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Animal Behavior

Gravel, Leaves, and Candy Bar Wrappers: An Analysis of the Case-Building Behavior
of Caddisflies in An Artificial Environment

Abstract

Introduction

Although it lacks the majesty of a butterfly being released from its cocoon, the caddisfly may be said to have one of the most interesting life cycles of any known insect. Ten months after being born, the caddisfly larvae will then enter its next stage of development by building itself a cocoon out of literally anything it can find, using a combination of secreted adhesive (as we might describe it) and present building materials to form a cocoon around itself, protecting itself from its surrounding environment while the pupae present within develops into an adult.

Although caddisflies have specific preferences for building materials, depending from species to species, it has been proven in multiple experiments that caddisflies will use different materials when forced out of their shells. One experiment showed that, when ejected from their cases prematurely, the caddisfly larvae will immediately rebuild their cases and do so as rapidly as possible, using whatever material is present (Hansell, 179). Another experiment shows that, oddly enough, caddisflies will actually use different materials for their cases as based on the presence of known predators, choosing stronger materials if needed (Boyero, Rincon, Bosch, 364), while yet another experiment discovered that caddisflies will

select materials that will assist with the collection of oxygen (i.e. by having water pass through the case), and will use materials that are best for their specific environments.

Using this information as our starting point, this group decided to create an experiment to test the case-material preferences of caddisflies living within Itasca State Park by ejecting them from their cases, placing them in a enclosed environment, presenting them with various materials, both natural and unnatural, and observing which materials they chose to use. For the purposes of this experiment, our initial hypothesis was that caddisfly choose case-building materials that are most common to their environments (i.e. organic/natural materials), and we predicted that, when given a choice, the caddisflies we used would select to use leaves/dirt more often than the various bits of inorganic/unnatural material we gave them.

Methods

In order to preform this experiment, this group began by collecting a total of 24 caddisflies, all still in the early pupa stage, present within their cases) from a nearby stream present within Itasca State Park. From the same site, a large amount of dead/decomposing organic material was collected (primarily dead leaves), and a large amount of mud/dirt/sediment was collected form the same general location as well (all of which would serve as both the caddisflies' food supply as well as building material. Shortly afterward, from various sources throughout the park (i.e. garbage cans, various stores, etc.) various forms of inorganic/unnatural material, including candy bar wrappers, soda can, soda bottles, plastic silverware, various other forms

of wrapper, bits of plastic, etc. were collected for the purposes of serving as inorganic building material.

After all necessary material was collected, a total of twenty-four plastic containers (i.e. yogurt tubs) had small holes cut into the sides (to promote water circulation) and a thin layer (approx. 2 cm) of sediment placed at the bottom of each container, in order to serve as the holding area for each caddisfly. After doing so, the twenty-four containers were then divided into two, and placed into 4 different fish tanks. Afterward, these fish tanks were then filled to approx. the height of the containers with water taken from the original stream.

Afterward, approx. 16 square centimeters of dead organic material (which was cut into a series of smaller pieces) was then placed into each plastic container. Then, all inorganic material used in this experiment was then cut up into a series of small pieces, combined into a single uniform mixture, of which sixteen square centimeters was placed into a total of fifteen containers (which would serve as the experimental group;. The control group would only receive the dead leaves. After creating their environments, all 24 caddisflies were then removed from their original casings through the use of forceps, and then placed individually within each container. Afterward, the caddisflies were given two days to rebuild their cases (acting under the assumption that the caddisflies would immediately begin to build their cases after being ejected) provided with 10 hours of light/14 hours of darkness through the use of fluorescent lights hooked up to timers. After two days had passed, the caddisflies were removed from their containers, and then, as before, removed from their cases with the use of forceps. Upon doing so, the total

proportion of each type of material provided (i.e. the percentage of leaf, sediment, inorganic material, etc.) was then measured for each caddisfly case. Once this was complete, we then proceeded to analyze the final results, in order to determine the case material preferences of these caddisflies.

Results

Before we actually conducted this experiment, we created a small prediction figure, for the purposes of helping us figure out how our final data may have turned out, how our results might have come out ultimately, as seen here:

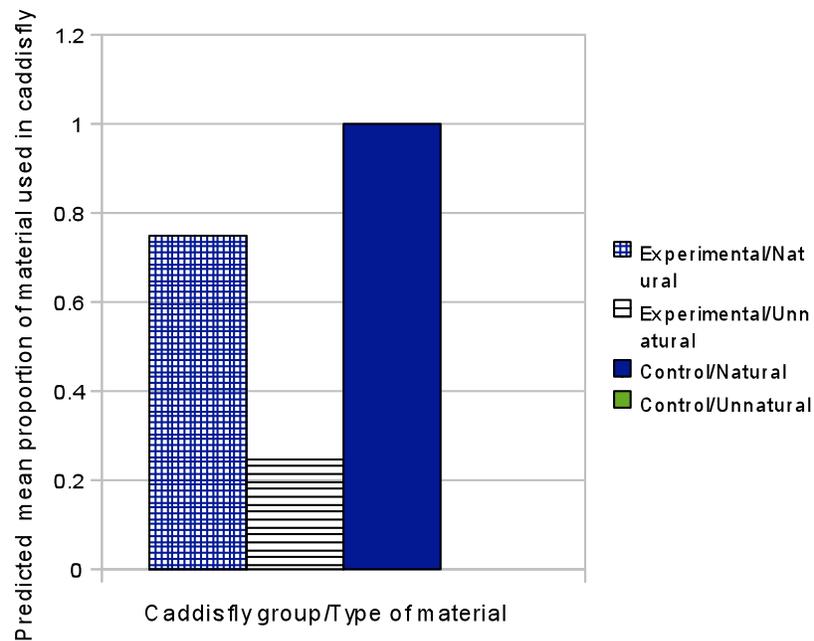


Fig. 1: This is a representation of the predicted mean proportions of both types of available material (natural and unnatural) that would be used by the two groups of caddisflies present, the experimental group having been provided both natural/unnatural material, and the control group only given natural material (i.e. leaves, rock, etc.)

When we actually conducted the experiment, and determined the mean proportion of either material used by either group, we quickly discovered that our initial predictions were surprising correct. Note that, in the control group, two of

our test subjects died (for unknown reasons), and that for the purpose of this experiment, we simply stated that said subjects used none of either material.

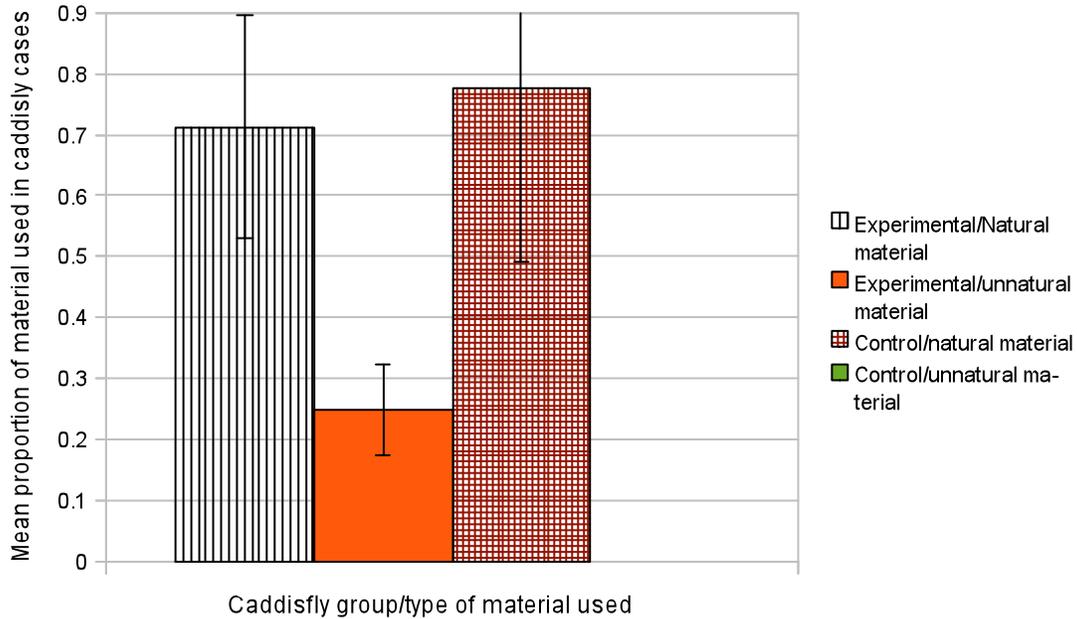


Fig. 2. This is a representation of the average proportion of the two types of material (natural and unnatural) used by both groups of caddisflies in constructing their cases. A two-sample t-test ($H_0: \mu_{EU} = \mu_{CU}$, $H_A: \mu_{EU} \neq \mu_{CU}$) concluded that, because ($T_{1,8}=2.07$, $P=.0019$), the null hypothesis must be rejected, and it must be concluded that the mean proportion of unnatural material (i.e. candy wrappers, plastic, etc.) used in the construction of caddisfly cases for both groups is not the same, and that one group used more than the other, etc.

Discussion

In retrospect, it appears that our attempt to study the building preferences/habits of caddisflies was a success, in that we were able to demonstrate, within an enclosed environments, which materials caddisflies will use in building their cases when ejected. The final results of this experiment were quite impressive; we were able to show that the experimental group had a distinct preference for the unnatural materials, and that would not reject using said materials when constructing their cases, which is, to say the least, very useful

information to know about the species. Ultimately, our initial prediction/hypothesis was correct; even in the experimental group, test subjects were much more likely to use the natural material offered than the artificial material given, as was subjected by earlier studies. Still, that they were willing to use artificial material at all suggests that they do have some “flexibility” in terms of these preferences.

However, our results do lead to a questions which cannot be so easily answered in this study: why the caddisflies in the experimental control group chose to use the artificial materials at all. Whether because the caddisflies believed (in a sense) that the artificial stuff would make a better case, or because it was merely there (that is, they chose to use it because it was easily available), it remains unclear why the test subjects to build using said substances. With any luck, we may be able to determine the cause later on in another experiment.

If we were to repeat this experiment on a later date, I would recommend that, this time, the number of subjects used increase dramatically, as well as the types of natural/unnatural material increase as well. I would recommend that, this time, preferences for specific types of artificial material (paper, plastic, etc.) should be tested as well, and the reason why these materials are selected should be investigated as well. Finally, I would recommend that more species of caddisflies be studied/investigated, in order to determine the specific preferences of multiple species, and how they all respond to the presence of multiple types of material.

References

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