

PRELIMINARY HOST PREFERENCE STUDIES OF *CULEX TARSALIS* COQUILLET AND *CULISETA INORNATA* (WILLISTON) IN UTAH*

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INTRODUCTION. In the summer of 1965, research was initiated to study host preferences of mosquitoes belonging to the species *Culex tarsalis* and *Culiseta inornata* in the vicinity of Salt Lake City, Utah.

The overall objectives of this study are to determine: 1) the hosts on which these mosquitoes feed, 2) the host preferences, 3) if there is a correlation between host preference and host availability, 4) if there is any seasonal variation in host preference, and 5) if geographic and biologic conditions would cause the patterns to differ from those observed in Colorado and California (Washino *et al.*, 1962; Tempelis *et al.*, 1965; Tempelis *et al.*, 1966).

METHODS AND PROCEDURE. The general area selected for this study was the agricultural and marsh area west and northwest of Salt Lake City in Salt Lake and Davis Counties, Utah. Specific sampling sites were selected within this general area, and collections of blood-engorged mosquitoes were made from each site at least once each week from the first of July to September 10. A maximum of 25 specimens per collection from each sampling site was used. Adult mosquitoes were collected from a variety of resting surfaces including farmyard buildings, duck club houses, vegetation and bridges. Specimens were also taken from light trap and car-top trap collections.

The mosquitoes were transported to the

field laboratory, anesthetized, and identified. The abdomen of each engorged mosquito was removed from the head and thorax and placed in a small gelatin capsule. Capsules with specimens of a mosquito species from each collection were placed in glass tubes, labeled for identification, and frozen. The specimens were packed in dry ice and shipped frozen to the testing laboratory at the School of Public Health, University of California, Berkeley, California. The blood analysis and identification of the host was made by Dr. C. H. Tempelis, University of California at Berkeley, by use of the precipitin test (Tempelis and Lofy, 1963).

For comparative purposes, the collection sites were divided into marsh and agricultural areas and the Redwood Game Farm. Unused outbuildings were the principal collecting sites in the marsh and agricultural areas, with additional collections made from the undersides of bridges in the agricultural area.

The marsh area contained a series of ponds inhabited by many species of waterfowl and passeriform birds. The agricultural area was primarily pastureland with livestock present during the entire sampling period. The Redwood Game Farm was used for raising and boarding a wide variety of animals, including both birds and mammals. All these animals were kept in sheds and pens and were equally accessible to the mosquitoes.

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RESULTS

Table 1 compares by month the various mammalian and avian feedings of *C. inornata* in each of the three areas. Of the 153 feedings, only one was taken from avian hosts. The avian feeding (passeriform) was found in the agricultural area.

TABLE 1.—Identification of blood meals of *Culiseta inornata* collected in three different ecologic areas of Salt Lake and Davis Counties, Utah, July–September, 1965.

	Area								Total all areas
	Marsh			Agricultural			Redwood Game Farm		
	July	August	September	July	August	September	August		
No. of mosquitoes	8	92	8	20	16	3	6	153	
Host	Percent								
Mammals									
Dog	0.0	0.0	12.5	0.0	6.25	0.0	0.0	1.3	
Horse	0.0	1.1	0.0	55.0	62.5	0.0	50.0	16.3	
Cattle	100.0	91.3	62.5	45.0	25.0	33.33	16.66	73.2	
Rabbit	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.65	
Rodent	0.0	0.0	0.0	0.0	0.0	0.0	16.66	0.65	
Pig	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.65	
Man	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.65	
Unidentified	0.0	4.3	25.0	0.0	6.25	33.33	16.66	5.9	
Subtotal	100.0	100.0	100.0	100.0	100.0	66.7	100.0	99.3	
Birds	0.0	0.0	0.0	0.0	0.0	33.3*	0.0	0.7	
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	

* Fed on a passeriform bird.

Cattle and horses were the principal hosts for *C. inornata* in all three areas.

Table 2 compares by month the various mammalian and avian feedings of *C. tarsalis* in each of the study areas. In the agricultural area and the Redwood Game Farm, feedings on birds were more common, while in the marsh areas feedings on mammals were more common. Cattle, rabbits, horses, and dogs were the most common mammalian hosts, while passeriforms, columbiforms, and chickens were the most common avian hosts.

DISCUSSION. Nielsen and Rees (1961) stated that *C. inornata* generally preferred blood meals from mammalian hosts. This has been confirmed by this study in the Salt Lake area, as well as in California and Colorado, in previous studies (Washino *et al.*, 1962; Tempelis *et al.*, 1966).

Culex tarsalis is generally considered to prefer feeding on birds, but will feed extensively on mammals (Tempelis *et al.*, 1965; Tempelis *et al.*, 1966). At the Redwood Game Farm, where these mosquitoes had equal opportunity for feeding on

either mammals or birds, birds were more often selected. The two predominant hosts at this site were chickens and columbiforms, and they were selected with about equal frequency.

There was no statistically⁴ significant difference between mammalian and avian feeding at the Redwood Game Farm and in the agricultural area, but there was a difference in the predominant avian hosts with the passeriforms being most commonly selected in the agricultural area. Passeriforms were very common in the trees adjacent to the sampling sites in the agricultural area.

There was a statistically significant difference between mammalian and avian feedings in the marsh and agricultural areas and the Redwood Game Farm, with mammals being selected over birds during all three months in the marshes. Mammalian preference increased sharply in August. The preferred mammalian hosts

⁴ Statistical comparison of host feedings in different areas was done by Chi square.

TABLE 2.—Identification of blood meals of *Culex tarsalis* collected in three different ecologic areas of Salt Lake and Davis Counties, Utah, July–September, 1965.¹

	Area							Total All Areas
	Marsh		Agricultural			Redwood Game Farm		
	July	August	July	August	September	August		
No. of mosquitoes	130	269	123	173	11	92	800	
Host	Percent							
Mammals								
Dog	0.0	0.0	7.3	4.6	0.0	0.0	2.1	
Horse	0.8	0.0	0.8	9.0	0.0	3.3	2.8	
Cattle	18.5	52.6	21.1	5.2	9.1	10.9	26.4	
Rabbit	33.1	27.4	4.1	4.6	0.0	14.1	18.0	
Skunk	0.0	0.0	0.8	0.0	0.0	0.0	0.1	
Pig	0.0	0.0	0.0	0.6	0.0	1.1	0.3	
Man	0.0	0.4	3.3	0.0	0.0	0.0	0.6	
Unidentified	3.8	4.8	6.5	5.8	0.0	7.6	5.4	
Subtotal	56.2	85.2	43.9	30.6	9.1	37.0	55.7	
Birds								
Chicken	1.5	0.0	12.2	11.0	0.0	29.3	7.9	
Columbiform	3.8	4.4	26.0	8.1	0.0	28.2	11.2	
Passeriform	13.1	5.2	4.9	41.6	90.9	2.2	15.2	
Anseriform	4.6	0.0	0.0	0.0	0.0	0.0	0.8	
Falconiform	2.3	0.4	0.0	0.6	0.0	0.0	0.6	
Strigiform	0.8	0.4	0.0	0.0	0.0	1.1	0.4	
Charadriiform	0.8	2.2	4.9	1.7	0.0	0.0	1.8	
Unidentified	16.9	2.2	8.1	6.4	0.0	2.2	6.4	
Subtotal	43.8	14.8	56.1	69.4	90.9	63.0	44.3	
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	

¹ Only one specimen was collected in the marsh area during September and that fed on a cow.

in the marsh area were cattle and rabbits, and the preferred avian hosts were again passeriform birds.

The question that is posed is why is there a predominance of feeding on mammalian hosts in the marsh areas when the results from the Redwood Game Farm seem to indicate that when there is equal opportunity for feeding on mammals or birds, birds are the preferred hosts. Several possibilities to this question might be considered:

1) There are more birds available in the agricultural area than in the marsh area.

Actually the opposite is probably true. Although no bird census was made, these marsh areas furnish an excellent habitat for a great variety and large number of birds.

2) The kinds of birds which the *C. tarsalis* feed upon are more numerous in the agricultural areas than in the marsh areas.

The preferred avian host in both areas appears to be the passeriforms. There are large numbers of waterfowl in the marsh areas, but the feedings on these birds were less than on the passeriforms. No census was made of the passeriform birds in the marsh and agricultural areas, but it appeared that the passeriform population of each area was about equal.

3) The mammals in the marsh area were more accessible to the mosquitoes than were the mammals in the agricultural area.

Rabbits were observed in the immediate vicinity of the sampling sites in the marsh area, and a herd of cattle was present in the marsh all summer, but it was excluded

by a fence from the immediate vicinity (200 yards) of the sampling sites. Cattle were in pastures in the vicinity of sampling sites in the agricultural area during the entire summer.

4) The birds (passeriforms) in the marsh area were less accessible to the mosquitoes than were the passeriforms in the agricultural area.

The primary sampling site from the marsh area was in abandoned buildings and club house buildings on the edge of marsh ponds. The large flocks of passeriform birds in the marsh area inhabited the cattail and bulrush areas out away from the buildings. In the agricultural area the passeriforms were in the trees in the immediate vicinity of the sampling sites.

5) The marsh *C. tarsalis* are of a different strain and have different behavior patterns than the agricultural *C. tarsalis*.

The agricultural and marsh areas are adjacent and the sampling sites are only about five miles apart. It seems unlikely that two different strains would be found in such a short distance with no migratory barriers present.

At the present time answer four seems to be most plausible, but is not completely satisfactory. It does not explain why the mosquitoes would travel several hundred yards to feed on cattle but not go the same distance to feed on the usually preferred bird hosts.

This study points out the necessity of investigating host ecology and mosquito behavior, along with the collection and analysis of blood samples. More emphasis will be placed on these ecologic and behavioral problems as this study progresses.

SUMMARY. In the summer of 1965 a project was initiated to study the host preferences of *C. inornata* and *C. tarsalis* in the vicinity of Salt Lake City, Utah. Engorged adult mosquitoes were collected from marsh and agricultural areas and from a game farm. The host blood was analyzed by the precipitin test. In all three areas, feedings from mammalian hosts were most common for *C. inornata*. For *C. tarsalis*, feedings from avian hosts were predominant in the agricultural area and the game farm, but feedings from mammalian hosts were predominant in the marsh areas. The reason for this difference cannot be adequately explained from the present data. Further studies including more seasons of sampling, host ecology and mosquito behavior should be made.

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