RECONNAISSANCE OF MOUNTAIN MOSQUITOES IN THE McKINLEY PARK REGION, ALASKA

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INTRODUCTION. Since World War II, rapid progress has been made toward a checklist of Alaskan mosquitoes; yet knowledge of those of the alpine zone which comprise nearly a hundred thousand square miles is still meager and scattered. Published lists, general or local, for the forms actually breeding above timber line are lacking and needed. Distribution data based on collections of biting *Aedes* are considered unreliable, due to the uncertainties of identification and because the provenience of winged insects collected on mountainsides is problematic. It has proved difficult, if not impossible, to predict mosquito problems at high priority mountain installations. Reliable data are not only scanty but their interpretation is also complicated, since alpine conditions, habitats, and biota descend even to sea level under the influence of glaciers. Altitude itself, like latitude and longitude, may give no clue to local precipitation and terrain aspects including slope direction, exposure, valley width and air drainage, and local temperature inversions which greatly affect mountain climate. Fortunately, the distribution of trees may be used in Alaskan zoogeographical and ecological studies as a criterion indicating local weather, and woods *per se* are decisive in determining mosquito distribution. Thus it was shown by Frohne (1955a) for tundra mosquitoes that the same arctic tundra forms and but few others characterize subarctic tundra. Hence emphasis is placed on the timber line rather than on actual elevations in this mountain study. The present progress report of larval surveys in the McKinley Park region introduces investigations of Alaskan alpine mosquitoes.

In the most recent listing including Alaskan alpine mosquitoes, Jenkins (1948) reported six species of *Aedes* from elevations usually above timber line, viz.:

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Aedes communis, punctor, impiger (nearcticus), nigripes, intrudens, and *pullatus.* The first four are known Alaskan arctic species (Knight, 1951). Natvig (1948) considers the latter two to be arctic forms also in Scandinavia. Beyond this generalization that arctic forms do occur in the mountains, knowledge as to vertical range of the score of other Alaskan mosquitoes is very scanty. It was apparent in planning alpine studies that it would be particularly instructive to determine, as well, the occurrence of wigglers and their characteristic habitats at (1) the upper levels of spruce woods or about 2,000 feet, (2) the transitional terrain called taiga or the hemiarctic, which lies just below timber line, in addition to (3) the treeless alpine zone between timber line and perennial snow, which usually begins at 5,000 to 6,000 feet.

MOUNT MCKINLEY NATIONAL PARK. The Mount McKinley National Park situated between Anchorage and Fairbanks comprises about 3,000 square miles said to be 60 to 75 percent above the timber line. No publication on the Park mosquitoes antedated the present surveys. However, Wildlife Ranger H. E. Booth collected and reared mosquitoes for H. H. Stage of the Bureau of Entomology in 1945. Jenkins (l.c.) refers to trips to the Park by Alaska Insect Control personnel in 1947, and Park Service files reveal one party was led by C. S. Wilson, who sprayed three acres experimentally in April, another by Alan Stone, who checked the effectiveness of Wilson's spraying in June. It seems likely that Jenkins' apt designation of *Aedes pullatus* as a species of "alpine meadows above timber line" refers in part to Dr. Stone's dipping notes in McKinley Park on that occasion. Frohne (1955b) described swarms of *Aedes communis* and *impiger* males seen in the Park in 1954.

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METHODS, AREAS, AND WEATHER. Representative larval collections were dipped along the Denali Highway connecting Park headquarters to (1) Wonder Lake about eighty miles to the west; and (2), in the opposite direction for about sixty miles from Park headquarters southward via Cantwell, then eastward to new road construction. Much of (2) is in the narrow Nenana valley. The 1954 collections were dated June 15, 16, 17, 24, 27 and July 3, 5, 7, 8. They came from elevations between 1,700 and 5,000 feet. The dipping in May 1955 included two road surveys of (2) and a foot survey of the phenologically early southeast slope of Mount Healy. Collections were made as weather permitted May 10–25 from elevations of about 1,700 to 3,000 feet.

Identification of mounted *Aedes* larvae was materially aided by saddle spine characters (Frohne, 1955c). Apical spine traits of fourth instar larvae are consistently recognizable as early as the second instar and in favorably mounted specimens usually so in the first instar.

Small larvae of *Aedes intrudens* and *nigripes* proved puzzling. The saddle spines of these species had not been studied.

When larger larvae were later collected in the same habitats where doubtful *intrudens* or *nigripes* small larvae had been taken, it was evident that the earlier collections of first instar larvae belonged to *nigripes.*

RESULTS. When the data are classified according to the vertical distribution of the species in the 3 major mountain zones (*woods,* below 2,000 feet; *taiga,* 2,000 to 3,000 feet; and *alpine,* above 3,000 feet), the following generalization can be made. *Aedes communis* (DeG.) was the most abundant and also the earliest species below about 3,000 feet. *A. impiger* (Wlk.) and *pullatus* (Coq.) also occurred abundantly in all three zones, the former appearing considerably earlier. *A. excrucians*

(Wlk.), which hatched about the same time as *pullatus,* was common to abundant in the two lower zones, not uncommon but about a month later above 3,000 feet. *A. punctor* (Kby.) and *hexodontus* (Dyar) were common in bogs only, but both occurred at all three levels. The remaining larvae were apparently restricted to lower, wooded zones, but the data are too few for conclusions. Two species of *Culiseta, alaskaensis* (Ludl.) and *impatiens* (Wlk.) were common on the wing at times in May and June. However, only thirteen larval collections of *Culiseta* were made, composed mostly of small larvae I could not identify with certainty. All were collected below 3,000 feet. Certain Central Alaskan mosquitoes, common elsewhere at low elevations, were *not* found in these mountain surveys, e.g., *Culex territans* (Wlk.), *Anopheles* sp., *Culiseta morsitans* (Theob.), *Aedes implicatus* (Vock.), *stimulans* (Wlk.), *flavescens* (Müller), and *decticus* H., D., and K. (*pseudodiantaeus* Smith).

LARVAL HABITATS. The following outline-key to eleven major larval habitat types provides only a framework for organizing the ecological data, but it should be useful with certain reservations as a general guide for later work. To save space and simplify the classification several omissions were made such as disregarding transitional habitats between types, and the temporary margins of permanent type waters including all microhabitats. As a result some strange bedfellows have been lumped as they occasionally seem to be in Nature. The key word, designated by capitals, facilitates discussion, and the Roman numerals designate types in Table 1.

OUTLINE-KEY TO LARVAL HABITAT TYPES. Pools and ponds below timber line protected by marginal trees and shrubs.

Bog waters, dystrophic, in peaty depressions, choked with vegetation.

Deeper, permanent bog pools.

Type I. SPHAGNUM-*Rubus-Eriophorum* community.... 7 examples

Type II. PINGUICULA-*Carex* community .... 5 examples

Type III. LEDUM and/or *Betula nana* communities..12 examples

Swamps and marshes, eutrophic-oligotrophic, rarely dystrophic, shaded or weedy, temporary or semipermanent, though often with permanent depressions.

Shallow, temporary vernal waters, usually within scrubby woods.

Type IV. Marginal trees of SALIX-*Picea* community.. 18 examples

Type V. Barren and exposed, or grassy TAIGA pools and ponds... 18 examples

Type VI. RANUNCULUS FLAMMULA flats .... 2 examples

TABLE 1.—Number of individual habitats belonging to eleven types in which each larval species was taken

Types	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
A. communis	3	1	6	13	15	2	4	2	4	3	
A. impiger		1		6	11	1	1		1	3	
A. pullatus	1	3	3	6	2	1	5	4	24	6	
A. punctor	5	4	1		2	1	7	1			
A. pionips	2	2	1	4	1		1			1	
A. excrucians		2		1	1	1	5				
A. hexodontus	3	1	1		1		3				
C. alaskaensis				1			6			1	
A. intrudens				1	2		2				
A. cataphylla				1	2	1	1				
C. impatiens	1			1			3				1
A. nigripes					1	1	1				
A. cinereus	2										
A. fitchii							1				
A. diantaeus		1									

Deeper, semipermanent or permanent, weedy ponds.

Type VII. CAREX communities.... 20 examples

Exposed pools above or below timber line, virtually unprotected by marginal plants, barren of or scantily occupied by vascular aquatic vegetation.

Natural (long-standing) depressions, water permanent or temporary.

Type VIII. Cold ALPINE pools fed by melt of adjacent snow-ice fields, *Caltha* community ...... 4 examples

Type IX. Warm, intermittent summer pools in dry beds of TORRENTS, gravelly flood plains, barren or with sprigs of *Equisetum, Carex,* or *Juncus*.. 24 examples

Man-made (recent) depressions, usually temporary.

Type X. Barren BORROW pits, ditches, caterpillar tracks, etc.... 9 examples

Type XI. Artificial CONTAINERS (wash tub) .... 1 example

Particular larval species more or less satisfactorily characterize each proposed habitat type arrived at without consideration of dominant larva or larvae present. The special advantage of these eleven habitat types chosen is that practically any pool may be classified almost at a glance and notes limited to peculiarities. Table 1 gives the distribution of the fifteen larvae in the eleven types indicated by the number of habitats positive for each. The table presents numbers of positive habitats, not individual collections. Nor is it justifiable from these preliminary qualitative dipping surveys to quantify by citing actual larval counts. However, it is perhaps descriptive of habitat types to note the dominant species as the characteristic larva. *A. punctor* and *hexodontus* were the typical larvae of SPHAGNUM bog pools (I), and *punctor* was taken in four out of five PINGUICULA pools (II), as well. LEDUM bog waters (III), usually more transient and formed early, favored *A. communis,* which is also the characteristic larva of SALIX pools (IV). Associated *A. impiger* and *communis* teemed in most TAIGA pools (V). In the peculiar RANUNCULUS FLAMMULA flats (VI) the comparative scarcity of both *communis* and *impiger* was striking, and one also received the impression that the collection of *A. nigripes* in numbers here, and here only, was ecologically significant. The chief reasons for the miscellaneousness of the larvae taken in CAREX ponds (VII) seem to be the confluence of temporary, vernal, marginal water early in the season with this permanent type, and the variability in elevation, water source, temperature and color. However, by late June CAREX ponds, even of different elevations, were more uniform and *A. excrucians* and *punctor* with the *Culiseta* larvae were characteristic. *A. pullatus* was the typical wiggler of ALPINE pools (VIII), and equally so of TORRENT pools (IX) in all three vertical zones. For both these habitat types occurring within the trees, however, *A. communis* breeding preceded *pullatus,* especially in shallow, sunny gravelly flats. *A. pullatus* also frequented new and artificial habitats like BORROW pits more than any other species. However, only *Culiseta impatiens* bred in an artificial CONTAINER habitat (XI), an intermittently used wash tub.

LARVAL ASSOCIATION. Larval association is concerned primarily with different larval species of the same habitat and may also take prevalences and phenologies into account. To be "associated," northern *Aedes* would ideally leave the egg the same day, and also pupate more or less simultaneously. No two Alaskan species are so closely matched. On the other hand, in emphasizing the common habitat it is often useful to regard all larval species occurring in a particular pool during the entire season as associated. The method of determining association for Table 2 was a compromise. Association indicates occurrence in the same dipping collection, thus stressing similar seasonal history and soft-pedaling habitat. For example, *A.*

TABLE 2.—Associations of McKinley region mountain larvae. The diagonal figures are the total collections of each species

	communis	*impiger*	*pullatus*	*punctor*	*pionips*	*excrucians*	*hexodontus*	*alaskaensis*	*intrudens*	*cataphylla*	*impatiens*	*nigripes*	*cinereus*	*fitchii*	*diantaeus*
communis	73														
impiger	26	34													
pullatus	11	9	52												
punctor	8	1	8	19											
pionips	6		8	5	14										
excrucians	3	3	3	1	1	10									
hexodontus	6		1	6	2		9								
alaskaensis			2	1				8							
intrudens	4	2				1			5						
cataphylla	5	7	2	1		1			1	7					
impatiens			1	1		1	1	2			5				
nigripes	3	4	2	4		1				2		5			
cinereus	1			2	1		2				1		2		
fitchii						1								1	
diantaeus			1	1	1										1

communis and *pullatus,* the most common larvae, were associated in only eleven of 125 *communis* plus *pullatus* collections, an index of association under 10 percent. This index would be much higher, however, if association were determined by occurrence in the same breeding place and the different collections lumped, because May *communis* larvae in persistent TORRENT pools, etc., are usually replaced in June and July by *pullatus* larvae. In the present reconnaissance, however, no distinction was made between large and small larvae. As a result the later (small) larvae of one species associated with earlier (large) larvae of a second species could not have hatched or grown in the ice-cold water which nurtured the earlier species. About 24 percent of *impiger* plus *communis* collections contained both species, which are early, common, and in one habitat type, the TAIGA (V), even codominants. The other pairs of larvae collected enough times so that their percent of association may be significant were: *punctor* and *hexodontus,* over 20 percent; and *punctor* and *pionips,* about 15 percent. It appears likely, since larval samples were small, that some association percentages, like 17 percent for *cataphylla* and *nigripes,* larvae which occurred "diluted" in *communis* collections, are too low.

SEASONAL OCCURRENCE. The phenology data for larvae found in the Park area will assist the planning of later workers, but the dates probably vary by as much as ten days for different years. Below timber line in 1955, when spring was late, the larvae of all thirteen *Aedes* were collected the latter half of May. None of the earliest species, *communis,* hatched in April, although this may be the case in some years. June and July collecting in 1954, a normal season, indicated that above the timber line these months correspond to May for the six *Aedes* larvae which were taken at all three vertical zones. Making exceptions for delayed hatching of eggs in the larger, later melting habitats, the succession of species below timber line by groups of more or less contemporaneous species was: (1) *A. communis;* (2) *A. impiger, punctor, hexodontus, cataphylla, nigripes, intrudens;* (3) *A. pullatus, pionips, excrucians, diantaeus, fitchii;* (4) *C. alaskaensis* and *impatiens.* The *A. cinereus* larvae were taken May 19 and July 5, but the species is believed to belong in group (3).

The order of occurrence differs from Jenkins (l.c.), mostly, I think, because he combined collection data of different latitudes and altitudes.

SUMMARY. Preliminary dipping surveys of mosquito larvae were made in the mountainous McKinley Park region of Alaska from which fifteen mosquitoes were identified: *Aedes communis, impiger, pullatus, punctor, hexodontus, excrucians, pionips, intrudens, cataphylla, nigripes, cinereus, fitchii, diantaeus, Culiseta impatiens,* and *alaskaensis.*

The vertical distribution of the larvae was related to three mountain zones dependent on altitude and presence of trees: (1) below 2,000 feet (woods); (2) between 2,000 and 3,000 feet (taiga); (3) above 3,000 feet (alpine). The first six mosquitoes listed occurred in all three zones.

Eleven principal types of larval habitats were recognized on the basis of vegetation, water, depression, and elevation where more or less characteristic assemblages of larvae bred in an orderly seasonal succession which was later at successively higher elevations.

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