THE HOST PREFERENCES OF *CULISETA INORNATA* IN SOUTHWESTERN MANITOBA

R. A. ANDERSON[1] AND W. J. GALLAWAY

Department of Zoology, Brandon University, Brandon, Manitoba, Canada R7A 6A9

ABSTRACT. The capillary tube precipitin test was used to determine the host utilization patterns of *Culiseta inornata* in southwestern Manitoba. Ruminant blood was identified in 83.3% and equine blood in 15.8% of 1,036 positively reacting blood-meals. Human, swine and avian blood accounted for 0.9% of these blood-meals and mixed blood-meals accounted for 1.5% of the total. *Culiseta inornata* preferentially fed on large mammals, and selection between cattle and horses reflected the relative abundance of these two hosts rather than a specific preference for either one.

INTRODUCTION

Information on host range and host utilization patterns of mosquitoes is essential in evaluating the medical and economic importance of specific mosquito species. *Culiseta inornata* (Williston) is a common and abundant mosquito in Western Canada (Wood et al. 1979). Western equine encephalitis (WEE) and California encephalitis viruses have been isolated from *Cs. inornata* in Manitoba (Sekla et al. 1980, Artsob et al. 1985) and this species has been shown to be a laboratory vector of WEE virus (Hammon and Reeves 1943). There is limited evidence that overwintered *Cs. inornata* feed on birds during the early spring in Manitoba (R. A. Brust, University of Manitoba, personal communication); if more extensive data for this time period confirm this pattern, this species may be involved in the spring amplification of WEE in Manitoba. An evaluation of the host range and host utilization patterns of *Cs. inornata* in Manitoba would provide information on the potential of this species as a vector of WEE and on its pest impact on man and domestic animals. In this investigation, we used the capillary tube precipitin test to determine the host range and host utilization patterns of *Cs. inornata* in southwestern Manitoba.

MATERIALS AND METHODS

The capillary tube precipitin test was used to identify the hosts of blood-fed *Cs. inornata* collected in the Brandon, Manitoba area (49° 50′N, 99° 57′W) in 1985 and 1986. Resting blood-fed mosquitoes were collected by hand-held aspirators from metal, wood and cement culverts, and bridges. Collections were made from May 1 to August 15 in 1985 and from April 22 to August 5 in 1986. The collection sites were located in a mixed farming area where cattle are the most abundant mammals. Humans, horses, swine, cats, dogs, deer and other animals are other potential, although less common, hosts in the area. Most of the collection sites were within 20 km of Brandon. All of the collection sites, with the exception of the Thunderbird Horse Center, had similar host availability. At this location, horses were more abundant than cattle. Many types of passerine birds were observed in close proximity to the collection sites and nesting swallows were often found in the larger culverts and under the bridges sampled. No blood-fed mosquitoes were collected from within the Brandon city limits where humans and birds are the most abundant potential hosts.

Established procedures were used to produce antisera (Gill 1984). Sera from local animals including human, bovine, beaver, swine, horse, cat, dog, chicken, duck, pigeon, coot, horned grebe and raven were used to produce antisera in separate adult rabbits. Antisera to dog, cat, rabbit, rodent, sheep and deer were purchased from Cooper Biomedical Inc., Malvern, Pennsylvania. Difficulties were encountered in separating bovine and deer blood-meals, therefore these are grouped together as ruminants. All of the antisera used had homologous titers of 1:10,000 or greater. Each antiserum was tested for cross reactivity and those which had extra-family titers greater than 1:1,000 were discarded.

Blood-fed mosquitoes were tested with the capillary tube precipitin test (Tempelis and Lofy 1963). The proportion of blood-meals attributable to each host type is given as a percentage of all the hosts detected. The host utilization pattern was determined as the relative frequency of each host identified. The host utilization patterns of *Cs. inornata* from three of the collection sites are presented to facilitate comparison between local host availability and mosquito blood-feeding on specific hosts.

RESULTS

In 1985, 729 freshly blood-fed *Cs. inornata* females were collected; hosts were identified for 728. Three hundred and nine blood-fed *Cs. in-*

[1] Department of Entomology, University of Massachusetts, Amherst, MA 01003.

Table 1. Hosts of *Culiseta inornata* collected near Brandon, Manitoba, in 1985 and 1986.*

Host type	Percent	(number)
Ruminant	83.3	(876)
Equine	15.8	(166)
Human	0.3	(3)
Swine	0.4	(4)
Avian	0.2	(2)
Total	100	(1,051)
Positive reacting blood-meals		1,036
Unidentified		2
Total blood-fed mosquitoes		1,038

* Each component of a multiple blood-meal is treated as a single host.

ornata were collected in 1986 and hosts were identified for 308 of these blood-meals. It is apparent that no important hosts species were missed.

Nearly all of the positively reacting blood-meals were from mammalian hosts (Table 1). Ruminant blood was identified in 83.3% of the blood-meals and horse blood in 15.8% of the blood-meals. Human blood and swine blood were the only other mammalian bloods detected. Two avian blood-meals were identified, these could not be identified beyond the class.

A comparison of the host utilization patterns for *Cs. inornata* collected from three specific locations are presented in Table 2. The blood-meals from mosquitoes collected near the Brandon Airport and Inganess Dairies were identified as being predominantly from ruminant sources; horses formed the second largest group. There were no avian blood-meals identified from mosquitoes collected near Inganess Dairies, even though many of the mosquitoes from there were collected from swallow nests with nestlings present. The most frequently detected hosts in the Thunderbird Horse Center collections were horses. The large number of horses available at this location correlates with the increase in the percentage of horse blood-meals compared to the relatively low percentage of horse blood-meals from the other locations (Table 2).

Fifteen mixed blood-meals accounted for 1.5% of all the positively reacting blood-meals. Thirteen of the mixed blood-meals were identified as ruminant-horse. The other two mixed blood-meals were identified as swine-ruminant and swine-equine.

Table 2. Host utilization patterns of *Culiseta inornata* collected from three locations near Brandon, Manitoba, in 1985 and 1986.

Host type	Location					
	Brandon Airport		Inganess Dairies		Thunderbird Horse Center	
	Percent (number)					
Ruminant	92.6	(239)	97.6	(41)	34.4	(55)
Equine	6.2	(16)	2.4	(1)	65.6	(105)
Swine	0.4	(1)	—	—	—	—
Avian	0.4	(1)	—	—	—	—
Unidentified	0.4	(1)	—	—	—	—
Total	100	(258)	100	(42)	100	(160)

DISCUSSION

Mosquito species exhibit a range of feeding patterns from specific to general. Those species which feed specifically on one or a few hosts are defined as having a narrow or fixed host range (Edman et al. 1972). *Culiseta inornata* fit this definition (Washino and Tempelis 1983). Large mammals such as ruminants and horses are the primary source of blood for this species (Table 1). Although avian blood was detected, the small number of avian blood-meals indicates that birds are not an important source of blood for *Cs. inornata* in the areas studied (Table 1). This is supported by the lack of avian blood-meals despite the presence of nestling swallows. The narrow host range of *Cs. inornata* is similar to that of *Culiseta melanura* (Coquillett) which feed almost exclusively on birds (Edman et al. 1972). In contrast, a wide host range is one which includes high proportions of both mammals and birds and perhaps even other types of animals, as is the case for *Culex tarsalis* Coquillett (Tempelis and Reeves 1964, Washino and Tempelis 1983).

The observed relative frequencies of blood-meals taken from ruminants and horses by *Cs. inornata* reflected the local availability of these two hosts rather than a definite preference (Table 2). A comparison of the relatively high frequency of horse blood-meals from the Thunderbird Horse Center to the low frequencies from the other locations demonstrates the relationship between relative number of hosts available and host utilization pattern. A preponderance of ruminant blood-meals was detected in the samples from the other locations where ruminants were more common. This pattern is sim-

ilar to that of *Cs. melanura*, which prefer birds over mammals but is not selective in the choice of bird species (Edman et al. 1972).

The number of mixed blood-meals relative to the total number of identified blood-meals is probably a low estimate, because blood-meals were only tested until a positive reaction was obtained. Blood-meals taken from conspecific or very closely related hosts such as cattle, sheep and deer could not be reliably separated using the precipitin test.

Preference for ruminants and horses, by *Cs. inornata*, is supported by a number of published studies (Andersen et al. 1967, Gunstream et al. 1971, Hudson and Edman 1978). The low number of avian blood-meals detected for *Cs. inornata* (Table 1) do not support Brust's results (blood-meals identified by A. E. R. Downe, Queens University, London, Ontario) of bird feeding in a sample of 10 presumably overwintered adults collected in mid-May in Winnipeg, Manitoba (R. A. Brust, University of Manitoba, personal communication). The lack of avian feeding by this species indicates that it probably is not involved in the amplification of WEE virus in birds in Manitoba. How *Cs. inornata* obtains WEE virus in nature (Hammon et al. 1945, McLintock et al. 1970, Sekla et al. 1980) is not known, and the lack of avian blood-meals would indicate that this species utilizes other viremic hosts besides birds. Whether or not *Cs. inornata* is involved in the amplification cycle of WEE, its host utilization patterns make it a potentially important vector of this virus to horses and a potential agricultural pest.

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