, flat, soil).

Species not found by me but reported from previous literature in N.W.T. or Y.T. or both:

+26. *Episyron biguttatus biguttatus* (Fabricius).

Known distribution. – Occurs throughout North America east of the Rockies, from Texas and Florida to N.W.T. and Labrador; west of the eastern slopes of the Rockies, and also in the Black Hills of South Dakota . . , etc. (Evans, 1950).

Records. – NORTHWEST TERRITORIES. – +XVI, ♀ 6 August (Evans, 1950: CNC).

GENERAL ZOOGEOGRAPHY AND DISTRIBUTION OF POMPILINI (Evans, 1951)

Species, subgenera, and genera collected in N.W.T. or Y.T. or both are marked * in the following text.

Many species have remarkably broad ranges. The range of approximately 46 per cent of the species found in the Nearctic Region is "transcontinental".

Three major distribution patterns have been proposed: – a predominantly northern group

extending further south in mountains, with strong affinities with the Eurasian fauna – a possible indication of Holarctic distribution. The affinities of the following genera or subgenera are considered predominantly holarctic: * *Evagetes*, *Agenioideus* (s. str.), * *Episyron*, *Lophopompilus*, * *Pompilinus*, * *Anoplius* (s. str.), * *Ammosphex*, * *Arachnospila* and * *Anoplochares*. As can be seen, this group is heavily represented in the sample taken from the Northwest Territories and Yukon. According to Evans, this northern group represents approximately 59 per cent of the total number of species found in the Nearctic Region and is also well represented in Eurasia; a few of them are also found in the Neotropical Region. This strongly suggests a migration pattern – probably intermittent – through the Siberia-Alaska regions and the Bering land bridge. Present day patterns of distribution and the importance of morphological differences between Eurasian and North American relatives have been interpreted in terms of possible successive migration waves at different ages. * *Evagetes crassicornis crassicornis*, * *Anoplius (Anoplius) tenuicornis* and * *Anoplius (Anoplius) nigerrimus,* for instance, are found both in Eurasia and northern North America, which suggests a possible recent (postglacial?) migration. According to Evans the following, somewhat less boreal forms, differ only slightly – in color, size, pilosity, for instance – from their nearest Eurasian relatives: * *Evagetes crassicornis consimilis, Pompilus (Arachnospila) fumipennis eureka*, and * *Pompilus (Ammosphex) luctuosus*; this is perhaps indicative of a more ancient (last interglacial?) migration wave. More important differences are recorded in: * *Evagetes parvus, Anoplius (Anoplius) virginiensis* and * *Pompilus (Arachnospila) arctus*, which occur in general slightly farther south. * *Evagetes hyacinthinus, Anoplius (Anoplius) ventralis, Pompilus (Ammosphex) solonus* are considered predominantly Austral in distribution. *Anoplius (Anoplius) fulgidus*, although of Holarctic origin is now predominantly tropical in distribution.

A second group is predominantly a southern one, with some northern extension along coastal areas, and big river systems. Tropical affinities predominate in this group which represents 25 per cent of the species found in the Nearctic Region; some are found in the tropics of the whole World, others only in the Neotropics with some northern extension in the southern parts of North America; some reach even to Canada: *Anoplius (Arachnophroctonus) relativus* and *Aporinellus taeniatus*, for instance.

Affinities of a third "Sonoran group" are still debated; the group (an "endemic" group?) is characteristic of arid regions of the southwest of the U. S.

CONCLUSION

Considering the limited sample involved, no sweeping generalization is attempted. In order to assess the possible effect of latitude, altitude, geology, general and local climates, microclimates, soil and vegetation cover and man, a more complete and systematic sample, both in space and time seems required.

It is clear, however, that Pompilidae are able to cope with the severe conditions of subarctic regions; some of them even extend as far north as the Arctic Coast, on the Mackenzie River Delta (Reindeer Depot), which, however, is still included in the Subarctic Region. To what extent such a northern extension is possible only along a big river system such as the Mackenzie, is not known; undoubtedly this huge river system provides, at least locally if not all along its course, favorable habitats for fossorial wasps, probably in terms of soils, microclimates as well as vegetation cover. It would be interesting to see how far north this fauna extends on the Shield section of the Subarctic Region – where distribution of potentially favorable areas appears to be much more patchy – and whether or not it reaches the Arctic Region, as some bees do (and even the High Arctic: Hocking and Sharplin, 1964-1965).

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REFERENCES

Anon. Yukon today. 1968. Queen's Printer, Ottawa, 76 pp.

Brown, I. C. 1958. Geological Map of the District of Mackenzie – Northwest Territories (Map 1055A, 2 parts). Geological Survey of Canada, Ottawa.

Colinvaux, P. A. 1964. The environment of the Bering Land Bridge. Ecol. Monogr. 34: 297-329.

Coope, G. R. 1961. On the study of the glacial and interglacial insect faunas. Proc. Linn. Soc. Lond. 172: 62-65.

Evans, H. E. 1951. "Subfamily Pompilinae" *in* Muesebeck, C. F. W., K. V. Krombein *et al.* (see below).

Evans, H. E. 1950-1951. A taxonomic study of the Nearctic spider wasps belonging to the tribe Pompilini (Hymenoptera Pompilidae). Trans. Amer. Ent. Soc. 75: 133-270 (Part I), 75: 207-361 (Part II), 77: 203-335 (Part III).

Evans, H. E. 1956. Synonymic Notes on Nearctic Pompilinae (Hymenoptera: Pompilidae). Ent. News 67: 9.

Evans, H. E. 1966. A revision of the Mexican and Central American spider wasps of the subfamily Pompilini (Hymenoptera; Pompilidae). Mem. Amer. ent. Soc. 20: 442 pp. (p. 332).

Fuller, W. A., L. L. Stebbins and G. R. Dyke. 1969. Overwintering of small mammals near Great Slave Lake Northern Canada. Arctic 22 (1) : 34-55.

Geological Survey of Canada. 1955. Geological Map of Canada (Map 1045A), Ottawa. [Remark: no author on map].

Hocking, B. and C. D. Sharplin. 1964. Bees at 82° N. Bee World 45 (4) : 144-146.

Hocking, B. and C. D. Sharplin. 1965. Flower basking by Arctic Insects. Nature 206 (4980) : 215.

Jolliffe, A. W. 1942. Geological Map, Yellowknife Bay (Map 709A; District of Mackenzie – Northwest Territories). Bureau of Geology and Topography, Ottawa.

Krombein, K. V. *et al.* 1958. First Supplement to "Hymenoptera of America" . . . . (see Muesebeck, C. F. W., below).

Krombein, K. V., B. D. Burks *et al.* 1967. Second Supplement to "Hymenoptera of America" . . . . (see Muesebeck, C. F. W., below).

Laycock, A. H. 1968. Chapter "Water" (pp. 112-136) *in* Warkentin, J. (Ed.) 1968. (see below).

Mason, W. R. M. 1956. Distributional problems in Alaska. Proc. 10th int. Congr. Ent. 1: 703-710.

Mason, W. R. M. 1965. Ecological peculiarities of the Canadian North. Arctic Circular 16: 15-17.

Muesebeck, C. F. W., K. V. Krombein, H. K. Townes *et al.* 1951. Hymenoptera of America North of Mexico-Synoptic Catalog. U. S. Dept. Agric. (Agriculture Monograph No. 2), Washington, 1420 pp.

Péwé, T. L. 1966. Permafrost and its effect on life in the north. Oregon State University Press, Corvallis, 40 pp.

Rowe, J. S. 1959. Forest regions of Canada. Canada Department of Northern Affairs and National Resources, Forestry Branch, Ottawa, 71 pp. Map.

Smith, L. S. 1966. Ecology and field biology. Harper and Row, New York, 689 pp.

Warkentin, J. (Ed.) 1968. Canada a geographical interpretation. Methuen, Toronto, 608 pp.

Wonders, W. C. 1968. Chapter "The forest frontier and subarctic" (pp. 473-507) *in* Warkentin J. (Ed.) (see above).