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Field observations on the myrmecophilous beetle *Araeoschizus airmeti* Tanner (Coleoptera: Tenebrionidae) at harvester ant (Hymenoptera: Formicidae) mounds

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FIELD OBSERVATIONS ON THE MYRMECOPHILOUS BEETLE *ARAEOSCHIZUS AIRMETI* TANNER (COLEOPTERA: TENEBRIONIDAE) AT HARVESTER ANT (HYMENOPTERA: FORMICIDAE) MOUNDS

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Beetles in the tenebrionid genus *Araeoschizus* frequently are found with colonies of several ant species (Tanner 1945, Lavigne 1969, Papp 1981, Wheeler and Wheeler 1986, Clark et al. 1986). On occasion, however, *Araeoschizus* has been captured in pitfall traps (Papp 1981, Stafford et al. 1986), indicating that these beetles are sometimes active on the ground surface apparently away from ant colonies. Because of this observation, some biologists question whether *Araeoschizus* spp. are true myrmecophiles (see Papp 1981); additionally, the genus is not listed by Hölldobler and Wilson (1990) in their table of invertebrates symbiotic with ants.

Little information is available on behavior and ecology of *Araeoschizus* in the presence of their ant hosts, and the frequency of ant colonies occupied by these beetles has not been reported previously. In colonies of the harvester ant *Pogonomyrmex occidentalis* (Cresson) at a site in Wyoming, Lavigne (1969) found as many as 188 *A. armatus* Horn in seed and trash chambers to depths of about 160 cm. Beetles tended to be gregarious, with as many as 64 occupying a single chamber. Beetles were first found near the ground surface in the mound proper in April. Lavigne (1969) noted that at a 2nd site, *Araeoschizus* was not found associated with ants. In Idaho, *A. airmeti* Tanner was collected in June from seed chambers 9–10 cm below ground surface in a colony of *P. salinus* Olsen (Clark and Blom 1988). In Idaho and Oregon, Hendricks (1991) collected several individuals (>1 per colony) of *A. airmeti* in March at 3 widely separated colonies. Beetles were found in the presence of ants on undersides of stones partly buried in mound tops of *P. salinus.*

On 13 April 1998 we walked a 1.6-km transect near Black Butte, Elmore County, Idaho (43°03′30″N, 116°11′30″W; 854 m elevation), crossing an area sparsely covered with vegetation (including *Artemisia* and *Chrysothamnus*) growing on sandy soils overlying basalt flows. While walking the transect (09:35–10:50 MDT), we paused for brief periods (not more than 5 min each) at harvester ant (*P. salinus*) mounds where workers were active on the surface, and documented the presence or absence of *A. airmeti.* Weather was overcast, windy, and cold (7.5°C). As a consequence, <10 worker ants were present on the surface of any mound, and most ant activity was confined to a distance <10 cm around any entrance. Workers were sluggish and slowly removing germinating seed, dead workers, and detritus from the colonies. The small midden size around mounds indicated that cleaning of colonies had been underway for only a relatively short time.

We observed 19 *A. airmeti* around entrances at 11 (73.3%) of 15 mounds examined. Single beetles were noted at 6 mounds, 2 beetles at 4 mounds, and 5 beetles at 1 mound. Fourteen (73.7%) of the beetles at 9 mounds were carried in the mandibles of worker ants, some as they emerged from entrances at the time we first detected them. The number of beetles transported by ants was significantly different from that predicted (goodness-of-fit test, Williams's correction: $G = 4.318$, df = 1, $P < 0.05$), assuming equal probability of being carried or not. Most beetles were grasped around the elytra and carried lengthwise, with the

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anterior end pointed forward. Beetles were transported 3 and 8 cm from mound entrances in the 2 cases measured, then released by the ants. Beetles carried by ants resisted transport by grasping pebbles or twigs with their tarsi, rather than by vigorously struggling. In one case an ant persisted in carrying a beetle for 5 min before releasing it. In 2 cases resistance by beetles apparently agitated the transporting ants, which brought their abdomens forward ventrally, and they attempted to sting (we did not detect an extended stinger) or spray the beetles. Nevertheless, transporting ants did not injure any of the beetles. Released beetles tended to wander around on the mound, but in 6 instances the beetles immediately returned to the entrance and reentered the mound, passing other ants without additional interference.

The frequency with which we found *A. airmeti* around harvester ant colony entrances and the passive response often shown by ants to their presence indicate that this beetle is adapted for living with ants, as suggested previously by other authors (e.g., Papp 1981, Clark and Blom 1988). Clark and Blom's (1988) description of behavior between captive ants and beetles closely matches what we observed in the field; i.e., beetles are transported some distance by ants and then released. Clark and Blom (1988) noted that ants sometimes appeared to sting beetles if they struggled, as we also observed, but we observed no beetle injuries by ants. Ants appeared to ignore beetles returning to colony entrances.

Presence of *A. airmeti* on the surface of ant mounds when seed chambers were being cleaned by worker ants in a large percentage of our sample, and the large percentage of beetles carried by the ants, suggest that many beetles were occupying seed chambers at the time of our observations. *Araeoschizus* has been found in seed chambers of harvester ants throughout the year (Lavigne 1969, Clark and Blom 1988), although it is not known if ants carry beetles to the surface of mounds as long as the ants are active there. Nor is it known why harvester ants remove beetles from seed chambers. Possibly, ants mistake beetles for germinated seeds or detritus, or perhaps beetles release a chemical that promotes their transport by the ants, as has been conjectured for myrmecophilous pselaphid beetles (e.g., Leschen 1991). It could be advantageous for beetles to be moved to the ground surface, as was suggested by Hendricks (1991), analogous to the advantages of hilltopping (see Shields 1967, Alcock 1987). Concentration of beetles in a reduced space during a short span of time could increase opportunities for encountering potential mates, although nothing is presently known regarding sex ratios of beetles found throughout ant colonies, let alone near the surface. *Araeoschizus* may also make dispersal movements between colonies, judging by the presence of beetles in pitfall trap samples (Papp 1981, Stafford et al. 1986). One benefit of intercolony dispersal would be the reduction of inbreeding, but, again, nothing is yet known about the frequency or cause of surface activity and movements away from ant colonies.

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