

Microhabitat Preference of Two Common Species of Dragonflies at the
University of Notre Dame Environmental Research Center

BIOS 569 - Practicum in Aquatic Biology

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ABSTRACT

Larval Odonata live in a variety of microhabitats within an aquatic environment. Microhabitat refers to a specific site within a broad habitat (a bog or stream) in which an organism chooses to live, such as leaf litter or mud. The microhabitat in which they chose to live is often based on whether the dragonflies are burrowers, sprawlers, or climbers. In this experiment, Epithca spinigera and Leucorrhinia hudsonica were placed in tubs that had mud, leaves, sand, and synthetic vegetation so that they could chose which substrate was the most favorable habitat. Both species showed a preference for the leaf substrate, probably because it provided the best concealment from potential predators.

INTRODUCTION

In the larval stage, insects of the order Odonata inhabit aquatic environments; however, within that aquatic environment, there is great diversity in the microenvironment that a larva may choose to inhabit (Corbet *et al* 1960). There are three main behavior groups in larval Odonata, the climbers, the sprawlers, and the burrowers (Needham and Heywood 1929). These behavior groups, along with other physical characteristics are the prime indicators as to which habitat a specific larva will prefer (Corbet *et al* 1960).

Burrowers, which include the club-tailed larvae (Needham and Heywood 1929) tend to live in the mud and sand on the bottom of a pond or stream and have short, powerful legs that are adapted for digging (Corbet *et al* 1960). These insects will try to dig anytime they are placed in water, even if the bottom surface is hard and not suited for digging. They dig by removing the material that is directly underneath their bodies and pushing it to the side (Corbet *et al* 1960). It is believed that throughout a larva's life it will continually increase the size of a single burrow that it lives in for the duration of its life. These burrows may have several side chambers and grow to be fifty centimeters deep (Corbet 1983). While in their burrows, they keep the tip of their abdomen pointed up into the water and breathe rectally (Needham and Heywood 1929). It seems likely that this habit of deep burrowing is a defense against bottom-feeding fish predators (Corbet 1983).

The sprawlers, another sluggish group of dragonflies, lie on the bottom of an aquatic environment with splayed legs. They allow a thin layer of sand or silt

to cover their bodies as a form of camouflage. When prey comes close enough to a larva, the labium is rapidly extended and the prey is captured (Needham and Heywood 1929). Sprawlers tend to have broad flat abdomens and long spidery legs (Corbet *et al* 1960). These physical characteristics prevent the larvae from sinking into the bottom sediment far enough to inhibit respiration. The family Corduliidae has almost entirely adopted the sprawling habitat, and it is believed that the long legs of Corduliidae and other sprawlers may have mechanoreceptors for prey detection, an obvious advantage for larvae which remain stationary for days at a time (Corbet 1983).

The final group of Odonata, the climbers, tends to live in weeds, roots, or sticks. They are usually colored green, yellow, or brown colored, and they can change their color to match their surroundings at the time of a molt (Corbet *et al* 1960). Climbers that live in weeds tend to further camouflage themselves by adopting an orientation parallel to the support it is grasping (Corbet 1983). Rather than waiting for their prey to come to them as sprawlers do, the climbers stalk their prey. Once the prey is within reach, the labium is rapidly extended to grab it (Needham and Heywood 1929).

This experiment is important because, like all organisms inhabiting freshwater environments, the spread of urbanization has the potential to driving these insects to extinction. This is because urbanization often involves draining ponds and bogs, which destroys dragonfly habitats (Corbet 1980). If more can be learned about the preferred microhabitats of different species, a way may be found to prevent this extinction.

For this experiment, dragonfly larvae will be given a choice of a variety of microhabitats, which will include mud, sand, leaves, and synthetic vegetation. It is hypothesized that Epitheca spinigera will prefer the leaves because they are climbers/ sprawlers (Merritt and Cummins 1996). Leucorrhinia hudsonica are climbers, so they will also probably prefer the synthetic vegetation, although they may show an affinity for the leaves.

MATERIALS AND METHODS

Location of Experiment

This experiment was conducted at the University of Notre Dame Environmental Research Center (UNDERC). The research center covers land in both Vilas County Wisconsin and Gogebic County Michigan. Twenty-six aquatic habitats lie completely within the boundaries of the property. Included in these aquatic habitats are nine dystrophic bogs, several permanent ponds and lakes, as well as numerous marsh habitats. The property also has an abundance of vernal ponds, which exist during the late spring months. As for lotic water, the property has three streams, which range in length from 0.4 kilometers to 4.8 kilometers.

In this experiment, dragonflies were collected from Brown Lake, which is a permanent lake just north of the Wisconsin border in Gogebic County Michigan. Tender Bog, the other location from which dragonflies were collected, is located northwest of Brown Lake, and is also in Gogebic County Michigan.

Construction of Experimental Tubs

In order to determine the microhabitat in which the Odonata preferred to live, larvae were placed in a habitat coming four different microhabitats. The

habitats were constructed in 40.64 cm by 15.24 cm plastic storage tubs. The tubs were filled two-thirds full with water from a hose. A layer of sand approximately one centimeter deep covered the bottom of the tub completely. The sand was sifted twice, once with a piece of .64 cm diameter black plastic mesh to remove the larger pieces of gravel and a second time with a 115 micrometer sieve to remove the finest particles of sand. Dividers were fashioned from two strips of aluminum flashing fitted together to divide each tub into four quadrants of equal area. The four substrates used were sand, leaves, mud, and synthetic vegetation. Each substrate was placed into a randomly determined quadrant resulting in each tub having four different substrates of equal area (See Figure 3).

Gathering the Substrates

The mud substrate was collected from the bottom of Morris Lake. Any aquatic vegetation in the mud was removed by hand, and the mud was allowed to sit in the sun in a covered five-gallon pail overnight to kill by anoxia any animals, especially other Odonata, that might be living in the mud. Once this process was completed, the mud was carefully poured into one quadrant of the tub. The leaves were collected from the edge of Bay Lake and soaked in the lake overnight. Then they were added to the plastic unit to cover the surface where they were allowed to float in the water. The final microhabitat, the synthetic vegetation, was made by melting twelve, six centimeter long pieces of .48 cm nylon rope to hardware cloth with 1.27 cm mesh that had an area of approximately 150 centimeters in a regular pattern of alternating rows. These rows consisted of three pieces of rope in rows with two squares of the mesh between each piece of rope. The nylon rope

was melted to the hardware cloth with the flame of a candle so that the hardware cloth and the rope were perpendicular. The synthetic vegetation was then placed in its quadrant, and the hardware cloth was pushed into the sand in the bottom of the tub to make it blend in with the natural habitat. For the experiments with Epitheca spinigera, the larvae came from Brown Lake. The Leucorrhinia hudsonica came from Tender Bog. The tubs were then allowed to sit overnight, and, approximately

Running the Experiment

Once the setup with all four substrates was complete, they were allowed to sit overnight. The following morning, the dividers were removed carefully to avoid disturbing the substrates. One dragonfly larva, which had been collected and allowed to adapt to the laboratory environment for twenty-four to forty-eight hours, was dropped into the center of each where all four substrates met. The initial substrate the larva settled in was recorded. The tubs were then allowed to sit overnight, and approximately twenty-four hours later, the substrate each larva was occupying was recorded.

This procedure was conducted in twenty storage tubs using L. hudsonica and E. spinigera. The experiment was conducted twice for each species of Odonata. This resulted in a total of forty larvae per species. The L. hudsonica experiments were conducted from June 12, 1999, to June 13, 1999, and again from June 14, 1999, to June 15, 1999. The E. spinigera experiments were conducted from June 22, 1999, to June 23, 1999, and repeated from June 24, 1999, to June 25, 1999.

RESULTS

For the L. hudsonica, the leaf substrate was chosen twenty-one times, the synthetic vegetation was chosen six times, the mud substrate was chosen seven times, and the sand substrate was chosen six times (see Fig. 1). A g-test conducted on Microsoft Excel showed that the results were significant ($g=13.9081$, 3df, $p<.005$). The E. spinigera showed even stronger preferences ($g=62.95939$, 2df, $p<.001$), occupying the leaf substrate thirty-seven times, the mud substrate twice, and the sand substrate once (see Fig. 2).

DISCUSSION

Since neither E. spinigera nor L. hudsonica were burrowers, it makes sense that the mud and sand substrates were not popular substrates for the Odonata to inhabit. As for the synthetic vegetation, it was probably unpopular even among the climbing L. hudsonica because it did not provide adequate concealment. Odonata larvae probably conceal themselves only in part to avoid being seen by their prey since some of their prey are not visually adapted to identify dragonflies as predators. They also hide to avoid being seen by the many animals that prey on Odonata larvae, such as fish (Corbet 1983). The pieces of rope in the synthetic vegetation did not hang down at all; they only stood straight up, so they provided no overhang under which the larvae could hide. Therefore, the leaves were the only remaining suitable substrate for the larvae. For the E. spinigera larvae, they often started swimming towards the leaves as soon as they were dropped into the tubs, as if they immediately perceived visually that the leaves provided the best hiding places. It is believed that larvae choose a substrate that fits their particular

adaptations based on particle size, and it is known that *Petaluridae* and *Aesnidae* move nocturnally to find a suitable substrate. Once that substrate has been found, a larva may remain motionless for weeks. It seems likely that other kinds of Odonata have similar behavior (Corbet 1983).

If this project were to be repeated next summer, the synthetic vegetation should be altered so that it has places for the larvae to hide. This could be done by melting more pieces of rope onto the hardware cloth to make the vegetation thicker so that a total of perhaps twenty-five pieces of rope are on a single piece of hardware cloth. Another change to the synthetic vegetation would be to make the pieces of rope longer so that the larvae could hide underneath the overhang. Then again, the synthetic vegetation could be replaced entirely by a natural habitat of twigs and sticks.

Leucorrhinia Habitat Preference Graph 1

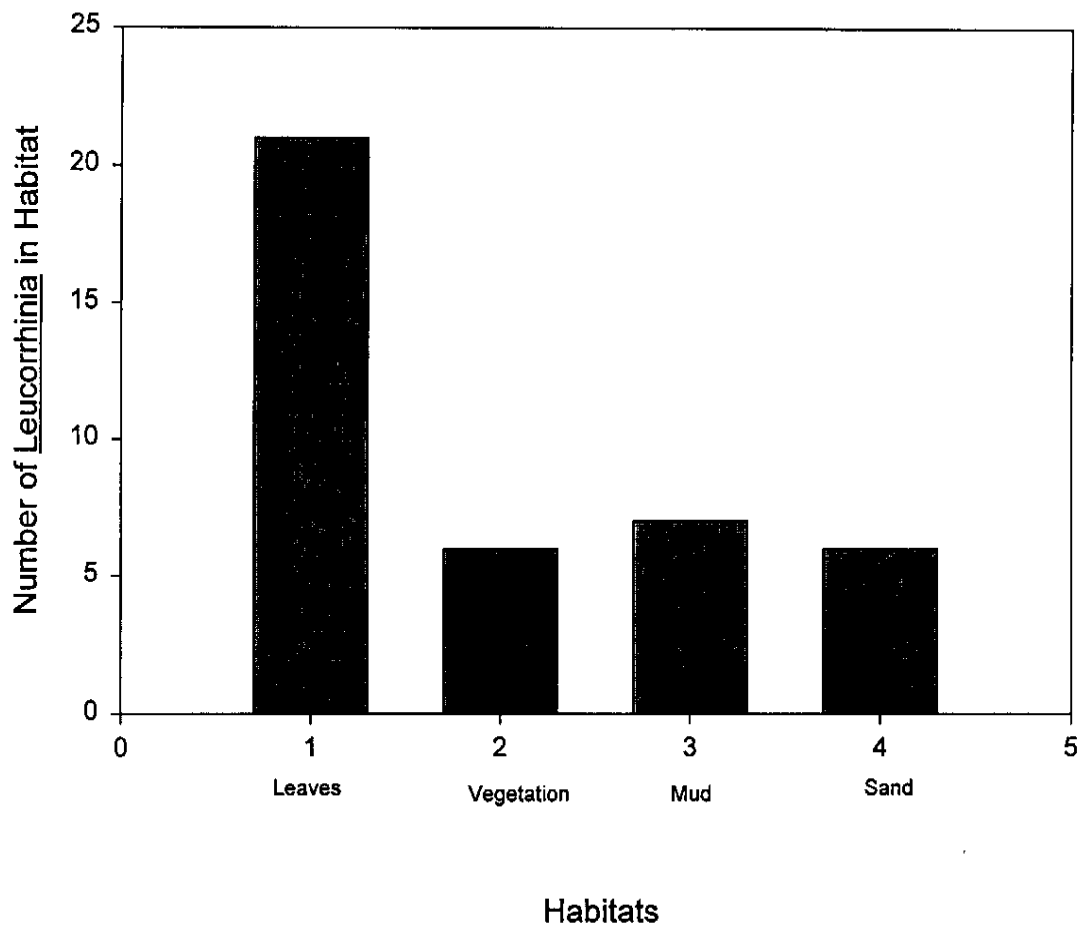


Fig. 1: The Leucorrhinia chose the leaf habitat twenty-one times, the synthetic vegetation six times, the mud seven times, and the sand six times. This shows a preference for the leaves.

Epitheca Habitat Preference Graph 2

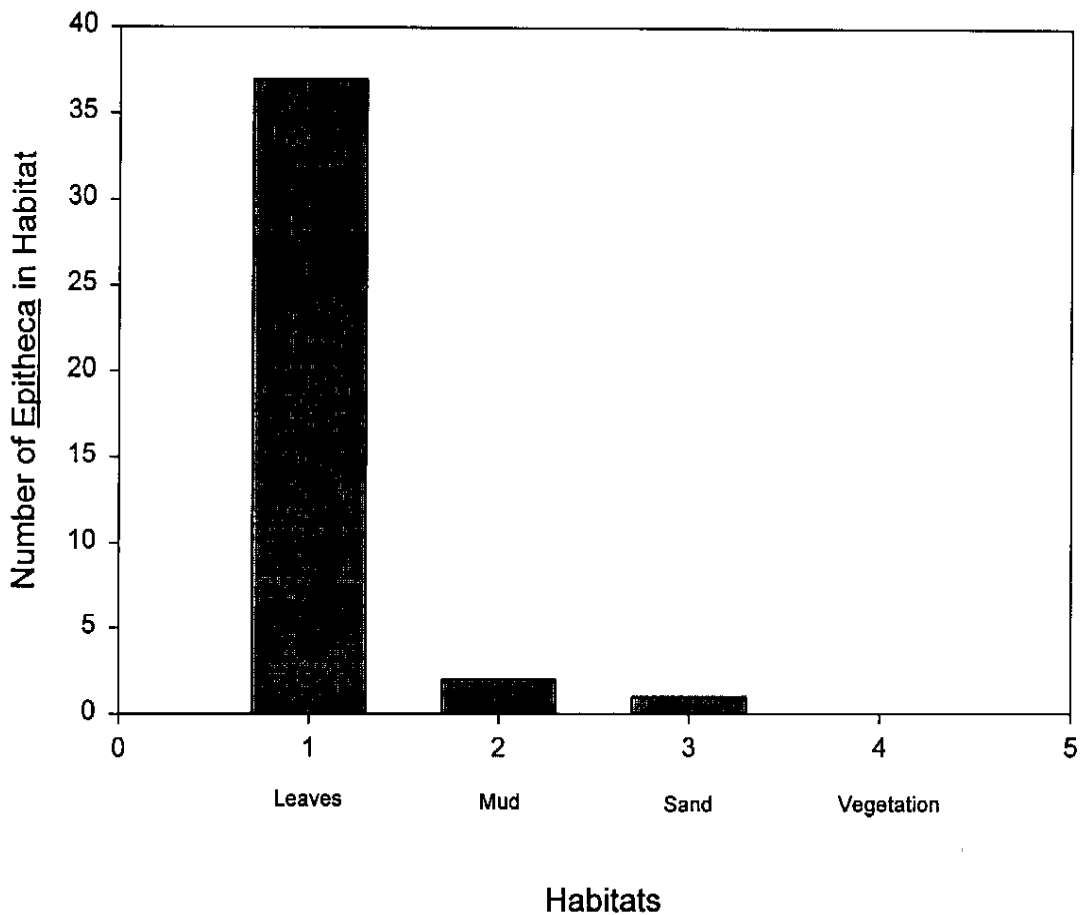
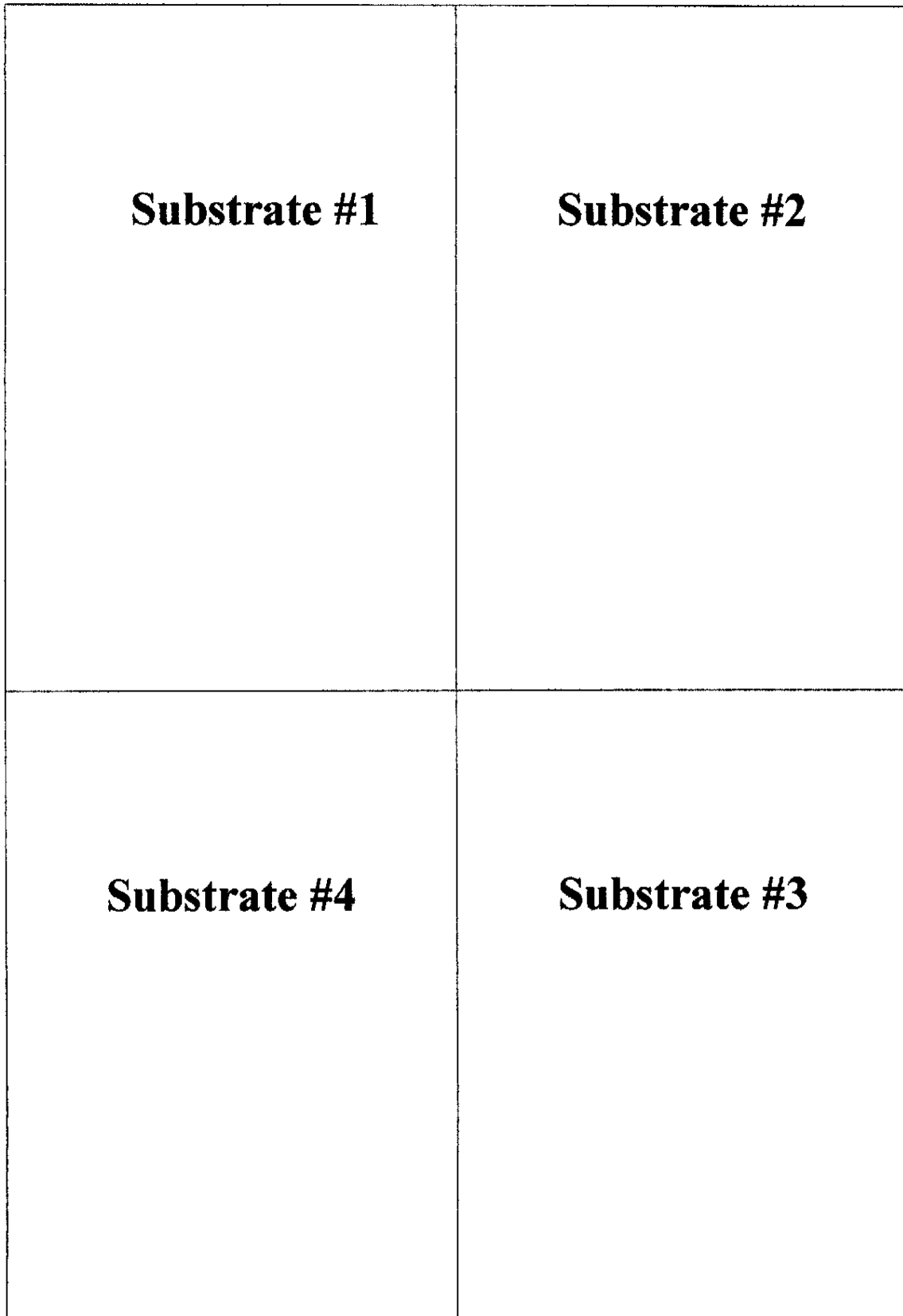


Fig.2: The Epitheca chose the leaf habitat thirty-seven times, the mud habitat twice, and the sand habitat once. They never chose the synthetic vegetation. This shows a clear preference for the leaf habitat.

Figure 3: Set up of the Microhabitat Tubs



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