

## INTRODUCTORY SURVEY OF ADULT MOSQUITOES IN THE YUKON-KUSKOKWIM DELTA OF ALASKA

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**ABSTRACT.** Rapid field surveys of adult mosquitoes from 19 localities in the Yukon-Kuskokwim Delta of Alaska during May 1 to October 1, 1970, produced nine species: *Aedes cinereus* Meigen, *A. communis* (DeGeer), *A. excrucians* (Walker), *A. hexodontus* Dyar, *A. impiger* (Walker), *A. intrudens* Dyar, *A. nigripes* (Zetterstedt), *A. punctator* (Furber), and *Culiseta alaskaensis* (Ludlow). A number of discrepancies are described in the taxonomy of *Aedes* species "complexes," of which one major case is the inability to distinguish *A. stimulans* (Walker) adults from those of *A. fitchii* (Felt & Young). Four speci-

mens of possibly an undescribed species of *Aedes* were taken from Napaskiak. The ecological distribution of mosquitoes is related to three typical kinds of tundra: the coastal desert tundra; the grass tundra, of flat lowland basins and upland rolling hills and bogs; and the bush tundra, of sheltered upriver valleys. In this Delta Area, the mosquito-biting period extended from mid-May to late September. The seasonal succession of species in Bethel was: *C. alaskaensis*, *A. impiger* and *nigripes* (simultaneous), *A. hexodontus*, *punctator*, (?) *intrudens*, *excrucians*, and *cinereus*.

**INTRODUCTION.** Although the literature on Alaskan mosquitoes has increased in the past two decades, very little is recorded of their seasonal incidence, species abundance, and health significance in the Yukon-Kuskokwim Delta. Berg (1952) conducted a preliminary survey of biting Diptera between June 15 and August 21, 1951 in the immediate vicinity of the Yukon River between Holy Cross and Andreafsky, which is the old townsite of Saint Marys. In general he found mosquitoes the worst pest but in some restricted areas blackflies were far more troublesome. This is still true today in most parts of the State. Fortunately Alaskan mosquitoes have not yet been demonstrated vectors of disease agents. Nevertheless, their annoyance and biting along with its associated allergic reactions, secondary infections and related medical problems are significant health hazards.

This survey was done to determine the general habits and pest importance of adult mosquitoes in the part of subarctic western Alaska where the author's official

duties were performed. It was conducted as an addition to the on-going program activities of the Office of Environmental Health, being carried out at the Bethel Service Unit by the Indian Health Service. Observations and collections were made as time permitted during the 5-month period, May to October, 1970, at Bethel and 18 out-lying localities shown in Figure 1.

Physiographically this 85,000-square mile Delta Area, outlined in Figure 1, is the southwest extension of the Intermontane Plateau System, consisting of lowland basins floored with alluvial deposits, dissected uplands, and narrow valleys. Approximately three-fourths of this Delta are lowland basins, marked by a myriad of meandering streams and sloughs, lakes and ponds, and shallow vales of the two giant rivers. The remaining one-fourth is the northeast portion of the Kuskokwim Mountain Range that embraces upland valleys and eventually flattens into upland rolling hills and bogs of the broad tundra plain. About 11,500 people inhabit 49 permanent rural settlements in this area.

According to Johnson and Hartman (1969) this area lies in the "transitional" climatic zone of Alaska, which has more pronounced temperature variations

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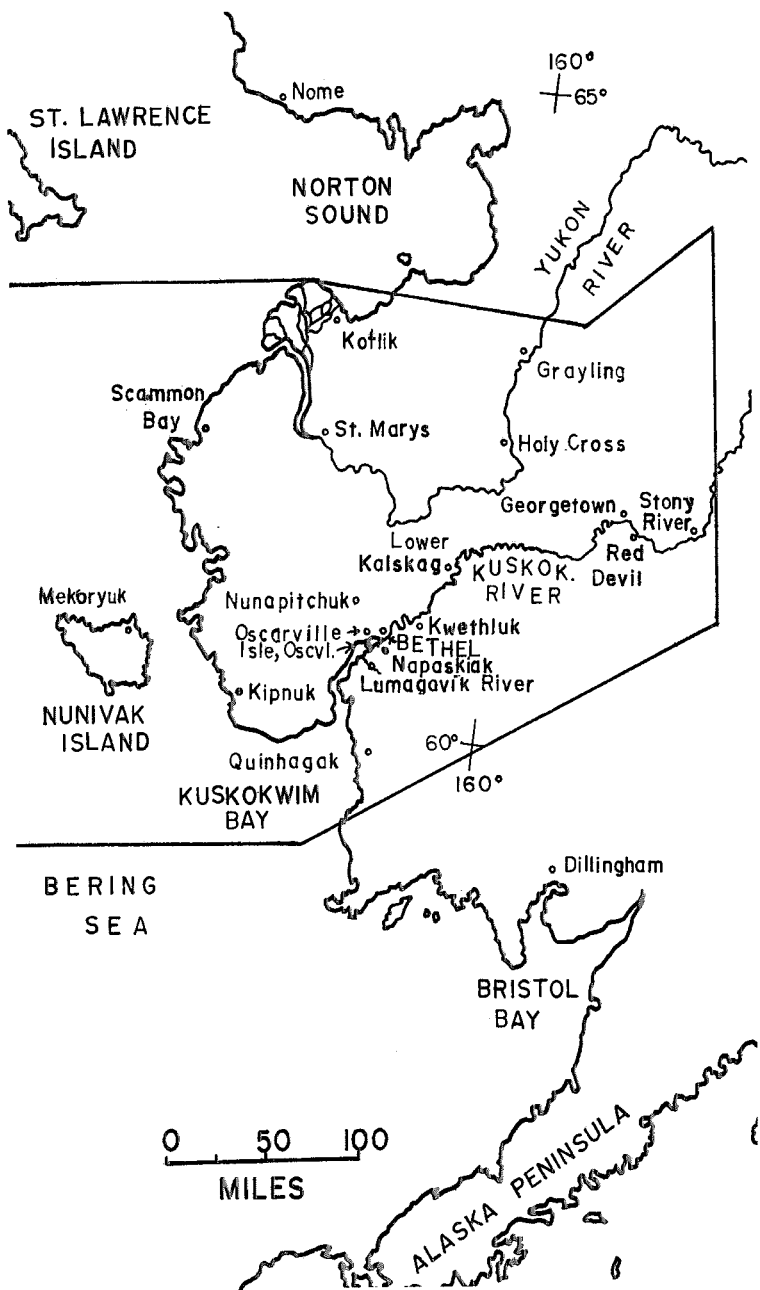


FIG. 1. Map showing location of 19 localities in the Yukon-Kuskokwim Delta where observations were made.

throughout the day and year, less cloudiness and lower precipitation and humidity than the "maritime" zone. Although the mean annual temperature is generally between 25° and 35° F., the mean mid-summer (July) minimum temperature varies at different locales from 46° to 48° F.; and the maximum, from 52° to 64° F. In the overall Delta the mean annual precipitation fluctuates from 16 to 20 inches (water equivalent).

The inhabited subarctic localities under investigation represent three types of tundra: the desert tundra of seacoasts; the grass tundra of flat lowland basins and upland rolling hills and bogs; and the bush tundra of sheltered upland valleys. The coastal desert tundra, characterized by expanses of bare silt and sand interspersed with patches of low grass in protected spots, is totally devoid of shrubbery. Farther inland, the extensive grass tundra supports sparse grasses, dwarf shrubs, herbs, and an abundance of mosses and lichens. Moreover, at the grass tundra localities of Oscarville, Napaskiak, and Kwethluk, the main watercourse is delineated by very narrow margins of arctic willow, dwarf birch, and alder thickets before the landscape becomes flat open plain. Still farther inland the bush tundra yields to forests in which conifers, particularly white spruce, predominate, interspersed with birch and cottonwood, on grass cover. In low places, sphagnum bogs constitute the natural flora.

On the open tundra in coastal and grassland areas, the steady moderate to strong winds prevent mosquitoes from flight so they are pestiferous only in small sheltered spots. Similarly, the mosquitoes of inland wooded areas tend to be reluctant to fly any great distance from the vegetative cover to bite. The mosquitoes were most active near twilight, mid-morning, and late afternoon, although sporadic biting occurred almost any time during daylight in both open and sheltered areas. The length of the mosquito-biting period in the Yukon-Kuskokwim Delta was a little more than 4 months, from mid-May to late September, in 1970.

Spring thaw and breakup on the rivers occur near or during the month of May, so at that time mosquito observations were limited to Bethel. Therefore the presence of *Culiseta*, *Culex* or *Anopheles* in the out-lying villages could not be confirmed. In most bush tundra communities the people spoke of the early appearance of "large, white-and-black legged" mosquitoes, which were soon followed by "black-legged" ones in late May. However it was the popular claim that these early mosquitoes were not numerous and did not constitute a grave problem. Berg reported larvae of *Anopheles occidentalis* Dyar and Knab (= *A. earlei* Vargas), *Culiseta alaskaensis* (Ludlow), and *C. impatiens* (Walker), and pupae of *Culex territans* Walker at Holy Cross between June 15 and August 3, so these overwintering species occur in the area.

Breakup on the Kuskokwim River at Bethel occurred May 10 to 13 in 1969 and May 15 to 17 in 1970. The ice goes out on the Yukon River approximately 2 weeks later. These are significant dates for future investigators because many out-lying settlements throughout the Delta area are inaccessible during the spring thaw due to the lack of, or poor condition of aircraft landing strips. Therefore arrival at a study area should occur prior to the spring thaw if surveillance or collection of these hibernating species is desired.

**PROCEDURE.** In Bethel, observations of mosquito immatures in semi-permanent and temporary pools on the tundra and adjacent to roadways were usually made on a daily basis, excepting the time expended on short field trips to out-lying localities. Hence collection of adults occurred shortly after emergence and during the initial biting phase of each species. Random adult collections were made between the varied times of emergence.

The out-lying localities were visited only once during the season and the observation period was usually limited to a day or two. Thereabouts and at Bethel, most of the observations and collections were done in very late afternoon or evening.



(1948) and Frohne (1955) described "tundra varieties" of a number of closely related *Aedes* species from larvae at Umiat and Naknek, respectively, indicate that more study is needed before the Alaskan species can be clearly defined.

**ECOLOGIC DISTRIBUTION.** The data concerning species distribution with reference to ecologic habitat, locality and date are shown in Table 1. Weather conditions, time of day, and seasonal time of observations and collections were undoubtedly reflected in the number of mosquitoes observed and captured, but a few generalizations can be made.

**COASTAL DESERT TUNDRA.** Only three species of *Aedes* were taken from the Bering Seacoast localities, *hexodontus*, *punctor*, and *nigripes*. As might be expected, collections from late July to early September revealed very sparse populations of *hexodontus* and *punctor* in wind-blown Kipnuk; *punctor* in Quinhagak; and *hexodontus* in Scammon Bay. At Mekoryuk, on Nunivak Island, which is 25 miles from the Alaska mainland, *hexodontus* was more common than *nigripes*. Observations made aboard a number of canvas covered boats and various aircraft indicated that mosquitoes were almost always present during the summer so mosquito distribution by transport is probably occurring.

**GRASS TUNDRA.** The adaptable and ubiquitous *A. punctor* far outnumbered all other species in this habitat, and it was also the only species found in all three types of tundra. *A. hexodontus* was the next most common and widely distributed; however, none was taken from the bush tundra. Conversely, *A. cinereus* and *impiger* were taken only from certain grass tundra localities. *A. nigripes*, *excrucians*, and *communis* each had a sporadic distribution in this habitat and also occurred in smaller numbers. *C. alaskaensis* was the only overwintering mosquito captured in Bethel during the spring thaw in May.

Mosquitoes collected in both wind-blown coastal and grass tundra areas were often obviously "rubbed," displaying the loss of some external morphological features necessary for identification. In such areas

field collections of larvae and pupae for laboratory rearing would be an ideal way to obtain fresh, intact adults.

**BUSH TUNDRA.** *A. stimulans/fitchii* (?) were taken only from the wooded localities of the bush tundra. These and *communis* were the dominant ones in all bush tundra communities except Lower Kalskag, where *punctor* appeared to be more abundant. *A. communis* apparently prefers wooded areas for it was also found only in the wooded margins of the Kuskokwim River in the grass tundra at Napaskiak and on an island 3 miles below Oscarville. *A. intrudens* was quite rare. With the unique exception of Red Devil, all localities in the bush tundra had relatively mild to moderate infestations, and biting occurred in spurts when wind velocities were below four miles per hour.

On June 22-23 there were overwhelming numbers of *communis* and *stimulans/fitchii* plaguing the small Kuskokwim village of Red Devil. While enroute to the village from the airstrip access road we were attacked by tremendous swarms from the tall, road-side vegetation. Varying numbers were found in all native homes surveyed, and several young children had innumerable bites. These observations were probably made at the peak of the mosquito season in that area.

While collecting and observing mosquitoes in Stony River, three horse flies (Tabanidae) were also taken from a screen inside an Athabaskan Indian home.

**SITUATION AT BETHEL.** Bethel's climate, affected by both the Bering Sea and the Kilbuck Mountain Range, is described by the local U. S. Weather Service as being "somewhat more maritime than continental in character." However, during June and July, when *Aedes* are the most numerous, the temperatures in Bethel rise noticeably under the influence of warmer continental air masses. Between June 1 and July 31, 1970, the air temperatures averaged a maximum of 59° F. and a minimum of 44° F., with the extremes being 76° F. (June 6-7) and 34° F. (June 1). The mean relative humidity during this period was 79 per cent.

The species succession of adult mosquitoes observed at Bethel throughout the summer of 1970 is shown in Figure 2, along with recorded air temperatures and rainfall. In general, with reference to population density, annoyance, biting and length of the biting period, the seasonal incidence of mosquitoes was mild to moderate. *Aedes* species were the sole offend-

ers. The major pests were *impiger*, with its extremely short but dense infestation period early in the season; and *punctor*, which was present and biting for the longest period.

*C. alaskaensis*, the only hibernating species seen in Bethel, first appeared at breakup, just 2 weeks before the earliest *Aedes* were on the wing. But only a few

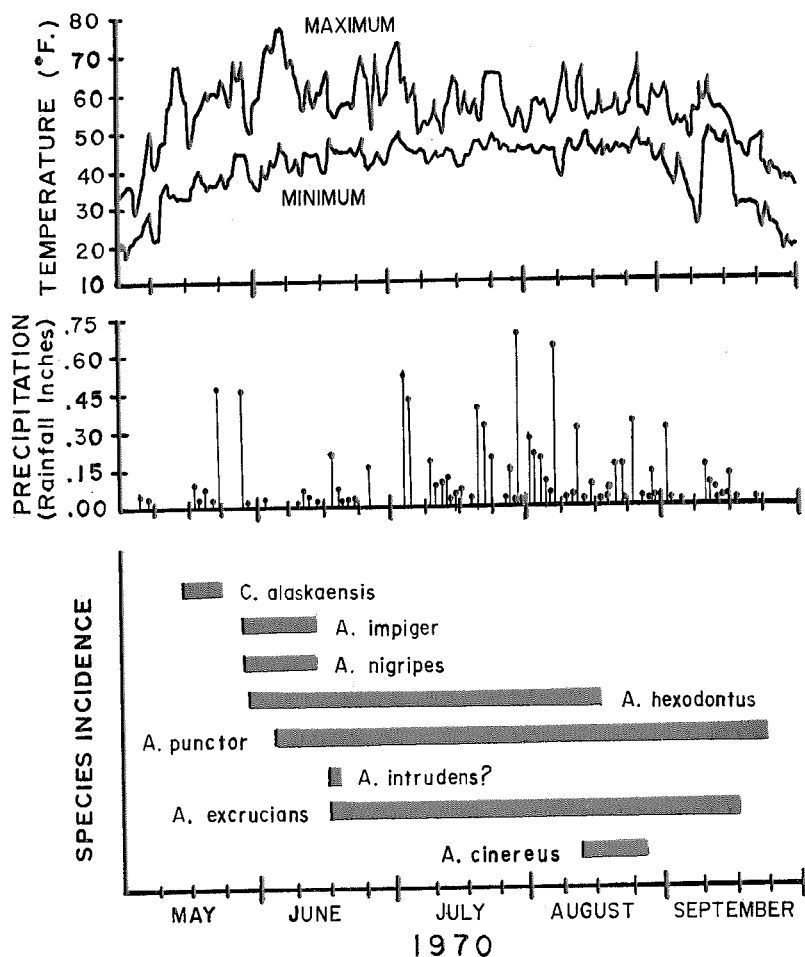


FIG. 2.—Species incidence of adult mosquitoes, precipitation and air temperature, Bethel, Alaska, May 1–October 1, 1970.

specimens were seen on May 14 and their numbers declined during the following week, with none observed after that.

Total snowfall for the winter of 1969-1970 (September to May), as recorded by the U. S. Weather Service at Bethel Airport, was a rather low 37.8 inches (water equivalent, 3.64 inches). No significant flooding occurred in Bethel as a result of breakup on the Kuskokwim River. At any rate the semi-permanent and temporary pools, formed on the tundra by the spring thaw, contained enough water to hatch eggs of *impiger*, *nigripes* and *hexodontus*. The first two species occurred on the wing by May 27, and the next day *hexodontus* was seen. Remarkably enough both *impiger* and *nigripes* were last seen June 12, but *hexodontus* persisted in small numbers until August 23. Emergence of *puncator* from the same semi-permanent pools closely followed on June 5. *A. puncator* was ubiquitous throughout the Bethel city limits and as far out as the BIA and "White Alice" Project sites. Females were taken intermittently until August 10 and in declining numbers thereafter, before their disappearance during the prolonged frost around September 21.

During the period May 16 to 29 there was 1.19 inches of rainfall, thereby increasing the water level in semi-permanent pools and creating a number of temporary pools on the tundra and in road-side furrows. This favorable condition prompted the hatching of *excrucians* eggs. Adults of this species emerged on June 16 in limited numbers and were last seen September 18. Only one specimen of *intrudens*(?) was captured, on June 16. Furthermore, between late May and mid-June a few observations revealed no mosquito immatures breeding in permanent ponds and lakes within a half-mile radius of Bethel PHS Native Hospital, and at Hangar Lake area.

The heaviest single rainfall occurred July 4 to 22, depositing 2.58 inches of water on the already saturated tundra. This was perhaps instrumental in activating the eggs of *A. cinereus* in temporary

boggy pools of sheltered tundra areas. The small and easily recognized adults were first seen on August 10. Infestation was mild and restricted to willow and alder thickets and other shrubs along margins of the nearby Kuskokwim River, Brown Slough, and Hangar Lake, but some were present around the Bethel PHS Hospital. *A. cinereus* was not seen after August 26. The occurrence of this species coincided with that of punkies, also called no-seesums (Ceratopogonidae: *Culicoides*). Although punkies were quite numerous their biting reportedly caused little annoyance.

With reference to injury caused by biting flies, the inpatient records at Bethel Hospital revealed only one case, a young Eskimo girl who has been repeatedly hospitalized since 1965 because of an allergic reaction to mosquito bites. Outpatient records indicate many impetigo cases among young Eskimo children, especially those staying at summer fish camps along the Kuskokwim River. Some hospital physicians state that many of these cases are skin complications arising from mosquito bites and consequent irritation, coupled with problems of poor personal hygiene.

There was no adulticiding for mosquito abatement in Bethel in 1969 or 1970. City records indicate that limited aerial spraying with DDT occurred in prior years.

The vastness of the breeding areas around Bethel makes it impractical to use non-chemical abatement methods such as draining, filling and flushing. Minimal small-area aerial spraying, as done in the past, is rather ineffective and offers only temporary relief, since *Aedes* rapidly invade from surrounding untreated areas. The treatment is costly and it is further questionable if the temporary relief is worth the risk involved with the application of pesticide pollutants to the environment when no information is available concerning effects on the natural enemies of the mosquitoes and on the smaller organisms in the food chain.

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## EFFECT OF AMOUNT OF CO<sub>2</sub> ON COLLECTION OF TABANIDAE IN MALAISE TRAPS<sup>1, 2</sup>

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**ABSTRACT.** In three studies to determine the differential response of Tabanidae to incremental increases in CO<sub>2</sub> (rates of 0, 100, 500, 1000, 1500, and 2000 ml/min.) used as bait in Malaise traps, the response proved to be species specific though the increases in catch were proportionately less at rates above 1000 ml/min. In all, 12 of the 20 species collected were present in sufficient numbers for statistical analyses. Four of these, *Chrysops flavidus* Wiedemann, *Tabanus fuscico-*

*status* Hine, *T. lineola* F., and *T. subsimilis* Belardi, were present in all three studies; the other 8 were present in sufficient numbers in only one or two of the three studies.

The statistical analyses showed significant differences for rates of CO<sub>2</sub>, dates of collection, and trap site while the coefficient of variation for each species analyzed indicated a high degree of variation.

In my previous paper (Roberts, 1970), I reported the results of a preliminary study of the attractiveness of amounts of CO<sub>2</sub> to Tabanidae. The data indicated that a linear relationship probably existed between the CO<sub>2</sub> released and the number of Tabanidae collected, but several aspects of this study prevented a critical

analysis of the relationship. The present paper presents the results of a new study of that relationship conducted in 1969 in the Delta Branch Experimental Forest located about 1 mile north of the Delta Branch Experiment Station, Stoneville, Mississippi.

**MATERIALS AND METHODS.** The Experimental Forest is a tract of 2580 acres (Putnam and McKnight, 1949), which is drained from west to east by two canals. One is located at the southern boundary of the forest and the other is 1 mile north. The forest area extends another mile north of the second canal. The east-west

<sup>1</sup>In cooperation with the Delta Branch of the Mississippi State University Agricultural and Forestry Experiment Station, State College, Mississippi 39762.

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