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## *AMPHION NESSUS* (SPHINGIDAE) ATTRACTED TO PHEROMONES OF *ANISOTA VIRGINIENSIS* (SATURNIIDAE)

On the afternoon of 9 June 1983 in Groton, Middlesex County, Massachusetts, at approximately 1500 h, I noticed a male *Amphion nessus* (Cramer) hovering about an emergence cage containing pupae of several species of moths. It was a bright early summer day with temperature, humidity and wind conditions within normal ranges. Shortly, there were as many as four *A. nessus* males in the vicinity of the cage. The moths were searching the cage and adjacent shrubbery as though they were attempting to locate a "calling" female.

The only moth in the cage was a female *Anisota virginiensis virginiensis* (Drury), whose scent organ was extended. Vegetation in the vicinity of the cage consisted of two evergreen shrubs and lawn. There was little possibility of a wild *A. nessus* female being in the area. Furthermore, it was obvious from the attention the cage was getting from the males that the *A. nessus* were attracted by pheromones coming from the cage itself.

Three *A. nessus* males were captured easily at the cage. The *anisota* female was left in the cage for a second day and again *A. nessus* came to investigate. On the basis of visual observation, these moths were also males.

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## A SIMPLE METHOD FOR MEASURING NECTAR EXTRACTION RATES IN BUTTERFLIES

The rate at which nectarivorous animals extract nectar from flowers is one of the major parameters determining the instantaneous rate of energy intake, a quantity which is presumed to be maximized by natural selection (Pyke, Pulliam & Charnov, 1977, Quart. Rev. Biol. 52:137–154). The rate of energy intake equals the rate of nectar extraction ($\mu$l/second) multiplied by the energy content of the nectar (Joules/$\mu$l). The rate of nectar extraction has been included in theoretical models of feeding energetics in butterflies (Kingsolver & Daniel, 1979, J. Theor. Biol. 76:167–179) and nectarivorous animals in general (Heyneman, Oecologia, 60:198–213). Although this rate has been measured in hummingbirds and incorporated into models of feeding energetics (Hainsworth, 1973, Comp. Biochem. Physiol. 46:65–78), it has apparently never been measured in butterflies (Kingsolver & Daniel, 1979). Here I present a simple technique for measuring extraction rate in butterflies which may be applicable to other nectar feeders as well.

Nectar of a known concentration is loaded into a calibrated microcapillary tube (Drummond Microcaps) which is mounted on a small balsa platform with a millimeter scale alongside the capillary tube. The platform also includes a perch for the feeding butterfly to grasp (Fig. 1). The platform is displaced at a slight angle from horizontal to cause the nectar column to move downward as it is removed. As many butterflies maintain a body temperature somewhat above ambient (Rawlins, 1980, Ecology 61:345–357), and since extraction rate in poikilotherms is most likely temperature dependent, I placed both the butterflies and the apparatus within a styrofoam chamber maintained at about 28°C with a heat lamp.

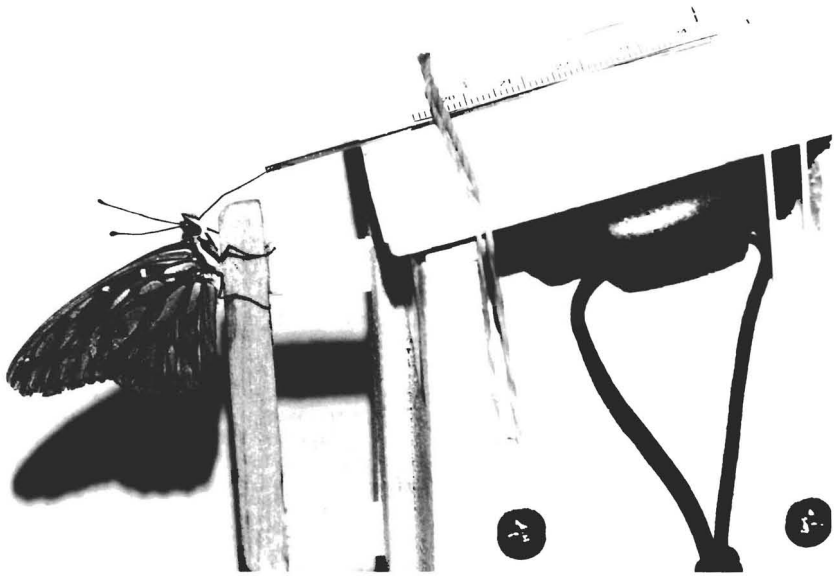

FIG. 1. *Agraulis vanillae* feeding at the described apparatus. The platform encloses a stopwatch with which the feeding bout is timed. Alternatively, the stopwatch can be handheld.

The technique for measuring extraction rate takes advantage of the apparently innate feeding response in butterflies which is released by the contact of the proboscis with a sugar solution. The butterfly is manually placed onto the perch and its proboscis is coaxed into contact with the leading edge of the nectar column contained in the microcapillary tube. As nectar extraction proceeds, the meniscus at the trailing edge of the nectar column can be timed with a stopwatch as it moves along the scale. I have had best success with 100 $\mu$l microcapillary tubes (as opposed to smaller sizes), as the hardest part of the process is in establishing by manipulation the initial contact between the proboscis and the nectar. Larger microcapillary tubes have larger internal diameters, thus facilitating this part of the procedure. Reducing the size of the capillary tube would increase the resolution of the system, however.

I have used this method with several species of papilionids, *Basilarchia archippus* (Cramer) and *Agraulis vanillae* (Linnaeus) (Nymphalidae) and *Phoebis sennae* (Linnaeus) (Pieridae) with equal success. All of these species exhibit a similar response to the initial contact of the proboscis with the sugar solution; the proboscis begins a series of probing motions which sometimes pulls it out of the nectar column. If the proboscis does not recontact the solution within a few seconds, the butterfly coils it and ceases probing. If the tip is thrust back into the capillary tube, feeding begins. Once the butterfly begins feeding, it is no longer necessary to restrain the insect as it grasps the perch and feeds as it would at a flower, in some species with a characteristic folding and unfolding of the wings while feeding.

Although my use of this method has been to investigate the relationship between nectar concentration, viscosity and extraction rate (May, in prep.), this method may also be useful for studies of adult diet, in which the effect of various dietary constituents on longevity or fecundity are measured. In studies of this type, researchers often feed the

insects to satiation (e.g., Murphy, Launer & Ehrlich, 1983, Oecologia 56:257–263). Using the method described here, one can precisely control the volume of nectar imbibed by individual insects by regulating the volume placed within the capillary tube or by simply removing them from the capillary tube once a predetermined volume has been consumed.

I would like to thank J. A. Cohen and C. S. Hieber for comments on this note.

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## OBSERVATIONS ON THE LIFE HISTORY OF *OCCIDRYAS ANICIA BERNADETTA* (NYMPHALIDAE) AT THE TYPE LOCALITY

Although Leussler's checkerspot, *Occidryas anicia bernadetta* (Leussler), was described over 60 years ago (Leussler, 1920, Entomol. News 31:102–103), little is known about its habits, and nothing has been published on the early stages or larval foodplant of this butterfly. Intensive collecting has been done at the type locality, Monroe Canyon (Sioux Co., NE); the latest report was from collections made from 1960–65 (Johnson & Nixon, 1967, Amer. Mid. Nat. 78(2):508–528). Even so, Leussler (1938, Entomol. News 49:3–9, 76–80, 213–218, 275–280) sums up all that had previously been known about *bernadetta*. He states that *bernadetta* is "very abundant along the canyon rims in Sioux Co. in late May and early June."

In an attempt to learn more about *bernadetta*'s life history, two years of observations were made at Monroe Canyon. This report identifies a larval foodplant, describes mature larval and pupal stages, and identifies three parasites associated with the butterfly.

Our experience with *bernadetta* began in 1982, when trips were made to Monroe Canyon on 22 and 29 May to search for larvae and/or adults. Several suspected foodplants were examined for damage, but no larvae were found. Only two adult males were seen and collected on 22 May. *Bernadetta* adults were common on 29 May, with highest densities observed nectaring on choke cherry, *Prunus virginiana* L. Adults were also seen resting on leaves of wolfberry, *Symphoricarpos occidentalis* (Hook.),. which was in close proximity to the *P. virginiana*. After watching *bernadetta* females alight on the *S. occidentalis* leaves, examinations of the leaves were made for ova but none were found. However, a pair of *bernadetta* were observed in copula at 1250 h, less than 0.5 m from the nearest *S. occcidentalis* plant. The pair was taken alive in an attempt to induce oviposition by the female, but the female died in transit.

We returned to the type locality again on 30 May 1983, with hopes of finding immature stages of the butterfly. Chances were better for finding larvae in 1983 since the season was slightly retarded due to a late spring snowfall. An afternoon of collecting resulted in many Lepidoptera, including a few male *bernadetta* caught on the canyon slopes, but no larvae were found until the sky became overcast about 1600 h. Several extremely fresh male *bernadetta* were flushed out of the grass near a stand of *S. occidentalis*. A search of the *S. occidentalis* yielded a dozen large larvae feeding on newly visible leaf tips of the plants. Damage was seen only upon very close examination; it seemed that larval feeding was restricted to newer leaves. A thorough search of the area also revealed pupae and desiccated larvae. Other stands of *S. occidentalis* were examined for larvae, but only several on the higher hillsides contained larvae. Altogether, 18 larvae and three pupae were found on 30 May.