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EFFECT OF TEMPERATURE ON THE HATCHING TIME OF *TRICORYTHODES MINUTUS* (EPHEMEROPTERA: TRICORYTHIDAE)

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Abstract.—Hatching time and mortality of the eggs of *Tricorythodes minutus* are directly related to temperature.

Water temperature has a direct influence on hatching time of aquatic insect eggs yet few studies have quantified this relationship. Several authors have noted that egg hatching is delayed and nymphal growth ceases during winter months (Moon, 1939; Larsen, 1968; Clifford, 1969; Lehmkuhl, 1970). Brinck (1949) found that Plecoptera eggs can take as long as 152 da to hatch in cold water. Illies (1959) noted that eggs of *Baetis* took up to 297 da to hatch in the laboratory. Elliott (1972) showed that *Baetis rhodani* eggs hatched in 10 da at 20°C, took 20 da to develop at 10°C and 135 da at 3°C.

Duration of egg development can affect production calculations and interpretations of length frequency data and therefore it is necessary to determine the relationship between water temperature and egg hatching. The objective of this study is to determine the effect of temperature on the hatching of *Tricorythodes minutus* Traver.

Methods

Several adult females were collected from a mating swarm during June and July using an aerial net. The attached, extruded egg clusters were removed, placed in a vial containing stream water and returned to the laboratory. Approximately 100 eggs were placed in each aerated petri dish full of stream water which was maintained in an environmental chamber. Temperatures in the environmental chamber were accurate to ±0.5°C. Over a 24-h period, the temperature in the chamber was brought to the test temperature and the hatching tests were initiated when the test temperature was reached. Tests were conducted at five temperatures: 7.5°, 12.5°, 21°, 23°, and 28°C. Photoperiod in the chamber was maintained at 12-h light and 12-h dark. Every three days the petri dish was removed from the chamber and examined under a dissecting microscope. The hatched eggs were removed and counted. Two weeks following the cessation of eclosion, unhatched eggs were counted to determine mortality.

Results and Discussion

Hatching time and survival of *T. minutus* eggs were directly related to temperature. At 7.5°C, hatching began after 125 da and lasted for 20 da

Table 1. Time (in days) required for the eggs of *T. minutus* to hatch at various temperatures and mortality rates.

Temperature	First eclosion	50% eclosion	Duration	Mortality
7.5°C	125	140	30	40%
12.5°	54	69	53	23%
21.0°	40	56	26	8%
23.0°	21	39	36	6%
28.0°	—	—	—	100%

(Table 1). During this test, 40 eggs were removed after 72 da and placed in a 23°C chamber to determine viability. These eggs began hatching in 6 da and 50% eclosion was achieved 48 h later.

Hatching began after 54 da at 12.5°C, 40 da at 21°C, and 21 da at 23°C. None was observed at 28°C. Duration of hatching was lowest at 21°C (26 da) and greatest at 12.5°C (53 da).

Highest egg mortality occurred at the highest (28°C) and lowest (7.5°C) test temperatures. Most rapid egg maturation occurred at 23°C, at which

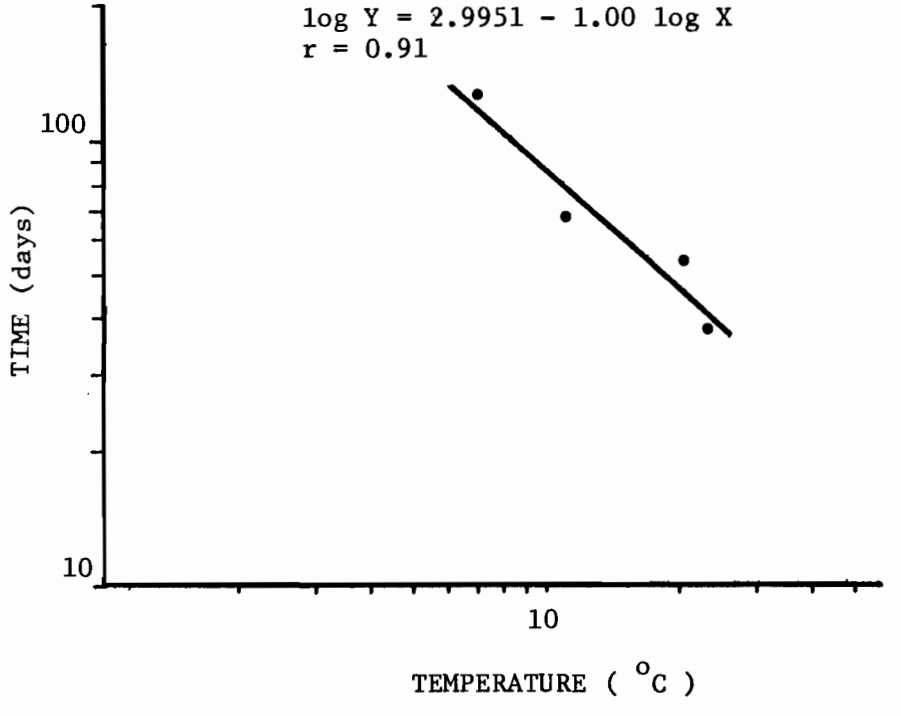

Fig. 1. Time required for 50% of the eggs of *T. minutus* to hatch in the laboratory at four test temperatures.

temperature 50% of the eggs hatched within 36 da and achieved the lowest mortality (6%). Egg mortality was a function of temperature. The relationship between time of hatching and water temperature is logarithmic and predictable (Fig. 1).

Using the regression equation derived from the data in Fig. 1 (log $Y = 2.9951 - 1.00 \log X$), hatching time (Y da) can be determined for water temperature (X) between 7.5°C and 23°C. The relationship between the time required for eggs to hatch and temperature is similar to results of the study by Elliott (1972) on *Baetis rhodani* (log $Y = 2.773 - 1.37 \log X$). Elliott found that duration of hatching of *B. rhodani* also decreased with increasing temperature but it was not correlated with water temperature in *Tricorythodes minutus* in this study.

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