

mette Valley show a rather uniform distribution throughout the summer. The collections from irrigated sections show an average increase in numbers from May to July and then a decrease in September.

Summary: Five species of *Culiseta* mosquitoes are known in the Pacific Northwest, but only two, *incidens* and *inornata*, are of economic importance. *C. morsitans* and *maccrackenae* are rare species with limited distribution. *C. impatiens* is found in limited numbers only in wooded mountainous regions.

C. incidens finds optimum environment in the temperate climate of Oregon and

Washington, but occurs in limited numbers throughout the region. The larvae prefer cool, acid water, and are the first species to be found in early spring and the last in the fall.

C. inornata is well distributed throughout the Northwest, but is of economic importance only in irrigated sections, where it breeds in large numbers in waste irrigation water. This species prefers alkaline water, and maximum reproduction occurs during the midsummer months.

Both species overwinter as adults. They occasionally bite man, but are more important as pests of livestock or poultry.

THE BLACKFLY PROBLEM IN ALASKA

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Extensive studies of biting Diptera in Alaska have been undertaken during recent years. Although the work was carried on most intensively during the summers of 1947 and 1948, studies were continued by various workers associated with the Alaska Insect Control Project through 1951. This project was conducted by the U. S. Bureau of Entomology and Plant Quarantine under a transfer of funds from the Department of Defense to the Bureau. Much of the work was directed toward solution of the serious mosquito problems of the Territory, but as time and resources permitted studies were made of the biology and importance of the other biting Diptera. The importance of blackflies as pests of man and livestock in many parts of the United States and Canada made it imperative that as much as possible be learned about these insects in Alaska.

The studies on biology and taxonomy confirm earlier reports of the abundance of blackflies in Alaska, and show that at

least 36 species are found there (Stone 1952). This is a larger number than is now known from any State in the United States or from any Province of Canada. Many of the species that cause severe pest problems in the United States and Canada are abundant in Alaska, yet curiously enough there have been few records of blackflies actually biting man. Reports are numerous of annoyance caused by swarms hovering about people's heads and crawling about their faces. Local residents relate stories of hunters and miners who have suffered severely from the bites of "gnats," which were probably blackflies, but in some cases might also have been one of the very large species of *Culicoides* common in Alaska.

During 1948 three survey trips were undertaken, which covered most of the highway system of Alaska. Observations were made at approximately 200 localities, most of which were visited twice and many three times during the season. Observations were also made at Naknek in

southwestern Alaska. Specimens were collected at all localities and subsequently identified by Alan Stone.

The largest population was seen at Naknek during the first week of June. This was predominantly *Simulium vittatum* Zetterstedt and was a source of severe annoyance to personnel of the air base. Another large population, consisting mostly of *venustum* Say and *tuberosum* (Lundstroem), was observed continuously along the Steese Highway from 20 to 60 miles northeast of Fairbanks on June 25.

During the July survey trip blackflies were encountered at 64 of the 173 stations where mosquito counts were made. The highest landing count was 100 (on the front and back of two men during 68 seconds) at mile 1377.5 on the Alaska Highway about 48 miles west of Tanacross.

The last survey trip was made between August 22 and September 8. This time blackflies were encountered at 54 out of 141 localities, and at 27 of them were present in sufficient numbers to give landing counts in excess of 4. The only annoying populations were encountered near Nabesna on August 28 and at Mentasta on August 29. Collections of the populations sampled during July and August were predominantly *venustum* but included *tuberosum* and *decorum* Walker as well as considerable numbers of *aureum* Fries and *vittatum*.

No actual biting was recorded either at Naknek or at any of the other localities mentioned. During the August-September survey the four men in the party received a total of only five bites. These bites were not observed, but were identified later by their characteristic appearance.

During this survey several people were interviewed who had recently been bitten by blackflies. One man at Eureka Lodge had a serious hand infection, which appeared to have been caused by a blackfly bite. Another at Sourdough Lodge had been badly bitten on the forearms while dressing a moose. He commented that the "gnats" seemed to bother only the parts of his arms that had been smeared

with blood. At Northway two carpenters told of having been annoyed by blackflies two days before our visit. They were working side by side, and one man was severely bitten on the forearms and lower legs. The other man was not bitten, though the blackflies had caused him considerable annoyance by crawling into his eyes and nostrils.

Three other cases of blackfly annoyance came to our attention during the survey activities. A road crew of the Alaska Highway Commission were annoyed and received some bites on July 9. at Sheep Creek, about 19 miles north of Valdez. An Army engineer unit working 37 miles north of Valdez suffered considerable annoyance from crawling and biting blackflies on August 26. On September 8 the proprietor of the Chicaloon Lodge told of sheep hunters who had been recently bitten by a "yellow fly" in Carbon Creek Canyon. The eyes of the men were swollen almost shut. *Prosimulium fulvum* (Coquillett) seemed to be the only species fitting the description, and it was the one causing most of the annoyance at Sheep Creek on July 9.

Observations were continued in the Anchorage area by K. M. Sommerman and her assistant, L. H. Dover, until the end of October. During July and August limited flight sampling had yielded *venustum*, *tuberosum*, *vittatum*, and *arcticum* Malloch and/or *corbis* Twinn (females of *arcticum* and *corbis* can not be distinguished) from the lowlands. *Prosimulium hirtipes* (Fries) and *fulvum* were taken at higher elevations in the nearby mountains.

During September the picture changed, with *venustum* and *tuberosum* greatly reduced in numbers and replaced by *arcticum* and/or *corbis*. The latter were common in the lowlands and equally plentiful at elevations of 2,500 feet in the Chugach Range. *S. vittatum* and *decorum* were also taken in the lowlands. *P. hirtipes* and *fulvum* continued to be common in the mountains, and *hirtipes* was becoming an aggressive biter.

During October *arcticum* and/or *corbis*

was the common species in both lowlands and mountains and was an active biter. *P. hirtipes* also continued to be aggressive in both areas. *P. fulvum* was taken from both locations, but did not bite. *S. latipes* (Meigen), *decorum*, and *venustum* were also taken in flight samples from the lowlands.

In late September and early October the blackflies engaged in much crawling and probing before they actually commenced biting, but by the middle of October biting was direct, and in late October they bit as soon as they landed. The highest biting rate observed was one *arcticum* and/or *corbis* per minute per person on October 13, when the sky was overcast, the temperature 40° F., and the air movement barely perceptible. From late September through October flight activity was observed at temperatures of 37° and above (49° upper observation limit) at times when there was no air movement or only a slight breeze. Sky conditions did not seem to affect activity, as flight was observed in bright sunshine as well as on overcast days, during gentle rain and light snow precipitations.

The fall blackfly activity in the Anchorage vicinity is remarkable compared with that noted in other parts of Alaska. It is not known whether the conditions observed there are typical of other Alaskan regions during the same season. From our observations it appears that the behavior of blackflies belonging to the same species is different in the fall from that observed in the summer.

During the August-September survey no activity was observed at temperatures below 44° F., and there were only 10 positive counts among 46 observations taken between 44° and 49°. At these temperatures the average landing count was 6. By contrast there were 21 positive counts out of a possible 31 between 56° and 61°, and the average landing count was 0.6.

Similar observations late in June, 1951, at Kotzebue revealed no blackfly activity at temperatures lower than 51° F., though the flies were continuously present at temperatures higher than 53°. One sweep

count (four sweeps with a 15-inch net on the windward and four on the leeward side of an observer) of 54 was taken at 59°. Furthermore, the flies, which judging from a flight sample consisted entirely of *venustum*, bit the two observers mercilessly. Despite head nets and gloves they received a total of 35 bites during one 7-hour period of flight activity.

Observations at Nenana earlier in June as well as at Fort Yukon in mid-July yielded results similar to those obtained at Kotzebue, except that the populations were smaller and much less aggressive. Biting counts at Nenana were undertaken by one observer at mid-day on June 15. Sweep counts were consistently between 6 and 18, and it was necessary to wear a head net to avoid annoyance. In a period of 90 minutes, during which the observer exposed one forearm, an average of 3 blackflies per minute landed on the bared surface. Their usual procedure was to land and immediately fly off. However, after 60 minutes one landed and bit immediately; 10 minutes later a second bite was received. Both flies fed to repletion and left wounds that were troublesome for several days. One of the two was captured and identified as *decorum*. Based on a flight sample, most of the population consisted of *venustum*.

At Fort Yukon during mid-July of 1951 blackflies were causing local residents much more annoyance than were mosquitoes. The mosquito population, however, was exceptionally low. Several people were complaining of bites, but it was evident that some *Culicoides* annoyance was being attributed to the blackflies. The two observers were each bitten at least once. The highest sweep count was 38 recorded at 6 P.M. on July 14. This population was also composed largely of *venustum*, but as at Nenana the one fly captured in the act of biting proved to be *decorum*.

From these observations it is clear that blackflies in Alaska may at times be serious pests both as crawling nuisances and as biters. At present we have no certain explanation for the aggressive biting behavior of *venustum* at Kotzebue and the lack of biting records for this species in

other parts of Alaska. Neither have we an explanation for the behavior of *articum* and/or *corbis*, so far reported only as a crawling nuisance during the summer but biting readily in the Anchorage area in late fall at air temperatures well below the minimum temperature for flight activity recorded earlier in the season. *P. hirtipes* has also shown the same tendency, biting much more readily in late October than in September.

Many of the observations reported here are contradictory, and the importance to be assigned to Alaskan blackflies is still a matter of conjecture. It is quite possible that the differences in the behavior of a species at different times and places reflect racial adaptations to local conditions. The fact that *venustum* readily bites man at Kotzebue though not elsewhere in Alaska is suggestive. Since pre-Columbian times the human population of interior Alaska has consisted of scarcely more than a few hundred people scattered over a vast ex-

pense of land in which wildlife, including several species of the larger mammals, has been relatively abundant. In such an area there would be little opportunity for blackflies to feed on man. By contrast Kotzebue has been the site of a sizeable village for at least 700 years.

If the question is one of host preference, then the importance of blackflies can be expected to increase rapidly as the population of Alaska grows. Such growth is already proceeding at a rapid pace and will doubtless be accelerated by the increasingly great strategic and economic importance of the Territory. With a larger population the wild host animals will in all probability become less numerous, and the blackflies may be expected to turn, from necessity, to feeding on man and his domestic animals.

Literature Cited

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PREPARING MOSQUITO EGGS FOR EMBRYOLOGICAL STUDY

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There is, at present, a great deal of interest in the biology of mosquitoes. To understand their development, methods of preparing the eggs for embryological study are needed. DeCoursey and Webster (1952) have described a method for clearing the chorion of *Aedes sollicitans* (Walker) which permits a rough appraisal of the degree of development. McLintock (1951) had done some work on the egg shells of *Culiseta inornata* (Will) using a modification of the Crabb (1949) technique of double imbedding in celloidin and paraffin for sectioning. This method is satisfactory for the very early stages of the *Aedes hexodontus* Dyar eggs

used in the present writer's work but does not give good results after the chorion has completely hardened. With Japanese beetle eggs Gese (1952) used a cedar-wood oil process prior to imbedding which softens the chorion and permits sectioning. This, however, is not effective with *Aedes hexodontus* eggs. Most of the workers on *Drosophila* use dechorionated eggs which fix and imbed readily with standard techniques (Demerc, 1950). Mosquito eggs can be dechorionated but only after they are 48 hours old when the transparent embryonic cuticle, which is resistant to sodium hyperchlorite, has formed. Fixatives enter the dechorionated egg rather