

Brood parasitism is well-known in its obligate form (e.g. Michener 2007) and little-known in its intraspecific form as an alternative reproductive strategy of pollen collecting bees (e.g. Field 1992). Cleptoparasitic bees with this life strategy are commonly called cuckoo bees.

Obligate cuckoo bees have evolved certainly more than ten times within the bees. Five groups in the family Megachilidae (Rozen 2000), nine possible lineages in the family Halictidae (Michener 1978, 2007), and four independent lineages in the family Apidae (Straka & Bogusch 2007a, Cardinal et al. 2010) have been identified. However, these numbers are highly unstable and changing from one publication to another.

The most common cleptoparasitic strategy is oviposition in the opened still-provisioned brood cells. This strategy occurs in all tribes of the subfamily Nomadinae (Roig-Alsina 1991a) as well as in the tribes Isepeolini (Rozen 2003) and Protepeolini (Roig-Alsina & Rozen 1994) (Apinae). Thus this derived strategy has evolved three times independently in the family Apidae; it is well-known also in some lineages of the family Megachilidae (Rozen 2003). These bees (embedders) generally embed their eggs in the cell wall or cell lining. Embedders use an adaptively modified metasomal apex for careful inletting and positioning of their eggs. Nomadine females have a bilobed sixth sternum with blunt, spinlike bristles, or the sixth sternum might be modified to a simple or bifid pointed apex (Roig-Alsina 1991a). Isepeolini have a similar modification of the sixth sternum with a sharply pointed apex, with or without analogous bristles (Roig-Alsina 1991b), while Protepeolini have an analogously modified sixth metasomal tergum (Roig-Alsina & Rozen 1994). Small eggs of embedders are often totally hidden in the cell wall (except opercula) and have a very complex shape (Rozen 2003). In Biastini, Hexepeolini and Isepeolini, the eggs are inserted parallel to and more or less flush with the wall (Rozen 1992, 2003, Rozen et al. 1997, Rozen et al. in press).

Another strategy of cleptoparasitic bees is oviposition in the fully provisioned nest cells that have already been closed by the host female. This strategy is known in Exaerete, Coelioxoides, Ericrocidini, Melectini, Rhathymini, most Osirini, as well as in cuckoo bees of the families Megachilidae and Halictidae (Rozen 2003, Rozen et al. 2006). These bees (openers) have to open and damage a closure made by host female. They carefully renovate the closure once eggs have been laid. Openers usually have no obvious morphological adaptations of metasoma or egg modifications in comparison with solitary bees.

*Epeoloides* Giraud (Osirini) seems to be neither an embedder nor an opener. Females of this cleptoparasitic bee may oviposit in opened host cells in the late phase of provisioning and enclose eggs in the cell (encloser); however, behaviour of this genus has not been fully resolved yet (Straka & Bogusch 2007b). This kind of strategy exists also in *Melecta albifrons*

(Förster) as an occasional alternative strategy to cell opening (Straka, unpublished). Behaviour of

*Epeoloides*

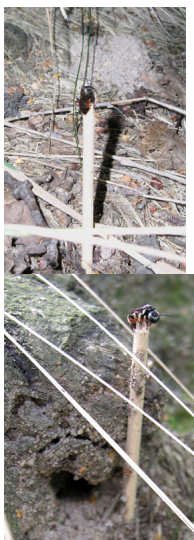
and *Melecta* Latreille could be a transitional strategy from openers to embedders. These bees are not the only enclosers.

*Sphecodes monilicornis*

(Kirby) females lay eggs in the still-opened cells of their *Lasioglossum* Curtis hosts. These cells are closed only after

*Sphecodes*

Latreille invasion (Sick et al. 1994). Enclosers close off the entire nest tunnel (including the cell) and mask the nest entrance. Host bees are not able to reopen it nor are they able to find the entrance.



**Cuckoo bee *Epeoloides coecutiens* is waiting for the moment, when its host depart, than enter the nest itself.**

## Obligate brood parasitism

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Parasitism is a type of symbiosis where one organism, the parasite, benefits at the expense of another organism, the host. This can occur in various forms, including obligate brood parasitism, where the parasite relies entirely on the host for its survival and reproduction.