Problem Statement:
Does a habitat which contains higher native plant diversity support a greater diversity of insects which form the basis of the food web?

Category: Plant Biology

Grade: 7

Name: Randi Rice

School: Spring Lake Middle
Title of Project: Biodiversity, A Key to Environmental Health

Problem:
Does a habitat which contains higher native plant diversity support a greater diversity of insects which form the basis of the food web?

Hypothesis:
If you have a higher diversity of native plants then you will have increased insect diversity because the insects will have more to eat.

Procedure:
To start my experiment, I completed a walk through survey of a native plant prairie located at my home, and an adjacent hay/agricultural field. The purpose of this survey was to identify the number of plant species in each habitat type.

To capture insects, I created sticky traps using 8.5x11 inch sheets of yellow construction paper and TangleFoot Glue. Yellow construction paper was chosen because it is considered a visual attractant to insects.

A single trap was placed on the ground in both the native plant prairie and the hay/agricultural field. Each trap was left in the fields for a period of three days. After three days I collected the traps and replaced them with new ones placing the new traps in different locations in the field. I repeated these procedures three times for a total of nine trap nights.

Each sticky trap was stored in a Ziploc bag and taken to an entomologist for analysis. Each trap was analyzed for the number of species and an estimate of the total number of insects.

Results:
My results show that a greater number of insect species utilize the native plant prairie (which contained a total of 89 species of which 68 are native plants) in comparison to the hay/agricultural field (which contained 8 species of which 2 are native plants). The total number of species using the native plant prairie was 37 in comparison to 29 different species using the hay/agricultural field. Although the median for these two habitat types is equal, the mean for native plant prairie is higher that the mean for hay/agricultural field.

My tables also show that the native plant prairie also had a higher total number of insects (672) than the hay/agricultural field (542). The native plant prairie has a higher mean and median in comparison to the hay/agricultural field.

Acknowledgements:
Steve Rice-father-helped type my report-helped make sticky traps
Kelly Rice-mother-helped conduct walk through survey of plants
Nick Gressick-entomologist-helped me count the insects
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Appendix A: Native Prairie and Hay/Agricultural Plant Species List
Introduction

Problem Statement:
Does a habitat which contains higher native plant diversity support a greater
diversity of insects which form the basis of the food web?

Background Information:
Nearly every creature on this planet owes its existence to plants, the only
organism able to capture the sun’s energy and, through photosynthesis, turn that
energy into food for the rest of us (Ruby, Wirsen and Jannasch 1981). Because
animals depend on plants for their food, the diversity of animals is closely linked
to the diversity of plants (Rosenzweig 1995).

When there are many species of plants, there are many species of animals
(Tallamy 2007). Because plants are so different from one another in their size,
shape, habitat, and chemistry, a greater number of plant species mean more
opportunities for animals to obtain their energy (Tallamy 2007).

E.O. Wilson called insects the little things that run the world because of their role
in transferring energy from plants to other animals (Wilson 1987). Worldwide
37% of animal species are herbivorous insects (Wiess and Berenbaum 1988).
These species are very good at changing plant tissue to insect tissue, and at
providing food, in the form of themselves, to other animals. A large percentage
of the world’s animals depend on insects to access the energy stored in plants
(Wilson 1987). 96% of the world’s birds depend entirely on insects for food for themselves and their young (Dickinson 1999).

But not all plants are created equally. It takes an evolutionary time span for insects to adapt to the specific chemistry of different plants (Kennedy and Southwood 1984). To use a plant, insects must evolve the ability to find their host species amid thousands of other plants and then synchronize their life cycle to their host (Kennedy and Southwood 1984). By definition, native insects have shared little or no evolution history with non-native plants, and are not likely to use non-native plants for nutrition (Tallamy 2004). Consequently, the solar energy captured by non-native plants is believed to be largely unavailable to native insects, and therefore is unavailable to animals that include these insects in their diet (Tallamy 2004).

This information suggests that biodiversity of native plants is essential to the stability, health, and existence of most ecosystems, including our own. Peter de Ruiter et al. 2005, suggests that we should compare ecosystems to the game known as Jenga. In Jenga, blocks are used to build a tower. Once the tower has been built, the goal of the game is for players to remove blocks from the tower, one at a time, without causing the tower to collapse. In the Jenga example, the role of any given species in maintaining the stability and health of an ecosystem is similar to the role the individual blocks play in keeping the tower
from crashing. If ecosystems are Jenga towers, almost any species can play a
critical role under the appropriate circumstances (Tallamy 2007).

All of this suggests that biodiversity of native plants is essential to the stability
and health of most ecosystems. We remove species from our ecosystems at the
risk of their complete collapse (Kinzig, Pacala and Tilman 2002).

**Reason for my Research:**
I want people to understand that a diverse habitat that includes native plants is
healthier for themselves and the entire environment. I am hoping to demonstrate
that a landscape including a diverse habitat of native plant species is healthier
than lawns that include non-native plant species.

**Hypothesis:**
If you have a higher diversity of native plants then you will have increased insect
diversity because the insects will have more to eat.

**Material List:**

<table>
<thead>
<tr>
<th>Material</th>
<th>Quantity or Amount</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>TangleFoot Glue</td>
<td>½ a bottle</td>
<td>To create sticky traps for collecting insects</td>
</tr>
<tr>
<td>Yellow Construction Paper</td>
<td>6 – 8.5x11 sheets</td>
<td>To attract and catch bugs</td>
</tr>
<tr>
<td>Ziploc bags</td>
<td>3 bags</td>
<td>Store sticky traps</td>
</tr>
<tr>
<td>Hiking Boots</td>
<td>2 pairs</td>
<td>To put on feet while putting traps out</td>
</tr>
<tr>
<td>Camera</td>
<td>1</td>
<td>To take pictures of traps once we bring them in</td>
</tr>
</tbody>
</table>
Methodology

Independent Variable: Habitat type
Dependent Variable: Number of insect species
Control: None
Constants: Time of day
Length of trapping time
Weather conditions

To start my experiment, I completed a walk through survey of a native plant prairie located at my home, and an adjacent hay/agricultural field. The purpose of this survey was to identify the number of plant species in each habitat type.

To capture insects, I created sticky traps using 8.5x11 inch sheets of yellow construction paper and TangleFoot Glue. Yellow construction paper was chosen because it is considered a visual attractant to insects.

A single trap was placed on the ground in both the native plant prairie and the hay/agricultural field. Each trap was left in the fields for a period of three days. After three days I collected the traps and replaced them with new ones placing the new traps in different locations in the field. I repeated these procedures three times for a total of nine trap nights.
Each sticky trap was stored in a Ziploc bag and taken to an entomologist for analysis. Each trap was analyzed for the number of species and an estimate of the total number of insects.
Photographs:

Randi making insect traps.

Hay/agricultural field sampled with insect traps

Prairie habitat sampled with insect traps.
Insect traps September 3, 2009.

Insect traps September 6, 2009.

Insect traps September 17, 2009

Example of insect trap in hay/agricultural field
Results

Tables:

Table 1: Total Number of Insect Species Observed By Habitat Type

<table>
<thead>
<tr>
<th>Trials</th>
<th>Date</th>
<th>Native Prairie</th>
<th>Hay/agricultural Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9/3/2009</td>
<td>16</td>
<td>11</td>
</tr>
<tr>
<td>2</td>
<td>9/6/2009</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>9/17/2009</td>
<td>10</td>
<td>8</td>
</tr>
</tbody>
</table>

NATIVE PRAIRIE
Mean - number of insect species by trial: 12
Median - number of insect species by trial: 10
Mode - number of insect species by trial: none

NON-NATIVE AGRICULTURAL FIELD
Mean number of insect species by trial: 10
Median number of insect species by trial: 10
Mode number of insect species by trial: none

Table 2: Total Number of Insects Observed By Habitat Type

<table>
<thead>
<tr>
<th>Trials</th>
<th>Date</th>
<th>Native Prairie</th>
<th>Hay/agricultural Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9/3/2009</td>
<td>304</td>
<td>212</td>
</tr>
<tr>
<td>2</td>
<td>9/6/2009</td>
<td>188</td>
<td>155</td>
</tr>
<tr>
<td>3</td>
<td>9/17/2009</td>
<td>190</td>
<td>125</td>
</tr>
</tbody>
</table>

NATIVE PRAIRIE
Mean - number of insects by trial: 227
Median - number of insects by trial: 188
Mode - number of insects by trial: none

NON-NATIVE AGRICULTURAL FIELD
Mean - number of insects by trial: 164
Median - number of insects by trial: 155
Mode - number of insects by trial: none
Graphs:

Graph 1: Number of Insect Species Caught per Trial
Graph 2: Number of Insects Caught per Trial

- **Number of Insects:** 0, 50, 100, 150, 200, 250, 300, 350
- **Categories:** Prairie, Hay/agriculture
**Written Results:**
My results show that a greater number of insect species utilize the native plant prairie (which contained a total of 89 species of which 68 are native plants) in comparison to the hay/agricultural field (which contained 8 species of which 2 are native plants) (Appendix A). Including all three trials, the total number of species using the native plant prairie was 37 in comparison to 29 different species using the hay/agricultural field. Although the median for these two habitat types is equal, the mean for native plant prairie is higher than the mean for hay/agricultural field.

My tables show that the native plant prairie also had a higher total number of insects (672) than the hay/agricultural field (542). The native plant prairie has a higher mean and median in comparison to the hay/agricultural field.

**Conclusion**
My hypothesis stated: *If you have a higher diversity of native plants then you will have increased insect diversity because the insects will have more to eat.* Data contained in Table 1 and Graph 1 shows that the native plant prairie contained 37 species of insects, during the observation sessions, while the hay/agricultural field only contained 29 species of insects.

Information in the book *Bringing Nature Home*, by Dr. Doug Tallamy (2007), suggests that biodiversity of native plants is essential to the stability, health, and existence of most ecosystems, including our own. Rosenzweig 1995, suggested
that because animals depend on plants for their food, the diversity of animals is closely linked to the diversity of plants. My results support these statements, findings, and beliefs.

I believe the primary problem with my experiment involved our insect sampling technique. I chose to use yellow sticky traps because they act as a visual attractant to insects, but the height of the prairie plants (many in excess of 3 feet) made it difficult to see the traps. However, the hay/agricultural field had very short grass (comparable to a lawn) so the traps could be seen from a long distance.

I also believe that the vibrant colors present in the prairie neutralized the visual attractant component of insect traps. The native prairie habitat was full of yellow, purple, and white flowers, whereas the hay/agricultural field was basically green.

To improve the experiment, I would recommend using different forms of insect trapping techniques. A different technique may include raising the traps above the prairie vegetation. I would also recommend that insects trapping be completed over a longer period of time to see if there were seasonal variations.

I believe everyone can benefit from this experiment because biodiversity of native plants leads to a healthier environment. People need to learn about the
affect that they are having on our environment by utilizing plants that can’t be used by insects.

This project could be continued by looking at the use of native plant communities by species other than insects. In theory, if there is a greater diversity of insects using a habitat, then there should be a greater diversity of birds, small mammals, and other animals using that habitat. It would also be interesting to see if there is a direct benefit that could be measured for humans. Maybe there is a way to compare the health of humans that live in areas with high native plant diversity to humans that live in cities.
Bibliography


Appendix A
Our Field 89 species total

68 native

- Virginia wild rye
- mares tail
- yarrow
- cup plant
- climbing hempweed
- path rush
- spiderwort
- cardinal flower
- great blue lobelia
- green ash
- lady's thumb
- multi-flora rose
- jumpseed
- Virginia creeper
- red maple
- silver maple
- may apple
- fox sedge
- narrowleaf mountain mint
- false nettle
- staghorn sumac
- forget me not
- woolly goss
- hypericum
- Dianthus

24 common plantain

21 b. beggar ticks (b. frondosa)
Our Field

- Grass level
- golden rod
- purple level
- willow
- herb
- poison ivy
- tall golden rod
- daisy flea bane
- Timothy
- honey suckle
- Queen Anne's lace
- autumn olive
- Stiff golden rod
- new england aster
- enchantus nightshade
- purple cone flower
- compass plant
- yellow cone flower
- spotted goosweed
- black eyed susan
- blue verlane
- gray headed cone flower
- switch grass
- rattle snake master
- curly dock
- syperus esculentus
- riverbank grape
- bone set
- water horhound
- tall ironweed
- foxtail grass
- indian grass
- carex comosa
- big blue stem
- common ragweed
- little blue stem
- bee balm
- cotton weed
- white vervain
- heeall
- horse nettle
- wild burr
- poke weed
- ruff avens
- rice cut grass
- cherry
- common milk weed
Species total

Stille's Field

Narrow leaf pondwort
Sword rush
Horse nettle
Yarrow
Dandelions
Queen Anne's lace
Daisy key bug
Red clover