

or 3rd week of May. These larvae reached adulthood by late June or early July. Females produced desiccation resistant, diapausing eggs with a highly sculptured exochorion, obvious adaptations to temporary pond existence. This apparently unique adaptation (shared by *C. nyblaei*, a Palearctic species) in the genus places larvae of *C. cooki* in the same habitat as some mosquito species and especially those of the genus *Aedes*.

I was able to observe both in nature and the laboratory that *C. cooki* larvae readily consume culicid larvae. For example, at a site 1.6 km south of Jasper, Alberta a mosquito hatch was directly observed to be devoured by *C. cooki* larvae and subsequent sampling of the pond failed to reveal any mosquito larvae.

Predation of mosquito larvae was observed throughout the study period (3 yrs.) in early spring and after heavy rains in a number of localities in Alberta (Borkent 1979). I regularly collected *C. cooki* at those times with mosquito larvae in their crops.

The purpose of this paper is to point out the potential use of *C. cooki* larvae as a biological control of those early season mosquitoes which occur in the boreal areas of temperate regions. Only the basics of the life cycle were determined by Borkent (1979), and many more data need to be obtained before any practical application can be made of *C. cooki*. Numbers of mosquitoes consumed, duration of each larval instar, effectiveness of predation at varying prey densities, adult behavior and the nature of egg diapause are all aspects which need to be investigated. It is hoped therefore, that some researcher or organization will be able to further investigate the potential of *C. cooki*.

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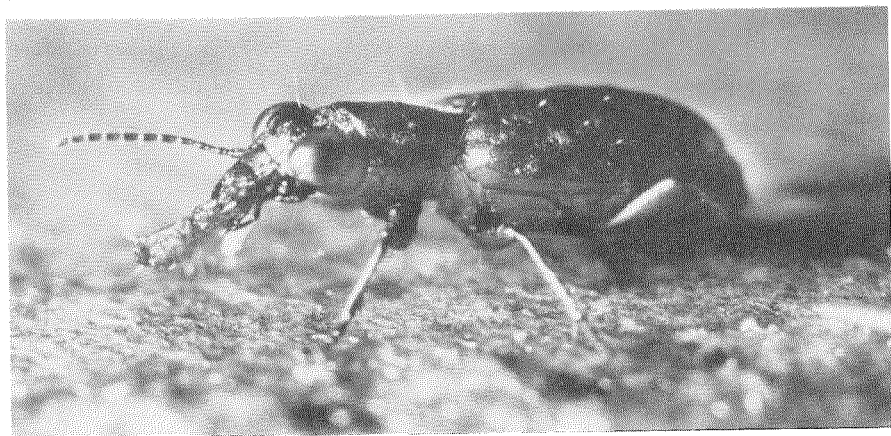
ELAPHRUS CUPREUS DFSCH. (COLEOPTERA, CARABIDAE), A PREDATOR OF THE PUPAE OF BITING MIDGES (DIPTERA, CERATOPOGONIDAE)

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Very few observations on insect predators of ceratopogonid pupae have been reported. In his review of literature of natural enemies of biting midges, Wirth (1977) cites only one case: Yaseen (1974) observed in Trinidad (West Indies), adults of the tiger-beetle *Cicindela suturalis* F. feeding on pupae and adults of *Culicoides phlebotomus* (Williston).

At a breeding place near Ichtratzheim (France), consisting of a mud-bank next to a river, where we are studying the spatial distribution of biting-midge larvae, we noticed that the number of *Culicoides* which emerged was more than 3 times lower than that obtained from mud samples kept in the laboratory (Rieb & Kremer). We considered that the activity of a predator could explain partly the diminution of the yield in the field. During the summer of 1979, we discovered by careful observations, the presence of a beetle: *Elaphrus cupreus* Dfsch. It is found on the surface of mud, in



Elaphrus cupreus eating a pupa of *Culicoides riethi*.

open spaces and between the plants (*Glyceria aquatica*, *Phalaris arundinacea*, *Carex pseudocyperus*, *Veronica beccabunga*, *Myosotis palustris*, *Nasturtium officinale*). This Carabid resembles the tiger-beetle and has predator habits: it runs with its body held well above the ground and stops suddenly from time to time; the eyes are wide and bulging, and the mandibles are very well developed. We estimated its density to be 2 or 3 per square metre.

We observed predation by this species by placing the beetle with *Culicoides riethi* pupae obtained from our breeding colony. An *Elaphrus cupreus* was placed in a vase of diameter 15 cm in which the bottom was covered with a wet filter-paper blackened with bone-black (on a white surface the beetle becomes excited and does not eat and dies).

The first day after the capture, we presented 20 *Culicoides* pupae to the beetle; it ate 18 of them. The second day, we presented 25 pupae; it devoured 19 pupae in 30 min. On the third day, we presented 25 pupae; it attacked the first pupa 3 min later and within 19 min the beetle had eaten 24 pupae.

The beetle attacked the pupae with its mandibles, where it was nearest, whether it be the anterior, median or posterior region. The beetle lifted the pupa by straightening the head and then its body remained quite still while the mandibles pierced the pupa. The pupa was crunched and progressively totally eaten. The beetle then immediately attacked the next pupa. The ingestion of a pupa took between 25 and 76 seconds.

Elaphrus cupreus ate also other prey which we gave: maggots and caterpillars. However, as the specific biotope of this beetle is the mud-banks of river and reed-beds in which larvae and pupae of Ceratopogonidae are particularly numerous, it would appear that *Elaphrus cupreus* is an important predator and could influence the number of Ceratopogonidae in a population.

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