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## BITING FLIES ATTACKING HOLSTEIN CATTLE IN A BLUETONGUE ENZOOTIC AREA IN COLORADO, 1976

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**ABSTRACT.** The biting midge *Culicoides variipennis* (Coquillett) was the most common biting fly collected attacking cattle in Colorado in 1976; it comprised 62% of the collections and 6 species of mosquitoes totalled 33%. Concurrent

New Jersey light trap collections supported the predominance of *C. variipennis*; it comprised 63% of the female biting flies collected for the species shown to attack cattle in this study.

A study area was established north of Denver, Colorado to study bluetongue disease, which appeared to be enzootic to the area. Luedke et al. (1977b) conducted laboratory studies that indicated bluetongue virus overwintered in cattle in the study area and that a vector-mediated mechanism was involved in the release of latent virus when weather conditions permitted vector activity. The data showed that the endemicity of the virus was enhanced because the virus was being transmitted both vertically through the placenta and horizontally by vector bite. Field collected data correlated with laboratory virus isolations (unpublished data of this laboratory) indicated that excessive calf mortality and related problems in the study area were associated with bluetongue virus infection: dams experimentally infected with the virus by vector bites in their 1st trimester of pregnancy commonly aborted or produced calves with congenital anomalies (Luedke et al. 1977a).

The biting midge *Culicoides variipennis* (Coquillett) was the primary suspected vector of bluetongue virus during the present studies because of pertinent previous research (Luedke et al. 1977a, 1977b). Previous research also showed that this biting fly was common to the study area, which is in the South Platte River drainage system north of Denver. Larval breeding sites had been located near Denver (Jones 1961) and northeast on the plains at Hudson, Colorado (Jones 1965). The large larval breeding site at Hudson was associated with an outbreak of bluetongue in sheep in 1963 (Jones 1965); this population of flies was subsequently shown to commonly attack sheep (Jones and Luedke 1969). Recent research (authors' unpublished data) indicated that larval breeding sites were common at 2-5 kilometers from the dairy farm that was selected as the center for our 1976 studies (closest cartographic name: Wattenberg, Weld County, Colorado). This paper presents data that show the species

of biting flies that commonly attacked Holstein dairy cattle at this farm in 1976.

**MATERIALS AND METHODS.** Holstein cattle, the only significant livestock species at the study site, were confined in corrals in a drylot operation. The closed herd had about 50 milking cows. Since most of the animals were not easily approached, collections of biting flies were made primarily from 3 cows and 1 steer and from 4 small calves that were stanchioned in the morning and evening for feeding. All biting collections were made in the corrals during the morning and evening crepuscular hours. Biting flies were collected from the animals by mouth aspiration. Collections were made from April 11 to October 11, 1976.

Some biting flies were collected, primarily from the windows, inside the milking barn during milking. A New Jersey light trap without CO<sub>2</sub> bait and with a 60-watt incandescent bulb was normally operated in the corrals during the summer. Catches of mosquitoes, black flies, and *C. variipennis* from this trap were used to confirm the relative abundance of biting fly species collected from the animals.

**RESULTS AND DISCUSSION.** The numbers of each species collected as they attacked cattle are given in Table 1. The small numbers of stable and horn flies (Muscidae) that were present were excluded from the results. A species was also excluded from the results if only 1 or 2 individuals were collected from the animals because our experimental design was such that these individuals could have been attracted to the human collectors as well as to the cattle. Table 1 further gives the light trap data for the species that were found to attack cattle in this study.

The data (Table 1) clearly showed that *C. variipennis* was the predominant biting fly collected attacking cattle; it comprised 62% (639/1035) of the females collected from animals. This predominance was supported by the results of light trap collections where *C. variipennis* females were 50% of the total females collected for all biting flies and were 63% (4214/6627) of the females for the species shown to attack

cattle in this study. *C. variipennis* was the most common species of biting fly throughout the entire biting fly season. The smaller numbers collected by light in October were because of cooler nights when light traps are less effective; the smaller numbers in April and May were from the overwintering larval population (Jones 1967), which gave rise to greatly increased numbers with the start of a continuous succession of summer generations in June.

A favored site of attack was not apparent when only moderate numbers of *C. variipennis* females attacked. However, when large numbers were attacking on September 15, the favored site was on the udder and along the mammary vessels of the venter.

An "attractiveness index" is calculated in Table 1 to compare the two methods of collection—light trap versus from animals—for the species here shown to attack cattle. This index equates the total number of females collected by each of the two methods (ratio is 6.4 overall for total females collected by light trap divided by total collected from animals) so that equal totals (1:1) were collected by each method with an overall index of 1.0. The index values for each species [Index: ratio (of number by light trap divided by number from animals) divided by 6.4, which is the overall ratio of the total number collected by light trap divided by the total number collected from animals] then become significant when compared with each other: values below 1.0 indicated that light trap collections were less effective than animal collections in sampling the population; values over 1.0 indicated that light traps were more effective.

The reasons for the effectiveness of one method over the other in sampling a species should depend on that species' behavioral characteristics. The lowest value of 0.2 for *Simulium vittatum* supports the known fact that black flies are not particularly attracted to light traps. The highest value of 9.0 clearly supported the fact that *Culex tarsalis* is primarily ornithophilic (Carpenter and LaCasse 1955); the species

Table 1. Comparison of female biting flies commonly collected from Holstein cattle and by light trap, Weld County, Colorado 1976.

Month	Number of females collected of listed species: from light trap/from animals										Total females for species here shown to attack cattle <sup>bc</sup>	
	No. of collections: light trap/animal	Ceratopogonidae <sup>a</sup>		Simuliidae <sup>a</sup>			Culicidae <sup>a</sup>					Total mosquitoes <sup>b</sup>
		<i>Culicoides variipennis</i> (Coq.)	<i>Simulium vittatum</i> Zetterstedt	<i>Culex tarsalis</i> (Coq.)	<i>nigromaculis</i> (Lucdow)	<i>dorsalis</i> (Meigen)	<i>vexans</i> (Meigen)	Total				
April	3/1	60/2	35/0	1/0	0/0	0/0	0/0	0/0	0/0	1/0	96/2	
May	3/0	10/-	0/-	0/-	0/-	2/-	0/-	0/-	0/-	3/-	13/-	
June	10/1	262/0	2/1	43/0	0/0	25/0	24/0	108/1	372/2	108/1	372/2	
July	15/6	1632/61	19/13	674/6	22/6	265/7	505/34	1509/58	3161/133	1509/58	3161/133	
August	18/16	1900/375	3/37	285/12	35/12	54/85	158/136	555/253	2463/667	555/253	2463/667	
September	10/1	320/201	1/1	28/0	5/0	42/28	45/0	144/29	466/231	144/29	466/231	
October	4/0	30/-	1/-	4/-	0/-	3/-	1/-	24/-	56/-	24/-	56/-	
Totals	63/25	4214/639	61/52	1035/18	62/18	391/120	733/170	2344/341	6627/1035	2344/341	6627/1035	
% of total <sup>b</sup>												
Ratio of totals <sup>d</sup>		63.4/61.7	0.9/5.0	15.6/1.7	0.9/1.7	5.9/11.6	11.1/16.4	35.4/32.9	100/100	35.4/32.9	100/100	
Attractiveness index <sup>e</sup>		6.6	1.2	57.5	3.4	3.2	4.3	6.9	6.4	6.9	6.4	
		1.0	0.2	9.0	0.5	0.5	0.7	1.1	1.0	1.1	1.0	

<sup>a</sup> Totals for other species commonly collected: *Simulium vittatum* Malloch 8/3; *Culiseta inornata* (Williston) 105/7; and *Aedes trivittatus* (Coq.) 17/8.

<sup>b</sup> Includes species in footnote a, excludes species not collected from cattle.

<sup>c</sup> Biting-fly females collected in light trap but excluded as not clearly shown in this study species attacks cattle: Ceratopogonidae *Culicoides* 1826, *Leptoconops* 2; Simuliidae 1; and Culicidae 23.

<sup>d</sup> Ratio of totals is the number collected by light trap divided by the number collected from animals.

<sup>e</sup> Calculated by equating collection methods overall to 1:1 by dividing ratio of totals by 6.4.

was attracted to light in preference to its secondary source of a blood meal, mammalian livestock. The values for 4 species that are known to commonly attack mammalian livestock are of interest. The higher figure of 1.0 for *C. variipennis* compared with 0.5 to 0.7 for the 3 *Aedes* species may indicate a major bias between the collection methods—mosquitoes were relatively easy to see and collect from animals compared with the small biting flies that move about more rapidly and that frequently crawl into the hair coat to feed. The equivalent values (62 and 63%) for the collection of *C. variipennis* by the 2 methods, and the median attractiveness index of 1.0, suggested that either method was an accurate overall indicator for the presence of this species attacking cattle in the study area.

Collections from the inside of the milking barn during milking were important because they again showed the predominance of *C. variipennis* and because *Leptoconops*, all with fresh blood meals, were collected in May—thus indicating that this species attacks cattle. The only other *Leptoconops* recovered during the study were 2 females from light trap collections. The numbers of the small biting flies in 40 collections from the milking barn were as follows: *C. variipennis* 236; *S. vittatum* 74; *S. bivittatum* 9; and *Leptoconops* 7. (95 mosquitoes were collected.) *C. variipennis* was 56.0% of the total females collected. The relatively small numbers of small biting flies collected, together with the fact that they were primarily freshly-blooded females, indicated that these flies came in the barn with the animals—probably in the hair coat. The relatively small number of *C.*

*variipennis* collected (6 per collection) indicated that the species does not enter buildings to feed.

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