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CONTRIBUTIONS ON HYMENOPTERA AND ASSOCIATED INSECTS DEDICATED TO KARL V. KROMBEIN

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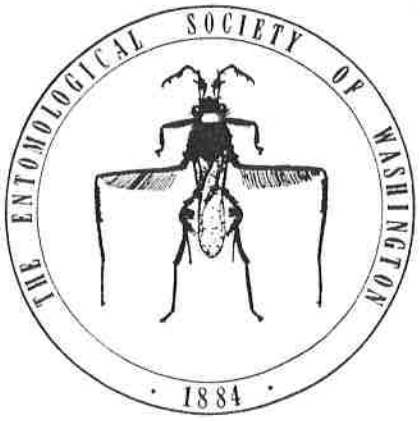

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PREY RECORDS AND NEST STRUCTURE OF SIX SPECIES OF ASTATINAE AND PHILANTHINAE FROM COLORADO (HYMENOPTERA: SPHECIDAE)

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Abstract.—Notes are presented on the nests and prey of six species of digger wasps (Sphecidae) studied in Larimer Co., Colorado. Four of the species belong to the Astatinae: *Astata bechteli, A. occidentalis, A. nevadica,* and *Dryudella caerulea.* The remaining two species belong to the Philanthinae: *Eucerceris superba bicolor* and *Cerceris bicornuta.*

Key Words: Sphecidae, digger wasps, predatory behavior, nest structure

Many years ago, when we were much younger, Karl Krombein and I indulged in two long field trips, during which we recorded the lives of the solitary wasps we encountered (Krombein and Evans 1954, 1955). Little did we suspect that so committed were we to these wonderful animals that we would still be doing the same thing forty years later, unfortunately separately.

Here I report on several species of astatine and philanthine digger wasps studied near my home on the eastern slopes of the Rocky Mountains, in Larimer Co., Colorado. Some of the species have been studied before, but it is always worthwhile to discover behavioral consistencies or differences when species are studied in diverse parts of their ranges.

ASTATINAE

Astata bechteli Parker. This is the commonest of several species of this genus that occur near my home, 23 km west of Livermore, Colorado, at an elevation of 2300 m. Other species occurring here include *A. nubecula* Cresson, *A. leuthstromi* Ashmead, and *A. occidentalis* Cresson. All four species are frequently seen in midsummer along little-used dirt roads passing through meadows. Males of these species occupy perches from which they fly often frequently, behavior often reported for members of this genus. Parker (1962) has noted that one often finds several species of this genus occurring together. Territorial behavior has not been studied in detail.

Several nests of *A. bechteli* were located during July and August 1985 and 1986. All were in hard-packed clay-loam along the sides or in the center strip of dirt roads. Nest entrances were left open during the day, and each had a small, nearly circular tumulus, measuring 6 to 8 cm in length and width and 1 cm high, in front of the entrance to an oblique burrow. Prey is brought in by flight, as usual in this genus, but the female may land some distance away and walk to the burrow. One nest had a single cell when excavated; the cell was 20 cm from the entrance and 11 cm in vertical depth. A second nest had 4 cells, from 10 to 15 cm deep and from 20 to 26 cm from the entrance. Cells were smooth-walled and measured about 9 by 17 mm. The stinkbug prey were fitted tightly into the cells, dorsum-up. A third nest had a single stinkbug in the burrow at a depth of 8 cm; I may have missed the cells, or they may not have yet been made, as species of this genus tend to leave prey in the burrow before making

cells. A fourth nest had a dead female in the burrow; one prey and several puparia were located at a depth of 9 cm.

All prey were adult Pentatomidae: *Banasa dimidiata* (Say), 23; *Thyanta pallidovirens* Stål, 6; *Holcostethus limbolarius* (Stål), 1. The number of prey per cell varied from 5 to 7. This is the first report on the nests and prey of this species. The closely related species *A. nubecula,* of which *A. behteli* was formerly considered a subspecies, has similar behavior, using immature rather than adult Pentatomidae as prey (Parker 1962, Evans 1970). This may not be a species difference, and may merely reflect differences in prey availability. *A. occidentalis* usually takes adults, but will sometimes use immatures, according to Powell and Burdick (1960).

Astata occidentalis Cresson. This is a relatively well studied species (Evans 1958, Powell and Burdick 1960). I include here notes on a single nest found in a cultivated field near Fort Collins, Colorado, on 3 August 1981, at an elevation of about 1520 m. The burrow was oblique and there were 3 cells 8-9 cm in vertical depth. The cells were in a tight clump, only 0.5 to 1.5 cm apart; each was packed tightly with adult stinkbugs, of which 5 were saved for identification: *Holcostethus limbolarius* (Stål), 2, and *Thyanta accerra* McAtee, 3.

Astata nevadica Cresson. This is the smallest species of the genus and has not previously been studied in the field. I found two nests at Chimney Rock, in northern Larimer Co., on 23 August 1981, at an elevation of 2400 m. The soil here consisted of degraded sandstone from nearby cliffs. It was the site of studies of four species of *Philanthus* reported by O'Neill and Evans (1982). In the course of these studies, two nests of *A. nevadica* were observed, both in a 20 degree slope along a gully. One female was seen bringing in small prey in flight, then landing and walking to an open nest under a piece of dried cattle dung. I was unable to find a cell in this nest, but I found two prey at a depth of 6 cm. Both were immature bugs of the family Cydnidae, only 2.5 mm long. They were tentatively identified as *Microporus obliquus* Uhler. A second nest, apparently incomplete, was in a path not far away. The female was digging, forming a small tumulus at the entrance.

Dryudella caerulea (Cresson). This species was studied near Seattle, Washington, by Alcock (1973). He found it to make shallow nests in slopes along a path, using immature Alydidae and Pentatomidae as prey. I add here a brief note on a nest found along a cultivated field near Fort Collins, in July 1981. The female was seen entering an open hole with a tumulus measuring 3.5 by 3.5 cm, about 0.5 cm deep, before the entrance. There appeared to be no completed cells in this nest. The single prey taken was a half-grown bug of the genus *Alydus* (Alydidae).

PHILANTHINAE

Eucerceris superba bicolor Cresson. This rather large member of the genus is widely distributed in the West, but its nests have not previously been reported. I found a nest at the site described above for *Astata nevadica,* on 8 August 1989. A female was seen carrying weevils into an open hole at the base of two small plants on the slope of a gully. The soil here was of reddish, degraded sandstone. The hole was surrounded by a circular tumulus, 8 cm in diameter, with the hole in the center. The nest was excavated 8 days later and the burrow found to descend vertically 27 cm, with only a few small bends. There were 6 cells at depths of 23 to 28 cm, 5–10 cm apart and 12–20 cm from the end of the burrow. Larger cells measured 10 by 20 mm and contained 12 prey; smaller cells measured 10 by 16 mm and contained 7–9 prey. Three of the cells had larvae in various stages of growth. The 28 prey that could be collected were all *Ophryastes sulcirostris* (Say). This same weevil was reported as prey in North Dakota (Scullen 1939), and

this or a closely related species was reported as prey in Alberta (Scullen 1968).

Males of this species are reported to be territorial and to rub their bodies on stems surrounding their perches, presumably applying a pheromone from head glands and clypeal brushes and spreading it by means of abdominal brushes (Evans and O'Neill 1985). I recently observed such behavior near my home 23 km west of Livermore, Colorado. On 24 August 1989, a male was seen defending a territory among *Helianthus* and *Grindelia* plants and marking these plants in the usual manner. This male was highly aggressive, sometimes pursuing insects several meters from his territory. No other individuals of either sex were seen nearby.

Cerceris bicornuta Guérin. This is a widely distributed and well studied species (Evans and Rubink 1978). I report here briefly on an aggregation of 4 to 12 females that have nested each of the last 11 years in sandy loam along the sides of a dirt road on a farm in Fort Collins, Colorado. Nests were spaced from 0.5 to 4 m apart and each had the characteristic circular tumulus with a vertical burrow passing through the center. I dug out only one of these nests, tracing the burrow to a depth of 19 cm, where there were 6 weevils in storage. There were 9 cells in an irregular pattern 21–27 cm deep, separated by 1–3 cm; the nearest cell was 3 cm from the end of the burrow. Cells contained from 12 to 16 weevils, all billbugs, *Sphenophorus parvulus* Gyllenhal and *S. cicatristriatus* Fahraeus in about equal numbers. From time to time, in different years, I have taken weevils from provisioning females. In every case they were weevils of this genus.

Billbugs of the genus *Sphenophorus* have previously been reported as prey of this species from Colorado, New Mexico, Missouri, Ohio, New York, Connecticut, and North and South Carolina (Evans and Rubink 1978). All of these records are for *bicornuta bicornuta* except for that from New Mexico, which relates to subspecies *fidelis* Viereck and Cockerell. One exceptional record is that of Krombein (1960) for *C. bicornuta fidelis* preying on a weevil of the genus *Eupagoderes* in Arizona.

Discussion

Many members of the genera *Cerceris* and *Eucerceris* are prey specialists. Of the many records for *C. bicornuta,* from diverse localities, all but one are for weevils of the genus *Sphenophorus.* Records for *Eucerceris superba bicolor* all relate to *Ophryastes sulcirostris* or to closely related species of this genus; the records are from three widely separated localities. In contrast, species of *Astata* that have been studied all take a variety of Pentatomidae, less commonly Lygaeidae or Cydnidae. This is true even when several species nest in the same area, as is often the case. Members of the related genus *Dryudella* prey on members of the same groups utilized by *Astata,* as well as several other families of Hemiptera. Presumably hemipterous prey are abundant enough that there has been little selection for specialization within the Astatinae. Also, members of this group have the option of taking immatures, while Philanthinae take only adults, the larvae living in cryptic situations.

Although both Astatinae and Philanthinae make multi-cellular nests and accumulate prey in the burrow before removing them to a cell, the nests of the two groups are of quite different form. Astatinae make an oblique burrow, with the resulting tumulus in front of the entrance, while *Cerceris* and *Eucerceris,* although not all Philanthinae, make a burrow that is vertical or nearly so, with a tumulus surrounding the entrance. Successive cells of Astatinae diverge from the lower part of the burrow, while those of *Cerceris* and *Eucerceris* are at the ends of short side burrows from the bottom of the burrow.

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