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Short Communication

An Unusual Manner of Aggregation in the Braconid *Chelonus (Microchelonus) hadrogaster* McComb (Hymenoptera)

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The purpose of this Short Communication is to report on several observations of *Chelonus (Microchelonus) hadrogaster* McComb (Hymenoptera: Braconidae) forming male-dominated aggregations in close association with mounds of the ant *Formica podzolica* Francoeur. It is hypothesized here that such mounds may form conspicuous landmarks that *Chelonus hadrogaster* orients toward for lek formation. This is the first record of any chelonine species being associated with ants or forming male-dominated aggregations and the first record of any braconid species possibly using ant mounds as a landmark.

In many braconid species the males often emerge before the females (protandry), and especially among idiobiont species [*sensu* Askew and Shaw (1986); the host is permanently paralyzed or killed at oviposition], where emerging females are associated with particular microhabitats (e.g., dead branches, tree falls), males may form mating aggregations at female emergence sites. *Coeloides dendroctoni* males are able to locate preemergent females still in their exit tunnels under bark (DeLeon, 1935). Among koinobionts [*sensu* Askew and Shaw (1986); the host continues to grow and metamorphose] the emerging females may be more dispersed because the host may move some distance from the feeding site to a cryptic pupation retreat prior to being killed, the parasitoid may exit the host and pupate away from the host remains, or cocoons attached to deciduous foliage, leaf litter, and other detritus may be scattered by the wind. Consequently, many koinobiont male braconids locate females using species-specific chemical sex pheromones (e.g., Bousch and Baerwald, 1967; Cole,

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1970; Fink, 1926; Hagen, 1953; Parker, 1931; Pemberton and Willard, 1918; Read *et al.*, 1970; Obara and Kitano, 1974; Kamano *et al.*, 1989). Although landmark orientation and mating aggregations are known to occur in some aculeate wasps (e.g., Alcock, 1978, 1981; Thornhill and Alcock, 1983), relatively less is known about such behavior in the parasitoid Hymenoptera. In a few koinobiont groups, male-dominated mating aggregations are known to occur, which presumably function in the same fashion as mating swarms in Diptera, Trichoptera, or Ephemeroptera to attract widely dispersed females from some distances (Emlen and Oring, 1977; Thornhill and Alcock, 1983). In Braconidae, such swarms occur most commonly in the Blacini (van Achterberg, 1975, 1977, 1988b; Benson, 1944; Čapek, 1983; Donisthorpe, 1944; König, 1967; Southwood, 1957; Stelfox, 1944; Syrjämäki, 1976) and, to some extent, within the Microgastrinae (Whitfield, 1987). The swarms observed by Whitfield (1987) were located over a hedge, but otherwise there is little indication that braconids may orient to landmarks.

On 27 June 1990 I was observing mounds of the ant *Formica podzolica* Francoeur located in a montane meadow of the Medicine Bow National Forest (Albany County, Wyoming) at an altitude of approximately 8500 ft. On this occasion a small, black species of chelonine braconid was found to be quite abundant on the grass stems in close association with the ant mounds. The wasps moved about very quickly, remaining on the grass stems for only short periods of 5–15 s and remained constantly in rapid motion, running back and forth over a distance of 1–2 in. Upon leaving one stem, a wasp would usually fly to a nearby stem and repeat this activity, but sometimes it might hover about the vicinity of the nest for several minutes. There was no indication that the wasps were chemically marking the stems, although this possibility cannot be ruled out. Although foraging worker ants were numerous on the same grass stems, the braconids avoided any close contact with the ants. Since chelonine braconids are egg-larval parasitoids of lepidopterans (Vance, 1932; Boyce, 1936; Harbo and Kraft, 1969; Shenefelt, 1973; Shaw, 1983; Kainoh, 1986; Walker and Huddleston, 1987; Kamano *et al.*, 1989), the grass stems by the ant mounds were carefully inspected for host eggs; however, none was noted. The usual host of *Chelonus hadrogaster* is not known; however, other *Chelonus* species most commonly utilize species of Torticoidea or Pyraloidea as hosts (McComb, 1968; Shenefelt, 1973). A sample comprising 17 specimens of the wasp was collected using an alcoholic aspirator at one ant mound during a period of about 10 min. Subsequent inspection of vegetation in the adjacent meadow failed to reveal any additional specimens, so a methodical sweep sample was taken. One hundred sweeps of the meadow yielded only one additional specimen, although the vegetation was not discernibly different from that near the ant mounds. No ant mounds were noted in the section of meadow swept. On returning to the laboratory, the wasp was identified as *Chelonus* (*Microche-*

lonus) hadrogaster McComb using the revision of McComb (1968). Voucher specimens are deposited in the collection of the Rocky Mountain Systematic Entomology Laboratory (RMSEL), Laramie, Wyoming. The sample taken at the ant mound was found to be strongly male-biased (16 males, 1 female). Similar aggregations were observed on several other occasions, and each of these sampled was also found to be strongly male-biased. The composition of these samples is summarized in Table I.

On 3 July two yellow pan traps (see Gauld and Bolton, 1988, p. 50) were placed near ant mounds where the above-noted aggregations had been sampled. The yellow pan trap is useful for sampling low-flying Braconidae, since it is placed at ground level and the color yellow is attractive. One pan trap was placed midway between two adjacent mounds, at a distance of about 3 ft from each mound. The second trap was situated about 1 ft away from a third mound. These samples were also found to be strongly male-biased. The composition of these samples is summarized in Table II.

During the same time period a Malaise trap (see Gauld and Bolton, 1988; p. 49) was operated on the north side of the same meadow, at of distance of about 150 ft from the nearest study mound. Unlike the yellow pan trap, the basic Malaise trap is an entirely passive sampling method. The Malaise trap is probably less effective at sampling low-flying Braconidae, since it is passive and the collecting head is about 6 ft above the ground; nevertheless, it is proven effective for sampling Braconidae (Matthews and Matthews, 1983; Darling and Packer, 1988) and has the advantage that it requires little attention over long periods. The vegetation near the Malaise trap was not discernibly different from

Table I. Composition of *Chelonus hadrogaster* Samples Aspirated from Grass Stems Near Mounds of *Formica podzolica*

Date	Number of males	Number of females
27 June	16	1
29 June	15	3
2 July	7	1
3 July	14	1

Table II. Composition of *Chelonus hadrogaster* Samples Taken from Yellow Pan Traps Situated Near Mounds of *Formica podzolica*

Dates	Number of males	Number of females
3–5 July	18	1
5–9 July	4	2
9–12 July	7	2

that near the ant mounds; however, there were no mounds near the trap. The number of wasps sampled by the Malaise trap was substantially lower than the numbers observed near the ant mounds, as indicated in Table III.

The low numbers of *Chelonus hadrogaster* sampled by the Malaise trap suggest that the wasp is ordinarily widely dispersed in the meadow. The relatively much higher numbers present at the ant mounds, and the strongly male-biased sex ratios, suggest that the wasps are aggregating at the mounds for mating purposes. Although copulation was never observed, that might not be unexpected. In most koinobiont braconids copulation is brief, normally 1 min or less (Boyce, 1936; Cardona and Oatman, 1971; Harbo and Kraft, 1969; Lewis, 1970; Oatman *et al.*, 1969; Matthews, 1974; Kainoh, 1986). The chance of actually observing copulation during the short periods spent at the mound would be low. Furthermore, given the aggressive behavior of the ants, it seems likely that mating pairs would retreat away from the ant mounds to copulate in safety. Presumably the mounds are a potentially dangerous site for aggregations to occur, although if the ants could be avoided the mounds might actually be a safe site, since the ants would deter other crawling predators. The evolution of the use of such a potentially dangerous site (assuming that the ants pose a threat to the wasps) for locating mates might not be that inexplicable. Since emerging females of *Chelonus hadrogaster* are probably widely dispersed, location of mates at emergence sites would be difficult, and attraction via sex pheromones might not be much easier. In the meadow microhabitat, the mounds of *Formica podzolica* form conspicuous visual landmarks, with their raised mounds and considerable activity. *Chelonus hadrogaster* may be utilizing ant mounds as landmarks for mate location, although the possibility of a chemical basis for the aggregations cannot be ruled out. Additionally there is the possibility that *Chelonus hadrogaster* locates the mounds via chemical cues released from the ants themselves, perhaps some chemical that resembles the usual sex pheromone of the wasp. Unfortunately, we know very little about the mating habits of braconid wasps under natural conditions. There are probably two underlying reasons for this dearth of information. First, although braconid wasps are among the most species-rich insect families, with an estimated 50,000 species (Mason, 1979; van Achterberg, 1988a), they are also very minute organisms and consequently are not often carefully observed in the field. Second, because many

Table III. Composition of *Chelonus hadrogaster* Samples Taken from Malaise Trap Situated About 150 ft Away from Ant Mounds

Dates	Number of males	Number of females
29 June–6 July	1	2
6–12 July	1	0

braconids are of value to biological control programs (Waage and Greathead, 1987; Gauld and Bolton, 1988), most of what we do know about their mating behavior comes from laboratory studies of a limited spectrum of taxa. Consequently, remarkably little is known about the mechanisms by which braconids locate mates under natural conditions. More studies are needed to determine if other forms of aggregation or landmark orientation are manifested in the Braconidae.

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