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Chapter 36 *Most Polyandrous*

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Polyandry refers to a female mating with more than one male. Although more common in eusocial Hymenoptera, polyandry is widespread across various taxa. Apis dorsata *(Hymenoptera:Apidae) is here named as the most polyandrous insect because it has been recorded to mate up to 53 times, each with a different male. A blue milkweed beetle,* Chrysochus cobaltinus *(Coleoptera: Chrysomelidae) female has recorded up to 60 matings, though some of these were multiple matings with the same male.*

Mating is a process that has important evolutionary consequences. There are three types of mating: in *polyandry* a female copulates with more than one male; in *multiple mating* a female mate repeatedly with the same male; and in *prolonged mating* a female copulates for a long time with a particular mate (Choe 1997). Some species may show both polyandry and polygyny (some males copulate with more than one female in a breeding season). Frequency of mating may be influenced by food quality, as was reported with burying beetles (Trumbo & Eggert 1994).

This report aims to find the most polyandrous insect, defined as the female insect with the highest number of matings with different males reported in scientific literature.

Methods

Primary literature was found mainly by searching Biological Abstracts and CAB, and querying the Entomo-L mailing list. Secondary literature was found in books at Marston Library. Entomology professors and USDA researchers gave me good advice on where to find information.

Results

In the primary literature, authors usually reported whether a species has single or multiple mates, and some specified proportions of multiple matings. Page (1986) reported mating frequencies of 98 species. Those with greatest number of matings were *Apis mellifera* (up to 20 times), *Apis cerana* (up to 30), *Atta sexdens* (up to 8) , and *Vespula maculiformis* and *V. squamosa* (up to 10). Moritz et al. (1995) reported that *Apis dorsata* females mated with as many as 53 mates. Dickinson (1997) indicated that *Chrysochus cobaltinus* (Coleoptera: Chrysomelidae: Eumolpinae) female mated up to 60 times, but not necessarily with different males.

Discussion

Currently the most polyandrous species are eusocial Hymenoptera, but records may change in the next few years. Numerous and profound studies on polyandry have been completed recently, and the results are becoming available (Croizer & Pamilo 1996).

Studies on *C. cobaltinus* marked individuals have shown that males and females mate with multiple partners in field, and often remate with the same individuals (Dickinson 1997). Single mating is certainly the case for honeybee males, because they lose their genitalia after mating (Croizer & Pamilo 1996). Polyandry in *Apis dorsata* was determined using single locus ge-

netic markers. Three DNA microsatellite loci with a total of 27 alleles provided sufficient genetic variability to classify the workers, deducing their genotype from father drones and queen mothers. The statistical procedure used to estimate the actual and effective number of matings is conservative, and may underestimate these parameters. Patrilines were biased due to the small worker sample size which ranged from 18 to 41. Mating estimates ranged from 16 to 53 (mean 30.17 ± 5.98 SE). For the largest sample, the best fitting estimate of the number of matings was 53, with 95% confidence limits of 37 to 96 (Moritz et al. 1995).

Since males of polyandrous species on average mate more often than males of monandrous species, not only is their total ejaculate greater, but the rate at which they are able to produce sperm and accessory substances is greater (Svard & Wiklund 1988). Cryptic female choice may occur if females bias sperm storage in favor of males with preferred phenotypes or by refusing to mate (Dickinson 1997). The female defines polyandrous behavior once copulation has begun (Thornhill & Alcock 1983).

The evolution of polyandry in social hymenopteran queens may be caused by colony level selection, either because polyandry affects the distribution of non-functional diploid males in colonies (the load hypothesis) or because it increases the genetic diversity of the worker force (the diversity hypothesis) (Pamilo 1991).

Artificially inseminated queens with semen from one drone opposed to equal amounts of mixed semen from several drones, showed that mixed patriline results in a group of advantages in performance of honeybee workers, resulting in higher comb building, storage of honey and pollen and brood rearing. This might have promoted the evolution of polyandry in honeybee queens (Fuchs & Shade 1994). Parasites and pathogens have been proposed as selective agents involved in maintaining genetic variability in populations and promoting polyandry in eusocial Hymenoptera (Shykoff & Schmidt 1996). By these facts and although *C. cobaltinus* mated up to 60 times, *Apis dorsalis* is considered the most polyandrous insect.

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