

THE EFFECT OF LIGHT INTENSITY UPON FEEDING ACTIVITY OF LABORATORY REARED *CULICOIDES* *GUTTIPENNIS* (COQUILLET) (DIPTERA: CERATOPOGONIDAE)¹

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ABSTRACT. Laboratory reared *Culicoides guttipennis* (Coquillett) were held without a blood meal for 24 or 48 hours after adult emergence. In replicated experiments female adults were exposed to the belly of a rabbit for 15 minutes at light intensities of 0.0, 0.1, 1.0, 4.0, 9.0, or 19.0 foot candles. Temperature and humidity were kept constant. Females that were held for 24 hours fed most readily at illuminations of 0.1 to 9.0 foot candles and significantly ($P < .01$) less readily at 0.0 or 19.0 foot candles. A greater

number of females held for 48 hours before a blood meal were found engorged at every light intensity, even feeding at 0.0 foot candles. These experiments would tend to confirm field observations regarding the crepuscular feeding habits of these biting gnats, and that light is an important stimulating factor. It was also indicated that hunger was of importance in intensifying their efforts to obtain blood meals, even feeding under conditions in which they normally would be reluctant to feed.

Investigators have shown that most species of the genus *Culicoides* are crepuscular in their feeding habits. Gluchova (1958) believes that rapidly changing light intensities at dusk and dawn were responsible for evoking the active hunting flight in the genus. According to Williams (1955), greatest activity of *C. obsoletus* (Meigen) occurred before it was dark enough for a light trap to attract them; thus, the activity of this species was possibly controlled to a great extent by light intensity. Snow (1955) considered changing light intensities at dusk and dawn to be the activating and deactivating influence for nocturnal and diurnal populations of blood-sucking Diptera. Jamnback and Watthews (1963), however, reported the lack of a direct relationship between light intensities and biting activity in *C. sanguisuga* (Coquillett). Kettle and Linley (1967) in working with the ceratopogonid

Leptoconops bequaerti (Kieffer) showed that light intensities, in conjunction with wind and air temperature, significantly affected biting. Bidlingmayer (1964) noted that the light intensity of a full moon approximated the level at twilight during which greatest flight activity occurred in mosquitoes. Moonlight presumably enabled feeding activity, so characteristic at twilight, to occur late into the night. A number of all-night collections of *Culicoides* permitted Bidlingmayer (1961) to show that *Culicoides* activity increased during that period of the night when the moon was shining. However, he pointed out the possibility that different populations of gnats might be responsible for the occurrence and subsidence of the various peaks of activity. Beadle (1959) suggested a 0.2 foot-candle reading as usually corresponding to the "first wave" of crepuscular forms of Culicidae at twilight.

In the above field studies it was not possible to eliminate variables sufficiently to establish clearly that a given stimulus intensity was independently capable of triggering feeding activity for a given species. A laboratory colony of *C. guttipennis* (Hair & Turner 1966) provided an opportunity to evaluate light intensity

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as a feeding stimulant under more precise conditions.

METHODS AND MATERIALS. Newly emerged adults were anesthetized by CO₂. Females were collected with a hand aspirator and placed in a ½ gallon cardboard food container with the open end covered by nylon stocking material. A 1½-in. (3.8 cm) diameter hole, plugged by a rubber stopper, was provided to allow for the introduction and removal of the females. They were retained in this cage for 24 or 48 hours, depending on the experiment, before being allowed to feed upon a rabbit. During this holding period, a cotton dental wick soaked in a 5 percent sugar solution was placed upon the nylon stocking for supplemental food. Just prior to blood feeding, 25 females were transferred to each feeding cage.

The feeding cages consisted of cardboard 1-pint food containers painted black with the open end closed with nylon stocking material. A 1½-in. (3.8 cm) diameter hole was cut near the screened end of the container and covered with clear plastic. This hole provided the only entrance for light when the feeding cage was in position under the rabbit as described by Hair and Turner (1966). A ½-in (1.27 cm) hole near the carton bottom was plugged with a rubber stopper to allow for introduction and removal of the adult females from the feeding container.

An American Optical Universal Illuminator with variable transformer was used to vary light intensities within the feeding cartons. A sheet of translucent Kimwipe tissue paper held in place by a rubber band over the lamp caused diffusion of the light and eliminated a "hot spot" within the container. Light intensities at the different lamp settings were determined by directing the diffused light through the plastic window onto the shaved belly of a rabbit. In a completely darkened room the photoreceptor of a Weston Model 756 photometer was placed between a rabbit and the nylon stocking. The light intensity within the feeding container was recorded and enabled calibra-

tion of the different voltage selections on the transformer. Intensities of 0.0, 0.1, 1.0, 4.0, 9.0 and 19.0 foot-candles were chosen for the tests. Throughout the tests, there were no air currents; air temperature was 31° C and humidity was 70 percent R.H. within the feeding chamber.

With the microscope lamp serving as the only light source, each feeding cage containing 25 female gnats was exposed to the belly of the rabbit for 15 minutes. Afterwards, the gnats were anesthetized with CO₂, examined, and the number engorged were recorded. Fourteen replications were made of the entire experiment.

RESULTS AND DISCUSSION. The percent of engorged females at each light intensity is presented in Table 1. The greatest feed-

TABLE 1.—The effect of light intensity upon feeding activity of laboratory reared *Culicoides guttipennis*^a

Light Intensity (ft. Candles)	No. Engorged Per 350 exposed	Percent Engorged
Females held 24 hr. between emergence and blood feeding		
1.0	203	58.6 ^a
0.1	192	54.9 ^a
4.0	190	54.3 ^a
9.0	183	52.3 ^a
0.0	131	37.4 ^b
19.0	114	32.6 ^b
Females held 48 hr. between emergence and blood feeding		
4.0	271	77.4 ^a
0.1	256	73.4 ^a
1.0	246	70.3 ^a
0.0	232	66.3 ^a
9.0	230	65.7 ^a
19.0	163	46.6 ^b

^a Percent engorged marked with the same letter are not significantly different ($P < .01$), according to Duncan's Multiple Range Test. (Duncan 1955).

ing activity of the 24 hour starved females occurred at 0.1 to 9.0 foot candles. Lesser amounts of feeding occurred in complete darkness (0.0 ft. candles) or bright light (19.0 ft. candles). Unpublished studies by the authors indicate that these results correspond closely with field observations. On the other hand, when the females were held for 48 hours before feeding, the per-

cent engorgement was greater at every light intensity. Hunger must then be considered as an effect which may cause gnats to feed during periods other than optimal environmental conditions.

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