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SCIENTIFIC NOTE
Nesting Biology of an Endemic Hawaiian Wasp, *Ectemnius molokaiensis* (Hymenoptera: Sphecidae)

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ABSTRACT. The biology of the solitary ground-nesting predatory wasp *Ectemnius molokaiensis* (Perkins) was observed near Pu'u Kolekole on the island of Moloka'i. Nest architecture was simple, with a short (5–10 cm) tunnel leading to 1 or 2 cells. Wasps mass-provisioned their nests with a single species of predatory fly, *Eurynogaster tergoprolixa*. Thus, *E. molokaiensis* in this population were acting as specialist higher-order predators, preying exclusively on other predators. From 20 to 33 or more flies were provisioned per cell. Female-female interactions were observed. Further work is required to assess the hypothesis that *E. molokaiensis* engage in prey theft from conspecific nests.

The Holarctic genus *Ectemnius* (Hymenoptera: Sphecidae) includes 22 species of predatory wasps endemic to the Hawaiian islands (Yoshimoto 1960). Limited observations of the biology of *Ectemnius* spp. were reported by early naturalists (summarized by Williams 1927), but the genus has received virtually no attention during the past 60 years. Here we present initial observations on the nesting biology of *Ectemnius molokaiensis* (Perkins), a species for which no behavioral data have been published.

We observed wasp activity on 1–4 May 1995 at nests located on eastern Moloka'i in a mixed lowland dry shrubland, approximately 0.8 km west of Pu'u Kolekole at an elevation of 1060 m. The flora of the area is dominated by *Metrosideros polymorpha*, *Dodonaea viscosa*, *Styphelia tameiameiae*, and *Vaccinium dentatum*, with occasional small stands of *uluhe*, *Dicranopteris linearis*, and a mix of native and alien grasses.

Nests were located in stretches of exposed soil on a disused dirt road that descends along the leeward side of the island to Kawela. Nest entrances (ca. 3.5–5.0 mm in diameter) were recognizable by excavated dirt, which on the gently sloping ground of the site formed a thin disk of soil on the downhill side of the nest. We excavated five active nests, revealing a very simple architecture (Figure 1). The main nest tunnel descended either vertically or at angles up to ca. 45° from vertical and incorporated 0–3 turns, each of up to 90°, with the final stretch of nearly horizontal burrow leading to the nest cells. One or two cells were located near the end of the main tunnel at distances of 5–10 cm from the nest entrance, and at very shallow depths (ca. 3–4 cm). Short side branches plugged with dirt led off the end of the main tunnel to completed cells, while cells being provisioned were open to the main burrow. In many instances, the details of the burrow's course and the spatial orientation of cells appeared to have been determined by rocks encountered during nest construction.

We made 33 hours of continuous observations of provisioning activity at four nests. Nests were left open while females hunted for prey. Although prey capture was never observed, hunting females were seen searching in grasses and other herbaceous plants in the immediate vicinity of the nesting site. We recovered only 1 species of prey from the nests, males and females of the endemic fly *Eurynogaster tergoprolixa* Hardy & Kohn (Diptera: Dolichopodidae). This fly was abundant at the study site, and could be collected by sweeping the grasses where foraging wasps were observed. *Eurynogaster* spp. are generalist predators; thus, *E. molokaiensis* in this population were acting as specialist

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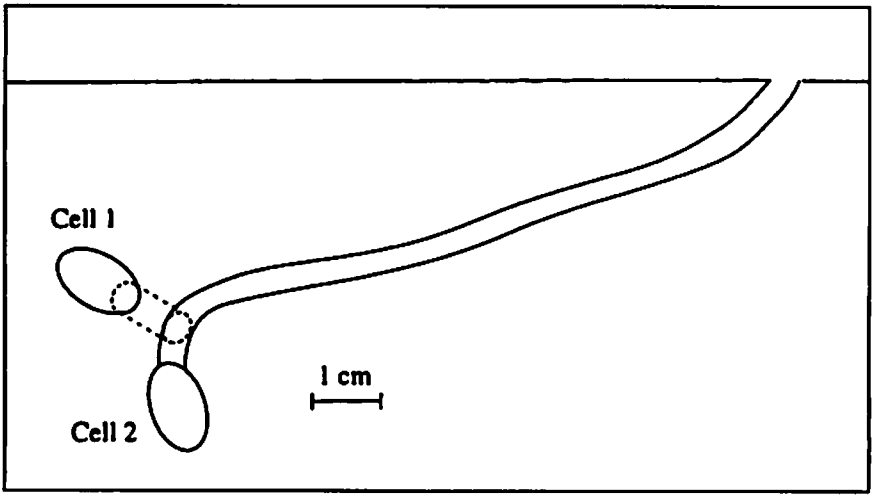

Fig. 1. Cross-section of a nest of *Ectemnius molokaiensis*. Cell 1 contained 21 prey (paralyzed flies, *Eurynogaster tergoprolixa*) and a wasp egg, and was isolated from the main nest burrow by a short dirt-filled side burrow (shown in dotted lines). Cell 2 contained a single prey and an adult female wasp, which was apparently sleeping in the cell.

higher-order predators, preying exclusively on other predators. Dolichopodid prey have been reported for one of the seven other Hawaiian *Ectemnius* species for which prey records are available (Yoshimoto 1960). Wasps returned to their nests in flight, holding flies beneath their thorax and abdomen with their middle pair of legs. Because these flies are small, and because wasps enter their nests rapidly when returning from foraging, it was often difficult to be certain that wasps were indeed carrying prey. Using only trips in which flies were observed clearly and excluding the very long first trip away from the nest in the morning (which took 57.4 min., and may have involved activities other than hunting for prey), one female required an average of 9.73 ± 8.15 min, (S.D.) (range: 0.75–25.33 min.; n = 12) to capture flies over a 2-day period of observation. The same female spent an average of 1.63 ± 0.51 min. (S.D.) (range: 1.00–2.50 minutes; n = 14) in the nest stowing prey before exiting to continue foraging. Sustained periods of hunting were sometimes interrupted when females remained in the nest and sealed the nest entrance from within with loose dirt pushed up the main burrow. The function of these non-foraging periods is unclear. However, it appears that nests are also sealed from within by females when a cell is completely provisioned and also at the end of daily activities.

Two completely provisioned cells, one with a wasp egg and the other with a newly hatched wasp larva, contained 21 and 25 prey. Two other cells that had not yet received a wasp egg, contained 20 and 33 flies. The wasp egg was found on the fly farthest from the entrance to the cell, and the entire volumes of the completed cells were filled with loosely packed flies. These observations suggest that *E. molokaiensis* mass-provisions its offspring. From one cell we also recovered an almost fully grown larva, which had consumed nearly all the provisioned flies.

We did not observe any heterospecific nest parasites. Despite observing a large number of cleptoparasitic flies (Sarcophagidae: Miltogrammini) in the nesting area (it was not uncommon for several flies to perch within 15 cm of open nest entrances), we never observed nest inspection or larviposition by these flies, nor were any maggots or puparia

found in nests. Parasitic bees (*Nesoprosopis* sp.) were observed searching in the nesting area, and occasionally entered wasp nests, but always exited after a few seconds. (The nesting site also supported a large population of non-parasitic *Nesoprosopis* sp. bees, which are presumably the hosts of these parasites, and whose nest entrances were superficially similar to those of the *Ectemnius*.) One female *E. molokaiensis* was observed carrying 39 individuals of the phoretic stage (hypopae) of a detritivorous mite on the lateral sides of her propodeum, beneath the wings. Although these mites were not observed in cells during nest excavations, they could easily have been overlooked.

Female *E. molokaiensis* were observed attempting to enter nests harboring resident females, and on one occasion being physically forced from the nest, which was then plugged from within by the resident female. Interactions between conspecifics can have many bases, ranging from prey theft or parasitism to various forms of sociality (Field 1992, Field & Foster 1995). Because (i) we did not mark wasps individually, and (ii) we did not attempt to catch females leaving nests to determine if they were removing prey, it is difficult to interpret the female-female interactions. However, observations over the course of 2 days on one nest suggest the hypothesis that females engage in theft of prey from conspecifics. A nest that was regularly provisioned over two days proved upon excavation to contain only a single completely empty cell. This nest received 97 visits by female wasps over 13.67 hours of activity (= 7.1 visits/hour), compared to an adjacent successfully provisioned nest that received 30 visits in 10.25 hours of activity (= 2.93 visits/hour). The larger number of visits at the nest that was empty may include visits by one or more prey-stealing females. Further work is needed to assess whether *E. molokaiensis* engages prey theft or other forms of intraspecific parasitism.

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