

THE BLOOD FEEDING HABITS OF *CULEX TERRITANS* WALKER

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INTRODUCTION

Culex territans Walker is generally acknowledged to derive the majority of its blood-meals from cold-blooded vertebrates. Although the species has been taken in human biting collections (West and Hudson, 1960) and has been reported biting man in nature (Means, 1965), most recorded feedings have been made from amphibian and reptilian hosts (Shannon, 1915; Dyar, 1928; Murphey *et al.*, 1967). Serological studies with *Culex territans* have not been extensive; thus most of our knowledge regarding host acceptance by this species is the result of either observation or bait trap exposure. Preliminary serological determinations with *Culex territans* in New Jersey confirmed that amphibians were most frequently fed upon but that other hosts were also occasionally accepted (Crans, 1964).

The object of the present study was to collect and serologically test numbers of wild-caught *Culex territans* to ascertain the extent and range of hosts fed upon in nature. Field observations have been included to give a more complete picture of the feeding behavior of the species.

MATERIALS AND METHODS

The majority of engorged mosquitoes tested in these studies were collected from resting boxes which were placed at numerous rural locations throughout New Jersey. Only limited numbers of engorged *Culex territans* were taken in light traps which were operated simultaneously at several of the collection sites.

Each blooded mosquito was simultaneously tested for a wide range of possible

hosts using the technique of agar gel diffusion described previously (Crans, 1969a). Specimens were initially tested against group antisera with a broad reactivity range (Table 1). A specific anti-

TABLE 1.—Group antisera employed in initial tests for host source.

Antiserum	Reactivity Range
Mammal Group I	Human, raccoon, opossum, deer, cow
Mammal Group II	Dog, fox, cat, skunk, bat
Mammal Group III	Horse, pig, sheep
Mammal Group IV	All rodents
Reptile Group I	All reptiles
Amphibian Group I	All amphibians
Avian Group I-V	All birds

rabbit serum was also included in the initial test pattern. Subsequent tests were performed with specific antisera to individual animals within each reactive group. Group antisera were produced in rabbits; specific antisera were produced primarily in chickens. The procedures used for the production of antisera were similar to those described by Tempelis and Lofy (1963).

Culex territans were also observed in the field. Though feeding occurred during the day as well as the night, observations were most easily made with the aid of a flashlight after dark. Adult specimens were aspirated directly from the host and brought to the laboratory for identification. Specimens collected in this manner were not included in the serological series.

RESULTS

SEROLOGICAL DETERMINATIONS. The results of 315 blood-meal identifications are presented in Table 2. Cold-blooded hosts

TABLE 2.—Serological identification of 315 blood-meals from wild caught *Culex territans* Walker.

	Warm-Blooded Hosts		Cold-Blooded Hosts		Unknown	Total
	Mammalian	Avian	Reptilian	Amphibian		
No. of Feedings	2 *	6	19 **	279	9	315
% of Total	0.6	1.9	6.0	88.5	3.0	100

* 1 rabbit, 1 rodent.

** 6 turtle, 13 snake.

accounted for nearly 95 percent of the feedings with amphibians being fed upon most frequently. Amphibian blood was found in 88.5 percent of the specimens tested. Although no attempt was made to serologically separate frogs, toads and salamanders in these tests, frogs were most often observed being engorged upon in the field. When toads congregated during their breeding season, they were only occasionally seen being fed upon. Salamander blood was included in the amphibian test serum and may have accounted for a small percentage of positive results. Feeding on salamanders was not observed in the field.

Reptilian hosts were fed upon to a lesser extent than expected. Only 6.0 percent of the specimens tested contained turtle or snake blood; no lizard feedings were recorded. Unavailability of reptilian hosts at the collection sites may in part have accounted for these results.

Warm-blooded hosts made up only a small percentage of the blood-meals; six avian and two mammalian feedings were detected. These results further emphasize that *Culex territans* is essentially a cold-blooded feeder in nature and that warm-blooded hosts are only occasionally accepted as a blood-meal source.

FIELD OBSERVATIONS. *Culex territans* was observed feeding on frogs in nature on numerous occasions and at many different sites. Several feedings were recorded from the spring peeper, *Hyla crucifer*; southern leopard frog, *Rana pipiens sphenoccephala*; and carpenter frog, *Rana virgatipes*, but feeding was most often observed on the bullfrog, *Rana catesbeiana*, and the green frog, *Rana clamitans* (Fig. 1).

Female *Culex territans* appeared to exhibit a high degree of activity while seeking the blood-meal. Specimens, apparently seeking a host, were often observed flying in an erratic pattern along the water's edge not more than one inch from the substrate. When a frog was located, mosquitoes generally hovered momentarily and then rapidly darted about before landing. Mosquitoes approached from the rear of the host and most often landed on or near the hind legs of the frog. In most instances, a mosquito would take flight and land several times before assuming the feeding attitude. In this way, many specimens worked their way from the posterior extremities of the host to the upper back or head of the frog. In



FIG. 1.—Two *Culex territans* feeding upon a green frog in a New Jersey pond. This site was observed on numerous occasions throughout the season.

no instance was a mosquito actually observed to approach from the front. On several occasions, mosquitoes eventually landed on adjacent vegetation and reached over to feed on the frog. This behavior has been described and photographed by other workers (Burgess and Hammond, 1961).

Frogs were often noticeably bothered by the mosquito bite. When mosquitoes fed on a frog's hind foot, it was common to see the frog shake the foot violently. When feeding occurred about the head, frogs often brushed the mosquitoes off with the forelegs. In areas where mosquito density was high, nearly every exposed frog revealed two or more engorging mosquitoes. A maximum of 20 *Culex territans* was seen on a large bullfrog at one time. In one instance, two *Culex territans* were observed engorging on an exposed metamorphosing tadpole.

The mosquitoes encountered during these observations spent a considerable amount of time upon the host. In most instances, a period of 6-10 minutes elapsed before a full blood-meal was ingested, but it was not uncommon for a mosquito to remain on the host longer than 15 minutes. The bright light of the flashlight beam did not appear to disturb the feeding process in any way, and at no time during these observations were *Culex territans* attracted to the observers.

DISCUSSION

The cold-blooded host-seeking behavior associated with *Culex territans* by numerous workers appears to be well founded. Other hosts, however, are occasionally accepted as a blood-meal source.

The propensity for amphibian blood exhibited by this mosquito suggests that frog populations are repeatedly subjected to the bite of this insect. In this regard, *Culex territans* may be involved as a vector of amphibian infections. Frogs are known to harbor a number of blood-parasites whose etiology is not well known. New Jersey bullfrogs have re-

cently been shown to be infested with filarial worms thought to be arthropod-borne (Crans, 1969b). The host-seeking behavior and wide distribution of *Culex territans* strongly suggest involvement of this mosquito in these little known amphibian infections.

SUMMARY

The blood feeding habits of *Culex territans* Walker were investigated in New Jersey. Serological tests performed on wild caught specimens revealed the species to feed essentially on cold-blooded hosts, primarily amphibians. Only a small percentage of the specimens tested contained the blood of warm-blooded animals.

Observations in the field revealed considerable feeding on frogs; an observational account of the mosquito's feeding behavior is included. Results strongly suggest *Culex territans* as a possible vector of frog parasites.

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