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A Revision of the *Tetrasphaeropyx* Ashmead Lineage of the Genus *Aleiodes* Wesmael (Hymenoptera: Braconidae: Rogadinae)

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Abstract

In this revision, seventy-two *Aleiodes* (*Tetrasphaeropyx*) species are described of which 28 are recently described species and 43 are new species. A morphological phylogenetic analysis provided to test the monophyly of the group using *Aleiodes coxalis*-group species as the out-group provides evidence for the monophyly of the *A.* (*Tetrasphaeropyx*) group, which is herein classified as a subgenus of *Aleiodes* Wesmael. *A. coxalis*-group species were used as the outgroup because previous work has shown that the *A.* (*Tetrasphaeropyx*) lineage falls at the apex of the *A. coxalis*-group. A dichotomous key to all species is provided as well as a glossary of terminology, illustrations referred to in the key, host information, and geographical collection information. *Aleiodes* (*Tetrasphaeropyx*) is easily distinguished from other *Aleiodes* species by the sculptured, carapace-like metasomal tergite IV. Host associations herein reported for about 35% of all *A.* (*Tetrasphaeropyx*) species suggest that the group exclusively attacks larvae of Geometridae. *Aleiodes* (*Tetrasphaeropyx*) species treated in this study are as follows: *A. accohannocki* n. sp., *A. alafuscus* n. sp., *A. anatariatus* Fortier, *A. aquaedulcensis* Fortier, *A. aranamai* n. sp., *A. arcticus* (Thomson), *A. areolatus* Fortier, *A. argyllacearivorax* Fortier, *A. arikarai* n. sp., *A. assateaguenus* n. sp., *A. axaceei* n. sp., *A. bretti* n. sp., *A. brevicellula* Fortier, *A. cartwrightensis* Fortier, *A. catherinensis* Fortier, *A. chisosi* n. sp., *A. chumashanus* n. sp., *A. citriscutum* Fortier, *A. cochisensis* Fortier, *A. copiosus* n. sp., *A. crassijugosus* Fortier, *A. dabai* n. sp., *A. dakotensis* Fortier, *A. dissiticarina* Fortier, *A. dorsofoveolatus* Fortier, *A. exiguus* n. sp., *A. fernaldellavorax* Fortier, *A. flavinotaulus* Fortier, *A. haematoxyloni* Fortier, *A. halifaxensis* Fortier, *A. hiisiis* n. sp., *A. huberi* Fortier, *A. illiniweki* n. sp., *A. iowensis* n. sp., *A. itamevorus* Shaw and Marsh, *A. jaliscoensis* Fortier, *A. karankawai* n. sp., *A. kisomm* n. sp., *A. kohook* n. sp., *A. luhmani*

n. sp., *A. magnoculus* n. sp., *A. maheono* n. sp., *A. maidunus* n. sp., *A. mannegishii* n. sp., *A. marinensis* n. sp., *A. maritimus* Shaw and Marsh, *A. min* n. sp., *A. nigrilatus* n. sp., *A. oaxacensis* Fortier, *A. parabretti* n. sp., *A. paracopiosus* n. sp., *A. paraluhmani* n. sp., *A. parareolatus* n. sp., *A. paraselu* n. sp., *A. parasquilaxensis* n. sp., *A. pilosus* (Cresson), *A. pooedooa* n. sp., *A. provancheri* Fortier, *A. pseudoanatariatus* n. sp., *A. quickei* Fortier, *A. quiniguanus* n. sp., *A. reisi* Fortier and Sherman, *A. sarceei* n. sp., *A. secwepemc* Fortier, *A. selu* n. sp., *A. sexmaculativorax* Fortier, *A. shawi* Fortier, *A. squilaxensis* n. sp., *A. totuyai* n. sp., *A. tulensis* Fortier, *A. tullyi* Fortier, and *A. wicayazipa* Fortier.

Key words: *Aleiodes*, Rogadinae, Braconidae, Geometridae, parasitoid, *Tetrasphaeropyx*, *Aleiodes pilosus*, phylogenetic, morphological, koinobioint, endoparasitoid, carapace

Introduction

With about 12,000 described species and an estimated actual species richness of about 50,000 (Whitfield *et al.* 2004), the Braconidae, a family of wasps most of which are larval parasitoids of other holometabolous insects (Quicke 1997, Shaw and Huddleston 1991), is the second largest family within Hymenoptera (Wharton 1997, Wharton and van Achterberg 2000). The family consists of two informal groups, the cyclostomes and non-cyclostomes. The cyclostomes, into which the subfamily Rogadinae falls, are characterized by the lower part of the clypeus sharply recessed, exposing the concave labrum (Shaw and Huddleston 1991; Shaw 1997; Wharton 1997; Zaldivar-Riveron *et al*. 2006). Among cyclostome braconids, koinobiont endoparasitism is thought to have evolved independently four times: in the (1) Alysiinae + Opiinae, (2) Braconinae (*Aspidobraconina*), (3) Aphidiinae, and (4) Rogadinae respectively (Zaldivar-Riveron *et al*. 2006). "Koinobiont" refers to a host relationship strategy in which the host is not permanently paralyzed or killed at the time of oviposition, but continues to feed and grow for a time after which it is killed by the parasite.

The genus *Aleiodes* Wesmael is a large group of parasitic wasps in the subfamily Rogadinae, comprising about 225 described species worldwide (Delfin-Gonzalez and Wharton, 2002). Although they are found on every continent except Antarctica, they are particularly species-rich in the New World (Shaw *et al*. 1997, Shaw 1997, Delfin-Gonzalez and Wharton 2002). In the United States and Canada at least 90 species are known and new species, such as those described here, are still being discovered (Shaw 1997). As in other members of the subfamily Rogadinae *s.s.*, *Aleiodes* are koinobiont endoparasitoids of lepidopteran larvae that mummify the host larva when it dies, pupating inside the mummy (Shaw 1997). Before pupating, the *Aleiodes* larva usually cuts a hole in the ventral thoracic region of the host mummy through which the mummy is glued to a substrate (leaf, twig, etc.). Upon emergence, the adult *Aleiodes* cuts a smooth, round hole in the dorso-posterior area of the mummy through which to exit (Fig. 1C, arrow) (Shaw 1997).

Numerous *Aleiodes* species-groups have been defined as monophyletic (Fortier and Shaw 1999, Shaw 1997, Shaw *et al*. 1997, Shaw *et al*. 1998a, Shaw *et al*. 1998b, Shaw *et al*. 2006). There is a tendency for basal species groups collectively to attack more than one host family, predominantly within Geometroidea, and for derived species-groups exclusively to attack Noctuidae (Fortier and Shaw 1999). The *A. coxalis* (Spinola) species-group is a large monophyletic group distinguished by the rugose vertex and sculptured fourth metasomal tergite in many species (Fortier and Shaw 1999). There is very little host information except for some records that indicate parasitism of larvae of Noctuidae, Arctiidae, and to a lesser degree Lycaenidae (Shaw *et al*. 2006).

Past evidence suggests that *Aleiodes* (*Tetrasphaeropyx*) is derived from within this lineage (Fortier & Shaw 1999, Shaw *et al*. 2006), and has been defined by the carapace-like and entirely sculptured metasomal tergite IV that covers all tergites posterior to it (Plate 1 Figs. A, B; Plate 28 Figs. 152, 153). Interestingly and uncharacteristically for a basal lineage of *Aleiodes*, all host records of species of *Aleiodes* (*Tetrasphaeropyx*) examined to date are exclusively Geometridae (Fortier and Shaw 1999; Fortier 2006a, b; Fortier 2007a, b, Fortier 2008). *Aleiodes* (*Tetrasphaeropyx*) species were previously known only from western North America (Shaw 1997) until recently (Fortier 2006b; Fortier 2007a, b). *Aleiodes* (*Tetrasphaeropyx*) specimens are infrequently collected (Shaw 1997), and their host associations remained unknown until recently.