

INVESTIGATIONS ON THE BIONOMICS OF *CULICOIDES* *OBSOLETUS* (MEIGEN) AND OTHER BITING MIGDES AT MOUNT SOLON, VIRGINIA *

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In the Shenandoah Valley near Mount Solon, campers and staff members at a Girl Scout camp have experienced severe annoyance from biting midges. An excellent opportunity was provided for studying the biology and ecology of these insects during the summer of 1951. Small shaded streams with sand and mud banks flow through the camp area and into a branch of the North River nearby. The elevation is between 1572 and 1620 feet.

METHODS. Three New Jersey light traps were used to collect *Culicoides* adults. Sixteen-mesh wire screening was fitted over the intake end and a double layer of gauze was wrapped about the lower cone of each trap. The traps were operated from just before dusk until an hour or so after sunrise. From June 16 to September 6, the traps were run 51 nights. During 28 nights at least one trap caught over 1,000 punkies, and catches of 7,000 to 10,000 were not unusual. The maximum for one trap in a single night was approximately 45,600. For the most part, the three traps were operated in three general areas within the camp and adjacent to it, but from time to time they were placed in different habitats with respect to vegetation, elevation, proximity to streams and the like.

SPECIES. *Culicoides obsoletus* (Meigen) comprised upwards of 95 percent of trap catches. Fourteen other species were taken and are listed in order of abundance: *C. guttipennis* (Coquillett), *C. biguttatus* (Coquillett), *C. stellifer* (Coquillett), *C. travisi* Vargas, *C. crepuscularis* Malloch, *C. villosipennis* Root and Hoffman, *C. arboricola* Root and Hoffman, *C. venustus* Hoffman, *C. haematopotus* Malloch, *C. piliferus* Root and Hoffman, *C. variipennis* (Coquillett), *C. nanus* Root and Hoffman, *C. baueri* Hoffman, and *C. spinosus* Root and Hoffman.

ADULT HABITATS. The adult habitats of *Culicoides obsoletus* are reportedly diverse, but according to the findings of Hill (1947) in England, Jenkins (1948) in Alaska, and Malloch (1915a) in Illinois, woods or woodland areas are preferred. Wirth and Bottimer (1956), in their population study of *Culicoides* in the Edwards Plateau region of Texas, state that *C. crepuscularis* is in greatest abundance in open, unwooded country. They report the muddy margins of stock ponds in pastures as the favored breeding places for *C. variipennis*, and that *C. haematopotus* and *C. arboricola* were among the commonest species in wooded locations. Root and Hoffman (1937) and other authors have reported *C. arboricola*, *C. guttipennis*, *C. baueri* and *C. villosipennis* to be tree hole breeders.

By varying the location of the three light traps for 51 nights in the Mount Solon area, and by comparing the resulting incidence of different species, an indication of the preferred habitat of most species was obtained. *C. guttipennis* and *C. villosipennis* were taken at higher forest elevations. Traps operated in, or at the edge of, the forest contained *C.*

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obsoletus, *C. arboricola* and *C. trivisi*. Collections from lowland fields and pastures consisted of *C. stellifer*, *C. crepuscularis*, *C. venustus*, *C. variipennis*, and *C. haematopodus*. *C. biguttatus* was recovered from nearly all forest and lowland habitats.

NOCTURNAL ACTIVITY AND BITING. The activity of most species of *Culicoides* has been reported greatest during the evening and early morning hours. Hill (1947) and Parker (1949) found *C. obsoletus* most abundant in England and Scotland during these hours, but had recorded few for the time between. Pratt *et al.* (1949) discovered similar peaks of activity for Alaskan species, with counts frequently dropping to zero during the middle of the day and at midnight. According to Goulding *et al.* (1949), 87 percent of *C. furens*, and other Florida salt-water species caught in light traps, were taken in the morning hours. Hinman (1936) found that *C. mississippiensis*, another salt-water species, also attacked man readily in the daytime.

To evaluate the little-known nocturnal activity of *C. obsoletus* from a different climate, a light trap was operated in relays during four nights in July and August near Mount Solon. Approximately 45,125 *C. obsoletus* comprised the basis for the following analysis. On two occasions, the catches from 11 p.m. to 5 a.m. were much greater than the total of those from 8 p.m. to 11 p.m. The average percentages for each interval were: 8 p.m. to 9 p.m., 6.75 percent; 9 p.m. to 10 p.m., 11.75 percent; 10 p.m. to 11 p.m., 16 percent; 11 p.m. to 2 a.m., 22.25 percent; and 2 a.m. to 5 a.m., 43.25 percent. (All time is Eastern Standard Time.)

Smaller numbers of *C. guttipennis*, *C. trivisi*, *C. biguttatus*, and *C. arboricola* also showed increased incidence during the 2 a.m. to 5 a.m. period.

Routine biting counts were taken three times weekly on arms exposed for 15-minute intervals. The identification of 80 specimens thus collected indicated that *C. obsoletus* was outstanding in numbers

and in its persistence in entering screened cabins from just before dusk to dawn. (On one occasion a group of people were severely bitten by large numbers of *C. obsoletus* in a lighted, screened cabin from 3:30 a.m. to 4:30 a.m. EST.) *C. biguttatus* bit in lighted buildings during early evening hours. *C. guttipennis* bit aggressively outdoors late in the evening, and *C. stellifer* bit occasionally during the day, apparently flying from emergent and overhanging vegetation along streams.

A study of recorded area climatological data and biting records showed that wind velocity greater than three to five miles per hour inhibited biting. Temperature increases or decreases of at least several degrees, and high humidity appeared to stimulate biting activity.

SEASONAL OCCURRENCE. The seasonal occurrence of many fresh-water *Culicoides* corresponds with two generations per year, whereas some salt-marsh species are observed throughout the year along Atlantic and gulf coasts. Hoffman (1925) in the Eastern United States, and Root and Hoffman (1937) in the Middle West record *C. obsoletus* from May to October, while Malloch (1915) recorded it during April and up to November. Hill (1947) and Edwards (1939) in England found peaks of *C. obsoletus* in early June and September with declining numbers in October. Foote and Pratt (1954) give the earliest and latest monthly record for the following species in Eastern United States: *C. obsoletus*, January 18 (1949) and November 29; *C. biguttatus*, March 30 (1949) and September 17 (1914); *C. stellifer*, January 20 (1947) and August 29 (1945); *C. guttipennis*, March 30 (1948) and August 31; *C. venustus*, January 20-21 (1945) and December 27 (1947); *C. trivisi*, April 8 (1949) and July 25 (1942); *C. haematopodus*, January 14 (1947) and September 14 (1942); *C. crepuscularis*, April 8 (1948) and September 4 (1945); *C. piliferus*, April 26 (1948) and July (1944); and *C. arboricola*, March 28 (1949) and August 8 (1945). Earlier and later monthly records on some of these

species have been reported by Wirth and Bottimer (1956) from the Plateau Region of Texas.

An index of seasonal occurrence of the various species at Mount Solon was derived from an analysis of trap data from June 16 to September 6. *C. obsoletus* numbers rose sharply twice during the season; from mid-June to mid-July, and again from July 20 to mid-August. Over 200,000 specimens comprised these crests. *C. biguttatus* and *C. stellifer* showed a high incidence of several hundred from mid-June to mid-July with smaller numbers taken in the weeks between and following this period. Thirteen *C. stellifer* were trapped September 5. Thirteen thousand fifty eight *C. guttipennis*, 183 *C. villosipennis*, and 101 *C. venustus* were taken from the last week in June to mid-July with smaller numbers of the former two species in late July, early August, and early September. Twenty *C. guttipennis* and four *C. villosipennis* were recorded from one trap on September 6. *C. venustus*, however, appeared infrequently in August, but 14 were caught September 5. A few *C. travisi* were collected from mid-June to mid-July with high catches of 33 and 79 on June 27 and July 2. Of these, seven were also collected July 27 and two August 7. Ten *C. haematopodus* occurred late in June and nine late in July. Most of 260 *C. crepuscularis* were trapped during the last week of June and until mid-July; however, two specimens were taken on September 5. Two *C. piliferus* were caught on June 22, and 13 more between July 13 and 15. A well defined increase comprised of 52 *C. arboricola* was obvious during the second week of July as was another by 96 specimens July 25 through August 31.

BREEDING AREAS. The larvae of *Culicoides* are found in mud, sand, and debris at edges of ponds, lakes and creeks and in treeholes. Hill (1947) recovered *C. obsoletus* larvae from clayey soil, decaying leaves in a treehole and from a shady ditch full of rotting leaves, but no definite opinion could be formed as to the nature

of essential features of the breeding media. *C. arboricola*, *C. guttipennis*, *C. villosipennis* and *C. nanus* have been reported by Root and Hoffman (1937) and others as typically treehole breeders. Wirth and Bottimer (1956) reared *C. baueri*, *C. crepuscularis*, *C. haematopodus*, *C. spinosus*, *C. stellifer*, and several other species from pond-edge mud samples in Texas.

The study of breeding areas in Mount Solon centered primarily around 71 locations along or near the small forest streams. Forty-five preliminary mud, sand, and humus samples yielded 92 pupae of six species which were reared to adults and identified. They included: 23 pupae of 14 female and nine male *C. haematopodus* collected in two locations between July 5 and August 23; 10 pupae of six female and four male *C. stellifer* collected in two locations between July 7 and July 12; seven pupae of six female and one male *C. biguttatus* collected from six locations between June 25 and July 6; eight pupae of six female and two male *C. piliferus* collected in five locations between June 25 and July 7; 37 pupae of 26 female and 11 male *C. guttipennis* collected in three treeholes between July 30 and September 29 (collecting from treehole debris continued several weeks after field work was concluded); and seven pupae of five female and two male *C. obsoletus* collected from two treeholes July 2 to September 7.

As indicated by soil sample results, inverted cans fitted with glass vials having tin-foil cones were distributed throughout the areas of known or suspected *Culicoides* breeding. Thirty-two can traps captured 183 adults. These included: 160 adults of 97 female and 63 male *C. haematopodus* trapped in three locations between July 12 and September 3; one adult female of *C. stellifer* trapped in one location on July 29; two adult males of *C. biguttatus* trapped in two locations on June 25; and 20 adults of 14 female and six male *C. obsoletus* trapped in four locations between July 12 and September 7. Can traps were not used at treeholes.

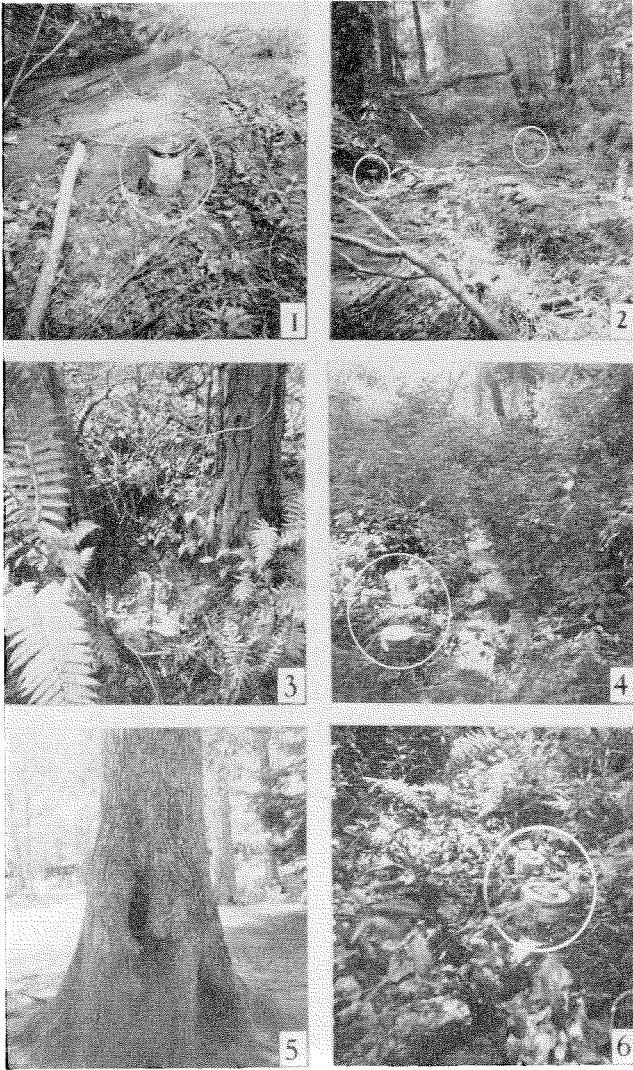


FIG. 1.—Stream edge habitat of immature *Culicoides haematopodus*. (Can trap circled.)

FIG. 2.—Stream bed area from which *Culicoides stellifer* adults and pupae were taken. (Can traps circled.)

FIG. 3.—Marginal stream pocket where *Culicoides piliferus* pupae were collected.

FIG. 4.—Vegetated stream margin habitat of immature *Culicoides biguttatus*. (Can traps circled.)

FIG. 5.—Water-filled treehole from which *Culicoides guttipennis* larvae and pupae were collected.

FIG. 6.—Compost heap of damp leaves which yielded adult *Culicoides obsoletus*. (Can traps circled.)

By comparing the incidence thus obtained, with the type location, conclusions were made concerning the preferred larval habitats of several species. *C. haematopotus* was found a few feet from the stream edge in damp sand containing leaf mold (Fig. 1). The soil temperature averaged 75° F. as shade was incomplete during the day. *C. stellifer* was taken from shallow stream-edge depressions lined with black decaying leaves (Fig. 2). All sites were well shaded and soil temperatures averaged 71° F. *C. piliferus* preferred relatively clean moist sand in well shaded locations (Fig. 3). Soil temperatures averaged 67° F. *C. biguttatus* was recovered from several well shaded places along the streams which included sand that supported vegetation and muck, rich in decaying leaves (Fig. 4). Average soil temperature was 68° F. *C. guttipennis* was taken from water-filled treeholes in which water temperature averaged 70° F. (Fig. 5). A few *C. obsoletus* were found in treeholes rich in decaying matter and in sandy stream banks devoid of humus. The majority of *C. obsoletus*, however, came from two shaded compost heaps of damp leaves dumped near the streams (Fig. 6). Temperature of breeding media averaged 71° F.

SUMMARY. During the summer of 1951 a study of the *Culicoides* of the Mount Solon, Virginia, area was conducted in order to determine their biology and ecology. Three light traps were operated 51 nights from June 16 to September 6. *C. obsoletus* represented 95 percent of the trap totals; however, 14 other species were collected. By comparing the kinds trapped in each type of environment, the preferred adult habitat of several species was determined. *C. guttipennis* and *villosipennis* were found only in high forest elevation, and *obsoletus*, *arboricola* and *travisi* in or near forest areas. Lowland fields and pastures were inhabited by *stellifer*, *crepuscularis*, *venustus*, *varipennis* and *haematopotus*. On four occasions a light trap was run in relays from dusk to dawn. Twice the catches of *obsoletus*

from 11 p.m. to 5 a.m. were much greater than those from 8 p.m. to 11 p.m. Other species also showed increased activity during the late night and early morning hours. *C. obsoletus*, *biguttatus* and *guttipennis* were the primary nocturnal biters, while *stellifer* bit occasionally during the day. There were two general increases in *Culicoides* numbers during the study; one from mid-June to mid-July, and the other from late July to mid-August. Several species appeared in smaller numbers during late August and early September. Breeding areas were determined by rearing pupae from soil samples and by trapping emerging adults. All species required moisture and some shade, and most preferred sand rich in humus. *C. obsoletus* was taken in numbers from sand, compost heaps of leaves, and from treeholes.

Literature Cited

- EDWARDS, F. W. 1939. In Edwards, Oldroyd, and Smart. British bloodsucking flies. British Museum Nat. Hist., London, 156 pp., 45 pl.
- FOOTE, R. H., and PRATT, H. D. 1954. The *Culicoides* of the eastern United States. Public Health Monograph 18. 53 pp.
- GOULDING, R. L., CURRAN, R. F. and HARDEN, F. W. 1949. Cooperative salt-marsh sand fly investigations. Orlando Laboratory of the Bureau of Entomology and Plant Quarantine, Quarterly Report, Dec. 1949. pp. 55-68.
- HILL, M. A. 1947. The life-cycle and habits of *Culicoides impunctatus* Goetghebuer and *Culicoides obsoletus* Meigen, together with some observations on the life-cycle of *Culicoides odidilis* Austen, *Culicoides pallidicornis* Kieffer, *Culicoides cubitalis* Edwards and *Culicoides chiopterus* Meigen. Ann. Trop. Med. and Parasit. 41:155-115.
- HINMAN, E. H. 1936. Notes on Louisiana *Culicoides* (Diptera, Ceratopogonidae). Amer. Jour. Hyg. 15:773-776.
- HOFFMAN, W. A. 1925. A review of the species of *Culicoides* of North and Central America and the West Indies. Amer. Jour. Hyg. 5:274-301.
- JENKINS, D. W. 1948. Ecological observations on the blackflies and punkies of central Alaska. Mosquito News 8:148-154.
- MALLOCH, J. R. 1915. The Chironomidae, or midges, of Illinois, with particular reference to the species occurring in the Illinois River. Bull. Illinois State Lab. Nat. Hist. 10:275-543.
- MALLOCH, J. R. 1915a. Some additional records of Chironomidae for Illinois and notes on other Illinois Diptera. Bul. Illinois State Lab. Nat. Hist. 11:303-363.

PARKER, A. H. 1949. Observations on the seasonal and daily incidence of certain biting midges (*Culicoides latreille*, Diptera, Ceratopogonidae) in Scotland. Trans. Royal. Ent. Soc. of London. 100:179-190.

PRATT, R. L., MORRIS, B. L., and DALEY, G. J. 1949. Climatic studies: effect of meteorological factors on *Culicoides* activity. Progress Report of the Alaska Insect Project for 1948, Bureau of

Entomology and Plant Quarantine. Interim Report No. 0-137:68-70.

ROOT, F. M., and HOFFMAN, W. A. 1937. The North American species of *Culicoides*. Amer. Jour. Hyg. 25:150-176.

WIRTH, W. W., and BOTTIMER, L. J. 1956. A population study of the *Culicoides* midges of the Edwards Plateau region of Texas. Mosquito News 16(4):256-266.