FEEDING ECONOMY OF LARVAE OF A FLOWER FLY, *METASYRPHUS COROLLAE* [DIP. : SYRPHIDAE] :
PARTIAL CONSUMPTION OF PREY

C. A. BARLOW & JO ANNE WHITTINGHAM

Department of Biology, Carleton University,
Ottawa K1S 5B6

*Metasyrphus corollae* (F.) larvae ingested aphid contents at a decreasing rate over time because the contents of the aphid became increasingly difficult to obtain as the body of the prey was emptied. Starved larvae usually handled prey longer than well-fed larvae. Younger starved larvae fed longer than older larvae. Larvae starved for 24 h ate the most of a prey. Larvae held prey, on average, until 71 % of dry mass was extracted after which the prey carcass was discarded. Prey handling time and amount of each prey consumed were determined by size and hunger of larvae and degree of depletion of prey contents.

**KEY WORDS**: Syrphidae, larvae, feeding economy, predator-prey.

Prey handling time is 1 feature of predation that determines the maximum number of prey a predator can kill per unit time. It is, therefore, an important indicator of the efficiency of a predator as a biological control agent.

Larvae of *Metasyrphus corollae* (F.) are obligate predators of aphids. They withdraw the contents of their prey then discard the carcasses. Prey handling time increases with time since last meal because starved larvae extract more from aphids before discarding them (Leir & Barlow, 1982). The extent of this relation and the exact reason for its has not been explained. A number of other experimental studies have shown similar dependence of prey handling time on the abundance of prey or on the hunger of the predator (Haynes & Sisojevic, 1966 ; Sandness & McMurtry, 1972 ; Hågvar, 1974 ; Cook & Cockrell, 1978).

For syrphid larvae preying on aphids, the amount of time spent handling 1 prey is entirely a function of rate of ingestion of prey contents because, once a larva captures an aphid and begins to feed, it does not release it and the aphid is effectively subdued. Even a tiny larva feeding on a much larger aphid seldom releases its hold even though the larva may be transported by the aphid.

We examined the feeding behavior of *M. corollae* larvae to assess the effects of age and time since last meal on ingestion rate during a feeding cycle. We also tested if changes in this rate when the larvae fed on single prey or successive prey, were determined by hunger of the larvae or qualities of their prey such as depletion of easily available contents or prey abundance.
MATERIALS AND METHODS

INSECT REARING

The method described by Barlow (1979) was used to rear and obtain larvae of M. corollae. Only 4-to 7-day old larvae were used; younger larvae were tiny, difficult to handle without injuring them and died of starvation relatively quickly.

Larvae were fed 7-day old pea aphids, Acyrthosiphon pisum (Harris), reared according to the method of Harrison & Barlow (1972). Aphids of uniform age and size were obtained by placing 50-70 parthenogenetic A. pisum adults on 12-15 fresh pea stems in a large Petri dish lined with damp filter paper. After 24 h the adults were removed and the pea stems bearing the newly produced aphids were transferred to potted pea seedlings. This technique provided aphids of a known age for tests.

We estimated the average dry mass of 7-day old aphids by freeze-drying and weighing 79 individuals. The value obtained (256.9 ± 44.2 μg) was used as a constant for prey size in all experiments. The average mass of 10-20 individuals from each new group of 7-day old aphids was checked to ensure that it fell within this range.

EXPERIMENTAL

The 1st series of experiments was designed to measure prey handling time and the rate of extraction of contents of aphids by larvae. These experiments also examined if differential rate of ingestion was caused by increasing satiation of larvae or because contents of prey became more difficult to extract as the prey became increasingly evacuated. All feeding experiments were completed at 20°C ± 0.5°C during the same 4 h period each day.

Ingestion by 5-7 day old M. corollae larvae was determined with well-fed larvae and with larvae which had been starved for 24 or 36 h. Well-fed larvae were kept with aphids constantly until shortly before testing. To prepare starved larvae for testing, larvae of appropriate age were placed singly in 1.5 × 5.5 cm Petri dishes, lined with damp filter paper, each containing a small pea stem bearing 10-15 aphids. After 3-4 h, the aphids and pea were removed and the larvae starved for the desired times.

We tested feeding responses by offering aphids, held with light weight forceps, to individual M. corollae larvae in 1.5 × 5.5 cm Petri dishes. Larvae readily accepted aphids offered in this way and up to 5 larvae could be observed simultaneously. Consumption times were measured with individual stop-watches; elapsed times between piercing of the aphids' bodies by the larvae until they discarded the carcasses were recorded. Total handling times and amounts consumed were observed for 15-60 larvae at each of the 3 ages and 3 hunger levels. Rates of extraction of aphid contents were determined for 30-40 larvae of each age, either well-fed or starved for 24 h. Aphids were gently withdrawn from the larvae's jaws at various times (see table 2) before evacuation was completed and amounts consumed by that time were determined.

The effects of prey quality and larval hunger on rates of ingestion were determined by 2 different experiments. In the 1st, 5- and 6-day old M. corollae larvae, starved for 24 h, were fed 5-day old aphids which were considerably smaller (140.2 ± 21.1 μg) than 7-day old aphids. Total handling times and rates of extraction were determined as before. In the 2nd experiment, 6- and 7-day old larvae, starved for 24 h, fed on a series of 7-day old aphids for 1 min each before the prey was gently withdrawn. Amounts ingested were determined for each aphid offered.