2014 Field Station Annual Report

UNIVERSITY of WISCONSIN
UWMILWAUKEE
Field Station

Table of Contents

On the Cover: Jim Reinartz installing the new Campbell CR3000 datalogger for the Field Station weather station. See 2014 Highlights for more details.

About Us

2014 Highlights

- The Field Station celebrated its 50th anniversary in 2014! A short history is available on our website.
- We were featured in Wild at UWM, a UWM Spotlight on Excellence video. A link to the video is given on our website.
- We installed a brand new data-logger and digital automatic rain gauge for our weather station as part of an upgrade and modernization of that equipment. This major improvement was made possible with funding from UWM, the Friends of Cedarburg Bog, the Besadny Foundation, and several of the research programs that use the weather station data.
- Expansion of the on-line component of our Natural History Workshops so that more of those topics are now offered as "blended" in-person/online courses for college credit.
- 32 research projects in 2014.
- Over 10,000 student hours of instruction and group use in 2014.

The UWM Field Station

The UWM Field Station is used as an outdoor laboratory by researchers from various disciplines, including plant and animal ecology, evolutionary biology, ethology, taxonomy, geology, hydrology, and climatology. Located in the Town of Saukville, Wisconsin, about 30 miles (45 minutes) north of Milwaukee, the main Station facility has about 2000 acres including a wide variety of habitats available for research and teaching. The University of Wisconsin-Milwaukee owns approximately 320 acres, most of which were donated by The Nature Conservancy in 1964. Research at the Station has produced 343 scientific publications and 146 theses since 1970.

Natural Areas at the Field Station

The Cedarburg Bog State Natural Area - One of the largest and the most biologically diverse of the wetlands in southern Wisconsin, is accessible to researchers and classes by the Field Station's boardwalk. Shallow and deep lakes, marshes, shrub communities, sedge meadow, hardwood swamp, conifer swamp, and the southernmost string bog in North America are just some of the vegetation types of the Cedarburg Bog. Populations of at least 35 species of higher plants and 19 birds are at or near the southern edge of their range in the Bog. The Bog is part of the national system of Experimental Ecological Reserves established by the National Science Foundation and The Institute of Ecology. A "Guide to the Natural History of the Cedarburg Bog," which serves as a ready introduction and reference source for researchers and educators using the Bog, is available from the Field Station and on our website. Emerald Ash Borer is now well-established in the Cedarburg Bog and is beginning to cause extensive mortality. Approximately 12% of the trees in the Cedarburg Bog are black ash, accounting for 10% of total tree basal area, and 2% are green ash, 4% of basal area; we expect to lose all of these ash over the next few years.

The Cedarburg Beech Woods State Natural Area – 80 acres of one of the finest mature beech-maple forests in southern Wisconsin. The scale insect associated with beech bark disease has been found in the Cedarburg Beech Woods, although the disease is not known to occur here yet. We have known that Emerald Ash Borer beetles have been present in the woods since 2012 when adults were captured in traps at the Station. We are now beginning to see signs of EAB-damaged ash trees in the upland forest. The Cedarburg Beech Woods SNA is likely to experience major changes within the next few years. The beech-maple forest and the Cedarburg Bog are each State Natural

Areas, and are classified as National Natural Landmarks by the Department of Interior.

The Sapa Spruce Bog State Natural Area – 12 acres of highly acidic black spruce/tamarack bog and 11 acres of swamp hardwoods. The southernmost black spruce bog in Wisconsin, the small, acidic, Sapa Spruce Bog provides an ecological contrast to the large, neutral-pH, Cedarburg Bog, with which it shares most of its flora.

Old Agricultural Fields – Over 100 acres in various stages of succession are available for experimental research. A history of the use and management of the fields over the past 40 years is maintained. Six separate areas in the old fields have been planted with prairie species native to Wisconsin. A new experimental prairie area planted in the "North Hay Field" in the fall of 2005 is now very well established and serves as the location for Dr. Karron's screenhouse.

Management – The primary management that Field Station natural areas receive is maintenance of trails and control of invasive exotic plants. Glossy buckthorn (*Rhamnus frangula*), common buckthorn (*Rhamnus cathartica*), Tartarian honeysuckle (*Lonicera tatarica*), autumn olive (*Elaeagnus umbellata)*, multiflora rose (*Rosa multiflora*), meadow parsnip (*Pastinaca sativa*), purple loosestrife (*Lythrum salicaria*), sweet clover (*Melilotus* spp.), motherwort (*Leonurus cardiaca*), Oriental bittersweet (*Celastrus orbiculatus*) and garlic mustard (*Alliaria petiolata*) are all present, and being controlled in the Field Station natural areas. Purple loosestrife biological control beetles were released in Mud Lake in both 2012 and 2013. Friends of Cedarburg Bog volunteers help Field Station staff with trail maintenance and our efforts to control invasives.

Only glossy buckthorn in the Cedarburg Bog and Oriental bittersweet on private properties south of the Station, are currently so widespread and abundant that their control seems intractable with the hand and mechanical methods we are using elsewhere. *Friends of Cedarburg Bog*, with grant funding from the Knowles-Nelson Stewardship Fund and the We Energies Foundation through the Natural Resources Foundation of Wisconsin, has been conducting major projects to control glossy buckthorn in parts of the Cedarburg Bog. The WDNR State Natural Areas crew has also been actively controlling buckthorn in the Bog. Planning for buckthorn control work was formalized with the Wisconsin DNR in 2012 and fruiting-sized buckthorn has been cut and treated with herbicide in 212 acres of the Bog since 2012.

Research and Teaching Facilities

General Facilities

- Office/classroom building with meeting rooms, teaching lab, and computer lab
- Research Lab constructed in 2004
- Service building – machine & wood shop
- The Farm House for researcher & student housing – The kitchen was remodeled and modernized in 2013
- The Researcher House for longer stays by individuals and groups
- Natural areas marked with a permanent grid – Accurately GPS-located in 2005
- Boardwalk to the center of the Cedarburg Bog – Reconstruction completed in 2009

- 14 aquatic mesocosms (200 gallon tanks)
- Several small boats, canoes, and trailers
- Global Positioning System equipment
- Extensive map and aerial photo collection
- Geographic Information System (GIS) for the Field Station area

Hydrology, Meteorology & Phenology

- Extensive array of environmental sensors recorded by a digital data logger
- Phenological observation garden & native plant observations maintained
- Lysimeter pit in the old-growth forest
- Transect of piezometers from upland to Bog – new piezometers added in 2013

Animal Ecology & Behavior

- Sound room facility for studies of frog communication and vocalizations
- Large outdoor experimental aviary
- Live traps & animal holding facilities
- Extensive arrays of bird nest boxes
- Insect collection, small mammal & bird study skins

Experimental Garden

- 9 fenced research gardens
- 1 acre Experimental Garden with water & electricity
- A 30' x 60' screen house for studies of pollination biology
- A screen house for studies of plant-insect interactions
- Greenhouse & garden building
- High capacity irrigation well
- Farm & cultivating machinery

Plant Ecology

- Herbarium & Plant lists
- Plant identification lab
- Vegetation sampling & surveying equipment
- Fenced deer exclusion plots in various plant communities and habitats

Outlying Natural Areas

Neda Mine Bat Hibernaculum State Natural Area - An abandoned iron mine, located on the Niagara Escarpment near Mayville and Horicon, Wisconsin, is among the largest bat hibernacula in the Midwest. Up to 150,000 bats of four species (Little brown bats, Big brown bats, Eastern pipistrelles, and Northern long-eared bats) use the hibernaculum. The hibernaculum has the infrastructure and instrumentation to be a productive facility for research on the behavioral ecology of bats at a major hibernaculum. An infrared beam system provides continuous counts of bat flights through the entrances to the mine and we have monitored bat activity continuously since 2000. In 2011 the infrared beam system in one of the four entrances was replaced with a new generation of detectors that will provide more reliable detection with lower maintenance. The mine is also of geological interest; its cliffs provide an excellent exposure of the Niagara Dolomite and the only accessible exposure of the Neda Iron formation.

Neda Beechwoods State Natural Area - Lies on the Niagara Escarpment, just north of Neda Mine and is a well developed stand of American beech (*Fagus grandifolia*) at the western boundary of its range.

Benedict Prairie - Near Kenosha, is a 6-acre tract of virgin prairie along a railroad right of way that has a remarkably diverse flora. A vascular plant species list for Benedict Prairie has been published in the Field Station Bulletin. Woody plants were cut from the prairie and controlled burns were conducted in spring of both 2012 and 2013. More extensive woody plant brush removal was conducted in 2014.

Downer Woods Natural Area - An 11.1 acre fenced woodlot, is an island of forested natural area in an intensely urbanized setting on the UWM campus. The Field Station assumed management of Downer Woods in

1998. Since that time we have been working very hard to control the garlic mustard, buckthorn, and honeysuckle with funding provided by the University. These invasive species are far from eliminated, but they are now well in control in Downer Woods.

UWM Innovation Campus – The UWM Monarch Conservancy – In the northwestern part of UWM's new Innovation Campus on the old Milwaukee County grounds in Wauwatosa is an area that has been set aside and dedicated as wildlife habitat. The special target conservation goal for this site is butterfly habitat since it has historically been an important roosting area for Monarch butterflies during their fall migration. The Field Station has been assigned the initial management and restoration of that habitat area and has been working with the UWM Foundation and a local volunteer group, *Friends of the Monarch Trail*, to control invasive plants and begin restoring native vegetation on that site.

Field Station Programs

• 32 active research projects conducted at the Field Station in 2014.

• Including: 5 M.S. thesis, 2 Ph.D. and 7 studies by researchers from outside of the University.

• 13 papers published during 2014. Several others are in press.

Database Development - The collection of a variety of long-term data is an important part of the Field Station's research program. Examples of our databases include:

• Vascular plant flora of the Field Station area (including approximately 720 taxa) & excellent herbarium.

• A complete stem map and diameter measurements of all trees in 5.5 acres (2.25 hectares) of the beech-maple woods first censused in 1987.

• Repeated surveys of the entire beech-maple forest at the permanent grid locations.

• A complete, quantitative, survey of the vegetation of the Cedarburg Bog, first conducted in 1991 and repeated in 2006.

• Phenological observations on leaf-out and flowering of standard genotypes of 6 species in a phenological garden, and 26 naturally occurring species at the Station since 2001.

• Long-term weather records from a standard US Weather Service weather station and a Bowen-Ratio energy flux monitoring system.

• Continuous monitoring of bat activity levels at the Neda Mine Bat Hibernaculum since 2000 and of temperatures in the mine since 1997.

• The Charles Weise 30-year study of Dark-eyed Juncos

• The Charles Weise 27-year intensive study of the Black-capped Chickadee

• The Charles Weise 26-year breeding bird survey of the Cedarburg Bog & upland woods from 1971 to 1996, repeated in 2006, 2007, 2008, and 2011.

• The Charles Weise 30-year bird-netting and banding program conducted in fall.

• The Field Station is a major site for long-term studies of avian vocalizations, including their organization and function.

• GIS developed for the Field Station area.

Educational Programs

• Over 10,000 student hours of instruction and group use in 2014.

• Seven workshops on topics in natural history.

• One undergraduate student project.

• 17 Friends of Cedarburg Bog programs for the general public on a variety of topics.

• The guidebook to the Bog is available to teachers using the boardwalk for instruction.

• Several field ecology exercises developed for the Field Station are available to instructors.

Friends of Cedarburg Bog

The mission of the ***Friends of Cedarburg Bog*** is to help preserve and study the Ce-

darburg Bog and to make the public more aware of its uniqueness. Specifically, their objectives are:

•To support research, including long-term monitoring.

•To assist in land preservation, management and stewardship.

•To develop formal and informal opportunities for public education.

•To generate volunteer labor for natural area management, education, public events, monitoring and research, and facility development and maintenance.

•To raise funds to support the activities of the group as defined above.

In 2014 the Friends sponsored 17 educational events for the general public. Volunteers from the Friends contributed many person-days of labor, including natural area and trail management, publishing a newsletter, raising funds, and sponsoring and providing staff for events. The Friends also continued large grant-funded invasive control projects in 2014 (see notes under Management above). In 2014 FOCB contributed substantial funding to our project to upgrade our weather station. If you are interested in the Field Station's programs and activities, or you wish to support the preservation of the Cedarburg Bog State Natural Area, **please consider joining the Friends group**. Contact the Field Station for information on how to become involved, or visit the FOCB website, www.bogfriends.org.

Friends of Cedarbug Bog hike - Bog in Bloom
Sunday, June 29, 2014

Abstracts of Research

Migration Patterns of Tree Swallows Revealed by Geolocators

David W. Bradley[1, 2], Robert G. Clark [3], Peter O. Dunn[4], Andrew J. Laughlin[5], Caz M. Taylor[5], Carol Vleck[6], Linda A. Whittingham[4], David W. Winkler[7], D. Ryan Norris[1]
[1] Department of Integrative Biology, University of Guelph, Guelph, Ontario, Canada
[2] Bird Studies Canada, Port Rowan, Ontario, Canada
[3] Environment Canada, Saskatoon, Saskatchewan, Canada
[4] Department of Biological Sciences, University of Wisconsin, Milwaukee, Wisconsin, USA
[5] Department of Ecology and Evolutionary Biology, Tulane University, New Orleans, Louisiana, USA
[6] Department of Ecology, Evolution and Organismal Biology, Iowa State University, Ames, IA, USA
[7] Department of Ecology and Evolutionary Biology, Museum of Vertebrates, and Lab of Ornithology, Cornell University, Ithaca, New York, USA

In 2011-12, we examined the migration patterns of tree swallows using light-sensing geolocators as part of a study across four breeding sites in North America. We found that all birds (n = 10) made a trans-Gulf flight of >850 km from Louisiana south to their wintering grounds in the Yucatan Peninsula in 12–36 hours, achieving minimum ground speeds as high as 32 m/s. Although most days during autumn migration were characterized by unfavorable headwinds blowing to the northwest, migration over the Gulf mostly occurred on days with strong winds blowing to the south. In contrast, in 8 of 9 (88 %) birds on spring migration returned from the wintering grounds towards Louisiana flying over land along the western shore of the Gulf of Mexico. During this spring period there were few days with prevailing winds from the south to assist northward migration. Although the spring route is up to three times longer (ca. 2,700 km), a coastal circum-Gulf spring migration represents the less risky route when wind conditions are not favorable. These findings also help to resolve a long-standing dispute in the literature concerning migration patterns between the US Gulf coast and Mexico, and provide insight into the factors shaping migration strategies of small songbirds migrating across large bodies of water. This research was supported by funds from the College of Letters and Science, UWM.

Wildlife Ecopassage Monitoring

Gary S. Casper
UWM Field Station, gsc@uwm.edu

Wildlife ecopassages are designed to afford safe passage for wildlife across roadways, thereby reducing road mortality and improving traffic safety. Ecopassages allow wildlife to pass underneath the highway lanes, and maintain habitat and population connectivity on the landscape. This can be especially important in maintaining genetic interchange across highways for more sedentary wildlife such as amphibians and reptiles. Few data are available for evaluating the conservation effectiveness of these structures. This project installed wildlife cameras and is conducting surveys of six ecopassages in Waukesha and Racine counties, Wisconsin, to collect data on patterns of wildlife use. Species documented to date include: raccoon, opossum, eastern cottontail, house cat, mink, woodchuck, gray squirrel, weasel (probably long tailed), white footed or deer mice, white tailed deer, American robin, house sparrow, song sparrow, dark eyed junco, barn swallow, eastern milksnake, snakes, painted turtle and American toad. We will continue data collection at one site in 2015. Funded by C.D. Besadny Conservation Grant, Natural Resources Foundation of WI, and Wisconsin Department of Transportation..

Wildlife Monitoring in Ozaukee and Washington Counties, Wisconsin

Gary S. Casper[1] and Shawn Graff[2]
[1]UWM Field Station, gsc@uwm.edu, [2]Ozaukee Washington Land Trust, sgraff@owlt.org

The Ozaukee Washington Land Trust (OWLT) began wildlife monitoring in 2004, as a means of assessing the success of habitat restorations, and identifying important wildlife resources for OWLT habitat management and acquisition and protection planning. In 2014 we continued herptile, crayfish and bird monitoring at several OWLT properties.

National Park Service Great Lakes Network Amphibian Monitoring Program

Gary S. Casper
UWM Field Station, gsc@uwm.edu

The goal of this project is to implement amphibian monitoring in seven National Parks in the Western Great Lakes region. A protocol utilizing automated recording systems and supplemental visual surveys was completed in 2012, and we began implementing the program in three parks in 2013. In 2014 we expanded to five Parks. Funded by the National Park Service.

Enhancing Ecological Productivity of Milwaukee Estuary Area of Concern Watersheds

Gary S. Casper
UWM Field Station, gsc@uwm.edu

The goal of this project is to assess and map wildlife habitat in the Ozaukee County portion of the Milwaukee River Basin, for ranking habitat restoration sites for best value. Work continued in 2014. Funded by EPA Great Lakes Restoration Initiative and Wisconsin Coastal Management Program awards to Ozaukee County.

Wildlife Population Target Refinement for the Milwaukee Estuary Area of Concern

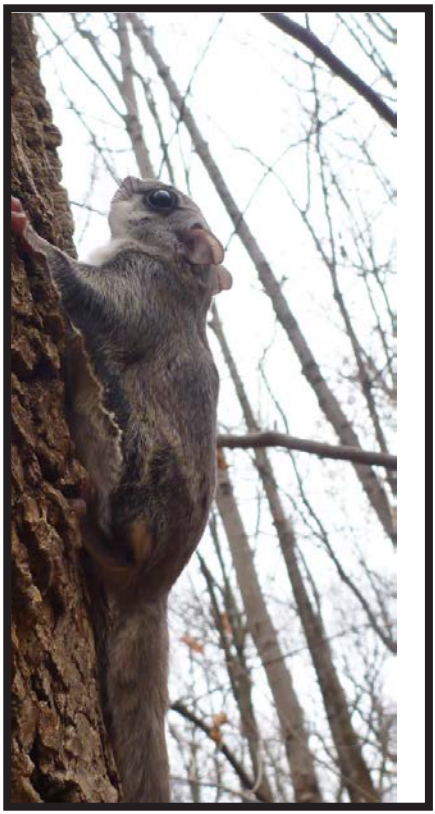
Gary S. Casper
UWM Field Station, gsc@uwm.edu

The goal of this project is to research the status of wildlife species in the Milwaukee County portion of the Milwaukee River Area of Concern, develop comprehensive species checklists, select focal species for habitat restoration projects, and develop survey methods and target species. Work included historical data collection, research and reporting. We completed the project in 2014. Funded by the Wisconsin DNR and the U.S. Environmental Protection Agency.

Wildlife Population Assessment for the Milwaukee Estuary Area of Concern

Gary S. Casper
UWM Field Station, gsc@uwm.edu

The goal of this 3-year project is to evaluate the status of selected wildlife populations in the Milwaukee County portion of the Milwaukee River Area of Concern, and make recommendations for addressing Beneficial Use Impairments through habitat restoration projects and monitoring. The project is coordinated with Milwaukee County Parks, participating under separate funding. Work includes historical data collection, wildlife surveys, landowner outreach, and reporting. Work began in 2014. Funded by the Wisconsin DNR and the U.S. Environmental Protection Agency.



Southern Flying Squirrel

Wisconsin Herp Atlas

Gary S. Casper
UWM Field Station, gsc@uwm.edu

The Wisconsin Herp Atlas is a distribution database of amphibians and reptiles in Wisconsin. The Atlas was initiated in 1986 at the Milwaukee Public Museum, with the cooperative support of the Natural Heritage Inventory Program (WDNR) and The Nature Conservancy (Wisconsin Chapter). The Atlas collects and verifies records obtained from museum collections, field surveys, the literature, and field notes provided by volunteer observers throughout the state. Over 500 new county records have been confirmed by the project. The data collected helps to map species distributions, document rare species occurrences, analyze distribution and habitat associations, and plan conservation priorities. Since 2007 the Atlas has been supported through the UWM Field Station, and it currently houses over 70,000 occurrence records for Wisconsin. Record collection and vetting continued in 2014.

Effects of Food Abundance on the Timing of Breeding in Tree Swallows

Peter O. Dunn and Linda A. Whittingham
Department of Biological Sciences, UWM. pdunn@uwm.edu, whitting@uwm.edu

Understanding the mechanisms influencing the timing of reproduction has taken on new urgency as climate change is altering environmental conditions during reproduction, and there is concern that species will not be able to synchronize their reproduction with changing food supplies. In 2014 we completed the 18th year of study of the reproductive ecology of tree swallows at the UWM Field Station. One of our main goals is to determine how environmental factors, particularly temperature and food abundance, influence the timing of breeding and reproductive success. A prominent hypothesis predicts that reproductive success is maximized when animals synchronize their reproduction with seasonal peaks in food supply. This mismatch hypothesis does not seem to be supported in tree swallows, and many other species. Instead, reproductive success appears to be more closely related to the absolute levels of food, rather than to the timing of food. We thank Gretchen Meyer and Lou Nelson for their assistance, particularly in collecting data. This research was supported by funds from the College of Letters and Science, UWM.

Characterization of Groundwater Flow Processes in the Cedar Creek Watershed and the Cedarburg Bog in Southeastern Wisconsin

Jack Graham[1], Weon Shik Han[1], Daniel Feinstein[2], and David Hart[3]
[1] Department of Geoscience, UWM, jpgraham@uwm.edu, hanw@uwm.edu
[2] USGS Wisconsin Water Sciences Center
[3] Wisconsin Geological & Natural history Survey

The purpose of this study is to characterize the geology and groundwater flow of the bog as well as the surrounding area, notably the Cedar Creek Watershed, a HUC (Hydrologic Unit Code) 12 watershed. The watershed is approximately 330 km^2, and borders the sub-continental divide separating the Mississippi River Basin from the Great Lakes Basin. The Cedar Creek watershed is composed of mostly agricultural and urban

land with a significant stress of groundwater withdrawal for both irrigation and residential use. This watershed has importance due to the contribution to both the Milwaukee River and Lake Michigan, and is integral

in the study of regional groundwater flow of Southeastern Wisconsin. Furthermore, the Cedarburg Bog, located in the northeast corner of the Cedar Creek Watershed preserves diverse ecology and is recognized by the U.S. Department of Interior as a National Landmark. Groundwater is the primary driver for the diverse and unique ecology that is contained within the bog.

Within the Cedar Creek Watershed, well data and glacial geology maps were integrated to develop a 3-dimensional subsurface map and watershed-scale groundwater flow model using the LAK3 and the SFR2 package to simulate surface water-aquifer interactions. The model includes 10 zones of the glacial sediments and the weathered and consolidated Silurian Dolomite bedrock. The hydraulic conductivity and storage parameters were calibrated with 203 head targets using universal parameter estimation code (PEST). Then, a series of future climate scenarios, developed by the Wisconsin Initiative on Climate Change Impact, were implemented to the USGS Soil-Water-Balance Code (SWB) to identify variations in recharge. The simulated recharge scenarios were adopted to predict the response of groundwater resources in the watershed and the Cedarburg Bog. Preliminary results produced from the MODFLOW model indicate the bog is acting as a recharge zone under current recharge conditions, approximately 12.7cm/year, with regional groundwater flow from the groundwater divide to Lake Michigan and a mean residual on calibration targets of 4.32m.

Knowledge acquired from this investigation can be used to better inform local agencies of potential threats, as well as predict future changes within this groundwater system. M.S. Thesis research, Dr. Weon Shik Han, Major Advisor.

Bacterial Communities in Carnivorous *Sarracenia purpurea* Pitcher Plants: Relationships Between Bacterial Taxa, Hydrolytic Enzymes, and Detrital Load

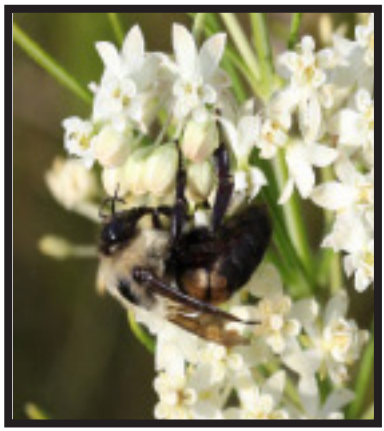
Jacob J. Grothjan and Erica B. Young
Department of Biological Sciences, UWM, Grothjan@uwm.edu, ebyoung@uwm.edu

The pitcher plant *Sarracenia purpurea* grows in nutrient-deficient soils of wetlands, including the Cedarburg Bog, and supplements mineral nutrition by carnivory. Newly formed pitchers open, fill with rainwater and capture prey and other organic detritus. The plants do not produce digestive enzymes, but rely on a food web of invertebrates and microbes to break down organic detritus. The microbial community is poorly understood and represented by a "black box" within food web studies. However, microbial hydrolytic enzymes (chitinases, phosphatases, proteases) are essential to the prey breakdown and nutrients release for plant uptake. This research aims to expand knowledge of the pitcher plant microbial community and its role in nutrient breakdown. Using plants from Cedarburg and Sapa Bogs we investigated: 1. Which bacterial taxa are present in pitcher fluid and how does bacterial taxon vary between pitchers, plants, and wetlands? 2. Does enzyme activity and bacterial abundance correlate with detritus mass in pitcher fluid? Bacterial taxa were identified using analysis of rRNA gene sequences, enzyme activities were measured using biochemical assays, and bacterial abundance was measured by epifluorescence microscopy. Pitchers from Sapa and Cedarburg Bogs harbored diverse bacterial taxa from Proteobacteria, Cyanobacteria, Bacteroidetes and Actinobacteria (notable genera: *Azospirillum, Aeromonas, Chitinophaga, Desulfosporosinus, Gemmatimonas, Herbaspirillum, Lysobacter, Mesorhizobium,* and *Paenibacillus*). In pitcher fluid, protease activity was positively correlated with both bacterial abundance and detritus mass, while alkaline phosphatase and chitinase showed little correlation with bacterial abundance and detritus. There was a 70-fold variation in hydrolytic enzyme activity found between pitchers within the same plants at Cedarburg Bog. Factors possibly influencing enzymes are detritus types, nutrient concentrations in pitchers, and different bacteria producing different enzymes. Ongoing experiments will examine bacterial succession in newly developed pitchers at Cedarburg Bog as well as in a more controlled greenhouse environment. Ph.D. research, Dr. Erica Young, Major Advisor.

Experimental Removal of the Most Abundant Pollinator Species in a Whorled Milkweed (*Asclepias verticillata*) System

Allysa C. Hallett and Jeffrey D. Karron
Department of Biological Sciences, UWM, ahallett@uwm.edu, karron@uwm.edu

Declines in pollinator species diversity are expected to have strong effects on the function of natural communities and agricultural systems. Detailed studies of the influence of pollinator loss on pollinator and plant communities can improve our understanding of the immediate and long-term effects of these disturbances. Using a manipulative field experiment, we excluded *Bombus griseocollis*, the most frequent visitor to whorled milkweed and explored how this change in pollinator composition influenced pollination success. At our study site, whorled milkweed (*Asclepias verticillata)* is primarily pollinated by the bumble bee *Bombus griseocollis* and by several species of wasps (see photos). This design highlights the response of a system to the loss of a single, prevalent pollinator species. We are currently analyzing flower samples collected this summer to determine whether the number of pollinia insertions and removals change with exclusion of the most abundant pollinator species. The number of pollinia on specimens of each pollinator species will also be quantified. This work was supported by a UWM Research Growth Initiative Grant, and by the Prairie Biotic Research Small Grants program. MS Thesis research, Dr. Jeffrey Karron, Major Advisor.



Bombus griseocollis **(top) and** *Polistes fuscatus* **(bottom) visiting** *A. verticillata*

Ornaments and Oxidative Stress in Common Yellowthroats

Amberleigh Henschen, Peter O. Dunn and Linda A. Whittingham
Department of Biological Sciences, UWM, Hensche9@uwm.edu, pdunn@uwm.edu, whitting@uwm.edu

We are examining the signaling function of male plumage ornaments in a warbler, the common yellowthroat (*Geothlypis trichas*). In particular, we are examining the relationship between the size and color of male ornaments and the health and vigor of males. In common yellowthroats, females prefer males with larger black masks for both social and extra-pair matings. In 2014 we continued testing the hypothesis that females prefer to mate with males that have more elaborate ornaments (eg, larger masks) because they signal their resistance to oxidative stress, and, by choosing these males, females produce offspring that are more likely to survive. We are also sampling developing feathers on males during molt to determine if genes involved in oxidative stress, immune response or nutrition are differentially expressed between ornamental and non-ornamental feathers. This research is supported by a Research Growth Initiative grant to LAW and POD. Ph.D. research, Dr. Peter Dunn, Major Advisor

Preparing mist net

Recouping Lost Information when Mark-Recapture Data are Pooled: A Case Study of Milksnakes (*Lampropeltis triangulum*) in the Upper Midwestern United States.

Eric T. Hileman[1], Joshua M. Kapfer[2], Timothy C. Muehlfeld[3], and John H. Giovanni[4]
[1]Department of Biological Sciences, Northern Illinois University, Dekalb, Illinois
[2]Department of Biological Sciences,UW–Whitewater, Whitewater, WI, kapferj@uww.edu,
[3]Wauwatosa, Wisconsin
[4]Rule Engineering LLC, Lakewood, Colorado

There is a surprising lack of data available on snake demography. This is largely because snakes are cryptic and difficult to detect. To address this problem, researchers often use nonrandom sampling methods (which can result in sampling artifacts) or pool capture occasions (which results in a loss of information). We conducted two spatially and temporally overlapping mark-recapture studies on milksnakes (*Lampropeltis triangulum*). Both studies used fixed trap locations (artificial cover objects), but varied in their sampling duration and intensity. We used multimodel inference within an information theoretic approach to estimate adult annual survival (0.72 ± 0.160 SE) and abundance (N = 85; ± 35.2 SE). To estimate density, we used a spatially explicit model (1.19 individuals/ ha ± 0.331 SE). We applied a novel approach to address sampling bias that resulted from the use of fixed trap locations. This involved modeling maximum detection frequency as a covariate, which better accounted for heterogeneity in detection probabilities than mixtures, sex, behavior, or month. This approach allowed for the recovery of information that was lost when capture occasions were pooled to account for low detection. We found support for this technique via re-analysis of datasets of known population size. This approach may be useful for mark-recapture studies that use fixed trap locations, especially if data are pooled to account for low detection.

Soundscape Ecology of Wisconsin Ecosystems

Gerlinde Höbel and Laurel Symes
Department of Biological Sciences, UWM, hoebel@uwm.edu, symes@uwm.edu

We placed long-term recorders at 3 sites in the Field Station (pond, meadow, forest) which were programmed to record 1 min of sound every hour for the duration of one year. We plan to analyze the sound recordings and calculate acoustic complexity indices to compare environmental complexity between sites and describe the diurnal and seasonal characteristics of the soundscapes of the three locations. This may allow us to formulate new hypotheses about the sources of selection that shape communication signals of animals that inhabit the different ecosystems.

Multimodal Communication in Eastern Gray Treefrogs, *Hyla versicolor*

Gerlinde Höbel
Department of Biological Sciences, UWM, hoebel@uwm.edu

Signal production and reception often encompass various modalities of communication. For example, a calling frog cannot but produce a visual component as it inflates and deflates its vocal sac to emit an acoustic signal. A frog calling in a pond also creates water surface waves, and calling on a branch he creates vibrational signals. Thus, a simple “acoustic signal” actually encompasses three modalities (acoustic, visual and surface wave / vibrational). An increasing number of studies show that multi-modal

signals are common and that mate choice is often based on multiple signal modalities, yet we know relatively little about the evolution of multimodal signaling. To better understand the evolution of multi-modal signals in frogs, we made detailed descriptions of visual (color, size) and vibrational portions of the signals of Gray treefrog males. We also conducted playback experiments with female gray treefrogs to evaluate whether they are attracted to visual (video of calling male) signal components, and started conducting preliminary trials testing whether females respond to vibrational signal components. Funded by the Research Growth Initiative, UWM.

Audiovisual Integration and Leader Preferences

Gerlinde Höbel and Laurel Symes
Department of Biological Sciences, UWM, hoebel@uwm.edu, symes@uwm.edu

Humans perceive several sounds in close temporal succession as a single event originating from the location of the leading sound, a trick played by the auditory system to improve sound localization. Surprisingly, a visual cue associated with the leading sound enhances sound localization, while a visual cue associated with the lagging sound inhibits it, suggesting that auditory spatial perception in humans is a fundamentally multisensory process. Many animals also focus on leading calls. For example, a female frog will approach the source of the first of two calls in close succession, resulting in higher mating success for the leading male. Whether visual cues affect the expression of leader preferences is unknown, but the fact that communication is frequently multimodal (i.e., a frog cannot produce a call without inflating his conspicuous vocal sac) suggests that this might be the case. We explore whether audiovisual integration during sound localization is unique to humans, or a general feature of animal sensory perception by conducting playback experiments with female treefrogs in which we compare their responses to sound alone, or sound combined with a visual cue (an LED). Funded by the Research Growth Initiative, UWM.

Can One Microbial Photosynthesizer Occupy Different Ecological Niches Within the Same Environment?

Suzanne Joneson[1], Nick Bilicki[1], and Heath O'Brien[2]
[1] Department of Biological Sciences, University of Wisconsin-Waukesha, suzanne.joneson@uwc.edu
[2] University of Bristol, Bristol, UK

It is well known that terrestrial cyanobacteria and algae (microbial photosynthesizers) can occupy a variety of ecological niches including in free-living and symbiotic relationships. One symbiotic niche for terrestrial microbial photosynthesizers that is relevant to this study is the mutualistic relationship with lichen-forming fungi; microbial photosynthesizers form long-lived symbiotic relationships with fungi, and together they form the lichen body. It is far less understood, however, to what extent one microbial photosynthesizer can occupy different ecological niches within a given habitat. The UW-Milwaukee Field Station offers a unique opportunity to investigate this question as members of two different microbial photosynthetic genera (*Nostoc* and *Trentepohlia*) are known to occur both free-living and in lichen symbiosis on the property. We proposed to answer the question "Can one microbial photosynthetic species occur both free-living and symbiotically in the same habitat?" by sampling free-living and symbi-

otic states of *Nostoc* and *Trentepohlia* at the UWM Field Station.

To date we have finished collecting data for the first microbial photosynthesizer, *Nostoc* and are in the process of analyzing the data. We will complete the second half of the project for *Trentepohlia* when more funding is available. An undergraduate student, Nick Bilicki, worked on this study in spring of 2014.

Peltigera sp. growing in moss on ground. Collections of this lichen were made as part of a study comparing lichenized and free-living *Nostoc* sp.

Long-term Monitoring of Turtle Populations Near the UW-Milwaukee Field Station

Joshua M. Kapfer[1] and Timothy Muehlfeld[2]
[1]Department of Biological Sciences, UW-Whitewater, kapferj@uww.edu, [2]Wauwatosa, WI

Information on long-term trends in reptile populations can yield useful conservation information. This is particularly true because long-term monitoring projects that involve reptile populations are relatively uncommon, especially in Wisconsin. In 2006 we began an annual turtle survey on the Field Station grounds, lasting for three days each year in late May/early June. We set turtle hoop traps approved by the Wisconsin DNR in several locations, which we checked daily during annual surveys. All of the animals captured were marked via marginal scute notches, following a well-established system. To-date, we have captured and marked a total of 95 painted turtles (*Chrysemys picta*; mean=11.9/year), of which 13 were recaptures (1.6/year). We have also captured 13 snapping turtles (*Chelydra serpentina*; mean= 1.6/year), with zero recaptures. During this time we captured only one other species, a single adult Blanding's Turtle (*Emydoidea blandingii*). Data collection will continue and future analyses will be conducted to elucidate information on abundance and survival rates. Collection of this type of long-term baseline data is critical to understand population fluctuations that may occur over time and the associated conservation implications.

Turtle trap

Linear-leaved Sundew (*Drosera linearis* Goldie) at Cedarburg Bog

Joanne Kline, Conservation Strategies Group, joanne@klines.org

Linear-leaved sundew is a State Threatened plant species whose populations are tracked by the Wisconsin's Natural Heritage Inventory program (NHI). NHI is part of NatureServe, an international network that gathers and provides information on the location and status of rare species, natural communities and natural features. Its purpose is to provide current, reliable, objective information to help inform environmental decisions. The accuracy of the NHI database depends on surveys of previously recorded locations to determine current status. As part of this regular update Wisconsin's Rare

Linear-leaved sundew

Plant Monitoring Program conducts surveys for endangered, threatened or special concern plants in Wisconsin.

We surveyed for *D. linearis* at Cedarburg Bog, one of many rare plant occurrences in need of an update, and reviewed previously unpublished vegetation survey data for recent verifiable observations. The species was confirmed at one of two previously recorded locations.

D. linearis is rare mainly due to its specific habitat requirements. It only occurs in neutral to alkaline fens of open undisturbed peatlands, and primarily in water tracks in the interiors of large peatlands like Cedarburg Bog. Its habitat is dominated by fine-leaved sedges such as wiregrass sedge (*Carex lasiocarpa*) with scattered low shrubs and stunted tamarack.

Like all sundews, *D. linearis* is a small, inconspicuous plant with leaves that are covered with mucilage-tipped tentacle-hairs that are adapted to trap insects. Once an insect is attracted by the sundew's bright red coloration and sweet nectar it becomes stuck on the sticky glandular hairs and the leaf slowly curls around the prey. The insect dies of exhaustion or suffocation right on the leaf. Glands on the leaf surface produce acids and enzymes to break down the prey's protein. The digested products are then absorbed through the leaf surface. This presumably supplies the plant with fixed nitrogen, which is a limiting nutrient in peatland habitats.

The Effect of Female Quality on Mating Preferences in Eastern Gray Treefrogs, *Hyla versicolor*

Robb C. Kolodziej
Department of Biological Sciences, UWM, rck@uwm.edu

Understanding the mechanisms driving female mate choice is critical to developing a holistic framework from which to assess effects and outcomes of sexual selection. I investigated the effects of female quality (measured as size, body condition and fecundity) on preferences for call traits that indicate either male quality (call duration) or species specificity (call pulse rate). I document large variation in both quality and call trait preferences of individual female Gray treefrogs, and show that preferences are influenced by female quality. Contrary to previous studies, however, I found that intermediate quality females show the strongest preferences, while low and high quality females show similar, and weaker, preferences. Further, preferences for male quality were influenced by more quality measures than preferences for species specificity, suggesting that species recognition is somewhat more immune to quality effects than choice for conspecific mate quality. M.S. Thesis research, Dr. Gerlinde Höbel, Major Professor.

Long-term Monitoring of Bat Activity and Temperature at the Neda Mine Bat Hibernaculum

Gretchen Meyer and James Reinartz
UWM Field Station, gmeyer@uwm.edu, jimr@uwm.edu

The Neda Mine, an abandoned iron mine located near Iron Ridge in Dodge County, supports about 150,000 bats each winter, making it among the largest hibernacula in the midwest. The mine is used primarily by little brown bats (*Myotis lucifugus*), with Northern Bats (*M. septentrionalis*), Eastern Pipistrelles (*Perimyotis subflavus*), and Big Brown Bats (*Eptesicus fuscus*) found in smaller numbers. We have been

monitoring bat activity at the mine since 2001 using an infra-red photo beam-break detection system that records bats entering and leaving the mine on a 5-minute interval 365 days per year. We have been collecting temperature data since 1996 using battery-powered temperature dataloggers at 10 locations within the mine and 2 locations outside. We are also monitoring airflow in the mine. We are currently using these data to examine trends over time in winter temperatures in the mine, and the phenology of bat emergence in spring. White-nose syndrome, a devastating fungal disease that attacks hibernating bats, has not yet been detected at Neda Mine. Our study will provide important baseline data on hibernation behavior of healthy bats, and will help us interpret changes in bat behavior when the disease arrives at Neda Mine.

Culvert entrance to Neda Mine Bat hibernaculum

Wood Duck Nest and Small Owl Nest/Roosting Box Project

John O'Donnell
Friends of the Cedarburg Bog, johnodonnell132@gmail.com

A total of ten Wood Duck nest boxes and four nesting and/or roosting boxes for small owls (i.e., Eastern Screech and Northern Saw-whet owls) have been installed from 2012 through 2014 in multiple locations around the Cedarburg Bog boundaries by the Friends of the Cedarburg Bog (FOCB) and by an Eagle Scout under the supervision of the FOCB and Wisconsin DNR. Four more Wood Duck boxes are slated

to be installed prior to Spring 2015 which will bring the total number of project boxes to 18. Stainless steel predator guards are being used with each box. The primary objective is to increase nesting populations of Wood Ducks and Eastern Screech Owls in and around the Cedarburg Bog, to provide roosting sites for both Eastern Screech and Northern Saw-whet owls in the fall and winter seasons, and ultimately to involve community volunteers in a citizen science

Screech owl in nest box

research project assessing which placement sites are most productive for box usage and nesting success and why. Monitoring and maintenance of the boxes is occurring at least annually prior to each spring. Thus far, 25% of the Wood Duck boxes have resulted in successful nesting and presumed fledging of wood ducklings. Based on evidence of owl pellets and prey remains in and around boxes, it appears that 38% of all the boxes were used by small owls sometime in the past year. However, there is no confirmed evidence that any of the boxes were used for nesting by small owls through the 2013 season. Analysis of prey remains to date suggests that voles are the primary food source of the small owls using these boxes. In addition to the addition of four more Wood Duck boxes in 2015, we are considering installing two American Kestrel nest boxes -- one at the far northeast corner and the other at the far southwest corner of the Cedarburg Bog complex. We may also install “trail cams” at several of the box sites to record activity at the boxes in 2015. We plan to recruit “Citizen Science” volunteers to assist in box maintenance and monitoring in 2015.

Male and female wood ducks on nest box

Comparison of Freeze Tolerance and Phosphoglucose Isomerase (PGI) within and among *Habrotrocha rosa* Metapopulations

Tatiana Tatum Parker and D. Liane Cochran-Stafira
Biological Sciences, Saint Xavier University, Chicago, IL, cochran@sxu.edu

The bdelloid rotifer *Habrotrocha rosa* is a component of the inquiline community that thrives within the water-retaining pitcher-shaped leaves of *Sarracenia purpurea*. This carnivorous plant ranges widely throughout the United States and Canada and is the only member of the genus that inhabits cold temperate climates. We examined freeze tolerance in two rotifer life history types (fast vs. slow population growth rates) within a bog in southeastern Wisconsin. Phosphoglucose isomerase (PGI), a dimeric enzyme that catalyzes the reversible isomerization of glucose-6-phosphate and fructose-6-phosphate, plays a key role in glucose metabolism and the resupply of ATP which could influence reproductive rates as well as freeze tolerance. We hypothesized that variation in *H. rosa* life history is correlated with freeze tolerance and PGI isozymes. Our sampling scheme was designed to provide samples across time as well as within habitats, between habitats and among plant locations on the bog. Three rotifers were randomly selected from each pitcher sample, and each one became the foundress of a clone representing one *H. rosa* genotype that was present in the pitcher on the date of collection. We examined PGI isozymes by electrophoresis and evaluated freeze tolerance at -20°C and -80°C. While no significant differences in recovery rates were found between fast and slow growers frozen at -20°C ($p > 0.05$), there was a statistically significant difference at -80°C for both time ($p = 0.01$) and life history ($p = 0.006$). All of the *H. rosa* clones exhibited identical heterozygous genotypes for phosphoglucose isomerase. There was slight variation in the intensity of the protein bands which we believe to be the result of differences in sample density. While there is a statistically significant difference in freeze tolerance at -80°C we do not feel that this is biologically relevant. Our results for -20°C contrast with those of Birkey et al. who were unable to achieve rotifer recovery after freezing at this temperature. The difference most likely lies with our method of applying a gradual reduction in temperature prior to freezing which mimics the natural seasonal decrease in temperature and allows for the production of cryoprotectants. Based on these results, we conclude that differences in population growth rates are not correlated with variations in freeze tolerance or PGI isozymes. Further tests are scheduled to look for differences in other key metabolic enzymes which could account for life history differences.

Effect of the Visual Signal Component on Approach Behavior in Female Gray Treefrogs

Jessica Pledge and Gerlinde Höbel
Department of Biological Sciences, UWM, hoebel@uwm.edu

A calling male frog cannot but produce a conspicuous visual signal as he inflates and deflates his vocal sac when producing a call. Although such multimodal signals are common in nature, it is often unclear whether receivers pay attention to all signal components, or whether a multimodal signal is “better” than the individual signal components. We presented female gray treefrogs with artificial mating calls that were either presented alone, or paired with a visual signal (computer animation of calling male frog) to compare whether addition of a visual cue helps females to approach the signal source more directly. We analyzed videos of females tested in unimodal (call only) and

multimodal (audio + visual) playback trials for differences in approach behavior. We found that females approached the multimodal signal more directly (shorter path length and fewer deviations from the direct route). This suggests that females pay attention to visual cues, and that attention to visual cues is adaptive because it allows females to spend less energy when choosing their mates. Undergraduate research project, Gerlinde Höbel, advisor.

The Influence of Social and Ecological Environments on Mating Signals and Mate Preferences

Rafael L. Rodríguez, Kasey D. Fowler-Finn and Darren Rebar
Department of Biological Sciences, UWM. rafa@uwm.edu, kaseyff@uwm.edu, dwrebar@uwm.edu

We are testing the hypothesis that variation in social and ecological environment influences the expression of phenotypic variation of individuals. Using members of the *Enchenopa binotata* treehopper complex (Hemiptera: Membracidae), we are addressing two causes of variation in phenotypes (and of selection on those phenotypes): interactions with conspecifics and interactions with their host plant environments. We are examining how variation in social groupings and in host plants influences phenotypic variation in male mating signals and female mate preferences, which have played an important role in speciation in these treehoppers. For example, we use suckers obtained from different clone patches of the host plant *Viburnum lentago* (Caprifoliaceae) as "rearing treatments" to ask how signal and preference phenotypes are influenced by genetic variation in the host plant. This captures differences in the environments offered by host plants under the umbrella of host plant genotypes, a powerful way of assessing environmental inputs on the expression of treehopper phenotypes. These patterns can then be compared with the magnitude of variation due to other environmental inputs, such as social environments, and with the magnitude of direct genetic variation in treehopper genotypes. To date, our results indicate that considerable variation in *Enchenopa* signals and preferences comes from their social and biotic environments, with interesting consequences for how selection is likely to act on those phenotypes.

Enchenopa binotata treehopper nymphs

PhenoCam Monitoring of Seasonal Plant Development and Senescence at Downer Woods and the UW-Milwaukee Field Station

Mark D. Schwartz
Department of Geography, UWM, mds@uwm.edu

An exciting new development in phenological science is the use of fixed cameras to provide continuous near-surface remote sensing observations of seasonal development and senescence within small patches of vegetation. The PhenoCam Network is a global project (P.I. Andrew Richardson, Harvard University, sites primarily in North America) that is designed to coordinate this type of data collection. The PhenoCam website is: http://phenocam.sr.unh.edu/webcam/

UW-Milwaukee added two nodes to the PhenoCam network with cameras installed in March 2013 on the Sandburg East Tower (viewing north toward Downer Woods, see http://phenocam.sr.unh.edu/webcam/sites/downerwoods/) and at the UW-Milwaukee Field Station (viewing a small grove of trees north of the main buildings, http://phenocam.sr.unh.edu/webcam/sites/uwmfieldsta/). The cameras record an image once every half-hour during daylight hours in both the visible and near-infrared. These data will be added to the traditional ground-based visual phenology observations and climate data collected at both sites to continue efforts to better understand phenological changes, as well as bridge the spatial and methodological gaps between visual phenology and remote sensing-derived measurements.

Bridging Spatial Scales Using Phenological Measurements to Improve Understanding of Autumn Atmosphere-Biosphere Interactions

Mark D. Schwartz
Department of Geography, UWM, mds@uwm.edu

Enhancing the accuracy of energy/carbon flux estimates at all scales is a critical part of improving understanding of the interactions between land surface biospheric processes and global climate change. Current approaches that scale between regional estimates with data from remote sensing, eddy covariance flux, and intensive plant- and stand-level flux measurements assume estimates from these extremely small areas are representative of larger regions. The timing of leaf senescence (coloring and subsequent fall; i.e., phenology) during autumn has large impacts on lower atmospheric energy-mass exchange through differential carbon assimilation and transpiration totals across the landscape, which are equal to or greater than those of spring phenology. However, spatial variations in autumn phenological timing at the community level have not been systematically measured and analyzed, and underlying environmental drivers are not well understood. If large, autumn leaf senescence variations may reflect gradients in plant growth that could foster systematic errors in seasonal fluxes of equal or greater magnitude than those during earlier portions of the growing season. Thus, autumn phenological data collected in a spatially explicit manner offer considerable opportunities for gauging landscape-level spatial variations crucial for accurate scaling-up of flux measurements to larger areas or downscaling regional-scale atmospheric circulation models. In this project, spatial variability of autumn phenological data will be measured and analyzed at the community level, compared to microclimatic and remote sensing measurements, and used as the basis for regional-scale multi-species phenological models, which could contribute to increased accuracy of energy/carbon flux estimates across large areas.

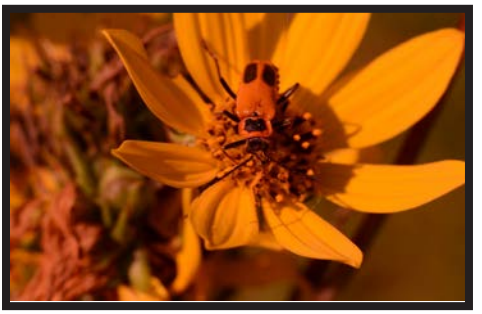
As part of this project, 108 evenly distributed trees have been marked in Downer Woods (on the UW-Milwaukee campus) and are being phenologically observed in autumn (since 2007). In addition, automatic air and soil temperature measurements are being collected at several locations to support analyses of these phenological measurements. These measurements will also be compared to data being collected on at least one similar species (*Tilia americana*, Basswood) at both the UW-Milwaukee Field Station and at the primary study site of this project near Park Falls, WI. Funded by the National Science Foundation.

Insect Herbivore and Pollinator Floral Trait Selection of Sawtooth Sunflower (*Helianthus grosseserratus*)

Jason S. Servi and Gretchen A. Meyer
Department of Biological Sciences, UWM, jsservi@uwm.edu, gmeyer@uwm.edu

Two significant insect-driven selective pressures on prairie flowers are herbivory and pollination. The strength of such selection by insects depends on how attractive a wide variety of floral traits are to pollinators and/or herbivores. Which of these particular traits are most responsible for attracting the detrimental herbivore and favorable pollinating insect to any one floral head, however, is a topic that is scarcely studied. In the fall of 2013, I began research into this topic at the Kettle Moraine Low Prairie State Natural

Area, the largest mesic prairie east of the Mississippi River. Sawtooth sunflower (*Helianthus grosseserratus*) is a composite flower which is common in this habitat, and was chosen as the focal species. Various traits, including ray dimensions, disc size, and ultraviolet patterns were documented for each head. Through insect observation, seed counts, and floral damage, the attractiveness of each head to insects was measured and correlated with floral trait values. In the second field season, the fall of 2014, the number of *H. grosseserratus* plants selected for the study was significantly increased in order to increase the power of results. In addition, the unique ultraviolet patterning of flower heads was identified as an area of particular interest and was investigated to a greater extent. Results from this study will provide key insight into the complex interaction between prairie flowers, pollinators, and herbivorous insects. Due to the increasing rarity of the prairie habitat, it is even more important to gain knowledge of this ecological system. Data are currently being analyzed. M.S. Thesis research, Dr. Gretchen Meyer, Major Advisor.



Differential Effects of Single Pollinator Species Removals on Local Plant Reproductive Success

Jason L. Vizelka and Jeffrey D. Karron
Department of Biological Sciences, UWM, Jvizelka@uwm.edu, Karron@uwm.edu

Over the last decade there have been dramatic changes in the relative abundance and diversity of bumble bee populations, including significant decline of many species both in North America and Europe. Often several species co-occur sympatrically and it is not known if these species provide equivalent pollination services for native flowering plants. Previous studies have shown that the removal of the most abundant pollinator species can dramatically reduce plant reproductive success, by altering the foraging behavior of the remaining pollinator species. However, studies have not shown if the effects of removing a single pollinator species differ depending on pollinator species identity. To address this question we are currently measuring the mean seed set of *Mimulus ringens* flowers placed in a mixed array, following the removal of different pollinator species. M.S. Thesis research, Dr. Jeffrey Karron, Major Advisor.

Bat Activity Surveillance Monitoring at Neda Mine Hibernaculum

J. Paul White, Erin Crain, and Owen Boyle
Wisconsin Department of Natural Resources, Bureau of Natural Heritage Conservation,
John.White@Wisconsin.gov

White-Nose Syndrome (WNS) has spread across 25 states and 5 Canadian provinces. The fungus *Psuedogymnoascus destructans* (Pd) that causes the syndrome has been found in three other states (IA, MI and MN). This deadly disease has and continues to cause massive bat mortality in eastern North America. Since the winter of 2006–2007, bat population declines ranging from 80–97% have been documented at surveyed hibernacula. Although exact numbers are difficult to determine, biologists estimate that losses may approach 5.7 to 6.7 million bats since 2007. This mortality represents the most precipitous decline of North American wildlife caused by infectious disease in recorded history.

Unfortunately white-nose syndrome was confirmed in Wisconsin on March 28th, 2014. The disease was detected in a single mine in far southwest Wisconsin (Grant County) by WDNR and USGS-NWHC staff. In addition to discovering WNS in southwestern Wisconsin, five counties in the upper peninsula of Michigan were confirmed to have WNS; one county directly borders northeast Wisconsin. Monitoring bat populations is crucial in states like Wisconsin that are currently considered unaffected, both for early identification of the disease and to develop pre-WNS baselines in this region. The bat populations of Neda Mine have been inspected for WNS annually for the past four hibernation seasons and continue to be inspected at least annually; no WNS has been found in the Neda Mine Hibernaculum to date.

We have installed a thermal infrared surveillance system at Neda Mine. This is a valuable new technique in the WNS surveillance toolkit that presents two great advantages: it reduces disturbance (i.e. less human presence at the site) and provides a continual stream of surveillance information. Thermal infrared surveillance is an effective tool because it can detect the change in a bat's body temperature as it arouses out of torpor, and because WNS-infected bats arouse

more frequently than healthy bats. Baseline information on Neda Mine's bats – obtained via these remote, non-invasive measurements on animals exhibiting spontaneous, normal behaviors during hibernation – will allow the infrared surveillance effort to detect WNS almost immediately if/when the disease arrives in the site. Information collected from bats this year can also be compared to information about WNS-affected bats regionally and nationally, to help better understand disease impacts on hibernating bat behavior.

We also conduct fall and spring trapping of bats with harp traps and mist netting at the Neda Mine entrances. This allows us to gather important data on bats, including baseline weight and WNS wing scoring before and after hibernation as well as collecting tissue for genetic work. When a bat is in the hand of an observer it can be examined for signs of WNS and samples for diagnostics are then easy to acquire. We trap a sample of bats in the post-hibernation period in order to 1) screen (wing score, swabbing) for WNS and collect genetic material which may help characterize the association between skin microbiome, bat host genotype, and resistance to WNS using metagenomic analysis, 2) Collect standard measurements (weight; forearm length; species; sex) on all captured bats, and 3) Repeat measurements during the fall return to the hibernaculum. The focal species are *Myotis lucifugus*, *Myotis septentrionalis*; *Eptesicus fuscus*; and *Perimyotis subflavus*.

State-threatened northern long-eared bat captured during disease surveillance in the spring of 2014. Note the mud across the forearm, an artifact of choosing Neda Mine as a hibernaculum. Photo: Heather Kaarakka, WDNR.

Extra-pair Mating and Sexual Selection in Tree Swallows

Linda A. Whittingham and Peter O. Dunn
Department of Biological Sciences, UWM. whitting@uwm.edu, pdunn@uwm.edu

Research on sexually selected male traits has intensified over the last two decades and there are now many species of birds for which male traits associated with extra-pair mating success have been identified. Some of the more commonly studied species have been examined in multiple populations; however, there is often little consistency in results between studies. In paired analyses of Tree Swallows breeding in Wisconsin, we found that successful extra-pair sires were more experienced breeders, heavier, had fewer lice holes in their feathers, had longer wings and tended to be in better condition than the male they cuckolded. Our results are similar to those from a population of Tree Swallows studied in Ontario but differ from a population studied in British Columbia. Such variation among populations may arise if environmental heterogeneity influences the information content, reliability, or importance of particular male traits as signals of male quality. Taking these factors into consideration will help us understand how selection on male traits varies between populations and the role of extra-pair mating in sexual selection. This research was supported by funds from the College of Letters and Science, UWM.

Recent Publications and Theses

Recent Publications Resulting from Field Station Projects

Bauer, B., J. M. Kapfer, R. A. Staffen, and G. S. Casper. 2010. Geographic distribution: *Pituophis catenifer sayi*, Wisconsin, Pepin County. Herpetological Review 41(4): 517-518.

Bollmer, J.L., P.O. Dunn, L.A. Whittingham, and C. Wimpee. 2010. Extensive MHC class II B gene duplication in a passerine bird. Journal of Heredity 101: 448-460.

Dunn, P. O., J. Garvin, L. A. Whittingham, C. Freeman-Gallant, and D. Hasselquist. 2010. Carotenoid and melanin-based ornaments signal similar aspects of male quality in two populations of the common yellowthroat. Functional Ecology 24: 149-158.

Flanagan R. J., R. J. Mitchell and J. D. Karron. 2010. Increased relative abundance of an invasive competitor for pollination, *Lythrum salicaria*, reduces seed number in *Mimulus ringens*. Oecologia 164: 445–454.

Joppa, L. N., C. K. Williams, S. A. Temple, and G. S. Casper. 2010. Environmental factors affecting sampling success of artificial cover objects. Herpetological Conservation and Biology 5(1): 143-148.

Monroe, E.M., C. Lynch, D.A. Soluk, and H.B. Britten. 2010. Nonlethal tissue sampling techniques and microsatellite markers used for first report of genetic diversity in two populations of the endangered *Somatochlora hineana* (Odonata: Corduliidae). Ann. Entomol. Soc. Am. 103(6): 1012-1017

Pairon, M., B. Petitpierre, M. Campbell, A. Guisan, O. Broenimann, P. V. Baret, A. L. Jacquemart, and G. Besnard. 2010. Multiple introductions boosted genetic diversity in the invasive range of black cherry (*Prunus serotina*; Rosaceae). Annals of Botany 105: 881-890

Rosenfield, R. N., L. J. Rosenfield, J. Bielefeldt, R. K. Murphy, A. C. Stewart, W. E. Stout, T. G. Driscoll, and M. A. Bozek. 2010. Comparative morphology among northern populations of breeding Cooper's Hawks (*Accipiter cooperii*). Condor 112: 347-355.

Schwartz, M. D., and J. M. Hanes. 2010. Continental-scale phenology: warming and chilling. International Journal of Climatology 30: 1595-1598.

Schwartz, M. D., and J. M. Hanes. 2010. Intercomparing multiple measures of the onset of spring in eastern North America. International Journal of Climatology 30: 1614-1626.

Stout, W. E., and R. N. Rosenfield. 2010. Colonization, growth, and density of a pioneer Cooper's Hawk population in a large metropolitan environment. Journal of Raptor Research 44: 255–267

Weller, W. F., S. J. Hecnar, D. R. Hecnar, G. S. Casper and F. N. Dawson. 2010. Quantitative assessment of intergradation between two subspecies of painted turtles, *Chrysemys picta bellii* and *C. p. marginata*, in the Algoma District of west central Ontario, Canada. Herpetological Conservation and Biology 5(2): 166-173.

Whittingham, L. A., and P. O. Dunn. 2010. Relatedness and female breeding experience influence extra-pair paternity in tree swallows. Molecular Ecology 19: 2328-2335.

Dunn, P. O., D. W. Winkler, L. A. Whittingham, S. J. Hannon, and R. J. Robertson. 2011. A test of the mismatch hypothesis: How is timing of reproduction related to food abundance in an aerial insectivore? Ecology 92: 450-461.

Flanagan, R. J., R. J. Mitchell, and J. D. Karron. 2011. Effects of multiple competitors for pollination on bumblebee foraging patterns and *Mimulus ringens* reproductive success. Oikos 120: 200-207.

Hanes, J. M., and M. D. Schwartz. 2011. Modeling the spring phenology of a mixed temperate forest using MODIS measurements of leaf area index and land surface temperature. Theoretical and Applied Climatology 105: 37-50.

Hapner, J. A., J. A. Reinartz, G. G. Fredlund, K. G. Liethoff, N. J. Cutright and W. P. Mueller. 2011. Avian succession in small created and restored wetlands. Wetlands 31: 1089-1102

Liang, L., M. D. Schwartz, and S. Fei. 2011. Validating satellite phenology through intensive ground observation and landscape scaling in a mixed seasonal forest. Remote Sensing of Environment 115: 143-157.

Mooi, R. D., J. P. Wiens, and G. S. Casper. 2011. Extreme color variation within populations of the common gartersnake, *Thamnophis sirtalis*, in central North America, with implications for subspecies status. Copeia 2011: 187-200.

Vasquez, E. C., and G. A. Meyer. 2011. Relationships among leaf damage, natural

enemy release, and abundance in exotic and native prairie plants. Biological Invasions 13: 621-633.

Beans, C. M., F. F. Kilkenny, and L.F.Galloway. 2012. Climate suitability and human influences combined explain the range expansion of an invasive horticultural plant. Biological Invasions 14: 2067-2078.

Casper, G. S., and T. G. Anton. 2012. Geographic Distribution: *Trachemys scripta elegans* (Red-eared Slider). USA: Wisconsin: Kenosha Co. Herpetological Review 43:100.

Fowler-Finn, K. D. and R. L. Rodríguez. 2012. Experience-mediated plasticity in mate preferences: mating assurance in a variable environment. Evolution. 66: 459-468.

Fowler-Finn, K. D. and R. L. Rodríguez. 2012. The evolution of experience-mediated plasticity in mate preferences. Journal of Evolutionary Biology. 25: 1855-1863.

Holmquist, K. G., R. J. Mitchell, and J. D. Karron. 2012. Influence of pollinator grooming on pollen-mediated gene dispersal in *Mimulus ringens* (Phrymaceae). Plant Species Biology 27: 77-85.

Kilkenny, F. F., and L. F. Galloway. 2012. Adaptive divergence at the margin of an invaded range. Evolution 67: 722-731.

Mills, J.E., G. A. Meyer, J.A. Reinartz, and E. B. Young. 2012. An exotic invasive shrub has greater recruitment than native shrub species within a large, undisturbed wetland. Plant Ecology 213: 1425-1436.

Placyk Jr., J. S., B. M. Fitzpatrick, G. S. Casper, R. L. Small, R. G. Reynolds, D. W. A. Noble, R. J. Brooks, and G. M. Burghardt. 2012. Hybridization between two gartersnake species (*Thamnophis*) of conservation concern: a threat or an important natural interaction? Conservation Genetics 13: 649-663.

Shutler, D., D. J. T. Hussell, D. R. Norris, D. W. Winkler, R. J. Robertson, F. Bonier, W. B. Rendell, M. Bélisle, R. G. Clark, R. D. Dawson, N. T. Wheelwright, M. P. Lombardo, P. A. Thorpe, M. A. Truan, R. Walsh, M. L. Leonard, A. G. Horn, C.M. Vleck, D. Vleck, A. P. Rose, L. A. Whittingham, P. O. Dunn, K. A. Hobson, and M. T. Stanback. 2012. Spatiotemporal patterns in nest box occupancy by tree swallows across North America. Avian Conservation and Ecology 7: 3.

Sonsthagen, S. A., R. N. Rosenfield, J. Bielefeldt, R. K. Murphy, A. C. Stewart, W. E. Stout, T. G. Driscoll, M. A. Bozek, B. L. Sloss, and S. L. Talbot. 2012. Genetic and morphological divergence among Cooper's Hawk (*Accipiter cooperii*) populations breeding in north-central and western North America. Auk 129: 427-437.

Wolkovich, E. M., B. I. Cook, J. M. Allen, T. M. Crimmins, S. Travers, S. Pau, J. Regetz, T. J. Davies, J. L.Betancourt, N. J. B. Kraft, T. R. Ault, K. Bolmgren, S.J. Mazer, G. J. McCabe, B. J. McGill, C. Parmesan, N. Salamin, M.D. Schwartz, and E.E. Cleland. 2012. Warming experiments underpredict plant phenological responses to climate change. Nature 485: 494-497.

Casper, G. S. and T. G. Anton. 2013. Current Scientific and Standard Common Names of Wisconsin Amphibians and Reptiles. Misc. Publ. PUB-SS-1121 2013. Bureau of Science Services, Wisconsin Dept. Natural Resources, Madison, WI.

Davies, T. J., E. M. Wolkovich, N. J. B. Kraft, N. Salamin, J. M. Allen, T. R. Ault, J. L. Betancourt, K. Bolmgren, E. E. Cleland, B. I. Cook, T. M. Crimmins, S. J. Mazer, G. J. McCabe, P. Pau, J. Regetz, M. D. Schwartz, and S. Travers. 2013. Phylogenetic conservatism in plant phenology. Journal of Ecology 101: 1520-1530.

Evans, G. A., F. F. Kilkenny and L. F. Galloway. 2013. Evolution of competitive ability within *Lonicera japonica*'s invaded range. International Journal of Plant Sciences 174: 740-748.

Fowler-Finn, K. D. and R. L. Rodriguez. 2013. Repeatability of mate preference functions in *Enchenopa* treehoppers (Hemiptera: Membracidae). Animal Behaviour 85: 493-499.

Höbel, G. and R. C. Kolodziej. 2013. Wood frogs (*Lithobates sylvaticus*) use water surface waves in their reproductive behaviour. Behaviour 150: 471–483.

Rebar, D. and R. L. Rodríguez. 2013. Genetic variation in social influence on mate preferences. Proceedings of Royal Society, B 280, 20130803.

Rodríguez, R. L., D. W. Rebar, and K. D. Fowler-Finn. 2013. The evolution and evolutionary consequences of social plasticity in mate preferences. Animal Behaviour 85: 1041-1047.

Rodríguez, R. L., A. C. Hallett, J. T. Kilmer, and K. D. Fowler-Finn. 2013. Curves as traits: genetic and environmental variation in mate

preference functions. Journal of Evolutionary Biology 26:434-442

Anton, T.G., T.F. Beauvais, and G.S. Casper. 2014. Geographic distribution: *Clonophis kirtlandii* (Kirtland's Snake), USA: Illinois: De Kalb County. Herpetological Review 45(3):465.

Beck, J.B., J.C. Semple, J.M. Brull, S.L. Lance, M.M. Phillips, S.B. Hoot, and G.A. Meyer. 2014. Genus-wide microsatellite primers for the goldenrods (*Solidago*; Asteraceae). Applications in Plant Sciences 2 (4): 1300093. doi:10.3732/apps.1300093

Beck, J.B., C.J. Ferguson, M.H. Mayfield, and J. Shaw. 2014. Reduced genetic variation in populations of black cherry (*Prunus serotina* subsp. *serotina*, Rosaceae) at its western range limit in Kansas. Northeastern Naturalist 21(3):472-478.

Casper, G.S. 2014. Geographic distribution: *Diadophis punctatus edwardsii* (Northern Ring-necked Snake), USA: Minnesota: Cook County. Herpetological Review 45(1):94

Bradley D.W., R.G. Clark, P.O. Dunn, A.J. Laughlin, C.M. Taylor, C. Vleck, L.A. Whittingham, D.W. Winkler, and D.R. Norris. 2014. Trans-Gulf of Mexico loop migration of tree swallows revealed by solar geolocation. Current Zoology 60:653-659.

Fowler-Finn, K.D., N. Al-Wathiqui, D. Cruz, M. Al-Wathiqui and R.L. Rodríguez. 2014. Male *Enchenopa* treehoppers (Hemiptera: Membracidae) vary mate-searching behavior but not signaling behavior in response to spider silk. Naturwissenschaften 101:211–220

Green, D.M., L.A. Weir, G.S. Casper, and M J. Lannoo (Editors). 2014. North American Amphibians: Distribution and Diversity. University of California Press, Berkeley, CA**.**

Höbel G. and T. Barta. 2014. Adaptive plasticity in calling site selection in gray treefrogs (*Hyla versicolor)*. Behaviour. 151:741-754.

Reichert, M., H. Galante and G. Höbel. 2014. Female grey treefrogs, *Hyla versicolor*, are responsive to visual stimuli but unselective of stimulus characteristics. Journal of Experimental Biology 217:3254-3262.

Rebar, D. and R.L. Rodriguez. 2014. Trees to treehoppers: genetic variation in host plants contributes to variation in the mating signals of a plantfeeding insect. Ecology Letters 17: 203–210.

Rebar, D. and R.L. Rodriguez. 2014. Genetic variation in host plants influences the mate preferences of a plant-feeding insect. American Naturalist 184: 489–499.

Thomas, J.J. and G. Höbel. 2014. *Hyla versicolor* (Eastern Gray Treefrog). Lacrimal Spot. Herpetological Review 45(1): 112.

Whittingham, L. A. and Dunn, P.O. 2014. Extra-pair mating and sexual selection on male traits across populations. The Wilson Journal of Ornithology 126:9-18.

Recent Theses

Goldsberry, Jessica K. 2010. Riparian plant communities of the fifth order Milwaukee River floodplain and islands. M.S. Thesis.

Hileman, Eric T. 2010. Abundance and survivorship of Butler's gartersnake (*Thamnophis butleri*) in Wisconsin. M.S. Thesis.

Ambardar, Medhavi. 2011. Effects of habitat and predation on reproductive success in eastern bluebirds (*Sialia sialis*). M.S.Thesis

Berg, Jason. 2011. Susceptibility of five wetland community types to invasion by glossy buckthorn (*Frangula alnus*, Mill.). M.S. thesis.

Kilkenny, Francis F. 2012. Gene flow and adaptation in *Lonicera japonica*. Department of Biology, University of Virginia, Charlottesville. Ph.D. dissertation.

Reis, Anne. 2012. Conservation of the southeastern Wisconsin tamarack swamp: Loss, persistence, and restoration. M.S. Thesis.

Kim, Son Young. 2012. Real-time adjustment of satellite behavior to local competition in gray treefrogs. M.S. Thesis.

Rebar, Darren. 2013. Influence of genetic variation in the biotic environment on phenotypic variation in a plant-feeding insect. Ph.D. dissertation.

Yu, Rong. 2013. Examining spring and autumn phenology in a temperate deciduous urban woodlot. Ph.D. dissertation

Kolodziej, Robb C. 2014. The effect of female quality on mating preferences in Eastern Gray Treefrogs, *Hyla versicolor.* M.S. Thesis.

Cooperation with Other Groups and Agencies

Service to the local community, and to the state-wide community of individuals, groups, and organizations engaged in natural area study and preservation is a major part of the Field Station's mission. To the extent that our staff has time available, we provide natural area consulting services to the community. The demand for these services exceeds our capacity to help, but we feel that these cooperative efforts are a very important part of our mission.

1. Friends of the Cedarburg Bog. The Field Station cooperates with and helps to support this non-profit organization that has a mission to initiate and support activities that will enhance the natural history, public appreciation, and scientific study of Cedarburg Bog in cooperation with the Wisconsin DNR and UWM.

2. Department of Natural Resources. The Station continued its wide range of planning and management activities in conjunction with the DNR. These activities include the day-to-day surveillance of the Cedarburg Bog performed by Station staff and some assistance with maintenance activities such as snowplowing.

3. Natural Areas Preservation Council. The Station participates in the State Natural Areas program, since the Station owns and manages five properties that have State Natural Areas status.

4. Ozaukee Washington Land Trust. The Land Trust is a non-profit, land conservancy for Ozaukee and Washington Counties. The Field Station helps to support the organization's activities in various ways. Jim Reinartz served on the Conservation and Stewardship Committees and on the management committee for their Fairy Chasm propert**y.**

5. Riveredge Nature Center. The Field Station cooperates with RNC on a wide range of programs.

6. Regional School Systems. Advanced biology classes from several high schools in the region (Milwaukee, Ozaukee, and Washington counties) use the Field Station for ecology field classes.

7. National Oceanic and Atmospheric Administration – Milwaukee Office. Weather records are provided monthly and frost and snow depth data are collected in winter.

8. Organization of Biological Field Stations. The Station is an active member of this national organization and cooperates in the exchange of information on programs.

9. Wisconsin Department of Transportation. The Station raises beetles for biological control of purple loosestrife for WDOT.

10. Urban Ecology Center—Milwaukee. G. Meyer serves on the Citizen Science Advisory Council.

11. U.S. Fish and Wildlife Service. G. Meyer provides support for monitoring of the federally-endangered Hine's emerald dragonfly *(Somatochlora hineana***).**

12. Wisconsin Invasive Species Council. Reinartz serves on the Council and chairs the Science and Research Subcommittee.

13. Southeastern Wisconsin Invasive Species Consortium (SEWISC). Reinartz serves on the Board of Directors and as Treasurer for the organization.

14. Ozaukee Treasures Network. The Field Station is cooperating with this consortium of over 30 environmental organizations to promote conservation in Ozaukee County.

15. Wisconsin Phenological Society. G. Meyer serves on the Board of Directors.

2014 Natural History Workshops

This is a series of intensive workshops on specialized topics which provide a continuing education opportunity and a meeting place for biologists. Seven workshop topics were offered in 2014.

Workshop	Instructor	Date
Ecology and Physiology of Plants in Winter: Surviving the Big Chill	James Reinartz	January 3 & 4
Field Herpetology: Identification of Wisconsin Amphibians and Reptiles	Josh Kapfer	May 30 & 31
Sedges: Identification and Ecology	Anton Reznicek	June 6 & 7
Vegetation of Wisconsin	James Reinartz	June 16 - 21
Dragonflies and Damselflies: Identification and Ecology	Robert DuBois	August 2 & 3
Plant - Insect Interactions	Gretchen Meyer and Robert Clare	August 8 & 9
Mushrooms and other Fleshy Fungi: Identification and Ecology	Alan Parker	September 27 & 28

Class and Group Use

Winter - Spring 2014	Number of Student Hours
Ecology and Physiology of Plants in Winter Workshop	360
Field Herpetology: WI Amphibians & Reptiles Workshop	380
Winter Ecology Hike and Friends Chili Dinner	420
Friends of Cedarburg Bog – Owl-prowl hike	80
Friends of Cedarburg Bog – Woodcocks and frogs	80
Friends of Cedarburg Bog – Frogs & amphibians	75
Friends of Cedarburg Bog – The Bog in Spring	60
Friends of Cedarburg Bog – Ecology of the Bog – North	85
Friends of Cedarburg Bog – Spring Bird walk	45
Friends of Cedarburg Bog – Planning Retreat	50
Friends of Cedarburg Bog – Meetings	110
Field Station Garlic Mustard Search/Pull	40
Wisconsin DNR – Bog buckthorn Work Crew	480
Great Lakes Bird and Bat Observatory Meeting	30
American Society of Foresters Chapter Meeting	70
Church Group – Spring Frog Walk	40
Riveredge Nature Center Home School group	70
Schlitz Audubon Center field trip	80
Natural Resources Foundation – Bog History core	60
Natural Resources Foundation – Birding Blitz	160
Shorewood High School – Ecology Club	50
Wisconsin Master Naturalists' Class	20
Birds of Wisconsin Field Trip event	120
Wisconsin Phenology Society – Phenology program tour	45
Wild Ones – Bog field trip	60
Milwaukee Area Technical College – Natural Landscaping	30
UW Arboretum Friends – Bog Tour	180
UWM Continuing Education – Wetland Hydrology course	110
UWM – CES 571 - Approaches to a Sustainable Future	360
UWM – Geography 120 – Our Physical Environment	270
UWM – Geophysics – Neda Mine exploration	120
TOTAL	4,140

Summer 2014	
Vegetation of Wisconsin Workshop	1,240
Dragonflies and Damselflies Workshop	260
Plant – Insect Interactions Workshop	310
Sedges: Identification and Ecology Workshop	380
Friends of Cedarburg Bog – The Bog in Bloom	70
Friends of Cedarburg Bog – International Bog Day hike	80
Friends of Cedarburg Bog – Spring Birds walk	55
Friends of Cedarburg Bog – Bog Bugs	60
Friends of Cedarburg Bog – meetings	75

Summer 2014	Number of Student Hours
Town of Saukville Quarry Committee meeting	20
Wild Ones – Prairie walk	120
Botanical Club of Wisconsin – Annual Meeting	120
Urban Ecology Center – Intern Field Trip	60
Home HS class group	30
UWM – Sustainable Peacebuilding Retreat	120
TOTAL	3,000

Fall 2014

Mushrooms & Other Fleshy Fungi Workshop	360
Friends of Cedarburg Bog – Annual Meeting & potluck	150
Friends of Cedarburg Bog – Forest Ecology walk	90
Friends of Cedarburg Bog – Bats Over the Bog	50
Friends of Cedarburg Bog – How do Trees Grow?	70
Friends of Cedarburg Bog – Owl Prowl	110
Friends of Cedarburg Bog – Ethnobotany	50
Friends of Cedarburg Bog – meetings	80
Kettle Moraine Lutheran High School – Ecology Club	50
Kettle Moraine Lutheran HS – AP Environmental Science	60
Greendale High School – Ecology	75
Cedarburg High School	440
Riveredge Nature Center – Christmas Bird Count	60
Garden Club of America – Environmental School	85
Alverno College – Wetland Ecology	80
Milwaukee Institute of Art and Design – Ecology class	40
University of Illinois-Chicago– Ecology field trip	640
UW – Whitewater – Ecology class	50
UW – Platteville – Ecology group	130
UWM – Chancellor's Office tour	20
UWM – Geology Club – Neda Mine	60
UWM – Geography – Soils	180
UWM – Geography 120 – Our Physical Environment	280
UWM – Geology – Hydrogeology	280
TOTAL	3,490

TOTAL 2014 Class & Group Use Hours. 10,630

Meteorological Data for 2014

This yearly summary is modeled, where possible, after the summaries provided by the National Oceanic and Atmospheric Administration (NOAA). Some differences between the two reports reflect differences in available equipment. Records for the Field Station are reported in degrees Celsius and in other metric measures. In addition, growing degree-days at 5° and 10°C, (see below for description) were substituted for the heating and cooling degree-days used by NOAA. The variables reported in the summaries are defined as follows:

Temperature

Average Daily Maximum: Monthly mean of the 30-min period in each day with the highest mean temperature.

Average Daily Minimum: Monthly mean of the 30-min period in each day with the lowest mean temperature.

Daily Average: Monthly mean of all 30-min means. (NOAA uses the midpoint between the daily minimum and maximum for this measure.)

Highest(Date): Highest 30-min mean temperature. (Day of month with highest temperature.)

Lowest(Date): Lowest 30-min mean temperature. (Day of month with lowest temperature.)

Degree Days

Sum at 5°: Sum of the number of degrees by which the daily average temperatures exceeded 5° C.

Sum at 10°: Sum of the number of degrees by which the daily average temperature exceeded 10° C.

Radiation (kW/m^2)

Mean: Mean of all 30-min means in the month.

Maximum: Maximum 30-min mean during the month.

Relative Humidity

Monthly mean of the 30-min means for each quarter of the day.

Number of Days

Precipitation of 0.25 mm or more

Temperature-Maximum

32° and above: Number of days with a maximum 30-min mean temperature of 32° C or above.

0° and below: Number of days with a maximum 30-min mean temperature of 0° C or below.

Temperature-Minimum

0° and below: Number of days with a minimum 30-min mean temperature of 0° C or below.

-18° and below: Number of days with a minimum 30-min mean temperature of -18° C or below.

Mean Pressure (mbars)

Mean of all 30-min means in the month.

Precipitation (mm)

Total: Sum of all precipitation during the month.

Greatest (24 hrs) (Date): Total precipitation on the day with the most precipitation and the date on which it occurred.

Wind

Mean Speed (m/s): Monthly mean of all 30-min means.

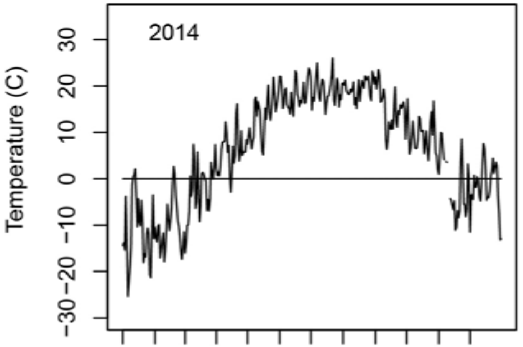
Maximum Speed (m/s): Highest mean wind speed during a 30-min period.

The Field Station can provide weather data in electronic format; datasets go back to 1989. Please contact us if you would like to receive the weather data.

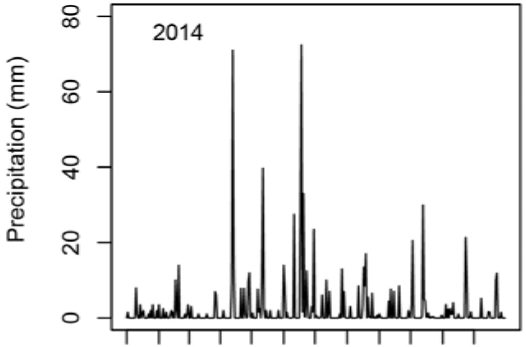
Meteorological Data for 2014

	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEP	OCT	NOV[3]	DEC
Temperature (C°)												
Average Daily Maximum	-6.4	-5.7	1.5	10.6	19.3	23.9	24.4	25.0	21.0	14.4	2.4	1.1
Average Daily Minimum	-16.4	-15.8	-8.3	0.8	7.6	13.2	13.3	14.7	9.0	4.5	-5.7	-5.0
Daily Average	-11.3	-10.2	-2.9	5.9	13.4	18.4	19.1	19.6	15.0	9.3	-1.3	-1.7
Highest (Date)	5.7 (12)	7.8 (19)	13.4 (31)	24.2 (20)	29.1 (26)	29.8 (16)	31.7 (22)	28.8 (29)	29.1 (4)	23.4 (27)	15.1 (3)	9.3 (14)
Lowest (Date)	-27.8 (9)	-27.4 (28)	-22.2 (3)	-6.4 (15)	1.7 (16)	6.5 (14)	9.1 (24)	8.9 (14)	2.7 (22)	-1.6 (30)	-16.6 (21)	-18.2 (31)
Degree Days												
Sum at 5°	0.0	0.0	5.6	61.7	261.6	400.7	435.8	452.9	300.9	138.1	14.9	4.0
Sum at 10°	0.0	0.0	0.0	12.9	127.1	250.7	280.8	297.9	159.2	36.8	0.0	0.0
Radiation (kW/m^2)												
Mean	NA[1]	NA	NA	0.18	0.25[2]	0.24	0.27	0.22	0.18	0.11	0.06	0.05
Maximum	NA	NA	NA	1.03	1.01	1.04	1.04	1.07	0.90	0.71	0.51	0.46
Relative Humidity (%)												
Hour 00-06 mean	79.5	73.7	76.4	77.1	80.7	86.2	87.4	91.6	89.4	84.5	82.9	85.5
Hour 06-12 mean	76.7	67.1	64.5	64.8	62.0	72.5	65.4	74.3	71.7	73.2	77.9	81.9
Hour 12-18 mean	72.1	57.6	55.7	55.9	52.8	61.5	57.8	65.3	61.7	63.0	66.4	74.7
Hour 18-24 mean	76.9	69.4	70.6	67.4	71.7	79.2	78.9	87.5	87.3	78.4	74.7	82.2
Number of Days												
Precip. 0.25mm or more	10	11	6	11	10	17	12	13	10	14	11	6
Max Temp 32° and above	0	0	0	0	0	0	0	0	0	0	0	0
Max Temp 0° and below	26	24	11	0	0	0	0	0	0	0	14	13
Min Temp 0° and below	31	28	27	13	0	0	0	0	0	7	22	25
Min Temp -18° and below	15	11	2	0	0	0	0	0	0	0	0	1
Pressure (mbars)												
Mean	1012.93	1016.44	1016.88	1013.68	1015.83	1013.93	1015.58	1016.30	1018.69	1012.50	1015.60	1020.33
Precipitation (mm)												
Total	25.5	40.0	21.5	135.4	71.2	231.3	47.2	67.3	32.0	67.7	50.3	32.0
Greatest (24 hrs) (Date)	8.0 (10)	14.0 (20)	7.0 (27)	71.0 (13)	39.8 (12)	72.5 (18)	13.0 (27)	17.0 (19)	8.5 (20)	30.0 (13)	21.4 (23)	11.8 (23)
Wind												
Mean Speed (m/s)	2.4	2.0	2.0	2.0	1.6	1.4	1.3	1.0	1.2	1.6	1.7	1.7
Maximum Speed (m/s)	5.9	7.3	6.0	6.1	5.9	5.6	3.7	3.5	4.6	5.4	4.6	5.0

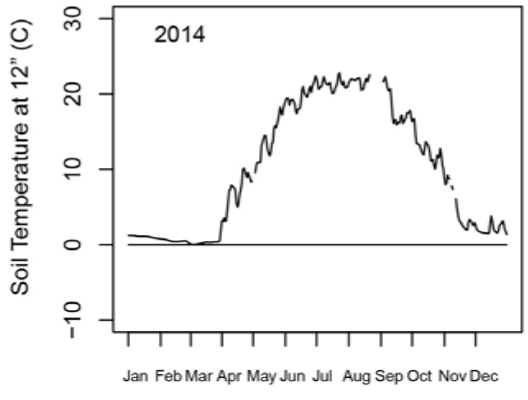
1- NA, not available. The pyranometer was removed for calibration from Jan 17 - March 10.
2- Radiation data are missing for May 1 and 2 because of a short circuit in a cable.
3- Data are missing for Nov. 7, 10, and 11 because of work done to upgrade the weather station datalogger.



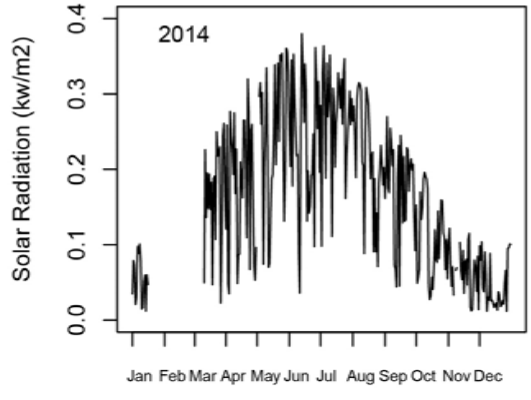
Mean Daily Temperature



Total Daily Precipitation



Soil Temperature at 12 Inches Depth



Mean Daily Radiation

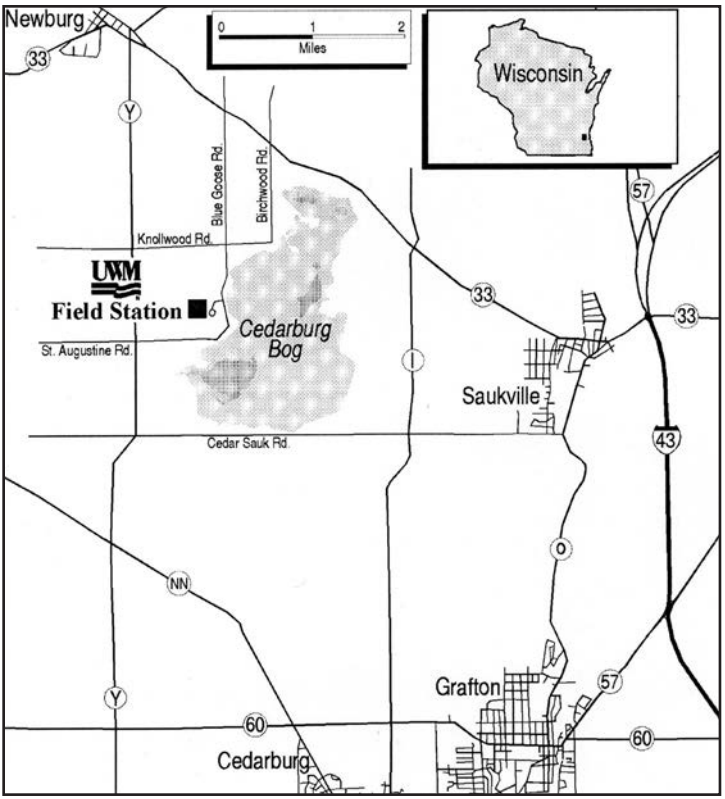
UNIVERSITY of WISCONSIN
UWMILWAUKEE

Field Station

3095 Blue Goose Road
Saukville, WI 53080

Phone: (262) 675-6844
Fax: (262) 675-0337

E-Mail: fieldstn@uwm.edu
Web: www. fieldstation.uwm.edu



UNIVERSITY of WISCONSIN
UWMILWAUKEE

Field Station
P.O. Box 413
Milwaukee, WI 53201

Address Service Requested

Nonprofit Organization
U.S. Postage
PAID
MILWAUKEE, WI
PERMIT NO. 864

FIELD STATION
UNIVERSITY OF WISCONSIN–MILWAUKEE