Investigation of the Diversity of Nocturnal Insects

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Grade level(s) targeted: K-12

This project will be suitable for all grade levels as the level of difficulty can be adjusted to meet the needs of any grade level, Kindergarten through 12th grade, including advanced placement (AP) courses.

Question:

During the evening hours you have probably noticed that many insects are attracted to the outdoor lights of your house or apartment (inside ones too if you have left a door or screen open!). Have you ever looked closely at how many different types of insects are present? Not only are many different moths (Lepidoptera) attracted, but you may be surprised at how many other types of insects seem to find that porch light irresistible.

How many different types of insect are attracted to a porch light?

Hints to form the hypothesis:

Students should think about why insects might be attracted to lights and what factors may influence this, such as wavelength and intensity, phase of the moon, temperature, wind, etc. Students should think about what factors might influence the abundance and diversity of insects in a given region, and how this might differ in different regions (e.g. in town versus on a farm/ranch; urban vs. suburban).

Hypothesis:

H: Only nocturnal moths (Lepidoptera) are attracted to artificial (porch) light sources.
H: A wide variety of nocturnal insects, not just moths, are attracted to artificial light sources.

Materials needed:

- Vials or jars to place insects in. These could be as simple as old, washed peanut butter or jelly jars.
- A freezer to place the collected insects in. This will kill and preserve the insects for later investigation and pinning (if desired).
- Optional: Isopropyl (rubbing) alcohol (70%) could be used for killing and preservation, but is not required depending on how the instructor wishes to run the project.
- A field guide to insects, or for more advanced students/classes, 'An Introduction to the Insects' by Borror, Triplehorn and Johnson.
- Optional: Light bulbs of different colors (red, green, yellow, blue).

- Forceps (= tweezers) may be useful for collecting and handling the insects.

The Experiment:

1) Students develop their hypotheses and predictions about how light will influence the number and type of nocturnal insects attracted to artificial light sources.

2) Students provide (or are provided with) vials or jars for collecting insects.

3) Students go home and collect insects from around their porch lights. The vials/jars are placed in the freezer to kill the insects.

4) Insects are brought to school the following lesson. Perhaps doing this over a weekend would allow for a greater number and diversity of insects to be captured.

5) Insects can then be sorted and identified. There are a variety of possibilities here: formal identifications (to Family or Subfamily) can take place that introduce students to the details of insect structure, or less detailed identification can be used (e.g. Lepidoptera vs. Diptera vs. Hymenoptera). This can of course be varied with grade level, but students are still being introduced to the concepts of classification and morphology.

Of course the importance of locality can be emphasized if desired so insects collected at different localities can be compared (different parts of town, urban vs. suburban vs. rural, etc.). This decision should be made before sorting and identification begins so insects can be pooled or separated as necessary.

Safety 1: If Isopropyl alcohol is used there is a flammability risk should the containers come too close to an open flame. There is also an ingestion risk so students should be appropriately instructed about how to handle this chemical. As this is an optional component (an alternative to freezing) this risk can be avoided altogether.

Safety 2: Some Hymenoptera may be attracted to the lights and this brings the risk of being stung. Students should use due caution when collecting Hymenoptera or avoid collecting them altogether.

Safety 3: Some beetles (e.g. Cerambycidae) can deliver a painful bite; again due caution when handling the insect should avoid this risk.

Result:

Results can be presented as species lists, graphs comparing abundance of different taxa, species richness http://www.eoearth.org/article/Species_richness and diversity indices (e.g. Shannon-Weiner Diversity Index), or some combination of the above. All of these can be done for within and between site comparisons.

Equations:

Shannon-Weiner Diversity index:

The Shannon-Wiener Diversity Index, H, is calculated using the following equation:

$H = -\sum P_i(\ln P_i)$ where P_i is the proportion of each species in the sample.
http://chs.carlsbadusd.k12.ca.us/DeCino/Webpage/APES/shannonlab.htm

Also, with the numbers that should be generated students should be able to run grade-appropriate statistical analyses. Lower grade levels can do descriptive statistics such as mean, median, and mode; while more advanced students could potentially use t-tests, ANOVAs, correlation, and regression to analyze data.

Discussion:

Findings could be presented as a lab report, a poster, or as an oral presentation. There is a clear opportunity here to get especially high school students into the primary literature if it is available at the school or local library to compare their findings with other studies.

References:

1) Borror, D.J., Triplehorn, C.A., Johnson, N.F. 1989. *An Introduction to the Study of Insects*, 6th Edition. Harcourt College Publishers. ISBN: 0-03-025397-7

2) Eaton, E.R., Kaufman, K. 2007. *Kaufman Field Guide to Insects of North America* (Kaufman Field Guides). ISBN 13: 978-0-618-15310-7

3) BugGuide.net: http://bugguide.net/node/view/15740

4) InsectsAbout.com: http://insects.about.com/

5) Shannon-Wiener diversity Index:
http://chs.carlsbadusd.k12.ca.us/DeCino/Webpage/APES/shannonlab.htm

6) Species Richness: http://www.eoearth.org/article/Species_richness

7) Insect Diversity Project: http://www.discoverlife.org/pa/or/idp/

8) Insect diversity (Order descriptions):
http://userwww.sfsu.edu/~biol240/labs/lab_20insects/pages/insectdivers.html

Estimated time conduct the experiment:

The basic instructions on how to do the project should take no more than one class period.

Data collection could be one night, over a weekend, or multiple nights. This can be adjusted according to the needs of the instructor.

Data analysis (insect identification, counting, etc) should take 1-2 class periods depending on the volume of material and detail required by the instructor. Some of this work could be done as homework.

If this is done as a project a class period could be used for the presentations.

Time estimate: 2-4/5 class periods.

Estimated cost:

This should be a really cheap exercise to run, as the only real expense is the 70% ethanol (rubbing alcohol) if this is chosen as a preservation material: Approximately $2 per 500 ml bottle at retailers.

Forceps: these can cost anywhere from about $3 per pair to upwards of $15 per pair (e.g. Wards Natural Science, http://wardsci.com/search.asp?t=ss&ss=forceps. For this experiment cheaper forceps will generally work. Fine-tip forceps will be more useful for handling small insects when compared to round-nosed forceps.

Field Guides (if not already available in the library): Approximately $20 each

Contact: For help or questions concerning the project, please contact the authors – Kenwyn Cradock and Darren Pollock- Kenwyn.Cradock@enmu.edu