INCIDENTAL CAPTURE OF MALE *EPIAESCHNA HEROS* (ODONATA: AESHNIDAE) IN TRAPS DESIGNED FOR ARBOREAL *CALOSOMA SYCOPHANTA* (COLEOPTERA: CARABIDAE)[1]

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ABSTRACT: Ten male *Epiaeschna heros,* the largest dragonfly in the northeastern US, were caught unexpectedly in traps designed to catch *Calosoma sycophanta,* a carabid beetle that feeds on the larvae of the gypsy moth, *Lymantria dispar* (Lepidoptera: Lymantriidae), and other lepidopterans. Examination of the intestinal contents and fecal pellets from five of the captured *E. heros* revealed the remains of prey insects but no identifiable fragments of lepidopterans. Only males were captured suggesting that the apparent attractiveness of the traps is related to breeding behavior. Modification of the traps might enhance their selectivity for aeshnid dragonflies.

The gypsy moth, *Lymantria dispar* (L.), was introduced from Europe into the United States in Medford, Massachusetts, in 1869 (Forbush and Fernald, 1896). Since then, its range has spread and it has become a major forest pest. At a peak in 1981, its larvae defoliated over 12.9 million acres (Anon, 1994). Among the predators introduced for control of gypsy moth larvae is a large, iridescent green carabid beetle, *Calosoma sycophanta* L. (Burgess, 1911). As part of a United States Department of Agriculture program to monitor biological control organisms of the gypsy moth, two of us (PWS and SEB) sampled populations of *C. sycophanta* at two locations in eastern Maryland during 1995. The sampling method used traps designed to collect *Calosoma* beetles as they foraged for caterpillars on tree trunks (Collins and Holbrook, 1929). While 83 *Calosoma* beetles were trapped for the season (77 at Site 1 and 6 at Site 2), ten male swamp darners, *Epiaeschna heros,* (Fabricius) [arguably the largest species of dragonfly in the northeastern United States (Needham and Westfall, 1955)] were also captured.

Study sites: Two woodlots with high densities of gypsy moth larvae and incipient defoliation were selected as study sites. Both are in Queen Anne's County, Maryland. Site 1, on the south side of Racetrack Road and 3.0 km south of Sudlersville, (39° 09.7' N, 75° 50.6' W; 21 m elev.), had 58 traps. Within a few hundred meters south of this site is a shaded woodland drainage ditch that is typical of *E. heros* breeding sites. Site 2, 10.6 km south of Site 1 on the west

[1] Received Feb. 14, 1996. Accepted May 25, 1996.

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side of Rabbit Hill Road near Ingleside (39° 04' N, 75° 52' W; 18 m elev.), had 40 traps. The traps were distributed over a couple of acres at each site. They were located about 1.5 m off the ground on the trunks of oak trees, mostly white oak *(Quercus alba),* but also red oak *(Q. rubra),* willow oak *(Q. phellos),* and swamp chestnut oak *(Q. michauxii),* with diameters ranging up to 63 cm. Traps were set out between 15 and 23 May 1995 and checked at least twice weekly through 10 July 1995.

Trap description: The traps used in this study were modified from the original design of Collins and Holbrook (1929) and were essentially the same as used by Weseloh (1985). The body of each trap was a 24 oz clear plastic cup (P-24, SOLO Cup Co., Urbana, IL 61801) purchased from a local supplier. The cups had a height of 152 mm with a base diameter of 63 mm and a lip diameter of 102 mm. Four small holes were put in the base to prevent the accumulation of rain water. Two pieces of 0.2 mm clear polycarbonate plastic (such as Lexan©, General Electric Corporation) stapled to each cup created a 53 mm peaked roof sloping to the lip of the cup and a back wall containing a pleat with a 8 mm x 22 mm horizontal hole for beetles to enter as they climbed the trunk from below as shown by Weseloh (1985). *Epiaeschna* dragonflies entered through the large opening at the front that formed an isosceles triangle with slightly bulging sides. Maximum width of the entrance was about 100 mm with a height of about 140 mm. Due to the different materials used, these traps were larger and relatively transparent compared to those of waxed paper used by Collins and Holbrook, (1929).

The traps were attached to trees as follows. First a 68 mm wide barrier strip of Lexan© was wrapped around a tree trunk at about 1.5 m such that it was not quite horizontal. Then a 30 mm x 65 mm piece of black emery cloth was oriented vertically and stapled to the tree on the lower edge of the strip at its highest point. Finally, the trap was stapled to the tree with its entrance hole and triangular slot positioned over the emery cloth. The emery cloth was a modification made to provide better footing for beetles entering the trap. This feature would not be accessible to the dragonflies but perhaps it provided a visual cue.

Capture of *Epiaeschna heros:* Because the specific purpose of trapping was to obtain *Calosoma* beetles for chemical analysis, the fact that the traps designed to catch beetles also were capturing *E. heros* dragonflies was a curiosity. Thus, the following records do not fully document the capture of dragonflies at both sites. On 23 May 1995, three male *E. heros* were found, all in a single trap at Site 1. All were alive but all had broken their wings about 2.5 cm from the thorax. Three days later two more males were taken from different traps at both sites. On 19 June 1995, three more males were captured in separate traps. On at least two other occasions before 5 June 1995, single individuals were captured

and released undamaged. At no time were both *E. heros* and *C. sycophanta* captured simultaneously in the same trap. The eight damaged dragonflies were killed in acetone and extracted for several days before drying. The intestinal contents of five individuals were subsequently examined as were several fecal pellets deposited in temporary holding cups.

Although *E. heros* were captured over a period of one month, their flight season is much longer. They are most common in May and June but are active throughout the summer. Two individuals were observed 10 July 1995 near the drainage ditch south of Site 1. It contained standing water during the period of this study.

Intestinal Contents: The intestinal contents of *E. heros* contained relatively large chitinous fragments, mostly legs with intact spines, of other insects that in many cases might be identified by persons familiar with individual prey species. None of the five specimens or the fecal pellets examined contained body parts that suggested any caterpillars had been eaten. Most of the adults were devoid of prey remains in the gut perhaps because of the time spent in the traps (up to four days). During that time, their gut contents were probably eliminated.

DISCUSSION

Dragonflies are large predators that search for prey visually and on occasion are caught in Malaise traps (Johnson *et al.*, 1995), ornithological mist nets (Baccetti *et al.*, 1990), spider webs (Ram and Prasad, 1978), or on surfaces with low surface tension (Labedzki, 1989). However, they are strong fliers that can escape entanglement and are known to avoid spider webs (White, 1979). It is remarkable that *E. heros,* a large dragonfly and a strong flier, would be captured on a number of occasions by a trap whose front entrance was slightly narrower than its wing span (116 mm). Escape would seem easy. However, *E. heros,* like other Anisoptera, cannot fold its wings and is apparently unable to climb the smooth walls of the trap. If smaller species were also attracted to the traps, they might be able to hover in the trap and escape without damaging their wings. Thus the species selectivity of the trap may be based solely on size; however, we suspect that species-specific behavior is involved. For example in this area, *E. heros* (and *Aeshna umbrosa* Walker) frequently fly in open windows and are collected inside buildings (Walker, 1958), a phenomenon associated with other crepuscular and forest dwelling species that normally fly in the shade (Corbet, 1962).

More remarkable than the fact that *E. heros* could not escape the trap is that they entered the trap at all. Since eight separate traps contained at least one individual, it seems probable that entry was active and not accidental. Most likely, something about the traps attracted them.

Given the high density of gypsy moth caterpillars and the fact that *E. heros* frequents woodlands, we first wondered whether *E. heros* could have been attracted to the infested woodlots to feed on caterpillars. That hypothesis is not supported by the contents of the gut or fecal pellets that show most, if not all, of the prey were small insects, probably Diptera. While Odonata can feed on non-flying prey, it is unusual, particularly among the Anisoptera (Corbet, 1962). The few reports of the eating habits of *E. heros* have them catching flying prey. For instance, large swarms of both males and females will feed on small flying insects at dusk in open areas near woodlands. Byers (1930) reported a swarm of *E. heros* that feasted on honey bees near an apiary, and Dunkle (1989) reported large prey including cicadas and moderately large dragonflies.

Certainly as intriguing as the species selectivity is the sex selectivity of the traps. The absence of females suggests attraction is related to breeding behavior rather than feeding behavior. Sawkiewicz (1989), adapting a collecting method used by children in southeast Asia, noted that only males of several species were attracted to an *Aeshna cyanea* Latreille tethered near a breeding site. However, unlike the males of most other aeshnid species, *E. heros* neither patrols over water nor establishes territories (Dunkle, 1989). Furthermore, *Epiaeschna* females typically oviposit at shaded woodland swamps, ditches, and vernal ponds, unattended by males (Walker, 1958). As noted by Corbet (1962), little is known about the mating sites of dragonflies that mate at one site and oviposit at another. Perhaps female *E. heros* perch on tree trunks where males actively search for them and that is why they were captured in the traps set for *Calosoma* beetles.

Although perching behavior has not been described for *E. heros,* it is not uncommon for other aeshnids to perch on sunlit tree trunks. They often hover facing a tree and appear to inspect the trunk as they fly upward. Wright (1946) observed *Coryphaeschna ingens* Rambur, another large woodland species, "flying up and down tree trunks searching for and catching gnats." While this undoubtedly was a search for food, similar behavior could be used by males seeking mates or confronting other males that are perched on tree trunks. This later possibility is suggested by our capture of three male *E. heros* simultaneously in a single trap.

If our hypothesis is correct, then some modification of the traps of the type we describe might attract aeshnids of a variety of species, particularly when placed on trees near suitable breeding sites. Although the *Calosoma* traps do not look like an *E. heros* to the human eye, there may be essential visual aspects of the trap in the forest environment that simulate distinctive visual cues attractive to males. For example, the clear plastic parts of the trap against the trunk might reflect light in much the same way that the wings of a large dragonfly would. The rough piece of black emery cloth might break up the pattern and appear as the body, and thus perhaps be the focus of a male as it approached the large clear opening of the trap. Alternatively, the clear plastic might act as a

reflector to which hovering males are attracted by their own image or reverberation, responding as if they were confronting another male, either resting or flying.

Both Sones (1995) and Soltesz *et al.* (1995) reported the appearance of large numbers of *E. heros* (and other species that breed in vernal ponds) along coastal sections of the northeastern United States from New Jersey to Cape Cod, Massachusetts where they occur infrequently. The influx occurred in April, May, and early June 1995 and was attributed to a severe drought in Virginia, the Carolinas, and Georgia where vernal ponds had dried up. Storm systems that were associated with strong southerly winds and suspected northward migration occurred on May 17 to 19, 21, and 24, 1995, the week when our traps were set up and our first captures occurred. Thus it is possible that the entry of *E. heros* into *Calosoma* traps was detected fortuitously as a consequence of the migration of large numbers of *E. heros* coincident with our studies. Roger Fuester, who has used *Calosoma* traps for many years in southern New Jersey, never recalls capturing *E. heros* (personal communication). This suggests that at typical population densities capture of *E. heros* is a rare event.

ACKNOWLEDGMENTS

We thank Linda Stevens who helped erect and monitor the traps and J. S. White who carefully critiqued an early version of the manuscript. Michael A. Valenti and Robert F. W. Schroder kindly reviewed a later draft. We thank landowners Willard Jackson, Jr. and Mr. and Mrs. Philip Beach for permission to use their respective woodlots for our trapping study.

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NOTE FROM EDITOR

It is a policy of *Entomological News* to publish papers as soon as possible after they have cleared reviews and editorial procedures. *Entomological News* does not hold papers already approved for publication until some future issue simply because a current issue, normally 64 pages, is 'full'. A considerably heavier influx of papers submitted and processed this year has resulted in this much larger than usual current issue. Present indications are this will continue at least through the first two issues in 1997.

H.P.B.