BIODIVERSITY OF INSECT POPULATIONS IN THE SPRINGFIELD BOG METROPARK IN SUMMIT COUNTY, OHIO

By Cynthia Perkovich
MS Student University of Nebraska-Lincoln
Entomology Dept.
What defines a bog and its’ surrounding habitats

This is a picture taken in early Fall of the newly constructed pond within the park.

Cindy Perkovich, University of Nebraska
Defining characteristics

• Acidic pH
• Stagnant water
• Carbon sink, decaying plant materials

Picture by Paul Bolstad, University of Minnesota, Bugwood.org
Indigenous Wildlife to Young’s Bog

Common Plant Inhabitants
- Purple pitcher plant
- Swamp milkweed
- New England Aster
- Water Willow

Common Animal Inhabitants
- Newts
- Dragonflies
- Finches
- Owls
- Deer
- Bats
- possum

Rob Routledge, Sault College, Bugwood.org

Alfred Viola, Northeastern University, Bugwood.org
Goal of Study

1. Examine Diversity of Families of Insects
   - Look at families present the role they play within the ecosystem
   - Analyze the impact they have and will have on future succession of other organisms

2. Sample Population values and examine growth of family population sizes
   - See how quickly population sizes increase
   - Use growth of insect populations to determine success of habitat succession
Methods
Locations*

- **Site A - Field**
  - Fielded area near beginning of park trail with many Poaceae species as well as little over hanging plants to provide shelter from elements and predators.
  - Seasonal burnings conducted on fielded area to help restore nutrients into soil and maintain the habitat

- **Site B - Wooded Area**
  - Brush covered area with several trees about 0.25 miles into trail.

- **Site C - Pond**
  - Newly established, man made pond with overhanging walkway
  - Positioned within the fielded habitat
  - Nearly central within the conservation area

*Young’s Bog is a highly protected conservation area at this point, sampling had to be done in the park area surrounding the actual bog*
Sampling Techniques

- Flight Interception Traps (FIT)- for sampling nocturnal flying insects in field in Location A
- Manual surveying of 5- 2’x2’ sections within open field
- Pitfall Trap- used to collect ground dwelling families near tree in Location B
- Beat sheet was used to collect families dwelling in overhanging branches within wooded site
- Kick seining used to collect families within the riparian zone of Location C
Common Insect Families Found in Sampling

Lesley Ingram, Bugwood.org
Common Insect Families

**Coleopterans**
- Pollination
- Detrivores
- Water quality indicators
- Coccinelidae, Carabidae, Tenebrionidae, etc

**Hymenopterans**
- Many hymenopterans are essential for pollination
- Many parasitoids necessary for population regulation
- Apidae, Vespidae, FOMICIDAE, etc

Jerry A. Payne, USDA Agricultural Research Service, Bugwood.org

Cindy Perkovivič, University of Nebraska
Common Insect Families Cont.

Lepidopterans

- Pollinators
- Caterpillars feed on vegetation
- Papilionidae, Noctuidae, Pieridae, etc

Dipterans

- Some pollinators
- Many lay eggs in aquatic conditions
- Stagnant water provides shelter for larvae
- Many decomposers that feed on dead tissues
- Culicidae, Sarcophagidae, Calliphoridae, Asilidae, etc
Hemipterans

- Many species thrive in large populations
- Sucking/piercing mouthpieces to feed on plant and animal fluids
- Some influential for pollination
- Many herbivorous species are host specific
- Pentatomidae, Miridae, Aphididae, Largidae, etc

Misc. Orders

- Many other orders had representatives present. Other families included Forficulidae, Libellulidae, Entomobryionidae, etc
Methods for Analysis of Data
This program allowed the following tests to be run:

- Assumptions Testing to ensure that data was plotted evenly on the NPP plots
- TWO-WAY ANOVA to evaluate the two independent variables that affected the dependent variables
- Tukey HSD Test to evaluate the means of the dependent variables and ensure the difference between two means of the variables are not greater than the standard error or significantly different from one another
Results of Tests
Important Notes

- 85 total families found, representing 13 insect orders, and 1 non-insect hexapod order
- A total of 1663 individuals sampled
- Collections only included adult insects, no nymphs, imagoes, or larvae were recorded although many were present throughout the study
Plot of Families Found/Site

Number of Families

- Field
- Pond
- Wooded
Analysis

- Throughout the year the field ranged from 12 families present at the lowest point to well over 40, averaging around 37 families present.
- Pond ranged from 2-19 families
- Wooded area ranged from 12-39 families
- Field by far had largest range as, but was close to the wooded site for the average numbers of families present
Plot of Families Found/ Season
Analysis

- Spring had largest range, having nearly 50 families present during a sampling.
- Summer and spring both had nearly the same average number of families present.
- Fall and winter had similar range number of families present as well as the same average.
Plot of Individuals Found/Site

- Field
- Pond
- Wooded
Analysis

- The field by far had the most individuals present, with average number being higher than either of the ponds or wooded area’s highest range.
- Field range reached nearly 500 individuals
- Pond and wooded area had similar range of individuals, topping out at approximately 150, but the pond’s lowest range was must lower than the wooded area
Plot of Individuals Found/Season

Number of Individuals

Fall  Spring  Summer  Winter
Analysis

- Summer had the widest range of individuals, but the same average number as spring.
- Winter had a very minimal range in individuals present.
- Numbers of individuals were greatly reduced in the fall and winter months compared to the spring and summer.
What this study says about the health and biodiversity of the newly conserved system

A brief evaluation of the insect families found
General Conclusions

The greater increase in individuals present during the summer than the families may have been a result of reproduction during the spring months. Families present did not decline during this time so it is likely to have been a result of populations increasing within the families.

Individuals present during winter months had a small range, but the family range comparatively suggests greater biodiversity while population sizes are still low. This would be expected during colder periods of the year.

There was no significant interaction found between the seasons meaning that there was a lack of seasonal differences vs the extensive variation between Site A (the field) and Site C (the pond). Concluding that Site may be a larger factor than Season.
Major Predatorial Orders/Families Found

- **Order Odonanta**
  - Major pond predators
  - Will affect non-insect populations as well
- **Order Mantodea**
  - Major predators in food webs
  - Capable of subduing large prey
- **Family Coccinelidae**
  - Major predator of herbivorous pests such as aphids
- **Family Reduviidae**
  - Avid stalkers and patient ambushing family
  - Many species are predators of pollinating community members
- **Family Hydrophilidae**
  - Major predators of aquatic insects and larvae
  - Will have impact on chironomid and culicidae larvae
Importance of predators in this ecosystem

- Maintain balance within the ecosystem, limiting pest populations and herbivory
  - Very important in bogs where many plant species are specialized and endemic
- Necessary for trophic cascade
  - Help regulate impact from other organisms
  - Affects on lower nutritional levels of food chain
- Sideways and circular impacts on competing predator populations
  - Helps limit their own populations
- Implies that ecosystem is healthy enough to sustain multiple trophic levels
Eusocial Families Present

- **Formicidae**
  - Build large colonies
  - Members found in bog had built their nest under cover from trees in the wooded area

- **Apidae**
  - Socially complex flying insects
  - Major pollinators in field
  - Hive was not located within sampling areas, but they are capable of traveling far distances
Analysis of Presence of Eusocial Insects within Bog

- Highly sophisticated and complex cast systems with a queen and workers.
- For a system to sustain a eusocial insect colony, several things must be present:
  - Sufficient land and acreage for colonies to make a domain
  - Ecosystem must maintain sufficient food and water sources
  - Complex food web necessary for foraging and predatory roles within the casts
- The bog must have a stable and abundant food network for ant colonies to persist and be successful
- The bog must also offer a variety of flowering plant species to attract honey bees
Common pest families to Northeast OH that were sound in sampling

Common pest families that were found in sampling

- Pentatomidae
- Coccinellidae
- Aphididae

What their presence may imply

- This may be an ecological source of pests or it may be an alternative habitat for them
- Many over winter in homes and could migrate to this habitat during active months
- Future studies could assess their role in the habitat as well as impact bog could have in decreasing their role as pests by providing alternative habitats

Note that families were found, further differentiation of actual species may find that the species are not considered pests
Families Important for Pollination Found in Samplings

- Many Lepidopteran families
  - Papilionidae
  - Geometridae
  - Pieridae
  - Hesperiidae

- Hymenopteran families
  - Apidae
  - Megachilicidae

- Dipteran families
  - Syrphidae
Implications about bog diversity and stability from pollinators presence

- Bog must have sufficient plant variety to attract the numerous pollinators it does.
- Pollinators are influential and link many habitats together to increase gene pool for plant species. Thusly, this bog must be playing a role and influencing the genetic variability of other plant populations within the region.
- Bog may play a viable role in the conservation and rehabilitation of declining pollinator species within the region.
Other important families to note

- Elateridae and Cerambycidae
  - Many highly endemic species within the family. Bog may serve as a home and conserved site for some species.

- Sarcophagidae
  - These flies are highly specialized as scavengers and play a major role in the cycling of nutrients. This bog may play an influential role in the cycling of nutrients which is an unusual and unique trait since most bogs are carbon sinks and do not cycle nutrients throughout the system.

- Dystiscidae
  - Highly influential predatory beetle. This presence may suggest a highly complex structured ecosystem and food web within the pond. Interesting concept to explore since the pond is newly constructed.
Future Studies

Analysis of Lepidopteran Biology and Migration
- Summit County Metropark Systems claims that there are over 15,000 species that visit or call this home. Studies could be done to survey the true diversity and analyze if this habitat is becoming a traveling oasis for migratory species.

Analysis of Growth after Annual Field Burnings
- The field area is maintained by scheduled burnings. This would be a peak opportunity to study ecological succession within the system and see how the diversity changes compared to the findings of this sampling.
Future Studies Cont.

Diversity and Population Sizes after 10, 15, 20 years...
- Future surveys taken can be evaluated and compared against the initial findings from this sampling when the conserved habitat was only under watch for 5 years. It would be interesting to see if population sizes increase as well as the number of families present.

Ecological Succession of New Insect Populations in Conservation Area
- Insects are often a primary source for carnivores within a food web. Studying the succession of herbivorous vs carnivorous insect species could give insight as to whether or not insects inhabit an area in any sort of pattern.
Thank You
Dr. David Costello- Assistant Professor, Kent State University Department of Biological Sciences- help with determining parameters and running biostatistics

Bethany M. Schmidt- MS Student, Kent State University Department of Biological Sciences- help with collecting insects and organizing data