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Conference Abstract

# Behavioral and chemical antipredator mechanisms in ground beetles: an attempt to reconcile within a phylogenetic frame

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## Abstract

Like other coleopterans, Carabids are recognized for the use of passive and active strategies against their enemies. They are known to produce dangerous and distasteful chemicals and to use anti-predator behaviors such crypsis/mimicry, gregariousness, intra- and interspecific helpful interactions, sound production and aposematism. While defensive chemicals have been an important element in the successful diversification of ground beetles, in many tribes of this wide adephagan family many other systems have evolved and discovered. Here we present a review on the current knowledge of the avoidance mechanisms in carabids, with a discussion of data on chemical products, morphological adaptations and behaviors used against vertebrate and invertebrate predators. The most widespread strategy is discouragement of the predators using pygidial gland secretions, but passive anti-predator strategies are also displayed as group-protecting behavior through intraspecific aggregations or communal roosting. Most adult carabids tend to be dark in color and thus less detectable, but chemically well-protected taxa use the opposite strategy, displaying bright colors related to mimicry or aposematism. In aposematic species, group-protecting behavior has probably evolved from intraspecific gregariousness into multispecies aggregations. Larval behavioral strategies are related more closely to the epigean or underground lifestyle. In surface-living larvae, cannibalism avoidance and the usage of defensive substances have been reported for Chlaeniini. In this tribe we found an

interesting coincidence between a high level of toxicity/distastefulness and a complex larval behavior. Based mainly on the genus-level supertree of Beutel et al. (2008) and the phylogenetic analyses of Ober & Maddison (2008) we reconstructed the evolutionary relationships among the chemical classes isolated inside the tribes. The scenario shows that several semiochemical classes (quinone/benzoquinones, formic acid, m-cresol, methacrylic acid, isovaleric acid, ß-necrodol, benzaldehyde, etc.) found in carabids are at least in part related to their life style and habitat selection. The proposed relationship still lacks other chemical data of the missing genera/species and even if the knowledge of carabid anti-predator strategies still seems to be in the pioneer stage, future studies on carabid anti-predator behavior look very promising.

## Keywords

Coleoptera Carabidae, avoidance behavior, gregariousness, mimicry, aposematism, behavioral ecology, defense chemicals

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