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Chapter 3 *Longest Diapause*

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The yucca moth Prodoxus y-inversus *Riley (Lepidoptera: Prodoxidae) has the longest reported diapause. Structures of* Yucca baccata *(Agavaceae) containing prepupae of this species were collected in Nevada, and successful emergence of adults was observed 19 years later, under artificial conditions.*

Prolonged periods of dormancy are well-known among invertebrates. Brusca & Brusca (1990) reported that a dried museum specimen of moss yielded living tardigrades, a small phylum that appears to be closely tied to the annelid-arthropod line, when moistened after 120 years on the shelf.

Some insects, such as the golden buprestid *Buprestis aurulenta* L., have an extended larval life. According to Linsley (1943), the larvae usually require from one to three years to complete their development, but Huguenin (1915) reported delayed emergence of specimens from structural timbers as long as 26 years after infestation. In a critical review, Smith (1962) presented 32 additional cases in British Columbia, with 11 of the cases being between 26 and 51 years.

However, other cases of delayed emergence in insects may reflect diapause rather than prolonged larval development. Diapause, as defined by Tauber *et al.* (1986), is a neurohormonally mediated, dynamic state of low activity that occurs during a genetically determined stage(s) of metamorphosis, usually in response to environmental stimuli that precede unfavorable conditions. The objective of this review was to determine the longest diapause recorded for insects.

Methods

Agricola, Biological Abstracts, CAB Abstracts and Life Science Collection were searched from year 1986 to the present. Secondary literature, mainly textbooks in entomology and ecology, also proved useful.

Results

Diapause lasting more than a year, also called "prolonged" or "extended" diapause, is known in many species of insects (Danks 1987). Sunose (1983) summarized cases of prolonged diapause and tabulated 64 insect species that present this phenomenon. In fact, prolonged diapause seems to be more common than one could imagine. Powell (1987) referred to approximately 90 species of Lepidoptera, in 10 superfamilies, that diapause for over one year.

Barnes (1952), studying wheat-blossom midges (Diptera: Cecidomyiidae), reported the emergence of *Cantarinia tritici* Kirby after the larvae had been in soil up to three years, whereas larvae of *Sitodiplosis mosellana* Géhin spent as many as 12 winters in the soil before emergence of the adults. However, Powell (1989) reported the emergence of adults of the yucca moth *Prodoxus y-inversus* Riley (Lepidoptera: Prodoxidae), after prepupae spent 19 years in diapause.

Discussion

Prolonged diapause may have appreciable adaptive value in habitats where resources are available only briefly each season and/or undergo erratic fluctuations in abundance (Sunose 1978). The prolonged diapause for *P. y-inversus* was

observed under unnatural environmental conditions. The prepupae of this prodoxid insect were housed in sealed cardboard boxes, and then exposed to variable temperature and humidity regimes, subdued light, and without direct moisture from rainfall (Powell 1987). Powell (1989) pointed out that this example indicates a potential for successful dormancy of insects adapted to extremely arid climates for much greater periods than previously supposed.

The physiological mechanisms of prolonged diapause are poorly understood (Tauber *et al.* 1986). Powell (1987) suggested that particular token stimuli needed to promote the late phases of diapause maintenance and diapause termination are not received. Hence, when thermal or other thresholds are reached that would have resulted in post diapause development, the diapause maintenance period continues.

According to Powell (1984), the study of two prodoxid species, *Prodoxus aenescens* Riley and *P. cinereu* Riley, indicated that temperature is the key factor in diapause development. Powell (1989) pointed out that exposure to temperatures that are colder than preceding winters are likely to interrupt the diapause maintenance in *P. y-inversus.*

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