Chapter 6

Biota of the Lehigh Gap Wildlife Refuge – Insects

LGWR Biota – Insects

Survey of the Insects at the LGWR

Part I of the Lehigh Gap Wildlife Refuge Ecological Assessment contained the results of insect surveys performed with light traps in 2006.[1] The vast majority of the specimens collected were moths (Lepidoptera).

Light Traps

In order to obtain a more complete picture of the insects of the Refuge, several other trapping methods were used for Part II of the assessment. As well as trapping, visual surveys were also conducted for diurnal species of butterflies (Lepidoptera) and dragonflies and damselflies (Odonata).

General Insect Trapping Methods:

Malaise traps (tent-like net traps shown in the photo below) are used to collect flying insects. The traps funnel insects into a collecting bottle filled with alcohol. The net trap is set up and checked periodically (every 1-2 weeks). The alcohol kills and preserves the collected specimens.

Malaise trap

Pitfall traps (see image on the next page) are used to collect crawling insects. These are homemade devices with a 1"x4"x24" board standing on edge that serves as a barrier to crawling insects. At each end of the board, a one-pint plastic deli container is buried and filled with Sierra brand antifreeze, which is nontoxic to vertebrates. A rain shield is affixed to the top edge of the board to prevent dilution of the antifreeze. The antifreeze kills and preserves the insects. Collecting the specimens was

[1] See Appendix D in http://lgnc.org/wp/wp-content/uploads/ 2009/06/lgnc-ecological-assessment.pdf.

accomplished by straining the insects from the antifreeze and storing them in alcohol in plastic bags. The antifreeze was subsequently re-used in other traps.

Pitfall trap

Malaise and pitfall traps were deployed from May through August 2008 at the same three sampling locations on the Refuge as the light traps in 2006. These sites included the bottomland wetland in the Kittatinny Ponds area; a mid-slope hollow with scattered trees amid the re-vegetated grassland area; and the pitch pine-hairgrass savanna near the crest of the ridge. Traps were set and insects were collected weekly when possible, and biweekly on a few occasions. Two malaise traps were destroyed during the sampling period. Samples were strained from the trapping medium and stored in a freezer until being transported to Dr. John Rawlins at the Carnegie Museum of Natural History in Pittsburgh for identification and cataloging.

Insect Trapping Results:

The complete results of the 2008 malaise and pitfall trapping surveys (and a more detailed description of the survey methods) are reported in Appendix C-1. Specimens from 13 insect orders representing over 100 families were collected in 2008. There were 33 Carabidae species that were new records for Carbon County; trapping for Part I of the assessment in 2006 yielded an additional 54 new county records. In the survey there were new state records as well.

One specimen of *Niphonyz segregata*, a Lepidoptera, was found in 2006 but not identified and confirmed until this report. This represents the northernmost record for this northeast Asian noctuid which might be a potentially new invasive insect in the U.S.

The report contains a complete listing of the species identified from the 2008 traps as well as some phenology data for these species. Given the importance of phenology data for monitoring impacts of climate change, the information in this part of the database could be extremely valuable for future monitoring at the LGWR and other regions along the Kittatinny Ridge.

Reference:

Malaise Traps. Mississippi Entomological Museum. http://mississippientomologicalmuseum.org.msstate.edu/collecting.preparation.methods/Malaise.traps.htm

Hymenoptera (Native Bee studies):

In addition to generalized insect trapping, the LGNC has been trapping bees since 2007. The survey at the LGWR is a part of a larger collaboration of scientist and naturalists surveying the native bee flora east of the Mississippi. Sam Droege, U.S. Geological Survey (USGS), is coordinating the project and providing support for data entry and storage, identification, and sample distribution for reference and related studies (i.e. DNA comparisons between species). The primary goal is to determine what species exist on the east coast, relative to studies done in the early 1900s, and what new species might be found, both native and exotic. As the survey continues over years, the population shifts will be documented. Transects have been placed in diverse habitats for species comparisons.

This study has national and international significance given the widespread occurrence of the Colony Collapse Disorder which is dramatically reducing the populations of honey bees that are essential for pollination of a number of crops. If the honey bee disappeared, crop plants would need to rely on native bees for pollination. This study helps scientists determine the presence, abundance, and range of these native bee species. For sites such as the LGWR, the abundance of species and individuals will provide a high quality measure of the effectiveness of the reclamation of damaged habitat. Additional studies may be done on the biology of specific species, including plants that they pollinate.

Participants in the project include the Coordinator for Northeast Pennsylvania and bee identifier, Dr. Anita M. Collins, Dept. Entomology, The Pennsylvania State University; site coordinator; Dan Kunkle; members of the LGNC Naturalists Club and other volunteers who comprise the sampling crew and help to collect, wash and pin the bees; and the national coordinator, Sam Droege.

Collecting specimens from bee traps

Bees are collected using a standard bowl trapping protocol in which a series of fifteen 3.2oz plastic bowls are distributed five meters apart, alternating blue, yellow and white bowls. This constitutes one transect line. These colors (paint specific) have been determined to be most attractive to foraging bees. A small amount of soapy water is placed in each bowl to drown and hold the bees. After 8 to 48 hours the bees are collected and strained, placed in alcohol, and stored in a refrigerator. Samples are later washed, dried and pinned for identification. Data on date, location, collector, GPS coordinates, species,

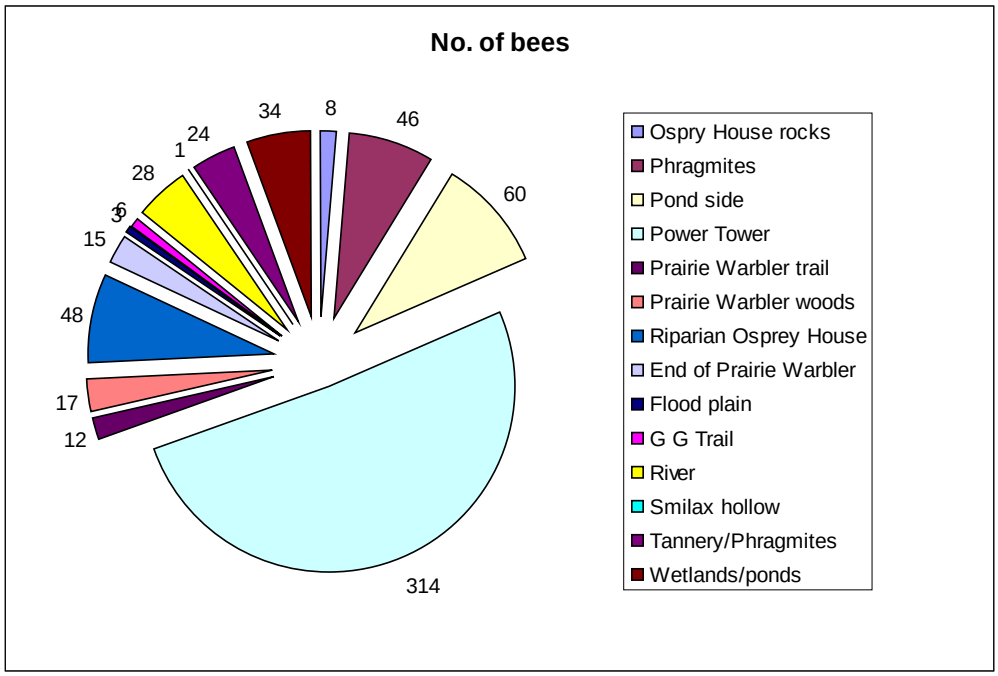
weather and habitat are entered into a national database (USGS). From this information, maps of specific transects can be generated. A more detailed description of the collection method written by Sam Droege can be found in Appendix C-2.

Washing the bees at the Osprey House

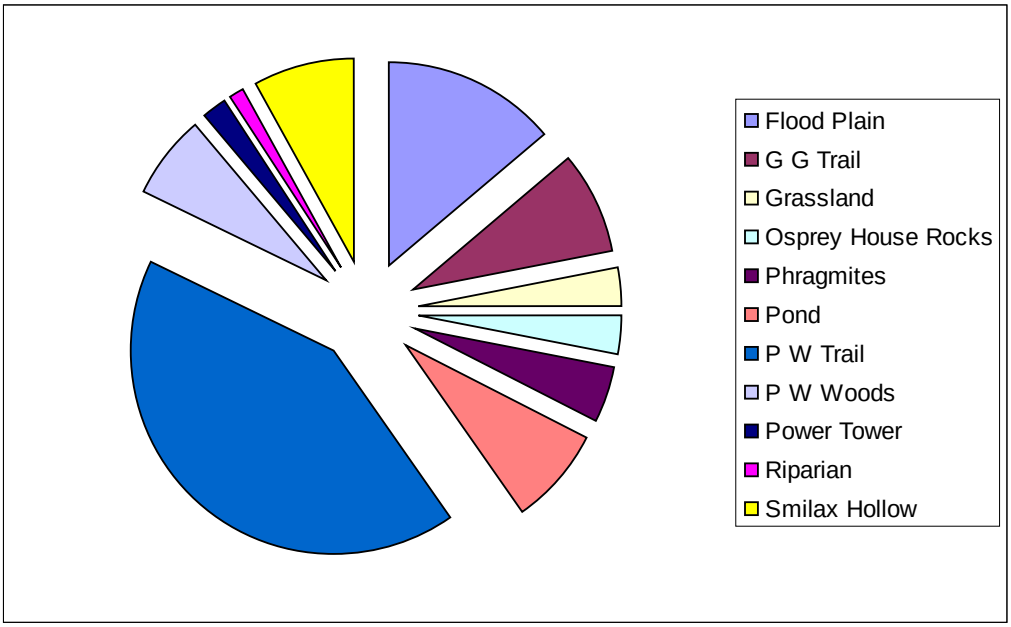
Identification of samples collected in 2007 (April 28th and June 14th surveys) and 2008 (survey dates from May 3rd to September 17th) is still ongoing, but some partial data and a preliminary species list are included in this report. Bees were found in all eight transects placed in the vicinity of Osprey House. Bees from additional transects throughout the Refuge have also been collected. Thirty-four bee species from 14 genera have been identified so far. A preliminary list of bee species identified to date (from the 2007 collection) is included as Appendix C-3.

Sorting through the collected specimens

Preliminary identification and pinning of specimens. Dr. Collins is on the left. Others in the photo are members of the LGNC Naturalists Club.



Number of bees by site – 2007



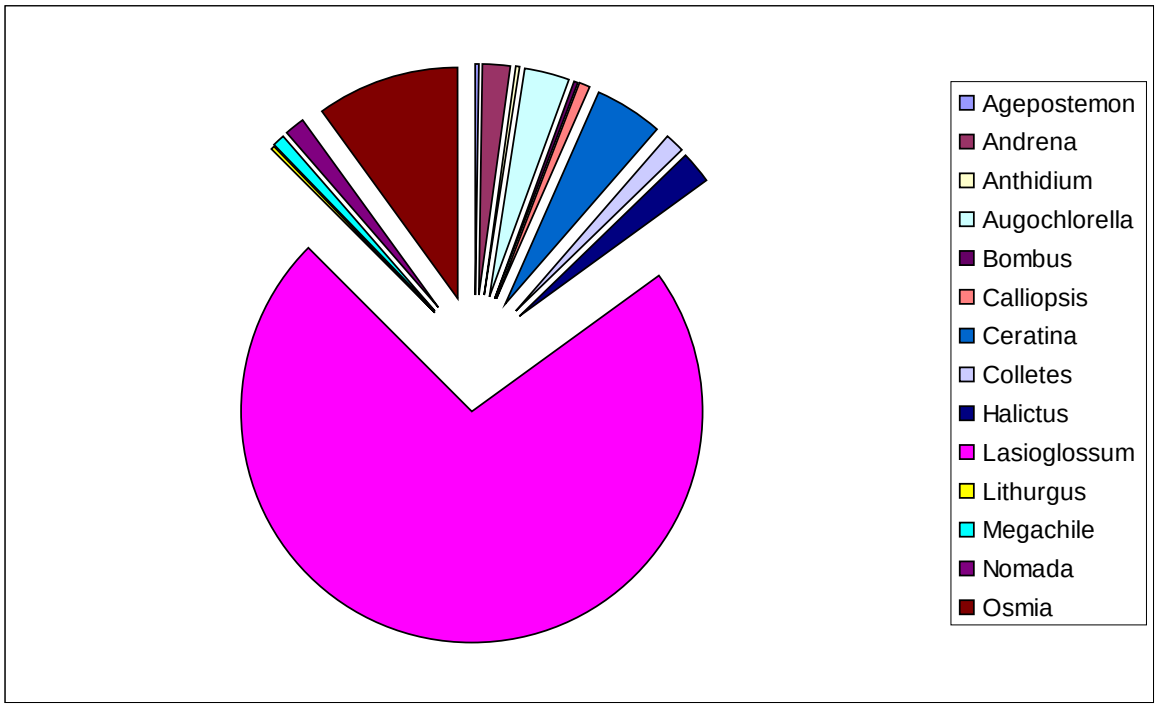
Number of bees by site – 2008

The above pie charts give a sense of the numbers of bees by site in various locations on the Refuge. It is important to note that not all sites were sampled an equal number of times. However, in reviewing the raw data, on a given date, the areas with the highest numbers of bees in pie chart also typically had the highest number of bees in a given survey.

In general, the highest numbers of bees were trapped in the month of May and the lowest numbers were from traps set in August and September. Exceptions to this were along the GG Trail (a woodland trail on west end of Refuge), in the phragmites transect between the road to LGNC and Lehigh River just to the south of the Osprey House, and the grassland areas. Consistent numbers of bees were trapped in these areas throughout the season.

***Megachile* sp.**

From 2007, a total of 306 specimens representing 14 genera and 31 identified to the species level were captured (see figure below). That diversity was concentrated in the *Lassioglossum* genus represented by 222 of the specimens of 15 different species.



Number of bee specimens by genus - 2007

One of the most interesting findings, and one with possibly the most important consequences, was the trapping of a specimen of an exotic carpenter bee, *Lithurgus chrysurus*, near the Osprey House and Tannery building at LGNC. This is a Mediterranean carpenter bee last documented in Phillipsburg, New Jersey in the early 1970s; this bee species destroyed a porch and was thought to have been eradicated. The discovery of this species at the LGWR initiated a search for more specimens by USGS and the Pennsylvania Department of Agriculture. More specimens were found, but the species is not currently known to be causing economic damage to structures.

***Halictus* sp.**

Short bibliography of relevant papers for the bee study:

Campbell, J. W., and J. L. Hanula. 2007. Efficiency of Malaise traps and colored pan traps for collecting flower visiting insects from three forested ecosystems. *Journal of Insect Conservation* 11:399-408.

Cane, J. H., R. L. Minckley and L. J. Kervin. 2000. Sampling bees (Hymenoptera: Apiformes) for pollinator community studies: pitfalls of pan-trapping. *Journal of Kansas Entomological Society* 73:225-231.

Cockerell, T.D.A. 1903. North American Bees of the Genus Nomada, *Proceedings of the Academy of Natural Sciences of Philadelphia*, Vol. LV, Edward J. Nolan, ed.

Giles, V. and J. S. Ascher. 2006. A survey of the bees of the Black Rock Forest preserve, New York (Hymenoptera : Apoidea). *Journal of Hymenoptera Research* 15: 208-231.

Hopwood, J. L. 2008. The contribution of roadside grassland restorations to native bee conservation. *Biological Conservation* 141:2632-2640.

Leong, J. M. and R. W. Thorp. 1999. Color-coded sampling: the pan trap colour preferences of oligolectic and nonoligolectic bees associated with a vernal pool plant. *Ecological Entomology* 24:329-335.

Roulson, T. H., S. A. Smith and A. L. Brewster. 2007. A comparison of pan trap and intensive net sampling techniques for documenting a bee (Hymenoptera: Apiformes) fauna. *Journal of Kansas Entomological Society* 80:179-181.

Toler, T. R., E. W. Evans, and V. J. Tepedino. 2005. Pan-trapping for bees (Hymenoptera: Apiformes) in Utah's West Desert: The importance of color diversity. *Pan-Pacific Entomologist* 81:103-113.

U.S. Geological Survey, National Biological Information Infrastructure. 2009. The Very Handy Manual: How to Catch and Identify Bees and Manage a Collection. http://bio2.elmira.edu/fieldbio/beemanual.pdf

U.S. Geological Survey, National Biological Information Infrastructure Online Bee Identification Guide. http://www.discoverlife.org/20/q?search=Apoidea

U.S. Geological Survey, National Biological Information Infrastructure. 2008. What Kind of Bee Is That? Online Identification of Native Bees. http://www.nbii.gov/images/uploaded/8496_1205443948002_Bee_ID_Guide_fact_sheet_1-08.pdf

Wasps

During late summer of 2009, Sam Droege of the USGS conducted a pilot study of wasp trapping techniques in the eastern United States. At the LGWR, three traps were set, which collected a total of 219 wasps of six species. The traps were 500mL plastic water bottles with the labels peeled off filled with apple juice.

Wasp trap

The three traps were set in different habitats in the southern section of the LGWR. The first trap was placed in a serviceberry tree in the Habitat Garden at the Osprey House. The trap was placed very close to several fall-blooming plants, which attract numerous species of wasps. The second trap was located in the riparian zone, which consists mainly of Red Maple and River Birch. The third trap was placed in the oak forest above the Prairie Warbler Trail. The three traps were put out on August 18, 2009 and left out for three weeks. The samples were then cleaned and placed in plastic bags with alcohol and sent to Sam Droege for identification.

Polistes fuscatus

A list of the species collected is included in the table below. S. Droege indicated that, as of October 2009, the *V. vidua* species trapped at the LGWR were the first that had been reported in over 100 traps in the USGS study. He also commented on the relatively high number of yellow jackets captured at the Refuge.

Results of 2009 Wasp Trap Survey at the LGWR

Trap:	**Trap 1 (Habitat Garden)**	**Trap 2 (Riparian)**	**Trap 3 (Forest)**	**Total**
Vespa crabro	1	1	8	**10**
Vespula maculifrons	11	29	26	**66**
Vespula flavopilosa	15	8	80	**103**
Vespula vidua	0	0	3	**3**
Dolichovespula maculata	12	12	12	**36**
Polistes fuscatus	1	0	0	**1**
Total	**40**	**50**	**129**	**219**

Diurnal Lepidoptera and Odonata Surveys

Visual surveys for diurnal Lepidoptera (butterflies and skippers) and Odonata (dragonflies and damselflies) were conducted at the Refuge starting in 2009. The purpose of these observations was to compile a species list for these insect groups to supplement the trapping that was conducted. Appendix C-4 records the species list compilation for these two orders.

Gray Hairstreak

Seventeen damselfly, seventeen dragonfly, and forty-six butterfly species have been recorded at the LGWR. This list is considered preliminary; additional surveys, some planned in conjunction with the Entomological Society of PA, will be conducted in the future.

Powdered Dancer

Of the butterflies observed at LGWR, several are important indicators of the health of the restored grassland. Several species of skippers (Hesperiidae), including Swarthy Skipper (*Nastra lherminier*) and Little Glassywing (*Pompeius verna*), require the grasses in the re-vegetated hillside to survive. As well as being an important place for grassland butterflies, the Refuge holds large populations of locally uncommon butterfly species including Common Roadside-Skipper (*Amblyscirtes vialis*) and Milbert's Tortoiseshells (*Aglais milberti*). Occasionally during the summer months, many of the Common Roadside-Skippers can be found on the old railroad beds along the river. During the late fall months, Milbert's Tortoiseshells fill the autumn flowers. It is not uncommon to find twenty or more of these spectacular butterflies along the railroad bed and in the gardens, even after most other butterfly species have disappeared due to the cold weather.

Milbert's Tortoiseshell

The Lehigh Gap Naturalist Club has also been trapping and tagging Monarch butterflies (*Danaus plexippus*) through the University of Kansas's Monarch Watch program for the past three years. During his bird surveys, Corey Husic recorded numbers of migrating monarchs. A high count of 1028 monarchs on September 2, 2007 highlights the importance of Lehigh Gap as part of the migration corridor for these butterflies, just as the Kittatinny Ridge is a leading line for raptor migration. The Refuge seems to serve as an important stopover site for resting and feeding, formerly almost exclusively on butterfly bush (*Buddleja davidii*), which is being controlled. Increasingly, the monarchs are feeding on late eupatorium or throughwort (*Eupatorium serotinum*), white-snakeroot (*Ageratina altissima*), and other species flowering in early autumn. Because of this, the Refuge is careful not to eradicate the entire population of butterfly bush until native nectar plants are well-established.

As well as the monarch research, several programs have been conducted at the Lehigh Gap highlighting the importance of monarchs and their migration. These programs have ranged from simple introductions to the butterfly and its natural history to monarch tagging programs, where the public captures and tags the Monarchs during the butterfly's migration to Mexico during the fall months.

Reference:

Migration and Tagging, Monarch Watch. http://monarchwatch.org/tagmig/index.htm.

The Regal Fritillary

In July 2009, several researchers and staff of the Lehigh Gap Nature Center visited Fort Indiantown Gap (FIG), Pennsylvania to learn about conservation efforts of the endangered Regal Fritillary (*Speyeria idalia*). The natural range of the Regal Fritillary used to cover most of eastern and central United States until humans began to destroy the grassland habitats required by the butterflies. Today, these butterflies are extremely rare in eastern United States, but FIG, with its extensive grassland habitat, has the only remaining breeding population in the East. Biologists at FIG are interested

in cultivating relationships with owners of potential Regal Fritillary introduction sites.

Regal Fritillaries require warm-season grasslands with key nectar and larval food plants to survive. This is of interest to the LGWR, as a grassland with native nectar sources is already being established. To make the site suitable for Regal Fritillaries, the nature center would need to establish the larval food plant, arrow-leaved (*Viola sagittata*) and bird's-foot (*V. pedata*) violets in the grassland.

Regal Fritillary

Arrow-leaved violet (*Viola sagittata*) grows naturally at the top of the ridge, and a few trial bird's-foot violets have been planted in the deer-exclosures at the Refuge to determine whether or not they can tolerate the metals in the soil. In November 2009, three members of the FIG team visited the Refuge. They determined that the site could potentially become desirable habitat for Regal Fritillaries. Since regals use Little Bluestem (*Schizachyrium scoparium*) grass clumps for pupating, the biologists were especially interested in finding that species and they did find scattered clumps that should be sufficient.

The FIG biologists identified two major challenges to the site for regal introduction. One is maintaining the area as grassland by halting the spread of woody plants into the grassland area. The second is establishing nectar and food plants for the butterflies.

Gray birch (*Betula pupulifolia*), aspens (*Populus sp.)*, and invasive butterfly ush (*Buddleja davidii*) and tree-of-heaven (*Ailanthus altissima*) are all colonizing the site and will lead to diminishing the amount of grassland available if ecological succession is not halted. In this region along the Kittatinny Ridge, forest is the usual outcome of succession. In order to keep the site as a grassland, a management plan must be put into place that resets the clock on succession continually. One component of a successful grassland management plan is fire, and prescribed burns could be used to help with the management of the grasslands at LGWR. The team from FIG could be a valuable resource to help us develop and implement management using fire.

The second challenge is already beginning to be addressed with the grassland enhancement and deer plot study area (see Chapter 8). Experimental planting of nine native flowering forbs that produce nectar, pollen and seed that is valuable to wildlife was conducted in 2009. In addition, we have planted several dozen native field thistles (*Cirsium discolor*) provided by FIG in 2009. We have also been spreading seeds of common and butterfly milkweed (*Asclepias syriaca* and *A. tuberosa*) and

several other species to enhance the grassland. Along with other species coming in on their own (e.g. *Eupatorium serotinum* and goldenrods, *Solidago sp.),* the FIG staff members felt that the nectar part of that equation is being taken care of; however, we still need to figure out how to establish essential violets that serve as the larval food plants of the fritillaries.

During the visit to the Refuge, the FIG staff mentioned that they are removing Big Bluestem (*Andropogon gerardii*) because of its tendency to be sod forming in their location, while Regal Fritillary needs clump grasses such as Little Bluestem. D. Kunkle expressed a concern that the LGNC cannot do "single species management" here just to host Regal Fritillaries, but that a goal is to maximize native biodiversity at the Refuge. The FIG researchers understood and agreed that single species management is not the proper approach at the LGWR. Kunkle also assured them that no grass species could form sod here because of the rocky conditions.

The FIG staff sees our site as a place with potential. We have the necessary grass species and are establishing nectar species. If we can also establish the critical violet species, the host plant for regal larvae, and develop a management plan to maintain the grasses, LGWR could become a Regal Fritillary introduction site. A number of FIG scientists returned twice in 2010 (July 30 and September 29) to further evaluate the site as potential Regal habitat, to conduct a survey of butterfly fauna, and to discuss control burn strategies.

Reference:

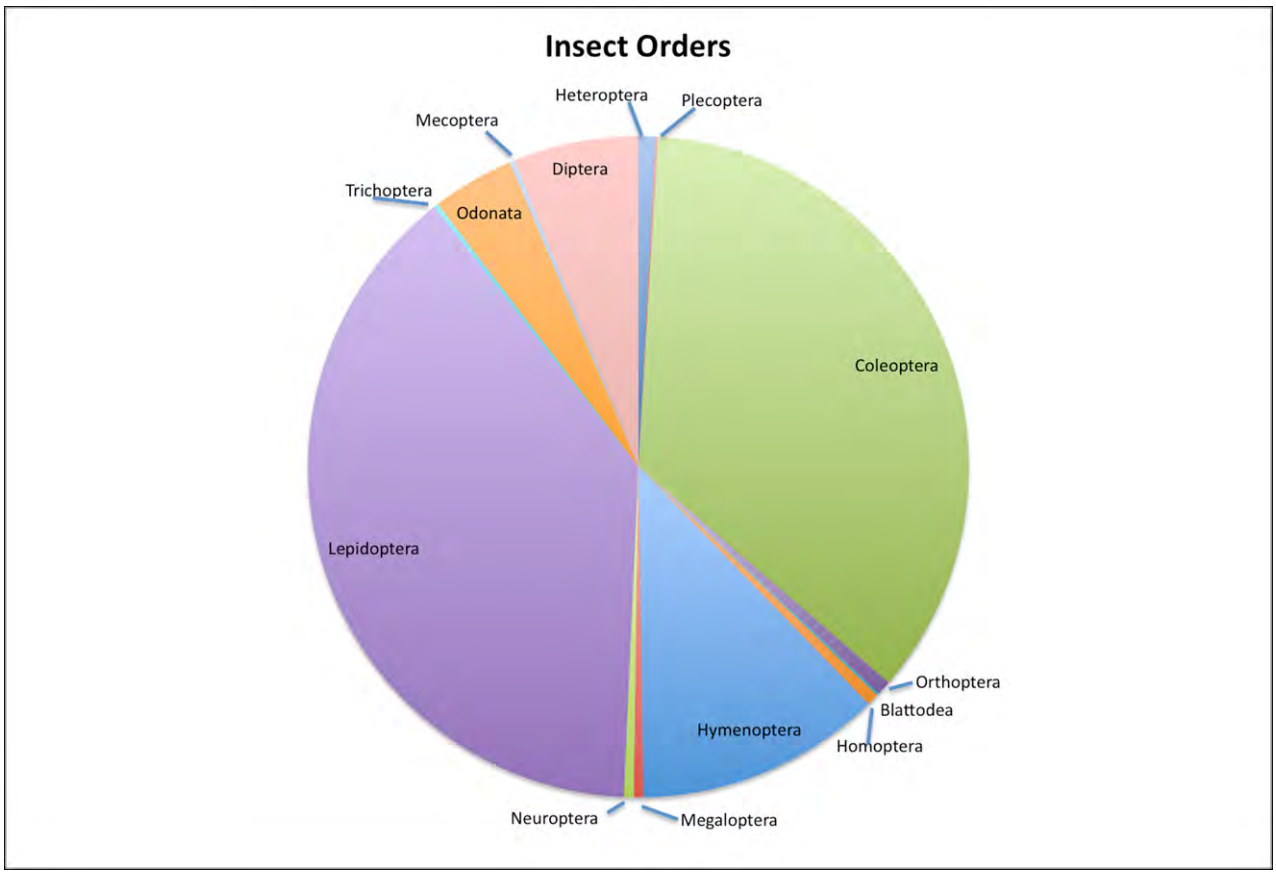
McNaughton, D., J. Hovis, M. Swartz, and N. Hoffman (2009) Grassland Restoration and Management Plan for the Repatriation of the Regal Fritillary Butterfly (*Speyeria idalia*), Report for Project Number 08-392, Department of Defense, Legacy Resource Management Program.

Crossline Skipper

Compilation of the Insect Inventory at the LGWR

A compilation by C. Husic of all 851 insect species observed at the Refuge through trapping and visual surveys (as of December 2010) is found in Appendix C-5. With this comprehensive database, further analysis using biotic indices should be conducted to determine the quality of the environment at the various sampling sites on the Refuge at this time and stage of restoration. In addition, the current survey data should be compared to historical records (e.g. the Cockerell bee study of 1903 referenced above and the Rehn insect collection reports from the early 1900s typically published by the Academy of the Natural Sciences of Philadelphia). The distribution of

species within insect orders is represented in the pie chart below.



Distribution of LGWR Insect Species Identified to Date by Order

Widow Skimmer

Macroinvertebrate Diversity Study LGWR Ponds

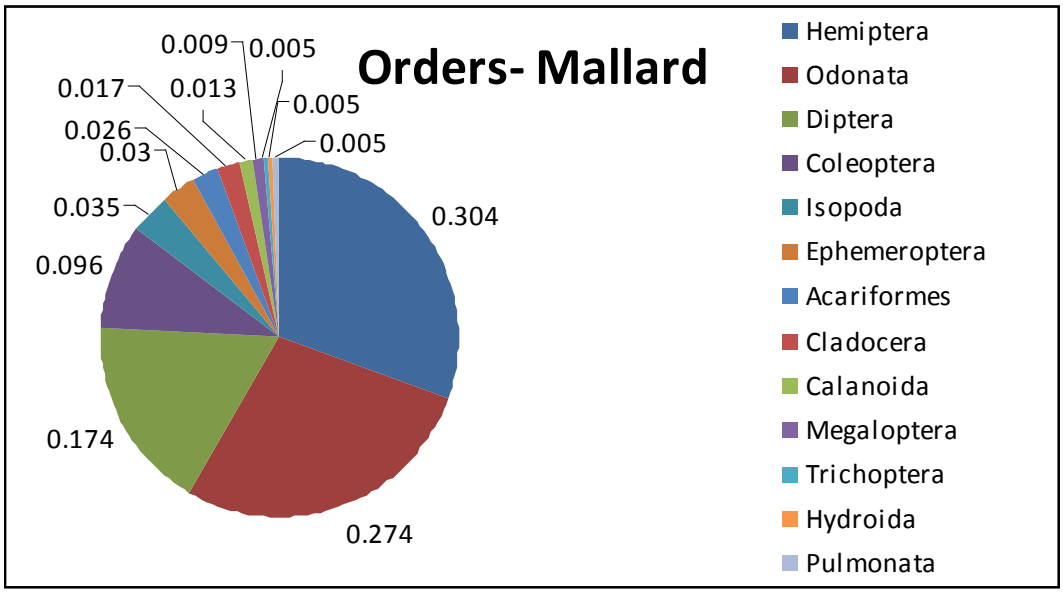
The purpose of this project was to establish an inventory of the macroinvertebrate populations in three ponds on the west end of the Refuge all of which had been historically impacted by heavy metal contamination from the zinc smelters. Each of the three pond sites were sampled with 1000 µm mesh nets. From 100 to 200 macroinvertebrates were sampled at each pond, yielding 25 to 50 different species.

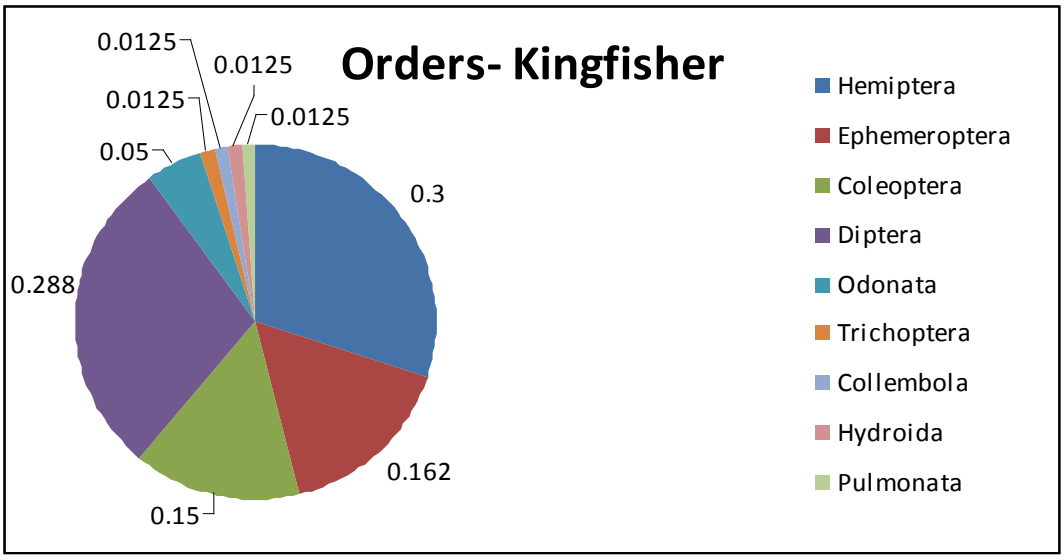
Macroinvertebrates were sorted and identified to family or genus and diversity measured using the Shannon and Hilsenhoff Family Biotic Indices. The samples included algae and protozoans, but also larval stages of insects. Thus, the study (summarized in a poster in Appendix D) is mentioned here.

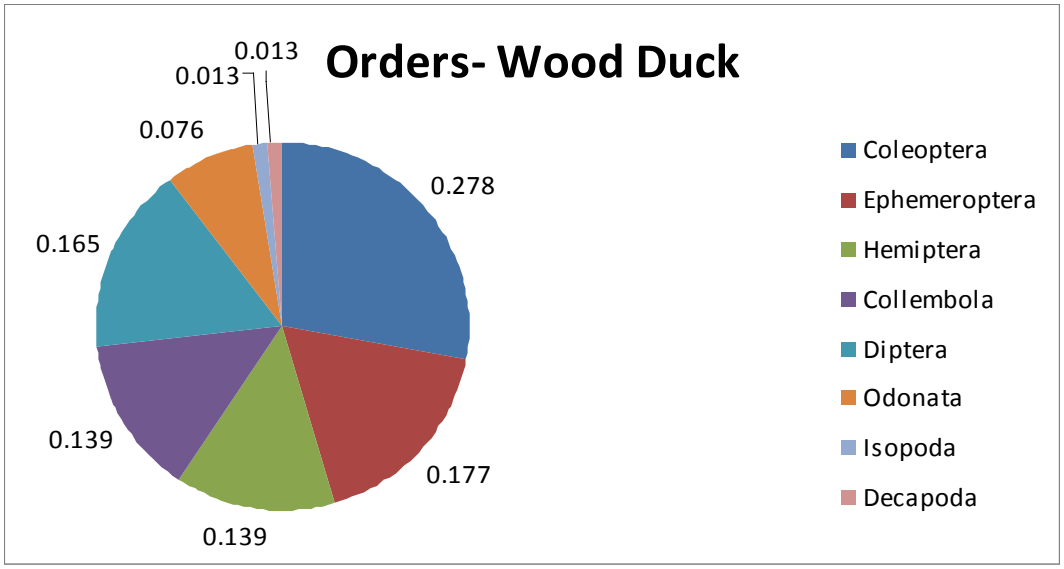
Baetidae sp

Two summary figures from this study are included on the subsequent pages.

Percentage of Individuals (Macroinvertebrates) in Each Order for the Three LGWR ponds







Number of Macroinvertebrate Genera Represented in Each Order from the LGWR Ponds