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## **Pupal cases of Nearctic robber flies (Diptera: Asilidae)**

D. STEVE DENNIS, JEFFREY K. BARNES & LLOYD KNUTSON



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## Pupal cases of Nearctic robber flies (Diptera: Asilidae)

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## Abstract

The literature on robber fly pupae published primarily since 1972 is reviewed. Terminology used in morphological descriptions of pupal cases is compared and standardized, and some new terminology is used. A general description of asilid pupal cases is presented. Diagnostically useful characters are identified, and a consistent format for descriptions is presented. Pupal cases of 24 species are described for the first time, those of 13 species are redescribed, and additional comments are made on the pupal cases of 12 other species. Keys to species, genera, and higher categories are presented. *Asilus lecythus* Walker is transferred to the genus *Machimus* (new combination).

**Key words:** pupal cases, *Nearctic*, *Andrenosoma*, *Apachekolos*, *Asilus*, *Ceraturgus*, *Comantella*, *Cyrtopogon*, *Dioctria*, *Diogmites*, *Efferia*, *Heteropogon*, *Lampria*, *Laphria*, *Laphystia*, *Lasiopogon*, *Leptogaster*, *Machimus*, *Mallophora*, *Megaphorus*, *Neoitamus*, *Neomochtherus*, *Ommatius*, *Proctacanthella*, *Proctacanthus*, *Promachus*, *Stenopogon*, *Triarla*, *Asilus lecythus*.

## Introduction

The Asilidae, or robber flies, are a worldwide family of insects known for their predatory habits and mimicry of other insects, especially some bees (Hymenoptera). Adults of many species are large and conspicuous, and they are easily recognized and frequently collected. Many species prey upon honey bees, sometimes causing significant damage to bee colonies (Dennis & Lavigne 2007, Lehr 1964). Some robber flies are regarded as potential biological control agents against scarab larvae (Wei *et al.* 1995).

Bionomic and systematic research on robber flies is hampered by inadequate knowledge of immature stages. We must be able to identify their eggs, larvae, and pupae in order to study their life histories. Furthermore, phylogenetic classifications cannot be considered complete until they incorporate data derived from studies of immature stages. Only about two percent of asilid species are known in any immature stage. Of the 856 described species in North America north of Mexico (Martin & Wilcox 1965), immature stages of about 35 species have been described. Only the more recent studies, such as those by Dennis & Lavigne (1976a) and Scarbrough & Kuhar (1995), are sufficiently detailed to facilitate identification and comparison of immatures. Furthermore, robber fly life history and phylogenetic studies are complicated because all known species have a one- to three-year life cycle, and knowledge of the biology and morphology of immature stages is mostly limited to mature larvae and pupae.

The purposes of this paper are to describe for the first time the pupal cases of 24 species of Asilidae, redescribe the pupal cases of 13 species, and to comment on the pupal cases of 12 other species. Previously described pupal cases have been re-examined because earlier descriptions are not adequate for taxonomic purposes, and it is necessary to describe the pupal cases in a consistent, comparable manner. Keys to genera and species are presented. Nine taxa for which information is available in the literature are included in the keys, and two species descriptions have been rewritten to fit our format to the greatest extent possible.