

## OVIGENY IN SELECTED GENERALIST PREDATORS

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Ovigeny refers to egg production and development in adult female insects. Extremes in ovigeny yield a dichotomy: species where adults emerge with a fixed complement of mature eggs are "pro-ovigenic"; whereas, species that display continued egg development during adulthood are "synovigenic" (Heimpel & Rosenheim 1998). Over 98% of parasitoid species surveyed emerged with at least some immature eggs (Jervis et al. 2001). A synovigenic insect may experience short-term egg depletion, though lifetime fecundity limitation should be rare (Carbone & Rivera 2003). Egg limitation has been demonstrated in the field, affecting host-parasitoid population dynamics, possibly resulting in inverse density-dependent parasitism (Heimpel & Rosenheim 1998). Jervis et al. (2001) suggested that synovigenic species tend to be longer-lived, and that the early reproductive cost in pro-ovigenic species incurred a biological cost.

Most research in ovigeny has been performed on parasitoids (mostly Hymenoptera), possibly because of the direct relationship between egg load and parasitism rates, and hence reproduction. However, ovigeny is a potentially unifying concept in entomology and should be applicable to all insect species (Jervis et al. 2001). Previous studies of ovigeny in insects other than parasitoids include those of Boggs (1997) in Lepidoptera. Further, *Cyzenis albicans* Fallen (Diptera: Tachinidae) and hoverflies in general (Diptera: Syrphidae) were determined to be synovigenic by Hassell (1968) and Gilbert (pers. comm., 1990), respectively. Legaspi & Legaspi (2004) found evidence of strong ovigeny in *Podisus maculiventris* (Say) (Heteroptera: Pentatomidae) by comparing egg loads at different times during female adulthood, against lifetime fecundity in the laboratory. Limited evidence of ovigeny in *P. maculiventris* was also found in the field (Legaspi & Legaspi 2005).

In this study, ovigeny was examined in 4 common generalist predators: *P. maculiventris*, *Orius insidiosus* (Say) (Hemiptera: Anthracoridae), *Geocoris punctipes* (Say) (Heteroptera: Geocoridae), and *Delphastus catalinae* (Horn) (Coleoptera: Coccinellidae). Dissection and feeding methods for *P. maculiventris* are described in Legaspi & Legaspi (2004). For the *O. insidiosus*, *G. punctipes* and *D. catalinae*, 40 newly-emerged females of each species were selected for study and placed individually in 10-cm Petri dishes with a damp cotton ball and lined with filter paper. The Petri

dishes were secured with a rubber band. A male was placed with each female throughout the experiment except on day zero. Each Petri dish comprised 1 replicate. The 40 females were assigned to one of 4 dissection times (10 replicates each). Prey was provided *ad libitum* as: *Bemisia tabaci* (Gennadius) (Homoptera: Aleyrodidae) for *D. catalinae* and *G. punctipes*; and *Ephestia kuehniella* Zeller eggs and pollen. Oviposition substrates for the predators were stringbean (*Phaseolus vulgaris* L.) for *O. insidiosus* and tomato (*Lycopersicon esculentum* Mill. syn. *Solanum esculentum* L.) leaf cuttings for *D. catalinae* and *G. punctipes*. Four dissection times were determined based on the expected lifespan of each species. At the beginning of the experiment (dissection time = 0), 10 females were dissected, and the numbers of mature and immature eggs were recorded. At each of the remaining 3 dissection times, 10 females were dissected and examined. At each designated dissection date, total numbers of eggs laid were recorded. Numbers of mature and immature eggs were counted upon dissection.

Results of dissections in *P. maculiventris* (Fig. 1A) showed that the numbers of immature eggs increased with the predator age, whereas the numbers of mature eggs declined (Legaspi & Legaspi 2005) providing a clear indication of continuous egg production during the adult stage. In the other predators that we studied, egg loads at time zero were always zero and tended to increase with time, except in *D. catalinae* (Fig. 1B). However, the numbers of eggs laid all increased with time. Total numbers of eggs laid were higher than total egg count recorded in dissections. In *O. insidiosus*, 71 eggs (7.7%) were counted in dissections, versus 857 laid (92.3%). Results were similar for *D. catalinae*: 7 eggs (5.8%) found in dissections and 113 laid (94.2%); and *G. punctipes*: 189 (13.8%) versus 1183 (86.2%). These findings suggested that egg production occurred during the adult stage in all these predators and that all predators studied were synovigenic to various degrees. In the case of *D. catalinae*, low egg load was likely a consequence of oviposition. Despite the fact that most studies on ovigeny have been done on parasitoids, it is not surprising that synovigeny is also common in other groups, including predators. Egg load dissections underestimate reproductive potential of various species and may not be good criteria in evaluating predators as potential biological control agents.

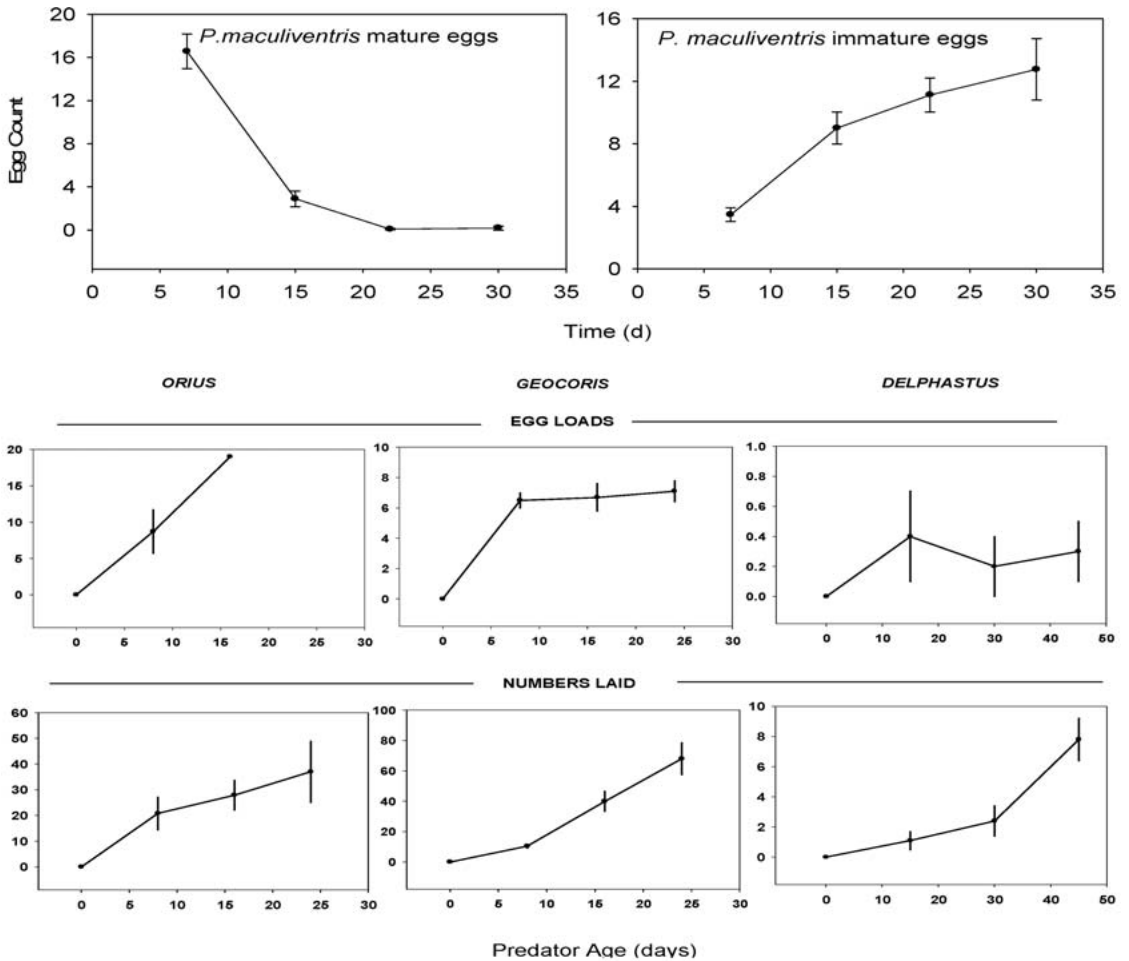


Fig 1. (A) Numbers of mature and immature eggs in *Podisus maculiventris* at different ages of the adult female (data from Legaspi & Legaspi 2004) ( $\pm$  SE); (B) Egg loads at dissection (top) and numbers of eggs laid (mean  $\pm$  SE) (bottom) in *Orius insidiosus*, *Geocoris punctipes*, and *Delphastus catalinae* at different ages of the adult females ( $\pm$  SE).

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SUMMARY

We examined ovigeny in 4 common generalist predators: *Podisus maculiventris* (Say) (Heteroptera: Pentatomidae), *Orius insidiosus* (Say) (Hemiptera: Anthicoridae), *Geocoris punctipes* (Say) (Heteroptera: Geocoridae), and *Delphastus catalinae* (Horn) (Coleoptera: Coccinellidae) through dissections and counts of the numbers of eggs laid. The predators studied were found to exhibit various degrees of synovigeny. The numbers of immature eggs increased with the age of the predator *P. maculiventris*, whereas the numbers of mature eggs declined. There was evidence of continued egg production in the other 3 predators that we studied because the numbers of eggs laid exceeded egg loads deter-

mined by dissections. We discussed possible implications in the evaluation of predators as biological control agents.

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