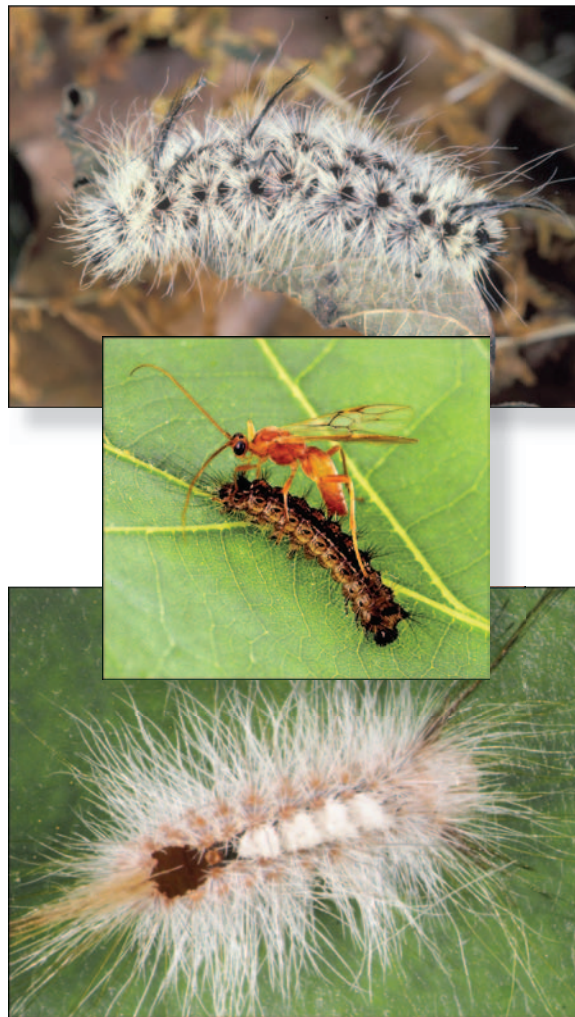


Forest Health Technology Enterprise Team

TECHNOLOGY
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Control*

***ALEIODES* WASPS OF EASTERN FORESTS: A GUIDE TO PARASITOIDS AND ASSOCIATED MUMMIFIED CATERpillARS**



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The Forest Health Technology Enterprise Team (FHTET) was created in 1995 by the Deputy Chief for State and Private Forestry, USDA, Forest Service, to develop and deliver technologies to protect and improve the health of American forests. This book was published by FHTET as part of the technology transfer series.

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On the cover:

Top: *Acronicta americana* mummy (induced by *Aleiodes stigmator*).

Photo by David Wagner.

Center: *Aleiodes indiscretus* parasitizing *Lymantria dispar* (gypsy moth). Photo by Scott Bauer.

Bottom: *Orgyia leucostigma* mummy (induced by *Aleiodes pallidator*).

Photo by Scott Shaw.

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A GUIDE TO PARASITOIDS AND ASSOCIATED MUMMIFIED CATERPILLARS**

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INTRODUCTION

The parasitic wasp genus *Aleiodes* is found all around the world, but the greatest diversity of species occur in northern Europe, Asia, and North America. In North America alone, there are at least 90 *Aleiodes* species, and new species are still being discovered, especially from the western United States and northern Canada. On the other hand, the *Aleiodes* of the eastern United States are comparatively better known, and a field guide for the most common species is now feasible. This work is intended to provide an introduction to the more common *Aleiodes* species of eastern U.S. forests for forest scientists, ecologists, students, and others interested in the ecology of forest caterpillars and their parasitoids.

For purposes of this guide, the “eastern” United States is defined simply as including all areas east of the Mississippi River. This was purely an arbitrary decision on my part to allow some limits on what to include, and because this area seems to be well-enough studied to make this guide possible. The actual distributions of *Aleiodes* species vary quite a bit. Some of the treated species, such as *A. virginiensis* and *A. wahli*, are known only from sites in the eastern United States. Most of the species treated here have broader distributions, with ranges extending into Canada, the western United States, Mexico (Delfín-González and Wharton 2002), and sometimes even Central and South America (Shaw *et al.* 1997, 1998b; Marsh and Shaw 1998, 1999). A few species in the northeast (*A. pallidator* and *A. gastritor*) have circumpolar distributions and occur also in Canada, Europe, and northern Asia.

The decision as to what constitutes a “forest insect” was also somewhat arbitrary. *Aleiodes*

species vary quite a bit in their behaviors. Many are found in association with caterpillars that feed in the canopy of trees or large shrubs, so would be defined as *arboreal*, and therefore, are true forest insects. In some cases, this characterization may not be so clear: in the eastern United States, *A. malacosomatos* is clearly arboreal, mainly attacking eastern tent caterpillars in wild cherry trees; the same species occurs in the western United States, where the wasp attacks western tent caterpillars on very low shrubs in windswept meadows with no trees. Many other *Aleiodes* species are associated with caterpillars feeding on grasses, low herbaceous plants, and low shrubs such as *Vaccinium*. These are species that, although not arboreal, are forest-associated, being found in the forest understory, in meadows, and in marshy areas. Many *Aleiodes* species might also occur in woody urban landscapes or in agroecosystems. But the natural habitat of virtually every eastern *Aleiodes* species is either forest or habitats near forest, so a practical decision was made to include essentially all known eastern *Aleiodes* in this guide.

Several distinct forest cover types occur in the eastern United States (Eyre 1980; Smith *et al.* 2000). *Aleiodes* species also seem to vary in their association with forest types. A few (*A. nigristemmaticum*, *A. wahli*) might be found only in association with oak-gum-cypress hammocks of far South. Others, such as *A. gastritor*, might only be found in the maple-beech-birch forests of the far North. Many others (e.g., *A. burrus*, *A. texanus*, *A. virginiensis*) favor the oak-hickory forests of the mid-Atlantic states.

WHY STUDY ALEIODES WASPS?

Aleiodes wasps attack and kill various species of leaf-feeding caterpillars. Included among their host caterpillars are several well-known forest pests, including the gypsy moth, eastern tent caterpillar, forest tent caterpillar, fall webworm, tussock moths, dagger moths, prominents, cutworms, and loopers. *Aleiodes* species are highly beneficial because they serve as biological control agents for the natural suppression of populations of these forest insect pests. In many other cases, the host caterpillars are not usually regarded as pests, but might have the potential to become forest pests were it not for the natural suppression caused by *Aleiodes* parasitism.

Aside from their great economic importance, there is another very good reason to study *Aleiodes* wasps. They demonstrate a particularly unusual and distinctive method of parasitism that renders them especially valuable as research organisms: the host caterpillar is *mummified*. Caterpillars in the wild are killed by a wide variety of organisms, including predators, pathogens, and parasitoids; in most cases the caterpillar is either completely consumed or the remains shrivel and decay beyond recognition. Parasitism by *Aleiodes* is unique because the caterpillar cadaver remains intact and identifiable as the *Aleiodes* larva feeds inside the caterpillar and eventually pupates within the somewhat shrunken remains. The resulting host *mummy* remains intact after the adult wasp emerges, and such caterpillar mummies provide valuable research tools.

There are several advantages to studying these organisms. First, the parasitized caterpillars can be readily identified before the parasitic wasp emerges, and in most cases, the wasp species can be correctly identified before it emerges. Second, since the host mummy remains intact indefinitely, the host remains can be associated with the parasitic wasp in research collections, and the host species can be identified from the mummified remains. Some of the mummified caterpillars photographed for this manual are museum specimens that are more than 100 years old! Third, since *Aleiodes* are the only common parasitoids that cause this type of mummification, in many cases the parasitoid species involved can be reliably and easily identified. As there are many unanswered questions about host associations and host ranges, it is therefore possible for even amateur collectors to make important new discoveries. As a child growing up in Michigan, I can remember several times seeing these mummified caterpillars, but for many years I did not understand what had caused this phenomenon; I hope that this work will make these fascinating insects more readily accessible to field studies by future generations of budding young entomologists. Finally, since the mummification process is unique to particular species, if something other than *Aleiodes* emerges from one of these mummies, it can safely be assumed to be a hyperparasitoid. Thus, the study of hyperparasitoid complexes can be more reliably done by examining these organisms.

BIOLOGY OF *ALEIODES* SPECIES

Some very detailed studies of European and Asian *Aleiodes* species have been done by Mark Shaw in Scotland (Shaw 1983, 1994, 2002; Shaw and Huddleston 1991; Quicke and Shaw 2005). The following account of biology is condensed from these sources and from Shaw *et al.* (1997). By comparison, there have been only a few detailed studies of the biology of North American *Aleiodes* (for example, Pennington 1916).

The species of *Aleiodes* are internal parasitoids of caterpillars, especially macrolepidoptera of the superfamilies Noctuoidea and Geometroidea, and to a lesser extent, Arctioidea, Sphingoidea, and Papilionoidea. All are *koinobionts*, which means that the host caterpillar is not permanently paralyzed but continues to feed and grow for a period of time after it is parasitized. The method of parasitism, unique to the tribe Rogadini (including *Aleiodes*), is very distinctive and noteworthy (Quicke and Shaw 2005). The *Aleiodes* larva completes its feeding and pupates within the shrunk and mummified remains of the host caterpillar. In all known cases, the form of the mummy caused by a particular *Aleiodes* species is characteristic for that host and parasitoid, so the mummified caterpillar remains are of considerable diagnostic value and should be retained with the parasitoid, when reared. Host caterpillar mummies are usually found attached to the host plant substrate on leaves, stems, or bark. Most caterpillar mummies are firmly attached to the substrate by a glue-like substance that exudes through a prosternal hole chewed by the parasitoid larva. The inside of the mummy is lightly lined with silk by the parasitoid larva, but the main support for the mummy seems to come from a premature host pupal cuticle below the remaining larval cuticle. Exit from the host mummy is

always through a circular postero-dorsal hole. Irregular exit holes formed in other regions of the mummy are invariably formed by hyperparasitoids.

The physiological basis for host mummification has not been experimentally investigated in *Aleiodes*, but Shaw *et al.* (1997) hypothesized that it might be caused by the physical elimination of the host's corpora allatum by the developing parasitoid larva. Removal of the corpora allatum would reduce the juvenile hormone levels in the host caterpillar and induce the formation of a pupal cuticle. This hypothesis is consistent with the observation that larval feeding by *Aleiodes* is located initially in the prothoracic region of the caterpillar, as evidenced by the opening of the glue-hole.

Host range is quite variable, depending on the *Aleiodes* species. Only a few species are strictly monophagous—attacking only one caterpillar species. An example of this is *A. ceratomiae*, a parasitoid of *Ceratomia amynator* hornworm caterpillars on various broadleaf trees. By attacking only a single species, such parasitoids by definition have the “narrowest” of all possible host ranges. Other *Aleiodes* species are oligophagous, attacking a small set of multiple caterpillar species. An example of this is *A. texanus*, a parasitoid of three different Sphingidae caterpillars on several broadleaf trees and vines. Oligophages are also regarded as having “narrow” host ranges as they are limited to a small set of host species. Finally, some *Aleiodes* species are polyphagous, attacking many different caterpillar species. An example of this is *A. simillimus*, a parasitoid of at least seven geometrid species on several broadleaf trees. It is fair to say that host range is an important, yet

poorly studied, aspect of the biology of most North American *Aleiodes*. There are several cases where an *Aleiodes* species has only one known host, but this does not prove that the species is really monophagous. It may be that there are other hosts that we have simply not discovered yet. Host range is an interesting aspect of the biology of these organisms to which students and amateur collectors can make valuable contributions to further our knowledge.

The host range of any given *Aleiodes* species is influenced by two factors. One important factor is phylogeny of the host caterpillars: that is to say, one parasitoid species may attack several caterpillar species that are closely related to each other. There are many examples of this in *Aleiodes*. *Aleiodes quebecensis* attacks four different species of Noctuidae on various broadleaf trees, but all of them are

members of the genus *Acronicta*. *Aleiodes malacosomatos* attacks two species of *Malacosoma* (tent caterpillars) in the eastern United States and other related species in the West. *Aleiodes ceratomiae*, *A. texanus*, and other members of the *A. praetor* species-group are entirely restricted to parasitism of hornworm caterpillars (family Sphingidae). The second factor that affects host range may be aspects of host ecology. In some situations, a parasitoid species may attack two or more caterpillar species that are not particularly closely related, but that share some similarities of appearance, feeding situation, or habitat preference. *Aleiodes stigmator* attacks various hosts in the Noctuidae and Notodontidae. The hosts are not particularly closely related, but all are rather large, apparent, setose caterpillars on wetland (river bottom) vegetation, such as willows and cattails.

COLLECTING CATERPILLARS AND MUMMIES

Caterpillars can be collected in various ways, as outlined in Covell (1984), Wagner (2005), Wagner *et al.* (1997), and many other sources, though generally, there are two approaches to finding and raising caterpillars that are parasitized by *Aleiodes* wasps. The first approach is to seek dead caterpillar mummies from which the *Aleiodes* has not yet emerged. The second approach is to collect live young caterpillars, keep them fed, and watch for those that become mummified later. The first approach is very important, because there is a great need for data on how mummies are formed in natural conditions.

Finding mummified caterpillars can be very easy or very difficult depending on the spe-

cies involved. The easiest to find involve host caterpillars that are gregarious and can be found in predictable circumstances. The best example of a very common mummy wasp is *Aleiodes malacosomatos*, which attacks young caterpillars of the eastern tent caterpillar. The mummies can be easily found in early June by peeling apart the silk layers of the tents. It's not unusual to find 10-15 mummies inside one silk shelter. In other cases, the caterpillar attacked is solitary, but still is very conspicuous. This is the case with some of the large, hairy, noctuid caterpillars attacked by the gregarious parasitoid *Aleiodes stigmator*. These can be easily found by walking through willow thickets in August or September. These parasitized caterpillars tend to die in a vertical

position on twigs well above the ground, and they are large enough to be easily seen from quite a distance away (up to 50 feet). This, however, is an unusual situation. Most caterpillar mummies are small, involve solitary species, and may be extremely cryptic. When attached to a twig or stem, they may resemble buds or galls, so close and careful visual inspection is needed to find them. Those mummies formed on leaves and thus harder to locate can be collected by beating foliage and examining the deadfall. In some cases, such as *Aleiodes albitibia*, the mummy is not glued to a substrate and falls to the ground; such mummies might be found, through close inspection, by sifting leaf litter. In many cases, mummified caterpillars could most easily be obtained by raising them from infected caterpillars that are still alive and feeding.

When collecting caterpillar mummies, few tools are needed. A small knife or pruning shears are useful, as well as a beating sheet. If possible, a photograph should be taken of the mummy in its natural condition. Field samples can be collected in plastic bags, but as soon as possible, these should be separated into individual containers. When found attached to foliage, the twig or leaf should be cut rather than detaching the mummy from the substrate. Field notes should also be taken regarding the natural situation and included in the data labels. Removing the mummy from the substrate, if done carefully, does not kill the developing wasp inside, but the specimen is more informative if still attached to its natural substrate.

Because the mummies are usually glued to a substrate, mummies up to several years old may be found. These may appear weathered (head capsule and setae will fall away as it ages), and emergence holes of the parasitoid may be visible. Solitary *Aleiodes* (most species) emerge postero-dorsally. Gregarious *A. stigmator* form numerous small round emergence holes, evenly spaced, across the dorsum of the mummy. Irregular holes on the sides or bottom of a mummy are indicative of hyperparasitoids. Even if the *Aleiodes* has emerged already, it is still valuable to collect older, mummified caterpillars: the caterpillar may still be identifiable, and it might give clues to previously unknown host relationships.

When seeking live caterpillars parasitized by *Aleiodes* wasps, it is important to consider certain issues. *Aleiodes* only attack caterpillars during certain stages of development. Usually, the second or third larval instar is attacked, and the wasp later emerges from the penultimate (next to the last) larva instar, so the best way to find infected caterpillars is to seek young caterpillars that are still feeding. You won't find *Aleiodes* by rearing caterpillars from eggs, and large caterpillars seeking pupation retreats are not likely parasitized by *Aleiodes*. The best way to find infected caterpillars is by visual inspection of foliage where feeding damage is found. Other productive methods include beating foliage and searching beneath bands of material tied around tree trunks. The later method is particularly important for finding caterpillars that feed at night, but hide during the day.

REARING *ALEIODES* WASPS FROM MUMMIFIED CATERPILLARS

Practical methods for rearing parasitic Hymenoptera from infected host insects were outlined by Mark Shaw (1997), an excellent publication that interested readers will find helpful. Some key ideas relating to *Aleiodes* are mentioned here.

When already-mummified caterpillars are collected from the field, the mummies should be isolated into individual rearing containers as soon as possible. By looking for emergence holes, it can be quickly determined if the parasitoid has already emerged or not. With wild-collected mummies, there is no way to know how soon the parasitoid may emerge. Unless the parasitoid is over-wintering in the caterpillar mummy, the adult wasp can emerge within a few minutes, hours, days, or weeks, so it is very important to inspect the mummies promptly and place each mummy in isolation. Any small container will serve, but I prefer to use plastic petri dishes, 90 mm diameter by 30 mm deep, lined with 90 mm white filter paper circles. Tops should be secured with a rubber band. Such containers can be easily set out on lab countertops for ease of viewing.

It is important for emergence to approximate natural conditions. If possible, the containers should be kept in an area that matches natural conditions of light, temperature, and humidity. For example, if the parasitoid is over-wintering in the mummified caterpillar, a prolonged cold period may be necessary to break diapause, and the containers might best be kept in an outdoor shed or unheated garage; mummies kept in a heated laboratory might not promote emergence. In any event, it is

preferable to collect data on natural parasitoid emergence rather than simply to obtain adult wasp specimens from lab rearings.

Once the adult wasp emerges, it can either be preserved for museum studies or kept alive for biological observation. Adult life may be prolonged by placing a sugar-water or honey-water solution in the container. Small vials with cotton-stopper wicks work well for feeding. If both males and females are reared, they can be placed in the same container to observe mating behavior. If live (potential host) caterpillars are available, female wasps can be placed in containers with caterpillars to attempt to rear more wasps or to test host acceptance on alternate hosts. Female wasps do not have to mate to lay fertile eggs—though unfertilized eggs will produce only males. When the studied wasp dies, the specimen should be preserved immediately.

When raising live caterpillars, the most important factors are to keep the caterpillars fed daily with fresh food, to keep the cages clean of frass and fungi, and to inspect the caterpillars daily for evidence of parasitism. When it is evident that a caterpillar is being parasitized, it should be carefully removed (with its substrate) to a separate rearing container. Careful observations, notes, and photos should be made regarding the mummification process in terms of its duration and how the caterpillar changes in appearance. Otherwise, once the mummified caterpillar is identified, the methods for handling the mummy are the same as outlined above.

SPECIMEN PRESERVATION

The simplest method for preserving emerging *Aleiodes* wasps is to place the insect immediately in 70 percent to 95 percent ethanol in a small vial (2 dram vials with polyethylene screw-caps are ideal). If you kept the wasp alive for biological observations, it is important to preserve the specimen as quickly as possible after it dies: once the insect dies, it begins to desiccate, and fungi may soon grow on it.

To achieve the best preservation, it is best to place the live wasp directly into the alcohol-filled vial. Eventually, the wasp specimen will need to be dry-mounted on point or card. But unless you have considerable experience with point-mounting small insects, most specialists (including myself) would probably prefer to get an intact, clean specimen in alcohol and do the dry-mounting themselves. In any event, the specimen should be clean, and better results can be obtained by placing wasps in alcohol first. The wasps can later be critical-point dried or chemically dried using chloroform (or similar methods) to achieve life-like, clean specimens.

Do NOT pin *Aleiodes* wasps directly through the body. Although some of the larger species are large enough to get a pin into, doing so destroys some features of the mesosoma and renders the specimen less useful for photography.

Mummified caterpillars require no special methods of preservation as they will not deteriorate further if kept dry. Having said that, it is remarkable how many museum specimens have been improperly prepared by thoughtless methods. *Do NOT* pin the mummy directly. Although convenient, pinning the mummy may break it and puts two more holes in the mummy, rendering it less desirable for photography. If removed from the pin later, the pin holes may be mistaken as emergence holes. *Do NOT* glue the mummy to a data label. The best method is to keep the mummy dry by placing it alone in a small vial or empty gelatin capsule. Gelatin capsules or genitalia vials containing mummies can be affixed directly to the pin and associated with a given wasp. The mummy should be clearly labeled (for instance, with a code number) to indicate its association with a particular wasp specimen. If possible, preserve the mummy attached to the substrate (leaf, twig, etc.). *Do NOT* remove the mummy from the substrate for preservation. Mummies on leaf parts, stems, etc. can be pinned by the plant material and kept dry in a collection. If the mummy is loose in a vial, it may be useful to put some cotton at either end to keep it from rattling about in handling or shipment. If the head capsule has fallen away (as normally happens with Sphingidae mummies and a few others), the head capsule should be kept with the mummy.

NAMES OF WASPS: SCIENTIFIC AND COMMON

By historical tradition, parasitoid wasps (including *Aleiodes*) are called by their Latin scientific names (genus and species). Some of the larger stinging wasps do have well-known common names—such as mud-daubers, paper wasps, yellow jackets, and bald-faced hornets—but very few parasitoid wasps have been given common names. This is a somewhat curious situation, as many parasitoid wasps are quite common insects, and many are very beneficial insects of significant economic importance. Certainly, they deserve to have common names. To some extent, this seems to be only a matter of tradition within particular groups: for instance, many small moths and beetles have been given names even though they are not particularly common, while some insects with common names are actually quite rare. And so, one curious thing about the family Braconidae is that, although they are one of the largest family-groups of all insects (more than 50,000 species worldwide)—and one of the most beneficial and highly economically important—no one has bothered to give them common names.

Several years ago, I suggested the common name “death-wasp” for insects in the family Braconidae as they are all parasitoids, and

their key defining feature, biologically, is that they kill their host. For *Aleiodes* in particular, the common name “mummy-wasp” is appropriate. Some of my students have adopted the practice of using common names for braconids, but it has not yet caught on widely. This is probably because most writing about Braconidae is still done in the scientific journals and not in the popular press. Still, there are some situations where common names for insects might be useful or even preferable, such as for informal communication among amateur collectors and articles for the general public. Because this field guide is directed, in part, at a non-scientist audience (amateur collectors and students), I’ve included suggested common names for the wasp species. I apologize in advance to those who may not like certain names or would prefer others, but simple common names for these insects are provided in the hope that it will encourage more people to study these wasps and discuss them more widely. Readers are reminded that, in all cases of scientific publications and rigorous scientific correspondence, that the full scientific names should be used. I hope that my readers will find these common names to be useful; time will tell.

SPECIES TREATMENTS

The following pages present descriptions of the *Aleiodes* wasps and photographs of both the wasp and its mummified host.

Aleiodes abdominalis* (Cresson)*Orange-bellied mummy-wasp****Diagnostic features of adult wasp.**

Body mostly two-colored with *contrasting orange and black*. Head and mesosoma black. Metasomal terga 1-3 orange, remaining metasomal terga varying from orange to black. Antenna and legs orange. *Hind tarsomeres orange to brown, similar in color to tibia*. Wings lightly pigmented. Tegula yellow. Body length 6.0-8.0 mm. Antenna with 54-63 segments. Oral opening circular, diameter about equal to

basal width of mandible. Malar space longer than basal width of mandible. Ocelli small, distance between eye and lateral ocellus distinctly broader than ocellus width. Median length of pronotum shorter than distance between occipital carina and lateral ocellus.

Mesopleuron smooth but setose medially, subalar sulcus rugose, sternaulus absent. *Fore wing vein 1cu-a beyond vein 1M by less than 3 times its length*. Vein RS of hind wing slightly curved downwards, marginal cell of hind wing gradually widening toward apex. *Hind wing vein m-cu present*. Apex of hind tibia without a row of flattened setae along inner margin, setae normal and hair-like. Tarsal claws strongly pectinate over entire length. First metasomal tergum not parallel-sided, wider apically than at base. Apex of metasoma not compressed in female. Metasomal tergum 3 costate at base, remainder smooth. *Males with metasomal terga 4-6 densely setose (subdivided medially)*.



Host caterpillars. One specimen from Maryland has been reared from an undetermined mummy of Noctuidae.

Diagnostic features of host mummies. Very dark brown, smooth, and about 1 cm long.



Wasp distribution. Widely distributed in eastern North America, from Quebec and Ontario south to North Carolina, westward to South Dakota and Arizona. More commonly encountered in the eastern parts of its range.

Biology. Adults appear in early June in the northern parts of its range.

Similar species. This species is similar to *Aleiodes flavitarsus*, but differs by its larger body size, fore wing with vein 1cu-a beyond vein 1M by less than three times its length, hind tarsomeres orange to brown, and hind wing vein m-cu present.

Best reference. Shaw *et al.* (1998a).

Comments. The smooth dark mummy would be highly cryptic if formed on a plant substrate, such as a twig, where it would resemble a bud. This might account for the scarcity of rearing records for a wasp that is fairly common in museum collections.

***Aleiodes aciculatus* Cresson**
Finely-scratched mummy-wasp

Diagnostic features of adult wasp. Body mostly or entirely *honey-yellow to light orange*, except antenna apically dark brown to black. Male with apex of metasoma dark brown to black. Wings clear to lightly pigmented. *Stigma* two-colored, *dark brown to black medially, pale yellowish-white basally and apically*. Body length 3.0-7.0 mm. Antenna with 36-52 segments. Oral opening small and circular, diameter about equal to basal width of mandible. Malar space longer than basal width of mandible.



Head rugulose dorsally. Ocelli small, distance between eye and lateral ocellus distinctly broader than ocellus width. *Pronotum long*, median length of pronotum longer than distance between occipital carina and lateral ocellus. Hind wing vein RS slightly sinuate, marginal cell of hind wing narrowest in middle. Apex of hind tibia without a row of flattened setae along inner margin, setae normal and hair-like. Tarsal claws simple, not pectinate. First metasomal tergum not parallel-sided, wider apically than at base. Apex of metasoma not compressed in female. *Metasomal terga 1-4 longitudinally costate or aciculate*.

Host caterpillars. This wasp has been recorded as attacking several species of Noctuidae, including *Feltia ducens*, *Feltia subgothica*, and *Mythimna* (= *Pseudaletia*) *unipuncta*, and the geometrid *Euchlaena serrata*.

Diagnostic features of host mummies. Very dark brown, slender, smooth, and about 7 mm long.



Wasp distribution. Widely distributed over the eastern United States, from Massachusetts south to Florida, and westward to South Dakota, Utah, and Texas.

Similar species. *Aleiodes aciculatus* is distinctive from most species because it has sculpturing on the fourth metasomal tergum resembling fine longitudinal lines, as though scratched by a needle. In appearance, it is somewhat similar to *A. angustipennis*, which also has similar sculpture on the fourth tergum. *Aleiodes aciculatus* can be distinguished by its two-colored stigma and a shorter pronotum than is found in *A. angustipennis*.

Biology. Not known in detail. Adult wasps have been collected from April through September, indicating that the species is probably multivoltine.

Best reference. Marsh and Shaw (2003).

Comments. This species is very distinctive in having the fourth metasomal tergum strongly sculptured and distinctly costate or aciculate, resembling fine longitudinal lines as though scratched by a needle.

***Aleiodes akidnus* Marsh and Shaw**
Small-eyed mummy-wasp

Diagnostic features of adult wasp.

Antennal flagellum brown.

Body color honey-yellow,
legs somewhat lighter.

Ocellar triangle black.

Fore wing stigma brown.

Body length 4.0 mm. Antenna with 43-45 segments.

Compound eye small, malar space equal to $2/3$ eye height. Ocelli small, ocell-ocular distance slightly more than twice diameter of lateral ocellus. Fore wing vein r equal to or slightly longer than vein 3RSa. Second submarginal cell of fore wing small and nearly square. Hind wing vein RS weakly sinuate. Hind wing marginal cell narrowest in middle. Apex of hind tibia with a row of flat setae on inner side.



Host caterpillars. Unknown.

Diagnostic features of host mummies. Unknown.

Wasp distribution. Southern Florida.

Biology. Adult wasps fly from July to October. They are attracted to blacklights.

Similar species. Of the species with a fringe of flat setae on the hind tibia, *A. akidnus* is quite distinctive by its very small ocelli, small eyes, and wide malar space. It is not likely to be confused with any other species in the eastern United States. *Aleiodes akidnus* is most similar to the Caribbean species, *A. sanctivincentensis*.

Best reference. Marsh and Shaw (1998).

Comments. Known from Big Pine Key and from the Tall Timbers Research Station.

***Aleiodes albitibia* (Herrich-Schaeffer)**
White-legged mummy-wasp

Diagnostic features of adult wasp.

Body color quite variable.

Head and antenna mostly black except malar space and mouthparts yellow.

Mesosoma with pronotum black, mesonotum yellow to black, scutellum yellow, mesopleuron mostly yellow, but sometimes with black markings, and propodeum black dorsally and yellow laterally, or sometimes entirely yellow.

Legs mostly yellow but *hind tibia yellowish-white*

on basal half. Hind tarsus brown. Metasomal terga usually mostly black, but first tergum with narrow yellow median area and second tergum widely yellow medially. Sometimes, first and second tergum almost entirely yellow. Wings clear. Stigma black, sometimes with light spots, basally and apically. Body length 4.5-5.5 mm. Antenna with 41-45 segments. Oral opening small and circular, diameter about equal to malar space. Malar space short, slightly less than basal width of mandible. *Ocelli large, distance between eye and lateral ocellus about half ocellus width.* *Mesopleural disc above middle leg and below wing base smooth and shining.* Vein RS of hind wing arched medially, marginal cell of hind wing narrowest in middle. Apex of hind tibia without a row of flattened setae along inner margin, setae normal and hair-like. *Tarsal claws with a wide gap between apical claw and basal comb of four or five spine-like setae.* First metasomal tergum not parallel-sided, wider apically than at base. Apex of metasoma not compressed in female.



Host caterpillars. Attacks mainly caterpillars of Notodontidae and possibly some species of Geometridae. Recorded hosts include *Nadata gibbosa*, *Nerice bidentata* on *Ulmus americana*, *Notodonta dromedarius*, and *Phaeosia* species.

Diagnostic features of host mummies. Caterpillars mummified by this species are smooth, very dark, and have an unusual expanded bubble-like area antero-ventrally. These mummies are also unusual in that there is no antero-ventral “glue-hole,” and the mummy is not attached to a substrate. The mummification process typically causes decapitation of the caterpillar, so the head capsule separates and falls away from the mummy. There has been some speculation that the unusual bubble-like area may allow this mummy to float in flooded areas. As the mummy does not have a glue-hole to attach the mummy to a plant surface, it would tend to fall to the ground (where floating might be adaptive).



Wasp distribution. This wasp is a widely occurring holarctic species found across Europe, Northern Asia, Canada, and the northern United States. In eastern North America, the species is found from Quebec southward to Georgia.

Biology. Shaw (1983) suggested that the antero-ventral swollen area may serve as an “air sac,” allowing the host mummies to float in water.

Similar species. This species can be easily distinguished from all other North American species by the central disc of the mesopleuron, which is smooth, highly polished, and without setae.

Best reference. Shaw *et al.* (1998b).

Comments. North American specimens of *A. albitibia* exhibit more range of color variation (often with more yellow or orange) than European specimens (which have more black areas).

***Aleiodes angustipennis* Marsh and Shaw**
Narrow-winged mummy-wasp

Diagnostic features of adult wasp. *Body color entirely yellow.* Fore wing stigma yellow. Body length 7.0 mm. Antenna with 49-50 segments. *Pronotum long and flat*, with median length about twice ocell-ocular distance. *Fore wing long and narrow*, width about 1/5 its length. Fourth metasomal tergum sculptured, costate basally.

Host caterpillars. Unknown.

Diagnostic features of host mummies.
 Unknown.

Wasp distribution. Known only from Florida.

Biology. The caterpillar hosts of this wasp species are not yet known. In Florida, the adult wasps have been collected in March, April, July, August, and September. This suggests that the wasp is probably multivoltine.

Similar species. The combination of long, narrow wings and a long, flat pronotum easily distinguishes *A. angustipennis* from most other wasp species. It is closely related to *A. granulatus*, but can be easily distinguished as *A. angustipennis* lacks dark color markings and lacks extensive granular sculpture. *Aleiodes angustipennis* is superficially similar to *A. aciculatus* (which is also yellow), but *A. angustipennis* has a yellow stigma, longer pronotum, and longer wings.

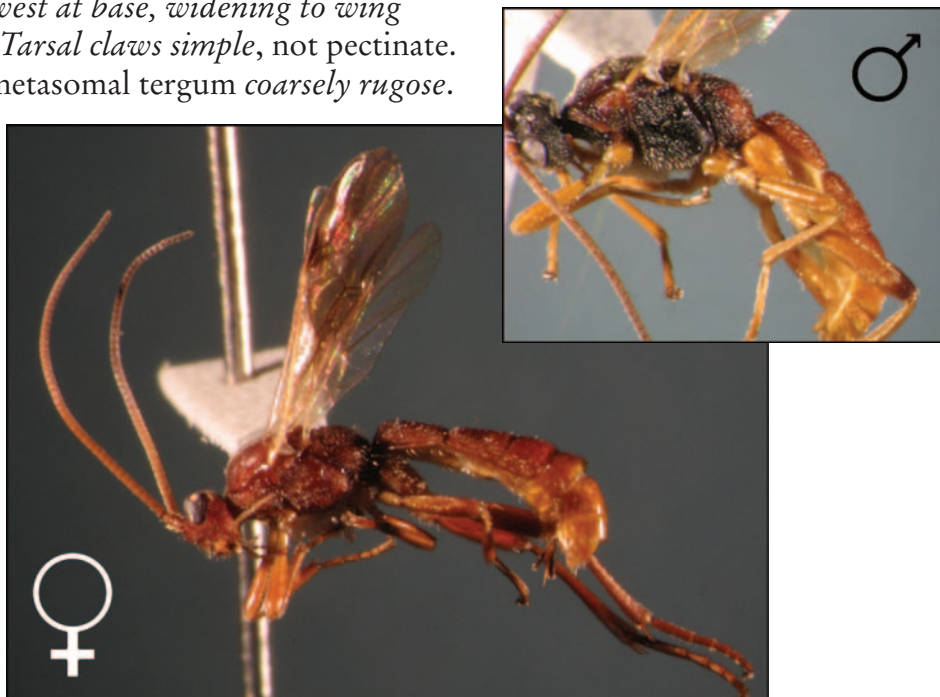
Best reference. Marsh and Shaw (2003).

Comments. The wings of this species are longer and more narrow than any other U.S. species.



***Aleiodes burrus* Cresson**
Little-horse mummy-wasp

Diagnostic features of adult wasp. Body color orangish brown in female. Males two-colored: black and orangish brown. Antenna orangish brown basally, brown to black apically, *without a white annulus*. Body length 6.0-8.0 mm. Females with 45-52 antennal segments; 55-60 antennal segments in males. Oral opening oval, diameter equal to or slightly greater than malar space. *Malar space wide*, greater than basal width of mandible. *Ocelli small*, ocell-ocular distance greater than width of lateral ocellus. Fore wing vein 1cu-a beyond 1M by distance distinctly greater than length of 1cu-a. Hind wing vein RS straight or bent downwards slightly near middle. *Hind wing marginal cell narrowest at base, widening to wing apex*. *Tarsal claws simple*, not pectinate. First metasomal tergum *coarsely rugose*.



Host caterpillars. This species has been reared from the cutworm *Feltia subgothica* (Haw.) and *Agrotis* species. It has been recorded in the literature (Marsh 1979a) as being associated with *Acronicta hasta* Gn. and *A. lobeliae* Gn., but these records are questionable and need confirmation. These two *Acronicta* species are more likely to be hosts of *A. quebecensis*.

Diagnostic features of host mummies. Rather large, thick-bodied mummies about 14-15 mm long and 4-5 mm wide. Smooth and rather dirty- to dark-brown. In dorsal view, the mummy widens posteriorly and is widest near the posterior end. The sides of the mummy have a slightly-flattened raised ridge, visible in lateral view as a longitudinal line.



Feltia subgothica



Agrotis sp.

Wasp distribution. This species is widely distributed, from eastern Canada southward to Virginia and westward to Alberta, Wyoming, and Arizona.

Biology. *Aleiodes burrus* is a common species in the eastern United States, but its biology has not been carefully studied.

Similar species. Similar to *A. smithi*, but *A. burrus* does not have a white annulus on the antenna.

Best reference. Marsh and Shaw (2001).

Comments. Cresson (1869) did not explain the meaning of this species name. The Latin word *burrus* means “red” but the wasp is mostly orangish-brown, not red. The name is possibly a variation of the Latin word *burricus*, meaning “a small horse.” Perhaps Cresson thought that this brown, fairly thick-bodied wasp looks like a little horse. I suppose it does, if you have a vivid imagination. Another possibility is that the name could be a now-obscure reference to a historic person: Sextus Afranius Burrus, a prefect of the Praetorian Guard during the times of emperors Claudius and Nero. Burrus is remembered for his military leadership and died in 62 A.D. (possibly by poison). However, this similar name may be just an interesting coincidence. I think it is unlikely that Cresson named this species after a person as, in his original paper, he did not capitalize the species name, whereas, in the same paper, he did capitalize the name of the species named after C.V. Riley (the species known to us now as *Aleiodes rileyi* was named “*Aleiodes Rileyi*” by Cresson). The custom of capitalizing species names based on a proper name has since been discontinued (now the species name is always in lowercase), but that was a common custom in Cresson’s time. It seems likely that if *Aleiodes burrus* were actually named after a person, then Cresson would have capitalized the name.

Aleiodes cameronii* (Dalla Torre)*Cameron's pitted mummy-wasp**

Diagnostic features of adult wasp. *Body color honey-yellow, except antenna and ocellar triangle brown. Body length 7.0-9.0 mm. Antenna long, with 60-65 segments. Flagellomeres all short and compact. Malar space short, about equal to half of mandible width. Oral space small and circular, about twice as wide as malar space. Ocelli very large, lateral ocellus nearly touching eye, ocell-ocular distance only one-twelfth diameter of lateral ocellus. Occipital carina complete. Antero-lateral margin of propodeum granulate. Tarsal claws strongly pectinate. Males with large setose pits medially on terga 5-7.*



Host caterpillars. In Maryland, this species has been reared from several exposed-feeding arboreal caterpillars on willow (*Salix nigra*). Confirmed hosts include a geometrid, *Eutrapela clemataria* (J.E. Smith), two catocaline noctuids, *Zale lunata* (Drury) and *Catocala cara* Gn., and one unidentified species of Notodontidae.

Diagnostic features of host mummies. The mummy formed from *Catocala cara* is quite distinctive: about 1.5 cm long, dark brown, densely wrinkled on apical half and ending with two long caudal prolegs that form a conspicuous forked “tail” at the tip of the mummy.



Wasp distribution. *Aleiodes cameronii* is widely distributed in the eastern and southern United States and ranges southward into Mexico and Costa Rica. In the United States, it occurs from Massachusetts southward to Florida and across the southern states westward to southern California.

Biology. Barbosa *et al.* (2001) found *A. cameronii* to be one of the dominant parasitoids of exposed-feeding arboreal caterpillars on willow in riparian habitats in Maryland. There, the species is a moderate-generalist, utilizing at least four different host species from three different lepidopteran families, but all willow-feeders. The adult wasps have very large ocelli and are attracted to lights, indicating that they are nocturnally active. This might be an adaptation for searching for larvae that feed at night.

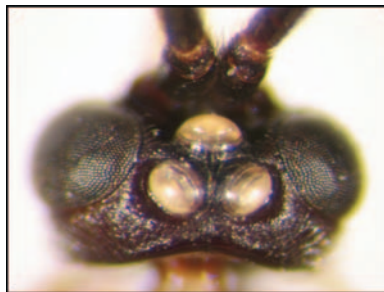
Similar species. A very distinctive species, not likely to be confused with any other. Only a few other species have setose pits on the male metasoma, and the pits in *A. cameronii* are much larger than in any other known species. It is most similar to *A. earinos* and *A. geometrae*, but in those species, the occipital carina is not complete, and the tarsal claw is not so fully pectinate as in *A. cameronii*.

Best reference. Shaw *et al.* (1997).

Comments. The function of the very large setose pits on the male abdomen is not known, but Shaw *et al.* (1997) hypothesized that they might serve to disperse sex pheromones. Studies of the courtship behavior of this, and related species, might be very interesting.

Aleiodes ceratomiae* Marsh and Shaw*Big-eyed mummy-wasp**

Diagnostic features of adult wasp. Body color black with yellow to orange markings. Metasoma partly or entirely black. Body length 9 mm. Antenna with 65-66 segments. *Malar space extremely short*, about three-fourths mandible width. *Eyes and ocelli enormous*, covering most of head. Ocell-ocular distance very narrow, lateral ocellus approaching eye margin. Lateral ocellus four to six times wider than ocell-ocular distance. Hind wing vein RS sinuate and strongly arched, *RS approaching wing margin medially*. Hind wing marginal cell very narrow in the middle.



Host caterpillars. Reared from a mid-instar larva of the waved sphinx moth, *Ceratomia undulosa* (Walker), on ash. Also recorded as associated with the elm sphinx moth, *Ceratomia amyntor* (Geyer), but that record is questionable; in this case, the larva was feeding on ash, the usual host plant of *C. undulosa*.

Diagnostic features of host mummies. About 15 mm long, smooth, pale brownish-white with bands of tiny reddish-brown dots. Broadly attached to the substrate by an antero-ventral glue-hole. *Head capsule decapitated from mummy* or attached by a small piece of cuticle that is prone to break as the mummy ages. Posteriorly, has a distinct caudal horn about 4 mm long or a distinct pit if the caudal horn has fallen off.



Wasp distribution. Known only from the northeastern United States (Connecticut, New Hampshire, New York) and eastern Canada (Ontario).

Biology. The host mummy is only about 15 mm long, indicating that the caterpillar is killed at an early stage of development—probably the third instar. This wasp is an arboreal species associated with ash and possibly other broadleaf trees and shrubs, including oaks, hawthorns, privets, lilacs, and elm. The wasp has been collected at lights, and the extremely large ocelli are indicative of nocturnal activity. Collecting dates for the wasp range from late April to mid-August, indicating that the wasp is active for much of the summer.

Similar species. Most similar to *A. texanus*, but *A. ceratomiae* can be easily distinguished by its exceptionally large ocelli and black metasoma, whereas *A. texanus* has smaller ocelli and a reddish-orange metasoma.

Best reference. Shaw *et al.* (1998b).

Comments. *Aleiodes ceratomiae* has large eyes and larger ocelli than any other North American Braconidae. Large ocelli are presumed to be an indication of nocturnal activity—presumably, the female wasp searches for host caterpillars at night. This species is a member of the *praetor* species-group, the only *Aleiodes* group known to exclusively attack Sphingidae. The caterpillar mummies are particularly distinctive because of the caudal horn and the tendency of the head capsule to be decapitated during the mummification process.

Aleiodes earinos* Shaw*Spring mummy-wasp**

Diagnostic features of adult wasp. *Body color yellowish to reddish-brown, except antenna black and tegula orange. Body length 6.0-7.0 mm. Antenna long, with 57-65 segments. Flagellomeres all short and compact. Malar space short, about equal to, or slightly narrower than, basal width of mandible. Oral space small and circular, about twice as wide as malar space. Ocelli large, ocell-ocular distance about 1/4 of the diameter of lateral ocellus. Occipital carina incomplete, weak, or absent on vertex. Propodeum granulate anteriorly, grading to rugose posteriorly. Tarsal claws pectinate at extreme base, with a wide gap between apical claw and basal pecten. First metasomal tergum slightly longer than wide. Males with small setose pits medially on terga 4-6.*



Host caterpillars. Unknown.

Diagnostic features of host mummies. Unknown.

Wasp distribution. Known only from Florida, Arkansas, and Texas.

Biology. Adult wasps are active in the spring during April and May and are attracted to lights.

Similar species. *Aleiodes earinos* is similar to *A. geometrae*, with which it has been often confused. Similarities with *A. geometrae* include claws with a wide gap between the apical claw and basal pectination, weak to incomplete occipital carina, and small setose pits on the male terga. Differences in *A. earinos* include the larger body size, darker reddish-brown color, longer flagellum, less broad gap in the occipital carina, coarser propodeal sculpture, and much longer first metasomal tergum.

Best reference. Shaw *et al.* (1997).

Comments. Although the host caterpillars are not known for *A. earinos*, the activity of the wasp in the early spring and the close relationship of this species to *A. geometrae* both suggest the possibility of Geometridae hosts.

Aleiodes femoratus* Cresson*Banded-leg mummy-wasp**

Diagnostic features of adult wasp. *Body color mostly honey-yellow. Pro-pleuron, mesopleuron, and hind femur marked with dark brown. Fore wing stigma unicolored brown. Body length 6.0-7.0 mm. Antenna with 47-52 segments. Ocelli large, ocell-ocular distance distinctly smaller than diameter of lateral ocellus. Hind wing vein RS straight. Hind wing marginal cell gradually widening to apex. Apex of hind tibia with a row of flat setae on inner side.*



Host caterpillars. Unknown.

Diagnostic features of host mummies. Unknown.

Wasp distribution. Found only in the eastern United States, from Illinois and West Virginia southward to Florida.

Biology. This species has been collected in Illinois and Virginia in mixed deciduous forests dominated by oaks, hickories, and maples. Adult wasps fly from mid-June to mid-August.

Similar species. Similar to *A. nigristemmaticum*, but *A. femoratus* is distinguished by its solid dark brown stigma, gradually widening hind wing marginal cell, and with dark markings on the hind femur.

Best reference. Marsh and Shaw (1998).

Comments. This species has been known for more than 100 years, but no one has yet reared it from a caterpillar host. It has been collected several times by Malaise trap, indicating that it flies low to the ground.

***Aleiodes flavitarsus* Marsh and Shaw**
Yellow-footed mummy-wasp

Diagnostic features of adult wasp. Body mostly two-colored with *contrasting orange and black*. Head and mesosoma black. Metasomal terga 1-3 mostly orange, remaining metasomal terga (4-8) black. Antenna light brown. Legs mostly *yellow* except for black apex of tarsus, apical fourth of hind femur, and apical half of hind tibia. Wings clear. Tegula yellow. Body length 4.5-5.5 mm. Antenna with 46-49 segments. Oral opening oval, diameter about equal to basal width of mandible. Malar space equal to basal width of mandible. Ocelli small, distance between eye and lateral ocellus equal to, or distinctly broader than, ocellus width. Median length of pronotum shorter than distance between occipital carina and lateral ocellus. Mesopleuron smooth but setose medially, subalar sulcus rugose, sternaulus absent. *Forewing vein 1cu-a beyond vein 1M by nearly three times its length*. Vein RS of hind wing straight, marginal cell of hind wing gradually widening toward apex. *Hind wing vein m-cu absent*. Apex of hind tibia without a row of flattened setae along inner margin, setae normal and hair-like. Tarsal claws strongly pectinate over entire length. First metasomal tergum not parallel-sided, wider apically than at base. Apex of metasoma not compressed in female. Metasomal tergum 3 costate at base, remainder smooth. *Males with metasomal terga 4-6 densely setose* (subdivided medially).



Host caterpillars. This species has been reared in Canada from an unknown species of the genus *Autographa* (Noctuidae) feeding on alder.

Diagnostic features of host mummies. Mummy smooth, with scattered small setae and irregular brown and whitish tan markings (as pictured).



Wasp distribution. This is a boreal species that is widely distributed across Canada, from Newfoundland westward to British Columbia, and extends southward into the northern United States, including Washington and Minnesota. In the eastern United States, *A. flavitarsus* has only been recorded in Maine and Michigan.

Biology. Adult wasps are active from late June to September. There is one record of an adult wasp emerging in March, but this may have been under laboratory conditions. The only confirmed host association is with an *Autographa* species feeding on alder.

Similar species. *Aleiodes flavitarsus* is similar to *A. abdominalis* but differs by having a smaller body size, vein 1cu-a of the fore wing beyond vein 1M by about three times its length, by the absence of vein m-cu in the hind wing, and by the hind tarsomeres 1-4 being yellow.

Best reference. Shaw *et al.* (1998a).

Comments. The mostly yellow legs, with the hind tarsi being mostly yellow, are quite distinctive.

***Aleiodes gastritor* (Thunberg)**
Thunberg's mummy-wasp

Diagnostic features of adult wasp. Body color *mostly honey-yellow*, except *ocellar triangle, propodeum, base of tergum 1, and sides of terga 2 and 3 dark brown to black*. Stigma two-colored but with darkened medial area not discrete, rather translucent, with dark color grading into lighter basal and apical areas. Body length 4.0-5.0 mm. Antenna with 35-36 segments. Hind wing with *vein RS arched in the middle*, marginal cell narrowest near middle.



Host caterpillars. Recorded in Europe as attacking a wide range of arboreal Geometridae and one drepanid. Confirmed hosts in eastern North America include the geometrids *Alsophila pometaria*, the fall cankerworm, and *Hypagyrtis unipunctata*.

Diagnostic features of host mummies. Mummies about 9-10 mm long, mostly light whitish to yellowish-brown, with fine mottled black markings and transverse black bands in prothoracic area. Smooth and slightly tapered at both ends.



Wasp distribution. This is a very widely distributed circumpolar boreal species found in northern Europe, northern Asia, Canada, and the northeastern United States.

Biology. *Aleiodes gastritor* is a generalist species attacking various arboreal Geometridae and sometimes Drepanidae.

Similar species. *Aleiodes gastritor* is part of a sibling-species complex including *A. laphygmae*, *A. malacosomatos*, *A. nolophanae*, *A. platypterygis*, *A. simillimus*, and *A. stigmator*. These species are quite similar in appearance and are most reliably identified based on reared material.

Best reference. Shaw (1994).

Comments. Although fairly common in northern states, the presence of *A. gastritor* in North America has not been generally recognized, and for many years this species has been confused with *A. stigmator*. Previous records of *A. stigmator* attacking *Alsophila pometaria* are erroneous (e.g., Marsh 1979a) and actually refer to *Aleiodes gastritor*. When reared, the two species are easy to distinguish: *Aleiodes gastritor* is a solitary species, attacking mostly small arboreal geometrids, while *A. stigmator* is a gregarious species, attacking much larger noctuids and notodontids.

***Aleiodes geometrae* (Ashmead)**
Geometrid mummy-wasp

Diagnostic features of adult wasp. *Body color honey-yellow to orange, antenna black and tegula yellow. Body length 5.0-6.0 mm. Antenna long, with 43-56 segments. Flagellomeres all short and compact. Malar space short, about equal to, or slightly narrower than, basal width of mandible. Oral space small and circular, about twice as wide as malar space. Ocelli large, ocell-ocular distance about two-thirds of the diameter of lateral ocellus. Occipital carina incomplete, weak, or absent on vertex. Propodeum mostly granulate anteriorly, grading to rugose posteriorly. Tarsal claws pectinate at extreme base, with a wide gap between apical claw and basal pectin. First metasomal tergum shorter than wide. Males with small setose pits medially on terga 4-6.*



Host caterpillars. Reared from geometrids, including the spring cankerworm, *Paleacrita vernata* (Peck); *Semiothisa ocellinata* (Gn.); and an unidentified geometrid host on honey locust.

Diagnostic features of host mummies. Mummies are about 9-10 mm long, forming a dark reddish-brown, smooth capsule with narrow transverse pale yellowish bands. Head capsule and anal prolegs are pale yellowish-white. Mummies sometimes found glued to the underside of host plant leaves.



Geometridae sp.



Geometridae sp.

Wasp distribution. Widely distributed from Ontario and New York, southward to Florida, and westward to North Dakota, Colorado, and Texas.

Biology. Adult wasps fly from mid-March to mid-August. This wasp is arboreal, nocturnally-active, and appears to be oligophagous on exposed tree-feeding geometrids. Hosts are associated with a variety of trees, including maple, honey locust, elm, birch, and *Prunus*.

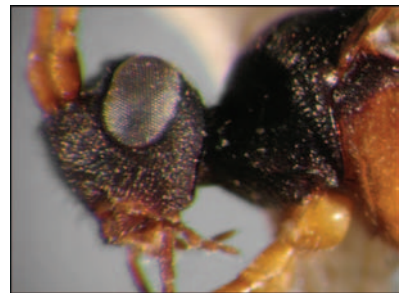
Similar species. *Aleiodes geometrae* is similar to the southern *A. earinos*, but *A. geometrae* is a more widespread and common species. Similarities with *A. earinos* include claws with a wide gap between the apical claw and basal pectination, weak to incomplete occipital carina, and small setose pits on the male terga. Differences between *A. geometrae* and *A. earinos* include the former's smaller body size; lighter, mostly yellow body color; shorter flagellum; wider gap in the occipital carina; more granular propodeal sculpture; and a shorter, wider first metasomal tergum.

Best reference. Shaw *et al.* (1997).

Comments. One of the host caterpillars, *Paleacrita vernata*, is sometimes a serious defoliating pest. *Aleiodes geometrae* may be a natural control agent for spring cankerworm.

Aleiodes granulatus* (DeGant)*Granular mummy-wasp**

Diagnostic features of adult wasp. Body multi-colored, black, yellow, and orange. Head black, antenna and mouthparts yellow. Mesosoma sometimes entirely black, pronotum and mesonotum always black, mesopleuron and propodeum sometimes orange. Metasoma with first tergum orange or black, second and third terga orange, remainder of terga black. Legs orange, except apical half of hind femur and tibia black. Stigma two-colored: brown with yellow at base and apex. Body length 4.5-5.0 mm. Antenna with 45-50 segments. Body with extensive *granular microsculpture on head and mesosoma*. *Pronotum long*, with median length greater than ocell-ocular distance. Fore wing vein 1cu-a beyond 1M by distance less than length of 1cu-a. Metasomal terga 1-4 *longitudinally costate*.



Host caterpillars. Reported as associated with the noctuid *Trichoplusia ni*.

Diagnostic features of host mummies. None available for study.

Wasp distribution. Found in the northeastern United States and Canada, from New Brunswick south to North Carolina and westward to Wisconsin and Ohio.

Biology. Unknown.

Similar species. *Aleiodes granulatus* is closely related to *A. angustipennis* but differs by having the fore wing vein 1cu-a close to vein 1M and by its black and orange body color.

Best reference. Marsh and Shaw (2003).

Comments. This species is very distinctive by its extensive granular microsculpture.

***Aleiodes graphicus* Cresson**
Black-winged mummy-wasp

Diagnostic features of adult wasp. *Body mostly yellowish orange, except ocellar triangle, palpi, and legs apically black. Wings black. Body length 7.0-8.0 mm. Antenna with 55-60 segments. Malar space short, slightly shorter than basal width of mandible. Eyes and ocelli large. Ocell-ocular distance narrow, lateral ocellus near eye margin. Lateral ocellus one to two times wider than ocell-ocular distance. Hind wing vein RS sinuate and strongly arched, RS approaching wing margin medially. Hind wing marginal cell very narrow in middle.*



Host caterpillars. This wasp species has been reared from at least two species of Sphingidae, but the host mummies have not been identified beyond the family level. The host mummy from Florida (pictured) was associated with *Camellia*.

Diagnostic features of host mummies. About 12-15 mm long, smooth, pale brownish-tan, sometimes with dark lateral markings, and with scattered tiny spinules. Broadly attached to the substrate by a large antero-ventral glue-hole. Head capsule either decapitated from mummy or attached by a small piece of cuticle that is prone to breaking away as the mummy ages. Has a distinct posterior caudal horn about 4 mm long or a distinct pit if the caudal horn has fallen off. The formation of a large irregular emergence hole by the emerging wasp may cause the posterior end of the mummy to fall away (resulting in a loss of the caudal horn).



Sphingidae sp.

Wasp distribution. *Aleiodes graphicus* is widely distributed across the southern United States from Arizona to Florida, northward to Colorado and South Dakota. It is more common in the southwest and central United States and is relatively uncommon in the East. The only collection record in the eastern states is from Florida.

Biology. Mummies are firmly glued down by a very large antero-ventral glue-hole, which usually results in decapitation of the caterpillar. Thus, wild-collected mummies usually lack a head capsule. The caudal horn of sphingid hosts is quite distinctive, but may fall off as the mummy ages or overwinters, leaving a visible pit. Adult wasps are attracted to lights and are probably nocturnally active.

Similar species. Most closely related to *A. texanus*, but that species has extensive black markings on the head and mesosoma. *Aleiodes graphicus* can be easily distinguished by its almost entirely orange body and black wings. The only species with superficially similar color is *A. politiceps*, but *A. graphicus* can be distinguished from that species by its strongly curved hind wing RS vein and very large ocelli.

Best reference. Shaw *et al.* (1998b).

Comments. *Aleiodes graphicus* is seldom collected in the eastern United States, where it may be restricted to the far south.

Aleiodes indiscretus* (Reardon)*Indiscrete mummy-wasp****Diagnostic features of adult wasp.**

Body color mostly honey-yellow except ocellar triangle black, dorsum of mesosoma and metasoma marked with light brown. Body length 6.0-8.0 mm. Antenna with 50 segments. Oral opening small and circular. *Ocelli* very large, ocell-ocular distance about one-third of the diameter of lateral ocellus.

Host caterpillars. *Lymantria dispar* (L.) and *Dasychira* species.



Diagnostic features of host mummies. *Dasychira* mummies are about 1.5 cm long and densely hairy, with white and black setae. Gypsy moth caterpillars mummified by this species were not available for study.

A. indiscretus on gypsy moth



Dasychira prob. *basiflava*



Wasp distribution. This species is native to India, but was introduced to the eastern United States (Connecticut and Massachusetts) in the late 1960s for suppression of the gypsy moth (Reardon 1970).

Biology. In India, this species is a parasitoid of *Lymantria obfuscata* Walker, a relative of the gypsy moth (Rao 1964). It was cultured in the laboratory on gypsy moth, *L. dispar*, and released for control of that pest. Details of its biology are provided by Reardon *et al.* (1973). Recently, it has been reared from *Dasychira* species in Maryland.

Similar species. This species is very similar to *A. pallidator*, and careful studies of both species are needed to determine whether they are really two distinct species. *Aleiodes indiscretus* differs from *A. pallidator* by having the temples more strongly converging behind the eyes; by having slightly more coarse sculpture on the mesopleuron, propodeum, and first tergum; and by the body color being somewhat darker and more reddish-brown. *Aleiodes indiscretus* reproduces sexually, while *A. pallidator* reproduces parthenogenetically.

Best references. Reardon (1970), Reardon *et al.* (1973), and Marsh (1979b).

Comments. This exotic species now appears to be established in the eastern states from Massachusetts southward to Maryland. Mummies of *Dasychira* induced by this species are virtually identical to those of *A. pallidator*.

Aleiodes itamevorus* Shaw and Marsh*Itame mummy-wasp**

Diagnostic features of adult wasp. Body mostly black with yellow markings on the face and orbits of the eyes. Legs yellow. Body length 3.5-4.5 mm. Antenna with 41-44 segments. *Metasoma carapace-like, in dorsal view with no segments visible beyond tergum 4.* *Vein m-cu of the hind wing distinctly tubular.*



hind wing



Host caterpillars. *Itame brunneata* (Thunberg).

Diagnostic features of host mummies. Mummies are 8-9 mm long, pale whitish to yellowish-brown, mottled with irregular black markings, and very smooth. The mummy is formed along small stems of the host plant and is very cryptic.

*Itame brunneata*

Wasp distribution. Known only from Ontario, Canada, but given the distribution of the host, this wasp is probably present throughout boreal parts of the north-eastern areas of the United States and Canada.

Biology. This wasp has been reared from the geometrid *Itame brunneata* (Thunberg) on *Vaccinium angustifolium*.

Similar species. Very similar to *A. maritimus*, but that species lacks a tubular vein m-cu in the lower part of the hind wing.

Best reference. Shaw and Marsh (2004).

Comments. This small but distinctive wasp is a resident of northern blueberry bogs.

Aleiodes laphygmae* (Viereck)*Armyworm mummy-wasp****Diagnostic features of adult wasp.**

Body color entirely honey-yellow. Antenna brown. Wings transparent. Pterostigma two-colored: brown with yellow spots at base and apex. Body length 4.0-5.0 mm. Antenna with 33-35 segments. Ocell-ocular distance equal to, or slightly wider than, lateral ocellus width. Angle between vein r of fore wing and pterostigma about 160 degrees, *vein r* often appearing nearly on same line as hind margin of pterostigma.



Host caterpillars. Recorded from several small noctuid caterpillars including the armyworm moth, *Mythimna* (= *Pseudaletia*) *unipuncta* (Haw.); the beet armyworm moth, *Spodoptera exigua* (Hbn.); the fall armyworm moth, *S. frugiperda* (Smith); and the yellow-striped armyworm moth, *S. ornithogalli* (Guen.).

Diagnostic features of host mummies. Although formed from several caterpillar species, mummies resulting from *A. laphygmae* parasitism are similar in appearance. Very early stages of the caterpillars are attacked, so the resulting mummies are quite small, being only about 8-9 mm long. They are very slender, smooth, and usually light brown or gray in color, with a darker head capsule. Mummies of caterpillar species with longitudinal stripes, such as *S. ornithogalli*, retain a visible striped pattern. The mummy lays very flat on its substrate or only slightly inclined upward from the front end.

Spodoptera frugiperda*Spodoptera ornithogalli*

Wasp distribution. Found in the southeastern United States from South Carolina southward to Florida and westward to Texas. Also recorded from Cuba and Nicaragua. Introduced to Hawaii.

Biology. This species is an oligophagous feeder on early stages of cutworm and armyworm caterpillars feeding in low vegetation. Associated naturally with open grassy meadows with mixed herbaceous vegetation. In forest areas, restricted to the undergrowth and open meadows. This species also occurs commonly in agroecosystems.

Similar species. *Aleiodes laphygmae* is very similar to *A. noloephanae*, but can be distinguished from that species by its shorter antenna, larger ocelli, and by the orientation of the vein r in the fore wing.

Best reference. Viereck (1912).

Comments. This species can be quite abundant, but because of its small size and the cryptic brown color of the mummies, its presence can be easily overlooked.

Aleiodes lymantriae* (Watanabe)*Gypsy moth mummy-wasp****Diagnostic features of adult wasp.**

Body color *mostly dark brown to black*, except legs *mostly yellow*, and with *1 or 2 yellow spots medially on the dorsum of the metasoma*. Body length 6.0-8.0 mm. Antenna with 55 segments. *Ocelli very large, diameter of lateral ocellus about three times the ocell-ocular distance.*



Host caterpillars. A parasitoid of the gypsy moth, *Lymantria dispar*.

Diagnostic features of host mummies. Although parasitized at an early stage, mummies of the gypsy moth induced by this species are rather large (11-12 mm long) and quite distinctive. The head capsule is yellowish-brown. The body is much darker and densely covered by raised, round, blue or brown protuberances, each of which is thickly set with long hairs. Many of the hairs project out to the sides of the mummy by as much as 1 cm.



Lymantria dispar



Lymantria dispar



Orgyia recens (Japan)

Wasp distribution. *Aleiodes lymantriae* is native to Japan but has been introduced into the eastern United States for control of the gypsy moth.

Biology. Adults occur in mid-summer. In addition to attacking the gypsy moth, in Japan this species overwinters inside caterpillars of *Orgyia recens*. In a laboratory setting, it has been raised on caterpillars of *O. thyellina* (Marsh 1979b).

Similar species. This species is most similar to *A. indiscretus*, but is easily distinguished by its much darker color with yellow markings. Both species have very large ocelli and are associated with caterpillars of the gypsy moth.

Best references. Watanabe (1937) and Marsh (1979b).

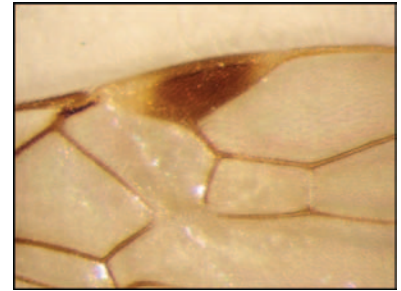
Comments. It is not known whether this species has become established in the eastern United States or, if so, how widely. It might now occur in the eastern states wherever the gypsy moth is found.

Aleiodes malacosomatos* (Mason)*Tent caterpillar mummy-wasp****Diagnostic features of adult wasp.**

Body color mostly yellowish orange, except metanotum and propodeum dark brown to black.

Metasoma usually entirely orange but sometimes with dark brown or black basally on first tergum.

Stigma two-colored, dark brown to black medially, pale yellowish-white basally and apically. Body length 5 mm. Antenna with 33-35 segments in female, 37-39 segments in male. Frons, temple, and vertex with fine granular sculpture. Malar space longer than basal width of mandible. Tarsal claws *weakly pectinate* basally, appearing simple. First metasoma tergum wider at apex than long. Hind wing with *vein RS arched in the middle*, marginal cell narrowest near middle.



Host caterpillars. In the eastern United States this species attacks young larvae of the eastern tent caterpillar (*Malacosoma americanum*) and the forest tent caterpillar (*M. disstria*). In the western United States and Canada, *M. californicum* is also parasitized. Mummies of *M. americanum* are commonly formed inside the silk tents of the host or on nearby vegetation. Large numbers of mummies can sometimes be found by peeling apart the layers of the silk tents in early June. Mummies retain cuticular color patterns characteristic of the different *Malacosoma* species.



Malacosoma americanum

Diagnostic features of host mummies. Mummy about 1 cm long, head capsule and body mostly black, with pale bluish white median line and scattered lateral bluish white marks. Covered with long yellowish-white hairs.



Wasp distribution. *Aleiodes malacosomatos* is widely distributed across the northern United States and Canada, from New Brunswick southward to New York and westward to Idaho and British Columbia. In the eastern United States, this species is common in Massachusetts, Michigan, and New York.

Biology. *Aleiodes malacosomatos* is an arboreal species associated with broadleaf trees and shrubs, especially wild cherry. It parasitizes the gregarious larvae of tent caterpillars, but the wasp is always solitary, with only one wasp emerging from the mummy of the half-grown caterpillar.

Similar species. *Aleiodes malacosomatos* is quite similar morphologically to *A. stigmator*, but has coarser and less shining sculpture on the head and mesosoma, and its fore wing stigma is distinctly two-colored. The habits of the two species are quite different, as *A. stigmator* is a gregarious parasitoid of much larger noctuid and notodontid caterpillars.

Best reference. Mason (1979).

Comments. Although *A. malacosomatos* can be locally quite abundant, it is not often collected unless it is reared from the host mummies. The mummified caterpillars can be easily collected in June by peeling apart the silk layers of the shelters of the host caterpillars. During the spring of 1988 these parasitoids were very common in tents of *M. americanum* on wild cherry trees at Rock Meadow, Belmont, Massachusetts. However, during the following spring of 1989, none could be found at the same sites. My studies of this wasp in Wyoming indicate that the mummies are subject to high rates of hyperparasitism by Encyrtidae, Pteromalidae, and Ichneumonidae.

This species presents a curious puzzle relating to its seasonal occurrence. Because the host *Malacosoma* species overwinter as egg masses on twigs and *Aleiodes* always oviposits into young larvae, it can be assumed that the adult

wasps are present in the very early spring (late April or early May), although oviposition has not been observed. As adult wasps emerge from mummies of parasitized *Malacosoma* in June and July, either the species has an alternate host later in the summer or the adults are extremely long-lived (as *Malacosoma* larvae will not be available for attack until the following spring). Overwintering as adults cannot be ruled out, but it seems unlikely that emergence would be in June and July unless there were a second generation on an alternate host. Also, in the laboratory, the adult wasps live only for a week or two. A search was made of wild cherry trees at Rock Meadow in July of 1988 for possible alternate hosts, but without success. The only likely prospect found was the ugly nest caterpillar, which is also a gregarious feeder making a large, prominent, silken shelter. These were presented to female *A. malacosomatos* wasps in the laboratory, but the parasitoids made no attempt to oviposit.

***Aleiodes mandibularis* (Cresson)**

Large-jawed mummy-wasp

Diagnostic features of adult wasp. Body *orange with brown antennae and clear to slightly dusky wings*. Body length 8.5-10.0 mm. Antenna with 55-65 segments. *Oral opening large and oval*, width greater than height of face. *Malar space short*, its width equal to or slightly less than width of mandible at base.



Mandibles large and robust. Width of ocell-ocular distance slightly less than width of lateral ocellus. Tarsal claws strongly pectinate.



Host caterpillars. Unknown.

Diagnostic features of host mummies. Unknown.

Wasp distribution. This species is widely distributed in the central United States, but it is usually rather scarce and seldom collected. It ranges from Ohio southward to Georgia and westward to Nebraska and Texas.

Biology. Unknown. It is attracted to lights, suggesting nocturnal activity. Other members of the *melanopterus* species-group (of which this species is a member) are known to attack caterpillars of Noctuidae.

Similar species. *Aleiodes mandibularis* is large and distinctive, and it probably would not be confused with any other species. The wasp superficially resembles *A. politiceps* because both have a large orange body, but can easily be distinguished from that species by its larger oral space, larger mandibles, and clear wings. It resembles *A. melanopodus*, but differs by having orange legs, whereas the legs of *A. melanopodus* are black.

Best reference. Marsh and Shaw (1999).

Comments. This is a very large and quite distinctive *Aleiodes* species, but it is rather rare and seldom collected. It has larger, thicker mandibles than any other eastern U.S. *Aleiodes* species. The reasons for its scarcity are not known.

***Aleiodes maritimus* Shaw and Marsh**

Maritime mummy-wasp

Diagnostic features of adult wasp.

Body mostly black with yellow markings on the face and vertex of the head. Legs yellow. Body length 3.5-4.5 mm. Antenna with 42-43 segments. *Metasoma carapace-like, in dorsal view with no segments visible beyond tergum 4. Vein m-cu of the hind wing absent or indicated only by a weakly pigmented line.*



Host caterpillars. *Semiothisa granitata* (Guenée), *S. sexmaculata* Packard, and *S. signaria dispuncta* (Walker).

Diagnostic features of host mummies. Mummies are 8-9 mm long, yellowish tan to brown, mottled with irregular black markings, and very smooth. When the mummy is formed along plant stems it is very cryptic.



Semiothisa sexmaculata

Wasp distribution. The majority of specimens collected so far are from the Canadian maritime provinces of Newfoundland, New Brunswick, and Nova Scotia. However, a few specimens from central and eastern Canada and Minnesota are known, indicating that this species is probably widespread in northern North America

Biology. Specimens have been reared from the following geometrids: *Semiothisa granitata*, *S. sexmaculata*, and *S. signaria dispuncta*. The host caterpillars feed on various coniferous trees, including pitch pine, scrub pine, firs, hemlocks, spruces, and larch.

Similar species. This species is quite similar to *A. itamevorus*, but differs from that species by lacking a tubular vein m-cu in the lower part of the hind wing and having more coarse sculpture on the basal terga of the metasoma.

Best reference. Shaw and Marsh (2004).

Comments. Most likely, this species occurs in the northeastern states of New England, but it has not been collected there yet.

***Aleiodes melanopodus* Marsh and Shaw**
Black-footed mummy-wasp

Diagnostic features of adult wasp. Body and base of legs (coxae and trochanters) orange. *Legs (beyond trochanters) black.* Wings dusky blackish. Body length 8.0-9.0 mm. Antenna with 53-58 segments. Oral space very wide and oval, its width about two times height of face. Malar space very short, its width about three-fourths width of mandible at base. Diameter of lateral ocellus about three-fourths ocell-ocular distance. Tarsal claws strongly pectinate. Ovipositor sheaths about 1.5 times longer than hind basitarsus.



Host caterpillars. Unknown.

Diagnostic features of host mummies. Unknown.

Wasp distribution. Known only from the eastern and southern United States. This species has been collected in Maryland, Virginia, North Carolina, Kentucky, and Louisiana.

Biology. Details unknown. Adult wasps fly in the late summer and early fall (September and October). Other members of the *melanopterus* species-group, of which this species is a member, are known to attack caterpillars of Noctuidae.

Similar species. This species is somewhat similar to *A. mandibularis* in color and shape of the mouthparts. It differs from *A. mandibularis* by having somewhat smaller mandibles, smaller ocelli, longer ovipositor, and black legs.

Best reference. Marsh and Shaw (1999).

Comments. This species, although large and distinctive, was not named until 1999. The first specimen that I saw was collected by a student in my Introductory Entomology class as part of a student collection. This demonstrates that this is still an area in which students and amateur collectors can make significant new discoveries and contributions.

***Aleiodes molestus* (Cresson)**

Troublesome mummy-wasp

Diagnostic features of adult wasp. Body *two-colored: black and orange*. Head black. *Mesosoma mostly orange*, except propodeum variously marked with black and *legs mostly black*. *Metasomal terga 1-3 always orange*, remaining terga varying from orange to black. Body length 5.0-7.0 mm. Antenna with 45-47 segments. Malar space long, greater than basal width of mandible.



Ocelli small. *Tarsal claws strongly pectinate* with 6-8 stout teeth. Marginal cell of hind wing narrowest basally, gradually widening to wing apex. *Males with terga 4-7 densely covered with silvery setae* (subdivided medially).



Host caterpillars. Reared from several species of noctuid and plusiine noctuids, including *Autoplusia egea* (Gn.); the soybean looper, *Pseudoplusia includens* (Wlkr.); the cabbage looper, *Trichoplusia ni* (Hbn.); and the variegated cutworm, *Peridromia saucia* (Hbn.). The known hosts are all generalist feeders on a variety of types of low vegetation, including several agricultural crops.

Diagnostic features of host mummies. Mummy about 1 cm long, with body forming a mostly smooth, pale yellowish-white capsule. Darker and densely wrinkled at anterior end. The head capsule is darker yellowish-brown and pulled flat to the substrate with anterior face upwards. Mummies sometimes formed on a dense silk mat spun by the host larva on the host plant.



prob. *Pseudoplusia includens*

Wasp distribution. This species is quite common in midwestern and southwestern states, ranging from South Dakota south to Arkansas, Louisiana, and Texas and westward to Wyoming, Utah, Arizona, and southern California. In the eastern United States it has been recorded from Florida, but it probably ranges across the Gulf Coast. It is also known from Mexico and Costa Rica.

Biology. Adult wasps fly from late April through mid-September in the southern states. *Aleiodes molestus* favors open meadows, fields with low vegetation, and agroecosystems.

Similar species. Quite similar to the northern species, *A. parasiticus*, but not likely to be confused as their ranges do not overlap. *Aleiodes molestus* differs from *A. parasiticus* by having the legs entirely black or dark brown beyond the coxa (in *A. parasiticus*, the hind femur and tibia are banded, orange and black).

Best reference. Shaw *et al.* (1998a).

Comments. The name “*molestus*” is Latin for “troublesome.” The wasp is not annoying to humans, but rather the name refers to the fact that the wasp makes trouble for the caterpillars it attacks. The wasp should be regarded as highly beneficial as it attacks several significant pest insects.

***Aleiodes nigristemmaticum* (Enderlein)**

Dark-marked mummy-wasp

Diagnostic features of adult

wasp. Entire body light yellow, except top of head (ocellar triangle) marked with black.

Fore wing stigma yellow. Body length 6.5-7.5 mm. Antenna with 50-57 segments. Ocelli large, ocell-ocular distance distinctly less than diameter of lateral ocellus. Occipital carina complete. Fore wing vein r nearly as long as vein 3RSa. Hind wing vein RS parallel to wing margin on basal third, then suddenly curved downward. Hind wing marginal cell suddenly widened at apex. Apex of hind tibia with a row of flat setae on inner side.



Host caterpillars. *Mocis latipes* (Gn.) and other *Mocis* species (Noctuidae).

Diagnostic features of host mummies. The mummified caterpillar is about 1 cm long, dark brown to black, smooth, and tapering at both ends. Mummies are formed vertically on grasses, twigs, and low vegetation, attached with the head-end downward. The remainder of the mummy is unattached and bends away from the substrate at a 45° angle. The resulting mummy is extremely cryptic, very much resembling a plant part (seed or sepal).



Mocis latipes

Wasp distribution. In the eastern United States, known only from southern Florida and Mississippi. The species is widely distributed around the Gulf of Mexico and the Caribbean, being recorded also from Mexico, Honduras, Costa Rica, Venezuela, Cuba, and sites in the West Indies.

Biology. This species is found in early-successional forests, among low vegetation in the understory, or in grassy areas along forest margins. The process of mummy formation was studied in Costa Rica by Les Price, and is described in Marsh and Shaw (1998).

Similar species. *Aleiodes nigristemmaticum* is similar to *A. femoratus*, but can be distinguished by its yellow stigma and by the lack of dark markings on the hind femur. *Aleiodes nigristemmaticum* is entirely light yellow, except for a single black mark on the top of the head (hence the species name).

Best reference. Marsh and Shaw (1998).

Comments. The recorded host in Honduras, *Mocis latipes*, is a common moth (and caterpillar) in the southern United States. It is a generalist feeder on grasses and other low vegetation, including several crop plants such as corn, rice, beans, and turnips.

Aleiodes nolophanae* (Ashmead)*Appleworm moth mummy-wasp**

Diagnostic features of adult wasp. Body color entirely honey-yellow. Antenna brown. Wings transparent. Pterostigma two-colored: brown with yellow spots at base and apex. Body length 5.0-6.0 mm. Antenna with 39-45 segments. Ocell-ocular distance equal to, or slightly wider than, lateral ocellus width.



Host caterpillars. Recorded as attacking the many-dotted appleworm moth, *Balsa malana* (Fitch), and other small noctuids, including the green cloverworm, *Plathypena scabra* (F.), *Bomolocha palparia*, *Lithophane* sp., and *Caenurgia erechtea*.

Diagnostic features of host mummies. Although formed from several caterpillar species, mummies resulting from *A. nolophanae* parasitism are similar in appearance. Very early stages of the caterpillars are attacked, so the resulting mummies are quite small, being only about 8-9 mm long. They are very slender, smooth, and usually light brown or gray in color, with a darker head capsule.



Bomolocha palparia



Lithophane sp.

Wasp distribution. This species occurs throughout the eastern half of the United States.

Biology. This species is a polyphagous feeder attacking several small noctuid species feeding on low vegetation or small trees, such as apple and boxelder. Lentz and Pedigo (1974) provided a detailed study of the biology of this species.

Similar species. Quite similar to *A. laphygmae*, but this species is distinguished by its longer antenna and larger body size.

Best references. Lentz and Pedigo (1974) and Barbosa *et al.* (2001).

Comments. Barbosa *et al.* (2001) recorded this species as a dominant parasitoid of small noctuid caterpillars on boxelder.

***Aleiodes notozophus* Marsh and Shaw**
Southwestern mummy-wasp

Diagnostic features of adult wasp. *Head including antenna dark brown to black. Apex of palpi light brown to nearly white. Mesosoma except propodeum brown to dark brown. Propodeum always light brown. Metasoma and legs light brown. Body length 6.5-7.0 mm. Antenna with 51-54 segments. Flagellomeres all short and compact. Malar space very short, about equal to 2/3 basal width of mandible, or narrower. Oral space small and circular, about as wide as basal width of mandible. Ocelli very large, ocell-ocular distance at most 1/4 diameter of lateral ocellus, lateral ocellus often nearly touching compound eye. Occipital carina incomplete, weak, or absent on vertex. Propodeum mostly granulate anteriorly, grading to rugose posteriorly. Tarsal claws strongly pectinate with seven to eight large spines. First metasomal tergum longer than wide. Males with small setose pits medially on terga 4-7.*



Host caterpillars. Unknown.

Diagnostic features of host mummies. Unknown.

Wasp distribution. In the eastern United States, this species is recorded only from Florida. It occurs in the southwestern United States (Arizona and California) and in Costa Rica.

Biology. The holotype specimen from California is labeled as reared from an “oak gall.” The plant association is probably correct, but it seems unlikely that this wasp would emerge from a gall. Most likely a mummified host caterpillar was confused with a gall. Some other members of this species-group (*A. geometrae*, for example) form mummies that are very smooth, dark brown, and might be mistaken for a gall.

Similar species. *Aleiodes notozophus* is a member of the *pulchripes* species-group, which includes other species with males that have setose pits on the metasomal terga (*A. cameronii*, *A. earinos*, *A. geometrae*). *Aleiodes notozophus* is easily distinguished from these by its dark-colored head.

Best reference. Shaw *et al.* (1997).

Comments. In Florida, this species has been collected in May. Adult wasps are attracted to blacklights (ultraviolet light).

***Aleiodes pallidator* (Thunberg) species-complex**

Pallid mummy-wasp

Diagnostic features of adult wasp. Body color entirely golden yellow. Antenna with 53-57 segments. Ocelli very large, ocell-ocular space distinctly narrower than width of lateral ocellus. Parasites of Lymantriidae caterpillars.

Host caterpillars. The satin moth, *Leucoma salicis* (L.). In Maryland, possibly other Lymantriidae, including *Orgyia definita* Packard; the white-marked tussock moth, *Orgyia leucostigma* (J.E. Smith); and *Dasychira obliquata* (Grote and Robinson).



Diagnostic features of host mummies. The body of the mummified host caterpillar is about 1 cm long, with hair tufts projecting both forward and backward such that the whole mummy is up to 2 cm long when hairs are measured as well as body. The lymantriid hosts are so densely hairy that dead mummified hosts look very much like living caterpillars except for the posterior emergence hole of the wasp. Mummies retain the color and hair characteristics of living caterpillars.



Dasychira obliquata



Leucoma salicis



Orgyia leucostigma

Wasp distribution. This species is native to Europe, where it is reported to be a monophagous parasitoid of the satin moth. During the 1930s, it was introduced and released in the northeastern United States (Maine, Massachusetts, New Hampshire, Rhode Island, and Connecticut) and the Pacific northwest (Washington) for biological control of the satin moth. More recently, it has been reported from Maryland (Barbosa *et al.* 2001).

Biology. Prior to its release into the United States, the biology of this species was studied in great detail. There is one generation per year, with the parasitoid overwintering as a larva inside overwintering caterpillars. Dowden (1938) studied this species (as *Rogas unicolor*) and reported that it is a monophagous feeder on caterpillars of *Leucoma salicis*. He also noted that, in Europe as well as the populations released into the United States, reproduction by this species is parthenogenetic, with females producing females without males. More recent studies by Mark Shaw confirm that, in Europe, the species is a strict monophage, reproducing parthenogenetically (Shaw 2002). The material recently found in Maryland poses an interesting puzzle as it includes both males and females and has been reared from other lymantriid hosts, including *Orgyia definita* Packard; the white-marked tussock moth, *Orgyia leucostigma* (J.E. Smith); and *Dasychira* species. It is not yet clear whether this is a sexually reproducing population of *A. pallidator* or whether this population is a previously unrecognized sibling species.

Similar species. Very similar to *A. indiscretus*, a parasitoid of the gypsy moth. However, *A. pallidator* is lighter in color and has less dense sculpture, especially notable on the side of the mesopleuron where there is a smooth shiny area. By comparison, *A. indiscretus* is more reddish-brown and has coarser sculpture on the mesopleuron.

Best reference. Dowden (1938) and Shaw (2002).

Comments. It is not yet clear whether the Maryland population on *Orgyia* and *Dasychira* is a sexually reproducing population of *A. pallidator* or whether this population is a previously unrecognized sibling species.

***Aleiodes palmatoides* Marsh and Shaw**
Palm-like mummy-wasp

Diagnostic features of adult wasp. Body color honey-yellow with brown markings on the mesosoma and metasoma. Body length 4.0-5.5 mm. Antenna with 33-35 segments. *First metasomal tergum* long, narrow, and *parallel-sided*. *Apex of metasoma laterally compressed in females*.

Host caterpillars. Unknown.

Diagnostic features of host mummies. Unknown.

Wasp distribution. Known only from mixed forest localities in Virginia and North Carolina.



Biology. Unknown. Adult wasps are active from July to October.

Similar species. Similar to the more northern species, *A. palmatus*. Easily distinguished from that species by the dark brown markings on the body.

Best reference. Marsh and Shaw (2003).

Comments. The compressed apex of the metasoma places this species in the *compressor* species-group. Studies of *A. compressor* in Europe indicate that the compressed metasoma is an adaptation for parasitizing host caterpillars that feed in the concealment of leaf shelters tied by silk (Shaw 1994). Therefore this species might also be attacking concealed host caterpillars.

***Aleiodes palmatus* (Walley)**
Walley's palmate mummy-wasp

Diagnostic features of adult wasp. Body color *entirely honey-yellow*. Body length 6.0-7.0 mm. Antenna with 33-35 segments. *First metasomal tergum* long, narrow, and *parallel-sided*. *Apex of metasoma laterally compressed in females*.



Host caterpillars. Hosts include the noctuids *Nycteola cinereana* Neumoegen and Dyar and *Enargia decolor* (Wlk.).

Diagnostic features of host mummies. Rather non-descript smooth mummies about 9-10 mm long, yellowish-brown with fine yellowish transverse wrinkles.



Wasp distribution. This species is known to range across Canada from Ontario to British Columbia and south into California, Utah, Minnesota, and Wisconsin. Given the known hosts and the association with *Populus tremuloides* forests, it seems likely that the species will eventually also be discovered in northern Michigan and Maine.

Biology. Recorded as a solitary parasitoid of the noctuid *Nycteola cinereana*. Based on museum specimens, it has also been reared from the noctuid *Enargia decolor* and an unknown caterpillar on *Populus tremuloides* (pictured).

Similar species. Very similar to *A. palmatoides*, but that species is smaller and has brown markings on the body; *A. palmatus* is a bit larger and entirely yellow.

Best reference. Walley (1941) (as a species of *Petalodes*) and Marsh and Shaw (2003).

Comments. This species and the closely related *A. palmatoides* are the only two U.S. *Aleiodes* species with a strongly compressed metasoma in the females. They are seldom collected, but are not likely to be confused with other species.

Aleiodes parasiticus Norton

Parasitic mummy-wasp

Diagnostic features of adult wasp. *Body two-colored: black and orange.* Head black. *Mesosoma mostly orange, but mesopleuron and propodeum black.* Legs orange and black. *Metasomal terga 1-2, and basal half of tergum 3, orange.* Apical half of tergum 3 and remaining terga black. Body length 5.0-7.0 mm. Antenna with 49-55 segments. Malar space long, greater than basal width of mandible. Ocelli small. *Tarsal claws strongly pectinate* with five or six stout teeth. Marginal cell of hind wing narrowest basally, gradually widening to wing apex. *Males with terga 4-7 densely covered with silvery setae* (subdivided medially).



Host caterpillars. Reared from caterpillars of plusiine noctuids, including *Anagrapha falcifera* (Kby.) and *Syngrapha epigaea* (Grt.). *Anagrapha falcifera* is a generalist-feeder on low plants including clover and blueberries, while *S. epigaea* is a generalist feeding on conifers such as pine, spruce, and fir.

Diagnostic features of host mummies. Mummies are about 12 mm long, cream-colored, and fairly smooth, except at anterior end. Cuticle is densely wrinkled at anterior end, behind head capsule.



Wasp distribution. Eastern Canada and the northeastern United States, southward to Maryland, and westward to North Dakota, Wyoming, and Colorado.

Biology. *Aleiodes parasiticus* is a distinctly northern species associated with boreal forests. Adult wasps are active for most of the summer, from late May to early September. The confirmed host records are from caterpillars of plusiine noctuids. Norton (1869) and Shenefelt (1975) report this species as emerging from a diprionid sawfly, *Neodiprion abietis* (Harris), on *Abies*, but that seems highly unlikely.

Similar species. *Aleiodes parasiticus* is most similar to the southern species *A. molestus*, but the ranges of the two species do not overlap. *Aleiodes parasiticus* differs by having the hind femur and tibia banded, orange on the basal half and black on the apical half, while the legs of *A. molestus* are mostly black.

Best reference. Shaw *et al.* (1998a)

Comments. *Aleiodes parasiticus* has a very distinctive black-orange-black-orange-black color pattern. It cannot be confused with any other northern species, and can be reliably spot-identified in the forest, even without a microscope.

***Aleiodes pardalotus* Marsh and Shaw**
Leopard-spotted mummy-wasp

Diagnostic features of adult wasp. *Body color mostly yellow but with dark brown and black spots on the head, mesosoma, and metasoma. Fore wing stigma two-colored: brown with yellow at base and apex. Body length 5.5 mm. Antenna with 50 segments. Ocelli large, ocell-ocular distance about one-third the diameter of lateral ocellus. Hind wing vein RS slightly sinuate. Hind wing marginal cell narrowest in middle. Apex of hind tibia with a row of flat setae on inner side.*



Host caterpillars. Unknown.

Diagnostic features of host mummies. Unknown.

Wasp distribution. Known only from Archbold Biological Station in southern Florida.

Biology. The caterpillar hosts of this wasp species are not yet known. Adult wasps fly in late January.

Similar species. Similar to *A. femoratus* and *A. nigristemmaticum* in body form, but *A. pardalotus* is easily distinguished from these and all other U.S. species by the very distinctive pattern of leopard-like dark-colored spots.

Best reference. Marsh and Shaw (1998).

Comments. The forest habitat at Archbold Biological Station is fairly open and dry, and is dominated by low oak scrub and some taller pine flatwoods (Mark Deyrup, pers. comm.).

***Aleiodes platypterygis* (Ashmead)**
Broad-winged mummy-wasp

Diagnostic features of adult wasp. Body color *mostly honey-yellow, but ocellar triangle dark brown to black*. Stigma two-colored but with darkened medial area not discrete, rather translucent, with dark color grading into lighter basal and apical areas. Body length 4.0-5.0 mm. Antenna with 34-36 segments. Hind wing with *vein RS arched in the middle*, marginal cell narrowest near middle.



Host caterpillar. Masked birch caterpillar, *Drepana arcuata* (Walker).

Diagnostic features of host mummies. The most distinctive feature of the mummy is the head capsule, which is yellowish-brown with two dark brown transverse bands. The mummy is about 9-10 mm long, light brown with irregular dark brown intersegmental color, and mostly smooth, but with some small segmental tubercles set with simple hairs. Mummies are formed attached to leaves of the host trees (aspen or birch), sometimes in association with silk webbing, and the body of the mummy is slightly inclined away from the substrate.



Wasp distribution. New Jersey southward to Virginia and westward to Iowa and Louisiana.

Biology. Recorded as a solitary parasitoid of the drepanid *Drepana arcuata* (Walker) on alder and birch.

Similar species. Aside from color differences (this species is paler), *A. platypterygis* is virtually identical in appearance to *A. gastritor*. The two species can only be reliably identified by association with host caterpillars.

Best reference. Ashmead (1889).

Comments. Although *A. platypterygis* has been recognized as a distinct species for more than 100 years, it is not clear if it should be held as distinct from *A. gastritor*. Careful field studies are needed to determine if this is truly a sibling species.

***Aleiodes politiceps* (Gahan)**
Smooth-headed mummy-wasp

Diagnostic features of adult wasp.

Body entirely orange but antenna, apex of hind tibia, and tarsi black. Wings black. Body length 7.0-9.0 mm. Antenna with 60-65 segments. Oral opening large and oval. Tarsal claws strongly pectinate. First, second, and basal half of third metasomal tergum with distinctive porcate sculpture, consisting of many longitudinal raised lines, surface appearing as though scratched by a comb.



Host caterpillars. The known hosts include noctuid larvae such as the green cutworm, *Anicla infecta* (Ochs.); and the armyworm moth, *Mythimna* (= *Pseudaletia*) *unipuncta* (Haw.).

Diagnostic features of host mummies. Mummies are about 1 cm long, entirely smooth, with a light yellowish-brown head capsule, and body mostly dark reddish-brown.



Mythimna unipuncta

Wasp distribution. Found from Virginia southward to Florida and westward to Arkansas and Texas. Also recorded from Costa Rica.

Biology. This species attacks cutworm-type noctuid larvae in low mixed vegetation, grassy meadows, and forest understories. The adults are nocturnally active and commonly attracted to lights.

Similar species. Superficially similar to *A. mandibularis*, but this species can be distinguished by its smaller mandibles and black wings.

Best reference. Gahan (1917) and Marsh and Shaw (1999).

Comments. This is perhaps the most common *Aleiodes* species found in the southern states. The orange body with black wings and coarsely sculptured metasoma are highly distinctive. It can be reliably identified in the field, even without a microscope.

***Aleiodes preclarus* Marsh and Shaw**
Beautiful mummy-wasp

Diagnostic features of adult wasp. Body *brightly colored with yellow, orange, and black markings*. *Antennal flagellum black*. Body length 5.5-6.0 mm. Antenna with 52-55 segments. *Ocelli large*, ocell-ocular distance half the diameter of lateral ocellus. *Occipital carina incomplete*, interrupted on vertex. Fore wing vein r shorter than vein 3RSa. Hind wing vein RS parallel to wing margin on basal third, then suddenly curved downward. *Hind wing marginal cell suddenly widened at apex*. *Apex of hind tibia with a row of flat setae on inner side*.



Host caterpillar. A solitary parasitoid of the painted lichen moth, *Hypoprepia fucosa* Hbn., an arctiid that feeds on lichens.

Diagnostic features of host mummies. Mummies are about 13 mm long, black, dorsally with segmental raised tubercles set with black spines. These spines are brittle, and break easily as the mummy ages, so they may be missing if the mummy is weathered. Along the sides are smaller whitish bristles.



Hypoprepia fucosa

Wasp distribution. Known only from the states of West Virginia, Virginia, and Kentucky.

Biology. This species has been reared from the lichen-feeding arctiid *Hypoprepia fucosa* from lichens found on white oak, red oak, hickory, and red maple. Caterpillars can be found by wrapping burlap bands around such trees with lichens. The caterpillars seek shelter under the bands, and will form mummies there.

Similar species. Similar to *A. wabli* but distinguished by its black antennal flagellum.

Best reference. Marsh and Shaw (1998).

Comments. The common name refers to the attractive body colors of this brightly patterned species. It is a resident of eastern oak, hickory, and maple deciduous forests where lichens are abundant.

***Aleiodes pseudoterminalis* Marsh and Shaw**
False terminal mummy-wasp

Diagnostic features of adult wasp.

Body mostly two-colored with *contrasting orange and black*. Head and mesosoma black. *Metasomal terga 1 orange or red*, remaining metasomal terga black. Antenna brown. *Hind tibia orange with black apex. Hind tarsomeres dark brown.*

Wings clear but lightly pigmented. Tegula yellow. Body length 7.0-8.0 mm. Antenna with 56-59 segments. Oral opening

circular, diameter about equal to basal width of mandible. Malar space equal to basal width of mandible. Ocelli small, distance between eye and lateral ocellus about equal to ocellus width. Median length of pronotum shorter than distance between occipital carina and lateral ocellus. Mesopleuron smooth except *subalar sulcus* and *sternaulus rugose*. *Fore wing vein 1cu-a beyond vein 1M by more than twice its length.* Vein RS of hind wing straight, marginal cell of hind wing narrowest at base and widening toward apex. *Hind wing vein m-cu present as short stub.* Apex of hind tibia without a row of flattened setae along inner margin, setae normal and hair-like. Tarsal claws *not pectinate*. First metasomal tergum not parallel-sided, wider apically than at base. Apex of metasoma not compressed in female. Metasomal tergum 3 costate at base, remainder smooth. Males with metasomal terga normal, not densely setose. *Ovipositor at least two-thirds the length of hind basitarsus*, sometimes nearly equal to basitarsus length.



Host caterpillars. Reared from the noctuid *Eupsilia devia* (Grote).

Diagnostic features of host mummies. Mummies induced by this species are 10-12 mm long, very dark brown, and the cuticle is compacted and somewhat wrinkled at the anterior end, just behind the head capsule.



Wasp distribution. Found in the northeastern United States and eastern Canada from the Great Lakes area, southward to Tennessee and Virginia.

Biology. This species is a solitary parasitoid of the noctuid *Eupsilia devia* (Grote). Mummies are similar to those formed by *A. terminalis* but less wrinkled, and may be formed in sandy soil, not attached to the food plants.

Similar species. Very similar to *A. terminalis*, but differing by the black second metasomal segment (orange in *A. terminalis*).

Best reference. Marsh and Shaw (2001).

Comments. For many years this species was confused with *A. terminalis*.

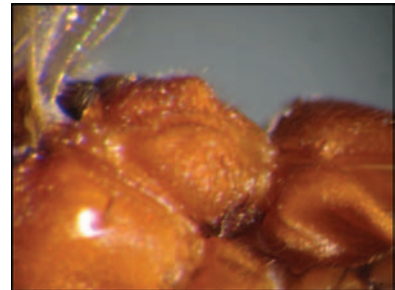
***Aleiodes quadratus* Shaw and Marsh**

Quadrate mummy-wasp

Diagnostic features of adult wasp.

Body mostly or entirely *honey-yellow to light orange*, except antenna partly to entirely dark brown to black. Wings clear to lightly pigmented. *Stigma two-colored, dark brown to black medially, pale yellowish-white on basal third*. Body length 6.0-7.0 mm. Antenna with 53-56 segments. Oral opening small and circular, diameter about equal to basal width of mandible.

Malar space longer than basal width of mandible. *Head rugulose dorsally*. Ocelli small, distance between eye and lateral ocellus distinctly broader than ocellus width. *Propodeum with small blunt tubercles on posterior corners*. *Second submarginal cell of fore wing short and quadrate, sometimes nearly square*. Vein RS of hind wing slightly sinuate, marginal cell of hind wing narrowest in middle. Apex of hind tibia without a row of flattened setae along inner margin, setae normal and hair-like. Tarsal claws simple, not pectinate. First metasomal tergum not parallel-sided, wider apically than at base. Apex of metasoma not compressed in female. *Metasomal terga 1-4 longitudinally rugose striate*.



propodeal tubercle

Host caterpillars. This wasp is recorded as attacking the arctiids *Grammia blakei* (Grote) and *Spilosoma virginica* (F.).

Diagnostic features of host mummies. Mummies of *Grammia* are about 1 cm. long, black, and densely hairy.



Wasp distribution. This wasp is common in the eastern United States, and it occurs from Vermont south to Florida and westward to the Rocky Mountains.

Similar species. *Aleiodes quadratus* is similar to *A. aciculatus*, but can be distinguished by its short and quadrate second submarginal cell and by the presence of tubercles on the posterior corners of the propodeum.

Biology. Not known in detail. Adult wasps have been collected from April through October, indicating that the species is long-lived as an adult or possibly is multivoltine.

Best reference. Shaw *et al.* (2006).

Comments. This species is very distinctive in having the second submarginal cell of the fore wing very short and quadrate, sometimes nearly square.

Aleiodes quebecensis* (Provancher)*Quebec mummy-wasp**

Diagnostic features of adult wasp. Body color mostly honey-yellow or light brown. *Antenna usually black on basal half, yellowish-white to orange on apical half. Hind tarsomeres 1-4 brightly colored, yellowish-white or white. Tegula yellow. Body length 6.0-8.0 mm. Antenna long, with 45-55 segments. Flagellomeres all short and compact. Malar space very short, narrower than basal width of mandible. Oral space small and circular, about twice as wide as malar space. Ocelli large, ocell-ocular distance about one-third diameter of lateral ocellus. Occipital carina incomplete, weak or absent on vertex. Propodeum mostly granulate anteriorly, grading to rugose posteriorly. Tarsal claws strongly pectinate. Hind wing with vein RS slightly arched at apical two-thirds; marginal cell narrowest at apical two-thirds, then abruptly widening toward wing apex.*



Host caterpillars. Reared from *Acronicta furcifera* Gn., *Acronicta grisea* Wlk., and *Acronicta hasta* Gn. Reared eastern specimens have also been associated with *Prunus sordinia* and with chokecherry, indicating that several other *Acronicta* are potential hosts. David Wagner has collected mummies of *Acronicta lobeliae* from *Quercus ilicifolia* and *Acronicta morula* from elm, and these are consistent with the style of mummification caused by *A. quebecensis*, but the adult wasps did not emerge.

Diagnostic features of host mummies. Mummies are about 12-14 mm long and very firmly glued to the substrate, usually a leaf or twig. The head capsule is pale yellowish-white, while the body of the mummy is mostly dark brown to

blackish. The body of the mummy is mostly smooth on top, but with some small setose tubercles and with some long setae or hairs around the lower margins. As the mummy forms the body shrinks, pulling the head capsule backward until it is tilted nearly face upwards. Thus, when viewed from directly above, the entire anterior face of the head capsule is clearly visible. When formed on a twig, these mummies are rather cryptic, somewhat resembling a bud or gall.



Acronicta lobeliae



Acronicta hasta



Acronicta morula



Acronicta morula

Wasp distribution. Although first discovered in Quebec, *A. quebecensis* is widely distributed from Quebec southward to Florida and westward through the northern states and Canada to Wisconsin, South Dakota, Oregon, and British Columbia.

Biology. The period of flight activity for adult wasps ranges from early June to mid-August. Wasps have been collected at lights and have very large ocelli, indicating that the species is nocturnally active. *Aleiodes quebecensis* is an arboreal species that appears to be oligophagous on young *Acronicta* caterpillars in several broadleaf trees.

Similar species. Most similar to *A. geometrae*, but *A. quebecensis* is very distinctive and can be distinguished from *A. geometrae* and all other members of the *pulchripes* species-group by the arched vein RS in the hind wing and the brightly colored yellowish or white hind tarsus.

Best reference. Shaw *et al.* (1997).

Comments. I've seen mummies formed both on leaves and on twigs, but the ones on leaves may have been lab-reared. Mummies formed on twigs are more cryptic than those on leaves.

***Aleiodes rileyi* Cresson**

Riley's mummy-wasp

Diagnostic features of adult wasp. Body *entirely honey-yellow or orange*. Antenna black. Body length 5.5-8.0 mm. Antenna with 53-55 segments. Malar space about equal to basal width of mandible. Ocelli large, ocell-ocular distance equal to, or slightly less than, diameter of lateral ocellus. *Tarsal claws strongly pectinate* with seven to eight stout teeth. Marginal cell of hind wing narrowest in middle, widening toward wing apex. *Males with terga 4-6 densely covered with golden setae* (subdivided medially).



Host caterpillars. Recorded from a variety of caterpillars, including the noctuids *Acronicta obliqua* (J.E. Smith), *Melanchra picta* (Harr.), and *Nephelodes minians* Gn.; the lymantriid *Dasychira vagans* (B. and McD.); and possibly the pyralids *Ostrinia obumbratalis* (Led.) and *O. penitalis* (Grt.). Most of these records need confirmation. I've only seen associated mummies of the smartweed caterpillar (=smeared dagger moth), *A. obliqua*.

Diagnostic features of host mummies. Mummies of the smartweed caterpillar, *Acronicta obliqua*, are 15-17 mm long, mostly black, with lighter yellowish-white along sides, and with mottled inter-segmental yellowish-white markings. The head capsule is black and widely separated from body of mummy by a very large glue-hole. Segments have bands of round, raised tubercles set

with long yellowish-white spines, but these tend to break off as the mummy ages. There are many long yellowish-white spines compressed into the area behind the head capsule. Mummies vary greatly in the number of spines remaining and in the extent of dark color. Light-colored parts appear to darken with age. The loss of spines on mummies and darkening of light colors indicate aging of the mummies and exposure to weather. Probably, the wasp over-winters inside a mummified host caterpillar.



Wasp distribution. Recorded from Connecticut southward to Florida and westward to Michigan, Kansas, and Saskatchewan. Probably present through most of the eastern United States.

Biology. All the recorded hosts are generalist-feeders on a variety of low vegetation, shrubs, and small trees, including *Prunus* and willow. Adult wasps are active in Florida as early as January, but in northern parts of its range, the wasp flies in late summer. It appears to be a polyphagous species, utilizing several unrelated hosts on a variety of low plants. In Illinois, the wasp has been found in pitcher plants.

Similar species. *Aleiodes rileyi* is a member of the *apicalis* species-group, distinguished by their strongly pectinate claws and males with dense setae on the posterior metasomal terga. *Aleiodes rileyi* is quite distinctive in being the only member of this group that is entirely orange, without black markings on the body.

Best reference. Shaw *et al.* (1998a)

Comments. This wasp is named after Charles Valentine Riley, one of the most famous American entomologists of the late 1800s.

Aleiodes rugulosus (Nees) Wrinkled mummy-wasp

Diagnostic features of adult wasp.

Body color *almost entirely black* except for some orange on legs and sometimes at base of metasoma. Body length 8 mm. Antenna with 65-70 segments. *First two metasomal segments extremely coarsely sculptured.*

Host caterpillars. In Europe this species attacks *Oxicea geographica*, *Simyra albovenosa*, and several species of *Acronicta*.

Its hosts in the northeastern United States are not yet known, but presumably the host range would include these and perhaps other related genera of acronictine Noctuidae. In Canada, this species has been reared from *Acronicta distans* and *A. obliqua*.



Diagnostic features of host mummies. Mummies formed by this species are 1.0-1.5 cm long, with black head capsules and numerous long, whitish hairs arising from raised segmental tubercles.



Acronicta distans



Acronicta obliqua



Acronicta rumicis

Wasp distribution. This species is native to Europe, but is now found in Canada and the northeastern United States.

Biology. Details of the biology in Europe are given by Mark Shaw (2002). The species is oligophagous on several acronictine noctuid caterpillars, only found on low plants.

Similar species. This species has extremely coarse metasomal sculpture and cannot be confused with any other North American species. It is the only member of the *rugulosus* species-group that occurs in North America, so it can be keyed to species using the species-group key provided by Shaw *et al.* (1997).

Best reference. Shaw *et al.* (1997) and Shaw (2002).

Comments. *Aleiodes rugulosus* was studied in Europe during the early years of the gypsy moth problem. Apparently, material was also studied in New England, but there is no record of releases. Subsequent collections in eastern North America indicate that it may have been released, or perhaps the species has a natural holarctic distribution, but has only been recently noticed in North America.

***Aleiodes sanctihyacinthi* (Provancher)**
Saint Hyacinth mummy-wasp

Diagnostic features of adult wasp. Body mostly *two-colored orange and black*. *Eye posteriorly margined with orange*. *Pterostigma entirely dark brown*. Body length 4.5-5.5 mm. Antenna with 46-48 segments. Top of head with rough rugose sculpture. *Fourth metasomal tergum with fine granular sculpture*.



Host caterpillar. *Hyphantria cunea* (Drury).

Diagnostic features of host mummies. The mummified caterpillars are 10-12 mm long, with a black head capsule, and a body with dark blackish dorsal longitudinal band and yellowish sides. There are numerous segmental round tubercles, each set with long, mostly white hairs. The resulting mummy is densely hairy, but the body color is still easily visible. Mummies are found inside the silk shelters of the host.



Wasp distribution. Found in northeastern North America (New Brunswick, Nova Scotia, Quebec, and Maine) westward to Wisconsin, Wyoming, and Utah. The southern extent of its range is not known, but *A. sanctihyacinthi* probably occurs throughout the range of its host caterpillar. This species has been introduced to Yugoslavia for biological control under the name *Rogas hyphantriae*.

Biology. This species is an apparently monophagous parasitoid of the fall webworm caterpillar, *Hyphantria cunea* (Drury). The host caterpillar is a common eastern pest known to feed on more than 100 tree species, including ash, hickory, maple, oak, walnut, and apple. The caterpillars form large communal silk webs near the tips of branches, and the mummified caterpillars can be found inside these silk shelters. Dunstan (1922) studied the biology of this species and found some silk webs with 30-40 percent of all caterpillars parasitized. He noted that young caterpillars, about 10 days old, are attacked. The caterpillars are mummified during the fourth larval instar, shrinking to 10-12 mm long. Adult wasps emerge after about two weeks. Dunstan noted that, because the season is well-advanced by the time adults emerge, they probably overwinter in the adult stage. He also speculated that, since a long period of time must elapse between the emergence of adults in the fall and egg-deposition into *Hyphantria* during the following summer, the species might well have another host in the spring. If so, it has not yet been discovered. During the introduction of this species to Europe for biological control purposes, the biology of this species was studied by Bogavac (1955) and Tadic (1959) under the name *Rogas hyphantriae*.

Similar species. *Aleiodes sanctihyacinthi* is similar to *A. aciculatus* (both species have rough sculpture on the top of the head). It can be distinguished from *A. aciculatus* by its entirely brown pterostigma and by the granular sculpture of the fourth metasomal tergum.

Best references. Gahan (1922) and Dunstan (1922) (as *Rogas hyphantriae*).

Comments. The scientific and common names for this species refer to the fact that it was first discovered in St. Hyacinth, Quebec (Provancher 1880). Most of the historical literature refers to this species as *Rogas hyphantriae*.

***Aleiodes scrutator* (Say)**

Yellow-marked mummy-wasp

Diagnostic features of adult wasp.

Body two-colored: honey-yellow with dark brown markings. *Metasoma* dorsally dark brown with a large yellow or yellowish-white medial spot. Pterostigma two-colored: brown medially, yellow at base and apex. Body length 4.5-6.0 mm. Antenna with 37-45 segments. Ocelli rather small, ocell-ocular distance equal to or wider than ocellus width.



Host caterpillars. Recorded (based on museum specimens) as attacking the choreutid *Caloreas angustella* (Clarke), the tortricid *Endopiza viteana* (Clemens), the geometrid *Lambidina fervidaria athasaria* (Walker), the notodontid *Clostera inclusa* (Hübner), and the noctuid *Plathypena scabra* Fabricius.

Diagnostic features of host mummies. Some mummies formed by this species are small (about 8 mm long), smooth, and rather non-descript yellowish-brown.



Wasp distribution. This species is widely distributed across the United States and southern Canada. It appears to be more common in the northern parts of its range and at higher elevations.

Biology. Not studied in any detail, but the recorded host records seem to indicate that this species is widely polyphagous on a variety of small caterpillars feeding on many trees, including aspen, poplar, white oak, and willow.

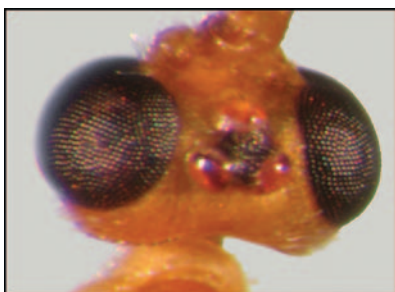
Similar species. Most similar to the European species *Aleiodes circumscriptus*. *Aleiodes scrutator* is the only common member of the *circumscriptus* species-group in eastern North America, and in some forest conditions, it can be quite common. It can be identified using the species-group key provided by Shaw *et al.* (1997).

Best reference. Shaw *et al.* (1997).

Comments. All the host records for this species need confirmation.

Aleiodes simillimus* (Ashmead)*Similar mummy-wasp**

Diagnostic features of adult wasp. Body color *mostly honey-yellow*, except *ocellar triangle, propodeum, base of tergum 1, and sides of terga 2+3 dark brown to black*. Stigma two-colored but with darkened medial area not discrete, rather translucent, with dark color grading into lighter basal and apical areas. Body length 4.0-5.0 mm. Antenna with 40-45 segments. *Eyes and ocelli large, ocell-ocular distance about half the diameter of lateral ocellus*. Hind wing with *vein RS arched in the middle, marginal cell narrowest near middle*.



Host caterpillars. Recorded from several small arboreal geometrids, including *Narraga fimentaria* Walker, *Semiothisa cyda* (Druce), *S. colorata* Grote, *Tornos scolopacinarius* (Guenée), *Glena cribrataria* (Guenée), *Itame pustularia* (Guenée), *Erannis tiliaria* (Harr.), and *Lomographa vestaliata* (Guenée).

Diagnostic features of host mummies. Mummies about 9-10 mm long, mostly light whitish to yellowish-brown, with fine mottled black markings and transverse black bands in prothoracic area. Smooth and slightly tapered at both ends.

*Erannis tiliaria**Semiothisa* sp.

Wasp distribution. This species is found throughout the eastern United States from New Hampshire south to Florida and westward to Michigan and Texas.

Biology. *Aleiodes simillimus* is a highly polyphagous parasitoid of small arboreal Geometridae caterpillars.

Similar species. As the name implies, this is a rather non-descript small yellowish species that is quite similar to several others in the *gastritor* species-group. In the east, it is most similar to *A. gastritor*, but can be separated by its larger ocelli and longer antennae. It is also similar to *A. buoculus* Marsh, a parasitoid of geometrid caterpillars on jojoba, but that species only occurs in the southwestern United States (Marsh 1989).

Best references. Ashmead (1889), Marsh (1989).

Comments. This species is very similar to *A. gastritor*, and careful field studies of the host ranges are needed.

***Aleiodes smithi* Marsh and Shaw** Smith's banded mummy-wasp

Diagnostic features of adult wasp. Body color mostly honey-yellow, sometimes with brown markings on dorsum of mesosoma. *Antennal flagellum black with white band consisting of 5-12 segments.* Body length 6-8 mm. Antenna with 44-50 segments. Oral opening oval, diameter equal to or slightly greater than malar space. Malar space equal to or wider than mandible width. Ocelli small. Tarsal claws simple, not pectinate. Hind wing marginal cell narrowest at base, widening to apex.



Host caterpillars. Reared from the noctuid *Lascoria ambigualis* Walker.

Diagnostic features of host mummies. Mummies are about 1 cm long, with the body of the mummy mostly very smooth and very dark reddish-brown, almost black. The head capsule is brown, mottled with light yellowish-white irregular spots. Behind the head, there is a short prothoracic collar that is narrower than the head or the remainder of the mummy, giving the appearance of a short neck. The front end of the mummy is densely wrinkled. The wrinkles are lighter yellow, and under close inspection, give the appearance of many fine yellow cross-bands.



Lascoria ambigualis

Wasp distribution. This species occurs widely through the eastern United States. It has been found from Ontario and Massachusetts southward to Florida and westward to Wisconsin and Missouri. It also occurs in Mexico and Costa Rica.

Biology. The only known host is the ambiguous moth, *Lascoria ambigualis*, a caterpillar known to feed on ragweed, chrysanthemum, and horseradish. This species is found in forest meadows, understory vegetation, and along streambeds.

Similar species. This species is most closely related to *A. ecuadoriensis* Brues, a South American species that does not occur in North America.

Best reference. Marsh and Shaw (2001).

Comments. *Aleiodes smithi* is the only *Aleiodes* species in the eastern United States that has a white-banded antenna, so it can be easily identified even without a microscope. The species is named after sawfly researcher David Smith, who collected many specimens of this species in Virginia.

***Aleiodes stigmator* (Say)**
Stigmata mummy-wasp

Diagnostic features of adult wasp. *Body color mostly yellowish orange, except metanotum and propodeum brown to black. Metasoma usually entirely orange, but sometimes with dark brown or black basally on first tergum. Stigma two-colored, translucent brown to black medially, pale yellowish-white basally and apically. Body length 4.0-5.0 mm. Antenna with 31-32 segments. Frons, temple, and vertex with fine granular sculpture. Malar space longer than basal width of mandible. Tarsal claws weakly pectinate basally, appearing simple. First metasoma tergum wider at apex than long. Hind wing with vein RS arched in the middle, marginal cell narrowest near middle.*



Host caterpillars. Host range includes several acronictine noctuids, including *Acronicta americana* Harris, *A. dactylina* (Grote), and *A. hastulifera* (Smith), as well as the notodontid *Simyra henrici* Grote. I've also seen a *Catocala* mummy that appeared to be attacked by this wasp species.

Previous records of this wasp species attacking the geometrid *Alsophila pom-etaria* are erroneous and actually refer to *Aleiodes gastritor*. Previous records of this wasp species as attacking *Malacosoma* species are also erroneous and refer to the species now known as *Aleiodes malacosomatos*.

Diagnostic features of host mummies. The mummies vary in appearance depending on the species, but all are exceptionally large for *Aleiodes*, ranging from 2-3.5 cm. in length. Most are hairy mummies, but the hairs may fall off as the mummy is exposed to weather. Once the wasps emerge, there can be no doubt about the identity of the species as this is the only gregarious *Aleiodes* species in eastern North America. It is not unusual for 40-50 wasps to emerge from a single mummy. The emergence holes are evenly spread across the top of the mummy, from front to back, leaving a quite distinct appearance, as though pelted evenly by shotgun pellets.



Wasp distribution. This species is widely distributed across Canada and the northern United States. It is associated with marsh areas and is usually found near plants such as willows and cattails.

Biology. Since the work of Mason (1979), this species has been interpreted as a polyphagous strictly gregarious parasitoid utilizing relatively large caterpillars. Hosts attacked include several acronictine noctuids such as *Acronicta americana* Harris, *A. dactylina* (Grote), and *A. hastulifera* (Smith), as well as the notodontid *Simyra henrici* Grote and some *Catocala* species. Adult wasps emerge in late summer or early autumn. Whether they overwinter as adults or have another host caterpillar for overwintering is still unknown.

Similar species. *Aleiodes stigmator* is quite similar morphologically to *A. malacosomatoides*, but has less coarse and more shining sculpture on the head and mesosoma, and the fore wing stigma is less distinctly two-colored. The habits of the two species are quite different, as *A. stigmator* is a gregarious parasitoid of much larger noctuid and notodontid caterpillars. This is the only gregarious *Aleiodes* species in the eastern United States, so when reared from caterpillars, it is quite easy to identify.

Best reference. Mason (1979).

Comments. This is the oldest known North American *Aleiodes* species, having been discovered by the first American entomologist, Thomas Say, in 1824. Despite this long history, the biology of the species has never been carefully studied, and much could be learned by detailed field research. The name “stigmata mummy-wasp” is a reference to the exit holes that are produced in the host caterpillar. Thomas Say thought they looked like the stigmata in the hands and feet of the Christ.

Aleiodes terminalis* Cresson*Terminal mummy-wasp, the Terminator**

Diagnostic features of adult wasp. Body mostly two-colored: *contrasting orange and black*. Head and mesosoma black. Metasomal terga 1-2 (sometimes tergum 3 partly) orange; remaining metasomal terga black. Antenna brown medially to black apically. *Hind tibia black with light yellowish-white band on basal third. Hind tarsomeres black*. Wings clear but lightly pigmented. Tegula yellow. Body length 5.0-8.0 mm. Antenna with 55-62 segments. Oral opening circular, diameter about equal to basal width of mandible. Malar space equal to basal width of mandible. Ocelli small, distance between eye and lateral ocellus about equal to ocellus width. Median length of pronotum shorter than distance between occipital carina and lateral ocellus. Mesopleuron smooth except *subalar sulcus and sternalus rugose*. *Forewing vein 1cu-a beyond vein 1M by more than twice its length*. Vein RS of hind wing straight, marginal cell of hind wing narrowest at base and widening toward apex. *Hind wing vein m-cu present as short stub*. Apex of hind tibia without a row of flattened setae along inner margin, setae normal and hair-like. Tarsal claws *not pectinate*. First metasomal tergum not parallel-sided, wider apically than at base. Apex of metasoma not compressed in female. Metasomal tergum 3 costate at base, remainder smooth. Males with metasomal terga normal, not densely setose.



Host caterpillars. Attacks several species of “cutworm-like” Noctuidae larvae, including *Mythimna* (= *Pseudaletia*) *unipuncta* (Haworth), *Nephelodes minians* Guenée, *Spodoptera frugiperda* (Smith), *S. ornithogalli* (Guenée), and *Xestia smithii* (Snellen).

Diagnostic features of host mummies. Mummies induced by this species are 10–12 mm long, very dark brown, and the cuticle is compacted and strongly wrinkled at the anterior end, just behind the head capsule. The head capsule sometimes falls away in older mummies exposed to weather. When formed on a twig or small branch, the mummy is highly cryptic as it resembles a bud or stem gall.



Wasp distribution. This species is widely distributed across Canada and the continental United States as far south as Mexico. It is very common in eastern forests and probably the most frequently encountered *Aleiodes* species in the East.

Biology. The biology of this species was studied by Pennington (1916). In Maryland, *A. terminalis* usually has four, and possibly as many as six, generations per year. Adult wasps emerge about 17 days after the mummy is formed. Mating takes place immediately after emergence, and females are able to begin laying eggs immediately after mating. Females live for an average of 32 days, but may live as long as 75 days. Males only live about half as long as females, averaging about 16 days. Females oviposit only into second or third instar hosts larvae. Overwintering is inside mummified host.

Similar species. Superficially similar to other large red and black *Aleiodes* species, such as *A. abdominalis*, *A. pseudoterminalis*, and *A. ufei*. *Aleiodes terminalis* can be easily distinguished from similar species by the light colored band on the anterior third of the hind tibia.

Best reference. Marsh and Shaw (2001).

Comments. Adults of this species are nocturnally active and commonly collected at lights. Perhaps the most commonly encountered *Aleiodes* species in the eastern states.

Aleiodes texanus* Cresson*Texas mummy-wasp****Diagnostic features of adult wasp.**

Body two-colored: black and reddish orange. Metasoma entirely reddish orange. Wings dusky. Body length 7.0-8.5 mm. Antenna with 58-62 segments.

Malar space short, about equal to mandible width.

Eyes and ocelli large.

Ocell-ocular distance narrow, lateral ocellus near eye margin. Lateral ocellus one to two times wider than ocell-ocular distance.

Hind wing vein RS sinuate and strongly arched, *RS approaching wing margin medially*.

Hind wing marginal cell very narrow in middle.



Host caterpillars. In the East this species has been reared from the walnut sphinx, *Amorpha* (= *Laothoe*) *juglandis* (J.E. Smith); the hog sphinx, *Darapsa myron* (Cramer); the Nessus sphinx, *Amphion nessus floridensis* B.P. Clarke; and other unidentified Sphingidae. In Arizona, this species has been reared from *Ceratomia sonorensis*.

Diagnostic features of host mummies. About 12-15 mm long, smooth, pale brownish-tan with dark brown bands, and densely covered with tiny spinules. Broadly attached to the substrate by an antero-ventral glue-hole. Head capsule either decapitated from mummy or attached by a small piece of cuticle that is prone to breaking away as the mummy ages. Has a distinct posterior caudal horn about 4 mm long or a distinct pit if the caudal horn has fallen off.



Ceratomia sonorensis



Darapsa myron

Wasp distribution. The name refers to the fact that the species was first discovered in Texas. It is actually very widely distributed in the eastern United States from Michigan and Massachusetts southward to Florida and the Gulf Coast and westward to Montana, Texas, and northern Mexico.

Biology. Mummies are firmly glued down by a very large antero-ventral glue-hole, which usually results in decapitation of the caterpillar. Thus, wild-collected mummies usually lack a head capsule. The caudal horn of sphingid hosts is quite distinctive, but may fall off as the mummy ages or overwinters, leaving a visible pit. Adult wasps are arboreal, attracted to lights, and probably nocturnally active. *Aleiodes texanus* is associated with sphingid hosts on several broadleaf trees and vines, including walnut, ash, and grape. The wasp is probably univoltine in the North and multivoltine in the South.

Similar species. Most closely related to *A. ceratomiae*, but *A. texanus* is easily distinguished by its smaller ocelli and bright reddish orange metasoma.

Best reference. Shaw *et al.* (1998b).

Comments. *Aleiodes texanus* is one of the few species that is large enough and with sufficiently distinctive markings that it can easily be spot-identified even without magnification. The black and orange body and blackish wings are distinctive.

Aleiodes vierecki* Marsh and Shaw*Viereck's mummy-wasp**

Diagnostic features of adult wasp. Body color entirely honey-yellow. Wings clear. Tegula yellow. Body length 7.0-8.5 mm. Malar space equal to basal width of mandible. Temple narrow, about half the eye width. Oral opening small, circular. Diameter of lateral ocellus equal to, or slightly greater than, ocellular distance. Tarsal claws not pectinate. Basal third of hind wing vein RS nearly parallel to wing margin, then curving downward, marginal cell suddenly widening.



Host caterpillars. Unknown.

Diagnostic features of host mummies. Unknown.

Wasp distribution. Known from Kansas, Oklahoma, and Michigan.

Biology. The adult wasp flies early in the summer, from April to mid-June and is attracted to lights.

Similar species. This species is similar to *A. atricornis*, a common species of midwestern grasslands and prairies. It differs from *A. atricornis* by having larger ocelli, narrow temple, and hind wing RS vein slightly curved.

Best reference. Marsh and Shaw (2001).

Comments. *Aleiodes vierecki* is a midwestern species that is not common in the East. In the East, it has only been collected from central Michigan. The wasp is named after H. L. Viereck, a student of the Braconidae who worked in the early 1900s.

***Aleiodes virginiensis* Marsh and Shaw**

Virginia mummy-wasp

Diagnostic features of adult wasp.

Entire body including antenna and legs entirely honey-yellow to light orangish-brown, without black markings. Tegula yellow. Fore wing stigma two-colored, brown medially with yellow at base and apex. Body length 7.0-8.0 mm. Antenna with 58-63 segments. Ocelli large, ocell-ocular distance half the diameter of lateral ocellus. Occipital carina incomplete, interrupted on vertex. Fore wing vein r shorter than vein 3RSa. Hind wing vein RS parallel to wing margin on basal third, then suddenly curved downward. Hind wing marginal cell suddenly widened at apex. Apex of hind tibia with a row of flat setae on inner side.



Host caterpillars. Unknown.

Diagnostic features of host mummies. Unknown.

Wasp distribution. So far, only known from Essex County, Virginia.

Biology. The caterpillar hosts of this wasp species are not yet known. In Virginia, adult wasps fly from mid-July to mid-September.

Similar species. This species is similar to *A. preclarus* and *A. wahli*, but can be distinguished by its entirely honey-yellow to orangish-brown body without black markings.

Best reference. Marsh and Shaw (1998).

Comments. According to David Smith, the collector of the type-series, the area where this species was found is dominated by mixed hardwoods and pine (mostly tulip tree, sweet gum, oaks, hickories, and *Pinus taeda*) in the coastal plain, in mostly sandy soils.

Aleiodes wahl* Marsh and Shaw*Wahl's mummy-wasp**

Diagnostic features of adult wasp. *Antennal flagellum yellow.* Mesosoma yellow with black or dark brown markings. Tegula brown. Fore wing stigma two-colored, brown medially with yellow at base and apex. Hind coxa brown on lower end. Hind femur brown on apical three-fourths. *Metasoma light yellowish-brown, without black markings.* Body length 5.5-6.0 mm. Antenna with 56-59 segments. *Ocelli large, ocell-ocular distance half the diameter of lateral ocellus.* *Occipital carina incomplete, interrupted on vertex.* Fore wing vein r shorter than vein 3RSa. Hind wing vein RS parallel to wing margin on basal third, then suddenly curved downward. *Hind wing marginal cell suddenly widened at apex.* *Apex of hind tibia with a row of flat setae on inner side.*



Host caterpillars. Unknown.

Diagnostic features of host mummies. Unknown.

Wasp distribution. Known so far only from localities in Florida and North Carolina.

Biology. The caterpillar hosts of this wasp species are not yet known. In Florida, the adult wasps have been collected on dates in late August through early January.

Similar species. This species is similar to *A. virginienensis* and *A. preclarus*, but can be distinguished by its yellow antenna.

Best reference. Marsh and Shaw (1998).

Comments. Most of the collecting records for this species are from hammocks of southern Florida. The species is named after Dr. David Wahl of the American Entomological Institute in Gainesville.

PHOTOGRAPHY CREDITS

Aleiodes indiscretus attacking gypsy moth larva: photo by Scott Bauer, USDA/ARS Image Gallery, image number K7656-1

Aleiodes stigmator parasitizing *Acronicta americana*: photo by David L. Wagner, University of Connecticut, DLW Lot 2004H97.

Aleiodes aciculatus mummy *Euchlaena serrata*, *Aleiodes albitibia* mummy *Nerica* sp., *Aleiodes pallidator* mummy *Dasychira* sp., *Aleiodes sanctahyacinthi* mummy *Hyphantria cunea* (left-hand photograph on page 84), *Aleiodes simillimus* mummy *Erannis tillaria*, and *Aleiodes smithi* mummy on *Lascoria ambigualis* (right-hand photograph on page 90): photos by Daniel Dalton, University of Wyoming.

All other photographs: Scott Shaw, University of Wyoming.

GLOSSARY

- abdomen** The posterior section of an insect body. In Hymenoptera, including parasitoid wasps, the apparent “abdomen” is usually referred to as the “metasoma” because part of the true abdomen is fused to the thorax to form the middle section of the body, the “mesosoma.”
- aciculate** Microscopic surface sculpturing resembling fine longitudinal lines, appearing as though scratched by a needle. Seen, for example, on the metasomal terga of *A. aciculatus* under high magnification.
- annulus** A light-colored band, usually white or yellowish-white, on the antenna. Only one eastern U.S. species (*A. smithi*) shows this characteristic, but it is common in some tropical Braconidae.
- arboreal** Tree-dwelling. Some *Aleiodes* species attack hosts living in trees, while others attack low-dwelling hosts in the understory or among herbaceous plants.
- banding** A method for collecting caterpillars in which bands of material, paper, or cardboard are wrapped around a tree trunk to create protected shade and attract caterpillars. Useful for sampling caterpillars that feed at night and hide during the day on tree-trunks or in the leaf-litter.
- beating sheet** A square of material supported by a wooden-frame, used for collecting caterpillars. The sheet is placed under a branch that is then shaken or beaten with a stick or net-handle to dislodge caterpillars, which fall on the sheet. Useful for dislodging mummies. A light-colored umbrella works just as well.

- body length** Size of an *Aleiodes* wasp measured from the front of the head to the end of the metasoma, excluding the antenna and ovipositor.
- broad host range** Indicates when a parasitoid wasp is able to use many different caterpillar species as hosts.
- caudal horn** A large spine-like structure on the posterior end of caterpillars of the moth family Sphingidae, which is a characteristic feature of sphingid larvae (horn-worms). This feature is preserved in sphingids mummified by *Aleiodes* of the *praetor* species-group (*A. ceratomiae* and *A. texanus*).
- clypeus** Lower part of the head just below the face and just above the oral opening. The upper corners of the clypeus are marked by the anterior tentorial pits, which appear as small round holes.
- compressed metasoma** The posterior section of the wasp's body is pressed together from side to side and so appears narrow when viewed from above. This condition is regarded as a potential adaptation for attacking host caterpillars that are concealed in narrow spaces, such as in leaf rolls.
- concave labrum** The labrum is the lower part of the head just above the mouth and below the clypeus. In *Aleiodes*, the labrum is concave and forms the back wall of the (scooped out) oral opening.
- costate** Microscopic surface sculpturing with longitudinal raised ridges.
- death-wasp** A common name for any species in the parasitic wasp family Braconidae.
- endoparasitoid** A parasitic larva, such as *Aleiodes*, that feeds inside the body of its host caterpillar.
- first metasomal tergum** The first segment of the apparent abdomen of a wasp, as viewed from above. This body part varies in shape, color, and surface sculpturing, and so provides useful diagnostic features for several *Aleiodes* wasp species.
- frass** Caterpillar droppings.
- hind wing vein RS** The radial sector vein of the hind wing, which is located in the outermost upper section of the wing. In *Aleiodes* species, the RS vein varies in shape and direction. Sometimes, it is gently sinuate (S-shaped), in which case the marginal cell appears narrowest toward

the middle. Sometimes, the RS is nearly straight and oriented toward the lower outer edge of the wing, in which case the marginal cell is broader as it approaches the wing margin. See the diagram at the end of the Glossary.

- host caterpillar** A lepidopterous larva that is attacked by a parasitoid and serves as its food source.
- host plant** The plant on which a host caterpillar feeds, so the parasitoid species is also associated with it.
- host range** The set of caterpillar species (one to several) that a parasitoid wasp is able to attack successfully in a natural setting.
- ichneumon-fly** An old-fashioned common name, formerly used for wasp species of the family Ichneumonidae and Braconidae. Not used much since the early 1900s, but appearing in much older literature.
- koinobiont** A parasitoid species, as in *Aleiodes* wasps, whose attacking parasitoid adult injects an egg but does not permanently paralyze the host larva. This allows for the attack of rather small host caterpillars. After being parasitized, the host caterpillar continues to feed and grow, often acting and appearing normal for some period of time before the parasitoid larva completes its development and emerges.
- lateral ocellus** Either one of the simple eyes on the top of the head that is situated laterally, closest to the margin of the compound eye.
- Malaise trap** A type of flight-intercept trap that is commonly used for collecting adult wasps. It consists of several panels of fine-mesh material topped by a tent-like portion that directs flying insects into a collecting jar.
- malar space** The space between the lower margin of the compound eye and the mandible. Usually measured relative to the width of the mandible at its base.
- marginal cell of hind wing** The outermost area of the hind wing along the leading (anterior margin) that is bordered by the radius (R) and radial sector (RS) veins. Because the RS vein varies in shape and orientation, the marginal cell appears to have different shapes in different *Aleiodes* species. Usually it has one of two shapes: broad and gradually wider toward the wing apex or very narrow near the middle as the RS vein curves toward the leading wing margin. See the diagram at the end of the Glossary.

- m-cu vein** Small cross-vein located in the lower middle area of the hind wing of *Aleiodes* wasps. It may be present or absent, depending on the species. See the diagram at the end of the Glossary.
- mesopleuron** In wasps, the section of the middle body located below the front wing and above the middle leg. Surface sculpturing of this body part varies among different *Aleiodes* species.
- mesosoma** The middle section of a wasp's body (apparent thorax), where the legs and wings are attached. In bees, ants, and wasps, this area is called the "mesosoma" rather than "thorax" because it consists of the true thorax and also part of the abdomen that is fused to form the propodeum at the end of the mesosoma.
- metasoma** The posterior section of an insect body. In Hymenoptera, including parasitoid wasps, the apparent "abdomen" is usually referred to as the "metasoma" because part of the true abdomen is fused to the thorax to form the middle section of the body, the "mesosoma."
- metasomal terga** The segmental plates on the top posterior part of a wasp's body. In *Aleiodes* species, these terga vary in size, shape, color, density of setae, and surface sculpture, and so provide many useful diagnostic features.
- multivoltine** Having more than one generation per year. Some *Aleiodes* species may have four to six generations per year.
- mummification** The process of forming a caterpillar mummy.
- mummy** A caterpillar that has been parasitized by an *Aleiodes* wasp larva. The remains of the host shrink somewhat but remain inflated and intact (mummified). The host remains, if protected from weather, do not degrade further and can be kept indefinitely in a museum collection without preservatives.
- mummy-wasp** A common name for any wasp in the genus *Aleiodes*.
- narrow host range** Indicates when a parasitoid wasp is able to use only one or a few caterpillar species as hosts.
- ocell-ocular distance** The shortest distance between a lateral ocellus and the margin of the compound eye. The ocell-ocular distance is commonly measured relative to the width of a lateral ocellus.

- ocellar triangle** The triangular area on the top of the head circumscribed by the three ocelli (simple eyes). In some species (e.g., *A. nigristemmaticum*), this area may be a different color than the remainder of the head.
- ocelli** (singular: **ocellus**) Three simple eyes located on the top of the wasp's head. The middle ocellus is the median ocellus. The other two are the lateral ocelli.
- occipital carina** A narrow rim or microscopic ridge that borders the back side of the head in *Aleiodes* wasps. If the side parts of the carina meet at the top of the head, the occipital carina is said to be "complete." If the side parts are separated, not meeting at the top of the head, then the occipital carina is said to be "broken" or "incomplete." The carina can be complete, narrowly broken, or widely broken, depending on the wasp species.
- oral opening** Not the true mouth, but the concave space formed by the lower margin of the clypeus, the concave labrum, and the mandibles. In *Aleiodes* wasp species, this space varies in shape (circular to oval) and size depending on the wasp species.
- ovipositor** The egg-laying device and "stinger" of a female wasp. *Aleiodes* females use this to inject temporary venoms and eggs. *Aleiodes* do not sting humans.
- oviposition** The process of injecting an egg into a host caterpillar via the ovipositor.
- pectinate** Comb-like: referring to the condition of the tarsal claws when there is a microscopic set of extra spines or setae, giving the claw a comb-like appearance under high magnifications.
- porcate** Coarse microscopic surface sculpturing resembling several raised parallel ridges separated by distinct furrows. Seen, for example, on the metasomal terga of *A. politiceps*, easily visible even at low magnifications.
- pronotum** The most anterior upper part of the mesosoma, located just behind the head. This structure varies in size and shape in several *Aleiodes* species.
- propodeum** The most posterior of the four segments of the mesosoma. The propodeum is actually the first true abdominal segment, which is

fused to the thorax and separated from the rest of the abdomen by a constriction.

Rogas Name of a genus of wasps closely related to *Aleiodes* and the type-genus of the subfamily Rogadinae in which *Aleiodes* is classified. Many North American *Aleiodes* species were formerly classified as *Rogas* species, so the name occurs frequently in much of the older literature.

rugose Microscopic surface sculpturing that is wrinkled, rough, and irregular.

setae Hair-like or bristle-like structures of the insect cuticle. Unlike mammalian “hairs,” these are skeletal features, and they do not grow.

sinuate Gently ‘S’-shaped, curving like a snake: refers to the condition of the hind wing RS vein in certain species.

sternaulus Located on the side of the body above the middle leg, this is a distinct area of the mesopleuron that is sometimes indicated by a patch of rough sculpturing. The presence and texture of sculpturing or its absence varies among species.

stigma A large prominent expanded area in the fore wing venation, along the leading edge of the wing. See the diagram at the end of the Glossary.

subalar sulcus A sculpture depression just below the base of the front wing on the upper side of the body: the upper mesopleuron.

tarsal claws A claw-like structure located at the tip of each leg, at the end of the fifth tarsomere. The true claw is at the tip of the leg. Below the tarsal claw, there may be several additional setae, spines, pegs, or teeth forming a pecten, or comb-like structure, on the lower side of the claw. These features, although microscopic, vary greatly among *Aleiodes* species and provide valuable diagnostic features. If the claw is not visibly pectinate, then it is called “simple.”

tarsomeres One of the five small segments of the tarsus, the end section of a wasp’s leg, between the tip of the tibia (where the two tibial spurs are situated) and the tarsal claws at the apex of the leg.

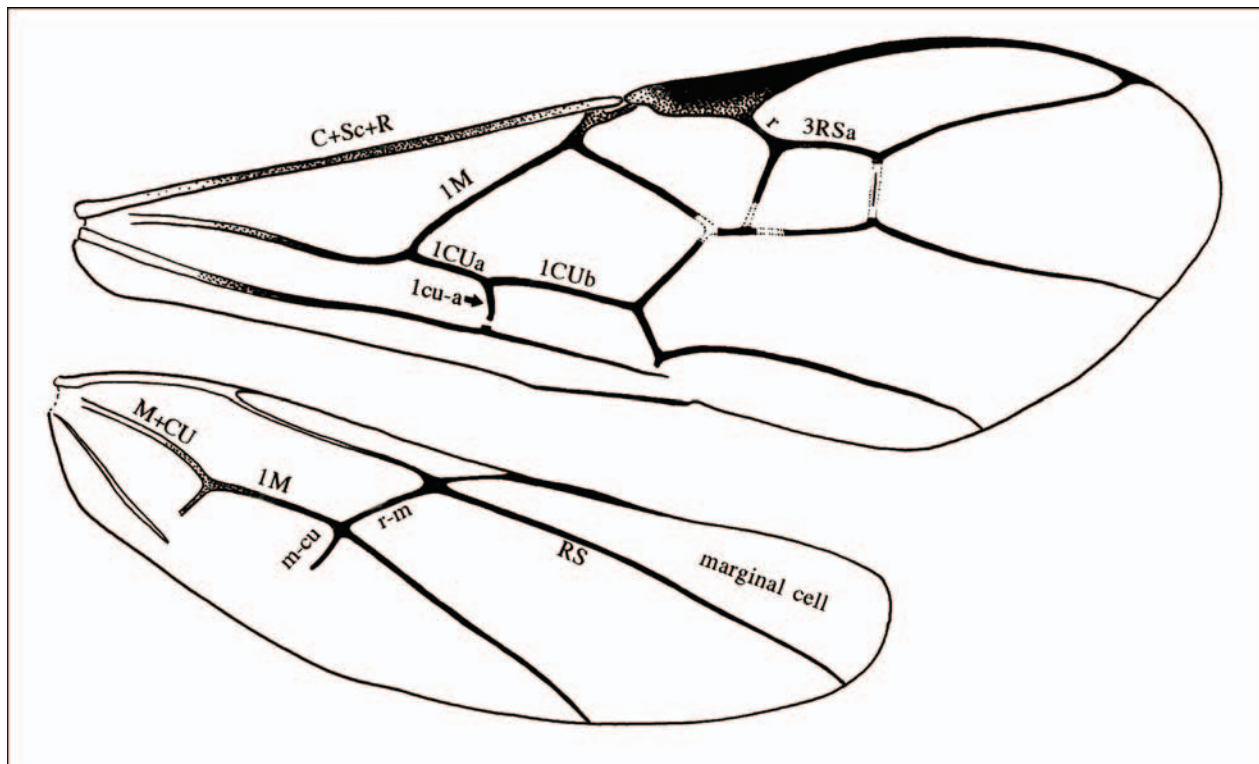
tegula Small flap located over the base of the front wing in wasps. In *Aleiodes* species, the tegula varies in color.

tibia The fifth, longest segment of an *Aleiodes* wasp leg. The hind tibia provides useful diagnostic features for some species, including color variation and variation in the form of setae at the inner apex.

univoltine Having only one generation per year.

vein r A small vein of the fore wing that emerges from the lower middle part of the pterostigma. It's orientation or size is diagnostic in some *Aleiodes* species. See the diagram at the end of the Glossary.

wing The following diagram shows venation patterns of the fore and hind wings (top and bottom, respectively), labelled with diagnostic features for identification of *Aleiodes* species.



Wing diagram of *Aleiodes* wasp. Drawing provided by Paul M. Marsh.

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