

PRELIMINARY HOST PREFERENCE STUDIES ON VIRGINIA *CULICOIDES* (DIPTERA: CERATOPOGONIDAE)¹

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Female *Culicoides* have available a great diversity of sources of blood meals, and the potential of these biting flies to act as vectors of a disease depends greatly on their source of blood. Kettle (10) believed that each species had a range of hosts on which it would feed, but generally preferred one. In addition to birds and mammals, *Culicoides* have been collected on turtles, lizards and recently engorged mosquitoes (4, 12, and 3). The most commonly reported mammalian host of *Culicoides* has been man. Jamnback (9) reported that 17 of the 37 species found in New York had been reported feeding on man. Numerous other reports are listed for species not found in the Eastern United States.

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The works of Fallis and Wood (8), Fallis (5), Bennett and Fallis (2) and Fallis and Bennett (6) on host preferences of ornithophilic species of *Culicoides* have been the most extensive studies on host preferences for this group of blood-sucking flies. These workers used only a few hosts and all were fowl. Because of the almost complete lack of data on host preferences, the present study, utilizing as many as 14 different hosts, was undertaken. Failures in disease transmission studies of avian infectious synovitis by Turner *et al.*, (13) and of eastern viral encephalitis and vesicular stomatitis by Lee (11) can possibly be attributed to the utilization of improper species as potential vectors. Lee (11) stated that possible guides as to species to consider as disease vectors should result from further knowledge of host preferences for species of this group.

HOSTS AND SITES USED IN THIS STUDY.
Due to inadequate knowledge as to the

host specificity of certain *Culicoides*, it was felt that in preliminary investigations as many hosts as practical should be used in as many different types of habitats as feasible. Bennett (1) has shown that some ornithophilic species have specific preferences (i.e. upland birds, ducks, etc.). Due to the large number of hosts used, the limited manpower, and the time involved in a single trapping, only one replicate was run at each site. Up to 14 hosts, including domestic rabbit (*Oryctolagus*), eastern cottontail rabbit (*Sylvilagus*), guinea pig (*Cavia*), opossum (*Didelphis*), domestic white rats (*Rattus*), chicken (*Gallus*), domestic turkey (*Meleagis*), mallard duck (*Anas*), bobwhite quail (*Colinus*), mourning dove (*Zenaidura*), common box turtle (*Terrapene*), southern painted turtle (*Chrysemys*), bullfrog (*Rana*) and man were used in seven different habitats.

Habitats included a wooded area near a small wildlife watering pond in Broad Run Game Reserve near New Castle, Virginia. This site was utilized most extensively due to its accessibility and productivity for a number of different species of *Culicoides*. Two sites were selected near Newport, Virginia. One of these was on the bank of a fresh water pond and was surrounded by dense forest. The other site at Newport was on Craigs Creek near Virginia Route 460. Other sites included an upland wooded area near Blacksburg, a peat bog area at Cranberry Glades, W. Virginia, a wooded mountainous area near several stream tributaries at Vesuvius, Va., and a salt marsh at Virginia Beach, Va.

TRAPS AND TRAPPING PROCEDURE. Traps used in these studies have been described by Bennett (1) and had three basic parts. The first was a restraining cage for the animal and was constructed of large mesh fish net ($\frac{1}{2}$ -1 in. mesh) or chicken wire. The restraining cage was placed on a white plywood base and covered with a collecting cage after exposure of the animals. A third part, the collecting cage, consisted of a frame covered with saran screening (40 mesh) or transparent plastic on five sides, leaving the bottom open. Plastic or rubber sponge glued to the bottom frame of the

cage formed a tight seal and prevented escape of the flies. Flies were removed by aspiration through an opening in one end of the cage. The opening was covered when not in use. Even though most cages used were covered with transparent plastic, it is now felt that the fine mesh screening or a combination of plastic and screening probably would have been superior. Infrequently there were moisture condensation problems with the plastic covered collecting cages.

The trapping procedure with the "Bennett" traps involved placing the host animals in restraining cages on the plywood bases, at random, in a habitat fairly uniform in vegetative cover, exposure to light, etc. Animals were placed about 15 ft. apart at ground level and an acclimation period of 15 min. was allowed after the last animal was exposed before the experiment was begun. Workers left the immediate area after the last animal was placed on a white base. It was hoped that this acclimation period would minimize the effect of man having been in the area and acting as an attractant. After the acclimation period, all hosts were exposed for 15 min. and then quickly covered with the collecting cages. *Culicoides* spp. visiting man during this 15-min. period were collected from the bare arms by aspiration. *Culicoides* visiting other hosts were given a 15 min. period after placement of the collecting cages to complete feeding before insect collections from the cages were begun. Generally a flashlight was required in the collecting of the flies from cages since activity and trapping began just prior to darkness. The light also aided in the collection of flies due to the phototropic nature of most species. *Culicoides* had to be aspirated from the cages which was both laborious and time consuming at night. All specimens were stored in 70 percent ethanol.

When a second or third exposure of animals was made on the same night, all animals were left covered with collecting cages until the last "punkies" were removed from the previous collecting period and then all hosts were exposed simul-

TABLE 1.—Totals of each species of *Culexoides* collected from different hosts in the summer of 1965 during 19 trapping nights.

Species Collected	Hosts Used										Accumulated Totals for all			
	tame rabbit	wild ¹ rabbit	guinea pig	opossum ²	white rats	chicken	turkey ¹	mallard ¹	quail ²	dove ²	man	mammals	birds	man
<i>arboricola</i>	0	0	0	0	0	3	6	1	3	1	4	0	14	4
<i>biguttatus</i>	25	2	16	5	11	13	10	9	7	7	13	59	46	13
<i>crepuscularis</i>	3	..	5	0	3	12	17	11	6	6	8	11	52	8
<i>fuscus</i>	9	25	13	*	5	20	*	6	*	*	70	52	26	70
<i>guttinennis</i>	36	11	107	10	75	8	14	12	3	2	130	239	39	130
<i>haematopotus</i>	12	6	17	4	12	21	34	22	7	5	39	51	89	39
<i>hinmani</i>	2	0	11	0	13	0	0	0	0	0	27	26	0	27
<i>hollensis</i>	0	0	0	*	0	0	*	0	*	*	50	0	0	50
<i>mollensis</i>	13	3	3	*	0	2	*	4	*	*	200	19	6	200
<i>parensis</i>	0	0	0	0	0	0	0	0	0	0	8	0	0	8
<i>sanguisuga</i>	369	119	222	50	226	46	58	40	11	6	498	986	161	498
<i>stellifer</i>	13	0	1	2	0	1	3	0	0	0	3	18	4	3
<i>travisi</i>	0	6	5	0	2	8	5	12	8	3	3	13	35	3
<i>varipennis</i>	0	0	0	0	0	0	0	0	0	0	3	0	0	3
<i>villosipennis</i>	0	0	0	0	0	0	0	0	0	0	1	0	0	1

* Hosts not used in breeding area of these species.

¹ Used only on 18 trapping nights.² Used only on 17 trapping nights.

taneously. Again, an acclimation period of 15 min. was allowed prior to starting the next test.

RESULTS AND DISCUSSION. Table 1 shows the totals of all species of *Culicoides* collected on 14 different hosts during the summer of 1965. Data from the box turtle, painted turtle and bullfrog are omitted from the table since nothing was collected on any of these hosts during the trappings. These totals represent 19 trap nights and the pooling of several trapping periods on some nights. Table 1 also includes accumulated totals of numbers of each species of *Culicoides* collected on mammals as a group, birds as a group, and man. It was thought that accumulated totals might give an indication as to the broad host preferences—that is, ornithophilic, mammalophilic, or man, whereas some individual observations on mammals, birds and man might not differ greatly. Since Bennett (1) concluded that certain species are fairly specific as to host, perhaps this is not a good idea.

Due to excessive variation (i.e. sites, seasonal variation of *Culicoides*, weather, etc.) and small numbers to work with, the data could not be analyzed statistically. However, it is felt that certain totals are possibly biologically significant. In the accumulated totals of Table 1, it is of interest to note the absence of *C. arboricola* on small mammals. Based on information given by Jamnback (9), the four specimens collected in this study on man represent the first records of this species feeding on man. *Culicoides biguttatus*, *C. furens*, and *C. haematopotus* appear to be more general feeders but some slight preference is shown in some cases. *Culicoides stelleri* also probably falls in this category. *Culicoides crepuscularis* has most generally been recorded as ornithophilic and our limited data tend to support this contention.

Culicoides hollensis and *C. melleus* have never been reported on hosts other than man but the few *C. melleus* collected on other hosts in these tests is an indication that other hosts can be involved. It is apparent that man is the preferred host of

these two species. *Culicoides parensis* is noted as a diurnal feeder and has been collected extensively on man. The eight specimens collected in Virginia were all on man. *Culicoides variipennis* has infrequently been recorded on man but seems to prefer the larger mammals (14). The three specimens taken in this study were collected in areas of heavy *C. variipennis* breeding. *Culicoides sanguisuga* has been recorded biting a variety of different hosts and is an especially vicious pest of man. Our experimental data would tend to show that it prefers mammals and man over birds as hosts. *Culicoides guttipennis* has previously been recorded feeding on man and other large mammals. Although Jamnback (9) lists it as probably an ornithophilic species, our data indicate that small mammals are probably the preferred hosts and that man is also very susceptible to attack. It is interesting to note that *C. guttipennis* was collected most frequently on the smaller of the small mammals. *Culicoides travisi* was collected most abundantly on birds. Jamnback (9) proposed that this species was a possible ornithophilic species based on the number of sensory pits on the antennal segments.

Since the host preference data in these tests do not show decided differences in specific host preferences (i.e. rabbit over guinea pig) as did some of Bennett's work (1) on ornithophilic hosts, it is felt that more preliminary work is needed on the ranges of hosts of *Culicoides*, that is, the range of mammalophilic feeding species and ornithophilic feeders. One might conclude on the basis of the data collected in these tests that many species readily attack any number of hosts. These data collected by Bennett (1) seem to infer more specific feeding habits of most species. A timely and extensive study is called for before definite conclusions on host preferences can be made. It is felt that far too little is known about the feeding habits of most species even to place them in one of the broad categories (i.e., ornithophilic).

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