EFFECT OF A PARASITIC WATER MITE ON THE PER CAPITA RATE OF INCREASE OF ITS HOST HYDROMETRA AUSTRALIS (HEMIPTERA: HYDROMETRIDAE)

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In some geographic regions within its range, the surface-dwelling aquatic insect Hydrometra australis Say (Hemiptera:Hydrometridae), formerly known as Hydrometra myrae Bueno, is commonly parasitized by larvae of the water mite Hydryphantes tenuabilis Marshall (Acari:Hydryphantidae), a possible synonym of Hydryphantes ramosus Day (Lanciani 1971). Although mites initially attach to nymphal as well as adult hosts, those attaching to nymphs feed little if at all. Instead they remain attached to the host as it develops to the adult stage, at which time the mites begin to engorge. Within 7 to 13 days of attaching to adult hosts, the mite larvae complete feeding, metamorphose to a nonparasitic stage, and detach from the host.

The relatively large size attained by parasites during the brief engorgement period (Lanciani 1975a) suggests that hosts suffer some consequences of parasitism, and significant parasite-induced reductions in survival and age-specific reproductive rates have been reported (Lanciani 1975b). Unfortunately, the parasitic effect on the most critical and inclusive measure of host fitness, the per capita rate of increase (r), was not determined then because methods of estimating variance in r were not readily available. However, estimating variance in r is relatively routine now because of modern statistical methods and computer accessibility, thus recognition of significant differences among sample r values is possible. Accordingly, in the present study I
re-evaluate life-table data from Lanciani (1975b), comparing r values of H. australis host groups harboring different loads of the water mite H. tenuabilis.

Details of the laboratory procedure were as described in Lanciani (1975b). Adult female hosts, the stage and sex focussed on in this study, were held individually in plastic petri plates lined with moistened absorbent paper. An adult male was kept with each female for 3 to 4 hours each day to ensure that females mated. Plates were placed in groups of 12 into covered clear plastic boxes, which were kept in constant-temperature chambers maintained at 28°C and a 12:12 (L:D) cycle. Hosts were fed male Drosophila melanogaster Meigen that had been frozen. Male flies of only the first generation produced by a fly culture were used because of greater body-weight constancy. In the original experiments, food levels of 1/2 (i.e., 1 fly every other day), 1, 2, and 3 flies per day were used, but data from only the lowest food level were included in the present study because all food levels produced similar results and the much greater life span at the lowest food level yielded a longer oviposition period.

Mite loads were controlled by manipulating mite numbers on fifth instars so that adult females emerged with 1 of 4 parasite loads: 0, 2, 6, and 10 mites per host. Each parasite-load group contained 20 host individuals.

Survivorship, \( l_x \), and age-specific fecundity, \( m_x \), were determined on adult females in each parasite-load group from daily survival and reproductive records. A sex ratio of 1 was assumed, so \( m_x \), which refers only to female eggs, was based on 1/2 the actual number of eggs laid per day. The per capita rate of increase, \( r \), was found by trial and error substitution in the Euler-Lotka equation: \( 1 = e^{-rx} \sum m_x \).

Variance in \( r \) was determined with the jackknife method (Tukey 1958), following the procedure outlined by Krebs (1989). This method seems to be as effective in estimating variance in \( r \) as the bootstrap method (Meyer et al. 1986). Knowledge of this variance then permitted (1) estimation of confidence intervals and (2) tests of significance with the Tukey method of multiple comparisons (Meyer et al. 1986). Group estimates of \( r \) (i.e., the \( r \) of the entire cohort of 20 individuals in each parasite-load group), jackknife estimates of \( r \), and 95% confidence intervals of each jackknife estimate were determined (Table 1). In each case, the jackknife estimate of \( r \) was within 0.001 of the group \( r \). Also, \( r \) decreased relatively uniformly as mite load increased. The \( r \) of unparasitized hosts was significantly greater (\( P < 0.05 \)) than that of hosts parasitized by 6 or 10 but not 2 mites.

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\begin{array}{|c|c|c|}
\hline
\text{Parasite Load} & \text{Group } r & \text{Jackknife Estimate of } r \\
\hline
0 & 0.080 & 0.080 \\
& & (0.075 - 0.085) \\
2 & 0.072 & 0.071 \\
& & (0.066 - 0.076) \\
6 & 0.059 & 0.059 \\
& & (0.051 - 0.067) \\
10 & 0.048 & 0.049 \\
& & (0.036 - 0.062) \\
\hline
\end{array}
\]
The drain on internal resources of \( H. \) australis by \( H. \) tenuabilis reduces the insect’s reproduction and survival (Lanciani 1975b). Because of the mathematical relationship between \( r \) and reproduction and survival rates described by the Euler-Lotka equation, the parasite would be predicted to reduce host \( r \). This prediction was realized in the present study. Thus, parasitized populations of \( H. \) australis would increase slower than would unparasitized populations. The effect on host \( r \) is especially strong because the mite exploits the host in early adult life when reproduction is otherwise maximal. Many other species of parasitic water mites adversely affect host life-history parameters related to fitness (Smith 1988). Thus, reductions in \( r \) values of other water-mite parasitized hosts are likely to occur also.

**Summary**

The effect of the parasitic water mite \( Hydryphantes \) tenuabilis on the per capita rate of increase (\( r \)) of the host insect \( Hydrometra \) australis was determined using the jackknife method of estimating variance in \( r \). The mite, which is known to reduce survival and age-specific reproductive rates, reduced host \( r \) as well; \( r \) was significantly higher in unparasitized hosts than in hosts parasitized by 6 or 10 mites.

**References Cited**


