NEUENSCHWANDER, P., F. SCHULTHESS, AND E. MADOJEMU. 1986b. Experimental evaluation of the efficiency of *Epidinocarsis lopezi*, a parasitoid introduced into Africa against the cassava mealybug *Phenacoccus manihoti*. Entomol. Exp. Appl. 42: 133-138.

SCHNEIDER, B., H. PODOLER, AND D. ROSEN. 1988. Population dynamics of the Florida wax scale, *Ceroplastes floridensis* (Homoptera: Coccidae), on citrus in Israel. 5.—Effect of the parasite *Tetrastichus ceroplastae* (Girault). Acta Oecologica, Oecol. Applic. 9: 75-83.

SOUTHWOOD, T. R. E., AND W. F. JEPSON. 1962. Studies on the populations of *Oscinella frit* L. (Diptera: Chloropidae) in the oat crop. J. Animal Ecol. 31: 481-495.

VAN DRIESCHE, R. G. 1983. The meaning of "percent parasitism" in studies of insect parasitoids. Environ. Entomol. 12: 1611-1622.

VAN DRIESCHE, R. G., J. CASTILLO, AND A. C. BELLOTTI. 1987a. Field placement of mealybug-infested potted cassava plants for the study of parasitism of *Phenacoccus herreni*. Ent. Exp. Appl. 46: 117-123.

VAN DRIESCHE, R. G., A. C. BELLOTTI, C. J. HERRERA, AND J. CASTILLO. 1987b. Host feeding and ovipositor insertion as sources of mortality in the mealybug *Phenacoccus herreni* caused by the encyrtids, *Epidinocarsis diversicornis* and *Acerophagus coccois*. Ent. Exp. Appl. 44: 97-100.

VARELA, A. M., A. C. BELLOTTI, AND J. A. REYES. 1979. Biologia y ecologia del piojo harinosa de la yuca. Rev. Colombiana Ent. 5: 9-15.

VARELA, A. M., AND A. C. BELLOTTI. 1981. Algunos aspectos biologicos y observaciones de un nuevo piojo harinoso de la yuca, *Phenacoccus herreni* (Homoptera: Pseudococcidae) en Colombia. Rev. Colombiana Ent. 7: 21- 26.

PREDATION RATE OF LARVAL *CORETHRELLA BRAKELEYI* (DIPTERA: CHAOBORIDAE) ON MOSQUITO LARVAE

R. E. MCLAUGHLIN
U. S. Department of Agriculture, Agricultural Research Service
Insects Affecting Man and Animals Research Laboratory
P.O. Box 14565, Gainesville, Florida 32604

ABSTRACT

Corethrella brakeleyi (Coquillett) larvae were collected from a small roadside pond in Alachua County, Florida, and offered 2nd instar *Anopheles quadrimaculatus* larvae in cups in a laboratory feeding test. The average number of mosquito larvae consumed/day by the 65 predator larvae ranged from 3.00 to 9.32 during the 19 days of the feeding test. The average total number of mosquito larvae consumed/*C. brakeleyi* larva was 76.9. The population of *C. brakeleyi* larvae in the pond, sampled by the standard mosquito larva dipper method between 3 February and 14 November 1989, ranged between 0.62 and 8.3 larvae/dip.

RESUMEN

Se colectaron larvas de *Corethrella brakeleyi* (Coquillet) de una laguna al lado de un camino en el Condado de Alachua en la Florida, y se les ofreció larvas en el segundo estadio de *Anopheles quadrimaculatus* en copas en una prueba de alimentación en el

laboratorio. El promedio del número de larvas de mosquito consumidas por dia por las 65 larvas depredadoras varió de 3.00 a 9.32 durante los 19 dias de la prueba de alimentación. El promedio total del número de larvas de mosquitos consumidas por *C. brakeleyi* fue de 76.9. La población de *C. brakelyi* en la laguna, muestreada por el método patrón de obtener larvas con un jarro, entre el 3 de Febrero y el 14 de Noviembre, varió entre 0.62 y 8.3 larvas por jarra.

Corethrella brakeleyi (Coquillett) is distributed in the North American continent from Texas to Florida and northward into Canada (Stone 1968, Ellis & Wood 1974). The adult females are blood feeders on vertebrates (Williams & Edman 1968) and more specifically on frogs (McKeever 1977). The larvae have been collected in cold springs, bog pools, margins of permanent ponds, swamps and canals (Smith 1902, Williams & Edman 1968), and in a quarry (Chapman et al. 1971). Chapman et al. (1971) also noted that *C. brakeleyi* larvae were voracious predators of 1st instar mosquito larvae. Ellis & Wood (1974) confirmed predation by 4th instar *C. brakeleyi* larvae on small ostracods, 1st instar chironomid larvae, and 1st instar larvae of the mosquito *Culiseta melanura* (Coquillett). I have observed *C. brakeleyi* larvae in rice fields in Louisiana preying upon 1st and 2nd instars of *Anopheles crucians* Wiedemann and *A. quadrimaculatus* Say. Larval densities in nature and predation rates have not been published. This paper presents the first record of rates of predation of mosquito larvae by *C. brakeleyi* from laboratory studies and the persistence of a natural population in a small semipermanent pond in Alachua Co., Florida, during the period 3 February-14 November 1989.

Materials and Methods

Laboratory predation rates. Sixty-five late instar *C. brakeleyi* larvae were collected from a semi-permanent pond, (about 100 m at its widest diameter), one edge of which ran alongside a road and bordered on the other sides by a sparse pine thicket, in Alachua Co., Florida, on 20 April 1988. Larvae were placed individually in 400 ml of tap water in white plastic cups (8 cm deep x 10 cm diam). Second instar *A. quadrimaculatus* were placed in each cup each day for the 19 days of the test. The number of mosquito larvae consumed each day was recorded and the remaining prey removed and replaced with new 2nd instars. More mosquito larvae were placed in each cup than had been consumed the previous day to ensure that the predator could feed to repletion. *Corethrella brakeleyi* pupae were held for adult emergence to verify species identification, using the key of Stone (1968).

Usually, the larger the predator the more food it can ingest. Thus, when all the mosquito larvae offered as prey are the same stage, larger predators would be expected to ingest more mosquito larvae. Therefore, calculation of the mean number of prey consumed per calendar day in the test would mask the effects of size (age) of the predator because both 3rd and 4th stage *C. brakeleyi* were collected. The day of pupation for each larva relative to the date the larvae were collected was used as a common reference point. Prey consumption was then related to the number of the day prior to pupation, permitting calculation of the mean number of prey consumed for a group of larvae according to a common age before each of them became a pupa.

Larval sampling in a pond. The *C. brakeleyi* larval population in the small permanent pond was sampled with a standard 400-ml dipper used for collection of mosquito larvae. Five dips were taken from each of 26 sites on 3-II-89, 7-II-89 and 15-III-89, and at 20 sites on 25-VII-89 and 14-XI-89. Samples were taken along the edge of the pond next to the road and were selected by moving several meters further along the edge from the prior sample. The number of each instar of *C. brakeleyi* was recorded for each

dip and averaged for the day. *Corethrella brakeleyi* larvae were observed there on 21-VIII-89 but quantitative data were not collected.

RESULTS

Prey consumption. The mean number of prey consumed/predator/day is shown in Table 1, grouped by the day of pupation. Daily consumption of prey for larvae that were youngest when collected and required 19 days of feeding before pupation is listed at the top of the table. Thus, 4 larvae required 19 days of feeding before they pupated, 26 fed for 17 days, and 2 pupated after their 4th day in the test. The average total number of prey consumed/predator was 76.9 (SD = 30.8, range = 13-153). The change from 3rd to 4th stage appears to have occurred at some time centered around the 11th day prior to pupation because this was the day the fewest prey were eaten after a gradual increase from the 19th through the 12th day before pupation. Daily prey consumption then increased from the 11th through the 5th day. The subsequent decrease in prey consumption indicated the pre-pupal period.

Larval occurrence in nature. Table 2 presents the mean number of 2nd, 3rd, and 4th larvae and pupae per dipper sample for the 4 sampling dates. Natural populations of *C. brakeleyi* persisted at least from March through November 1989.

CONCLUSIONS

The predation rates observed in these laboratory tests are estimates of the maximum sustained daily intake of prey by late stage *C. brakeleyi*. There were always living mosquito larvae in the cups at the end of each observation period, indicating that enough

TABLE 1. MEAN NUMBER OF SECOND INSTAR *ANOPHELES QUADRIMACULATUS* EATEN PER DAY PRIOR TO PUPATION BY *CORETHRELLA BRAKELEYI* LARVAE UNDER LABORATORY CONDITIONS.

Days of feeding prior to pupation	Number of *C brakeleyi* larvae feeding	Mean number (± SD) of prey eaten/day
19	4	3.00 (0.00)
18	5	3.00 (0.00)
17	26	3.19 (0.39)
16	27	3.48 (1.50)
15	29	4.21 (1.45)
14	31	4.32 (2.47)
13	39	5.28 (2.83)
12	42	5.64 (3.25)
11	43	3.35 (1.24)
10	58	4.38 (2.41)
9	59	4.58 (2.66)
8	59	5.14 (3.14)
7	60	6.27 (2.14)
6	61	7.77 (3.74)
5	63	9.32 (4.97)
4	65	8.28 (5.80)
3	65	5.75 (2.93)
2	65	6.65 (3.70)
1	65	5.37 (3.48)

TABLE 2. MEAN NUMBER (SD) OF *CORETHRELLA BRAKELEYI* PER DIPPER SAMPLE IN A SEMI-PERMANENT POND IN ALACHUA COUNTY, FLORIDA, 1989.

		LIFE STAGE (instar)				
Date	n	2nd	3rd	4th	Papa	All
3/II-89	130	0.08 (0.52)	0.22 (0.61)	0.56 (1.08)	0.01 (0.09)	0.86 (1.55)
7-II-89	130	0.11 (0.74)	0.09 (0.29)	0.41 (0.89)	0.01 (0.09)	0.62 (1.36)
15-III-89	130	0.05 (0.26)	0.19 (0.50)	0.56 (1.02)	0.02 (0.15)	0.83 (1.34)
25-VII-89	100	0.44 (0.57)	0.53 (0.43)	0.38 (0.38)	0.02 (0.06)	1.37 (1.14)
14-XI-89	100	1.41 (2.66)	0.22 (0.95)	0.0095 (0.0436)	0.0 -	1.65 (2.78)

prey were provided to satiate the predator and also that *C. brakeleyi* does not kill "surplus" larvae in the manner of *Toxorynchites*.

To my knowledge, these data represent the first attempt to quantify *C. brakeleyi* populations in nature. Natural populations of this species have been infrequently reported, and seasonal occurrence and densities of *C. brakeleyi* are unknown. This report documents the persistence of a *C. brakeleyi* population at one habitat from March through November. The importance of this predator as part of the natural mortality of anopheline larvae may therefore be greater than expected based upon the prior reports of its occurrence. The pond studied is similar to those in central Florida in that they are rather small, shallow, have abundant emergent and floating vegetation and are fed mostly by rainstorms. Extensive sampling is needed, however, to determine the distribution and abundance of *C. brakeleyi* in the region.

ACKNOWLEDGMENTS

The technical support and knowledge of Mr. O. R. Willis of this laboratory is respectfully recognized.

REFERENCES CITED

CHAPMAN, H. C., T. B. CLARK, D. W. ANTHONY, AND F. E. GLENN, JR. 1971. An iridescent virus from larvae of *Corethrella brakeleyi* (Diptera: Chaoboridae) in Louisiana. J. Invertebr. Pathol. 18: 284-286.

ELLIS, R. A., AND D. M. WOOD. 1974. First Canadian record of *Corethrella brakeleyi* (Diptera: Chaoboridae). Canadian Entomol. 106: 221-222.

MCKEEVER, S. 1977. Observations of *Corethrella* feeding on tree frogs (*Hyla*). Mosq. News 37: 522-523.

SMITH, J. B. 1902. Notes on the early stages of *Corethra brakeleyi* Coq. Canadian Entomol. 34: 139-140.

STONE, A. 1968. The genus *Corethrella* in the United States (Diptera: Chaoboridae). Florida Entomol. 51: 183-186.

WILLIAMS, J. A., AND J. D. EDMAN. 1968. Occurrence of blood meals in two species of *Corethrella* in Florida. Ann. Entomol. Soc. Am. 61: 1336.