

REACTIONS OF CERTAIN NYMPHS OF *STENONEMA* (EPHEMEROPTERA) TO LIGHT AS RELATED TO HABITAT PREFERENCE¹

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In Douglas Lake, Michigan, nymphs of *Stenonema femoratum* (Say) and *S. interpunctatum* (Say) display almost identical habitat preferences and are especially numerous wherever rocks are found. In this lake rocky situations occur in shallow water and are almost invariably subject to severe wave action. In the natural environment the nymphs of these two species live under rocks during the day but were often observed on top of the rocks at night during calm weather; however, when a strong light was held on them for a short time, they would move to the lower surface.

Definite reactions were observed during the day. They do not appear to live normally on the substratum beneath the stones. Nymphs are not found on those rocks which have the under surface buried in the substratum. If a stone under which they occur is lifted from the water and suddenly turned over they immediately scurry to the under side. The immediate reactions are the same when a stone is merely lifted from the bottom and turned over but not removed from the water. They will, however, soon leave a rock held for a short time in this position, swim to the bottom, and seek a new stone under which they can find shelter. It should be noted that the nymphs are rather weak swimmers but they can move with agility when attached to an object.

Both species exhibit a strong, positive, thigmotactic response which is illustrated by their especially tenacious efforts to cling to a stone even when it is lifted free of the substratum and shaken vigorously in the water. This response was further demonstrated by placing a number of specimens in a circular aquarium with no object to which they could hold. At first they swam around the aquarium almost continuously but soon began to clasp one another until finally all clung together in a single group. Such a strong thigmotactic response is evidently correlated with the wave action factor of the rather vigorous environment in which they live.

From field observations it may be concluded that two factors, wave action and light, within the natural environment are the principal influences that cause these nymphs to seek a rocky habitat. But, since both species occur also under rocks in situations where waves are a minimal factor of the environment, and from their reactions in the natural habitat to light as described above, it is concluded that the nymphs do not live under rocks primarily because of the presence or absence of wave action. That light is the more important of the

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two factors in determining the habitat preference of rocks is further established by the following experiments.

The laboratory conditions did not appear to upset the normal reactions of the nymphs. About 20–25 individuals of one species were placed in a circular, glass culture-dish (30 × 10 cm.) with a marl-coated rock from their natural habitat and lake water. Each species was subjected separately to all experimental conditions. Under aquarium conditions the nymphs thrived, the younger ones showing distinct growth, the older ones coming to maturity and emerging. In the daytime they remained under the rock ventral side uppermost and attached to it but during the night the nymphs ranged freely over the upper surface of the stone. Very seldom did any of the nymphs leave

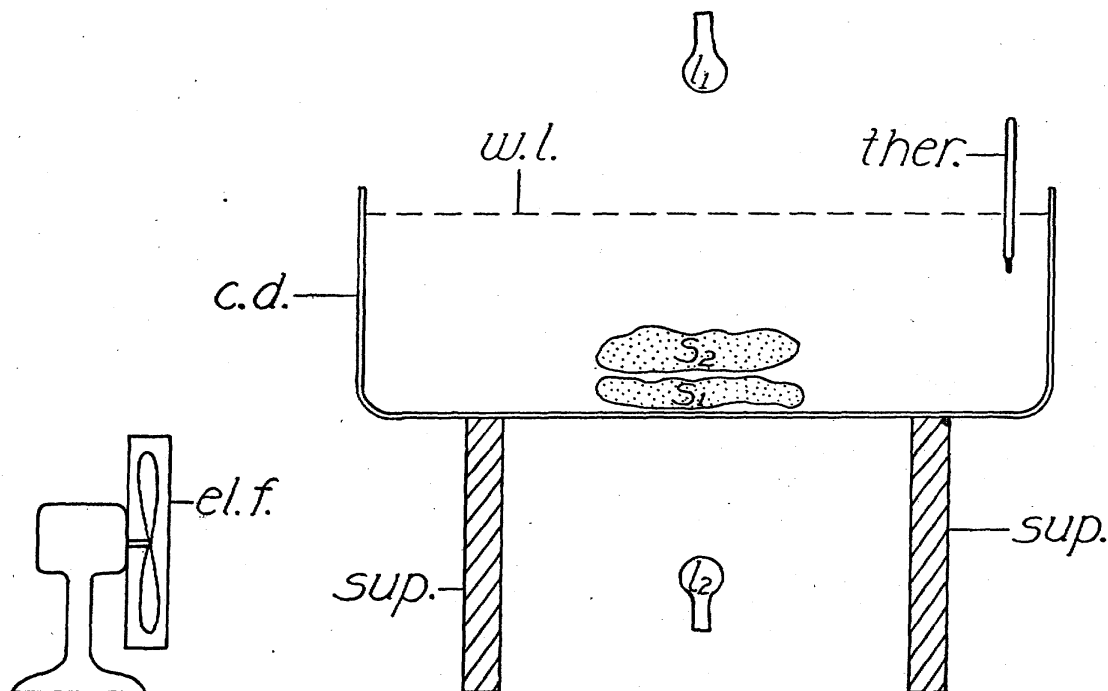


FIG. 1. L₁, light 1; L₂, light 2; ther., thermometer; c. d., culture dish; S₁, stone 1; S₂, stone 2; sup., support; el. f., electric fan for cooling light 2; w. l., water level.

the stone to swim around the aquarium. When a light was turned on at night, most of them would react quickly by moving to the lower surface. Their reactions to light were the same whether a clean stone or one covered with food was used.

Stomach examinations showed that the food of these nymphs consisted primarily of microscopic organisms associated with the marl-coated rocks of their natural environment. Feeding probably takes place only at night when the nymphs come to the upper surface of the stones. Very few were seen taking food during the day while under the stone even though food was available. It was difficult to make observations at night because of their negative reaction to any light, as soon as it was turned on, intense enough for such observations. However, most of those specimens on the upper surface at night which

did not react as rapidly as others to light were observed feeding. Food materials appeared to be more plentiful on the upper surface and sides of the rocks than directly under them. Since the presence of an adequate food supply must be considered as a possible factor limiting any given organism to a particular environment, the possibility was considered that these nymphs might be associated with the marl-coated rocks because of the lack of food elsewhere. However, the same food was available on the exposed sandy bottom near the rocks as occurred on the rocks themselves.

To further test their reactions to light, experiments were performed using the set-up as shown in Figure 1.

Nymphs chose the shadiest portion under the rock during the day although light entered from all sides. When the culture dish was covered with a heavy black cloth thus making the upper surface darker than the lower, all except two or three of the twenty-odd nymphs used in the experiment moved gradually around to the top and remained there as long as the cloth cover was present. When the cloth was taken away, they would again move below. The reactions were faster under the same conditions when lights 1 or 2 were turned on alternately. That the nymphs could detect movement when the cloth was raised seemed to be indicated by the fact that, if light 2 was on when that portion of the cloth nearest the observer was slowly raised, the nymphs in most instances moved around to the side of the stone furthest away from the observer. When light 2 was on and the nymphs had come to the upper surface, they would react almost immediately to any movement over the dish by moving to the sides of the stone. At night if light 1 was left on they remained under the rock.

The bottom of the culture dish was then painted black except for a small area at the center. Stone 1 was placed in the dish and time was allowed for the nymphs to gather under it. Stone 2 was placed on top of stone 1. Light 2 was then turned on so that the bottom of stone 1, but not stone 2, was illuminated. The nymphs moved to the top of stone 1 and in a short time most of them were on the bottom of stone 2. This result seems to show that they prefer to be ventral side up when under a stone, and that it is not necessarily the nature of the substratum which determines whether they choose to live ventral or dorsal side up, since in this instance the substratum was a stone in either case while in nature the substratum is sand.

SUMMARY

1. Field observations on the reactions of certain *Stenonema* nymphs leads to the conclusion that a rocky habitat is selected primarily because of the two factors, wave action and light.
2. Experimental laboratory evidence is presented to show that of these two factors, the negative reaction to light is the more important.
3. It was shown that food was not a principal factor determining habitat preference.