

2011

FIELD STATION ANNUAL REPORT



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On the Cover: The Field Station constructed a new sound chamber for use in studies of acoustic communication and sexual selection in amphibians. The sound chamber is being used by Gerlinde Hoebel and her students.

Director:	James A. Reinartz
Manager/Staff Biologist:	Gretchen A. Meyer
Maintenance:	Lou A. Nelson
Administrative Assistant:	Cynthia K. Boettcher
Field Station Committee:	Peter Dunn, Timothy Ehlinger, Glen Fredlund, Tim Grundl, Gerlinde Hoebel, Jeffrey Karron (Chairman), Craig Sandgren, Stefan Schnitzer, Thomas Schuck, Erica Young

About Us

2011 Highlights

- Construction of a new sound room facility for experimentation on frog vocalizations and communication.
- Jim Reinartz was honored by the Wisconsin Wetlands Association, receiving its Wetland Enjoyment Award for 2011 (see photo p. 37).
- Beginning of major Friends of Cedarburg Bog projects to manage invasives in the Cedarburg Bog area.
- First year of management of the Habitat Protection Area at UWM's new Innovation Park campus on the old Milwaukee County Grounds.
- Major increases in information available through the Field Station's website (www.fieldstation.uwm.edu).
- Use of Downer Woods on campus for education and research continues to increase.
- Summary of Neda Mine Hibernaculum bat activity and environment data sets completed and made available for collaboration with the UWM Biomathematics program.
- 50 research projects in 2011
- Almost 11,000 student hours of instruction and group use in 2011.

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 1965. Research at the Station has produced 309 scientific publications and 140 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 carrs, 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.

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. Emerald Ash Borer, first found in Wisconsin only about three miles from the Beech Woods, has not been found at the Station but may already be present. 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 (*Mellilotus* 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. Friends of Cedarburg Bog volunteer workdays and our regular stewardship volunteer, Dennis Goldsmith, contributed about 36 person days during 2011 to help Field Station staff with 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, began projects in 2011 to control glossy buckthorn in parts of the Cedarburg Bog and to kill fruiting-sized Oriental bittersweet on adjacent private land. Fruiting-sized glossy buckthorn has been removed, and continues to be excluded, from a 5-acre plot and a 45-acre plot at the center

of the Bog. The Wisconsin Department of Natural Resources also removed glossy buckthorn from large areas of the northern portion of Cedarburg Bog during the winters of 2006-07 and 2007-08.

Research and Teaching Facilities

General Facilities

- Office/classroom building with meeting rooms, teaching lab, and computer lab.
- A new Research Lab constructed in 2004
- Service building – machine & wood shop
- The Farm House for researcher & student housing – The kitchen was redecorated/painted in 2008
- 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

Animal Ecology & Behavior

- New 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.

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.

UWM Innovation Park – Habitat

Protection Area – In the northwestern part of UWM's new Innovation Park 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 for conservation of this site is as 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

- 50 active research projects conducted at the Field Station in 2011.
- Including: 6 M.S. thesis, 2 Ph.D. and 19 studies by researchers from outside of the University.
- 6 papers published during 2011. 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

- Almost 11,000 student hours of instruction and group use in 2011.
- Ten workshops on topics in natural history

- Five undergraduate student projects.
- Eighteen 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 Cedarburg 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 2011 the Friends sponsored 18 educational events for the general public. Volunteers from the Friends contributed many person-days of labor, including natural area management, publishing a newsletter, raising funds, and sponsoring and providing staff for events. In 2011 the Friends also began a grant-funded study to identify the surrounding areas that contribute groundwater supply to the Cedarburg Bog (see abstract by J. Kline). The Friends also began a large grant-funded invasive control project in 2011 (see notes under Management above). 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!

Abstracts of Research

Reproductive Success of Eastern Bluebirds on Golf Courses: Roles of Food, Foraging and Predation

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Habitat type can dramatically affect wildlife by influencing availability of resources (such as food) or the frequency of nest predation. Human-dominated areas such as golf courses can provide habitat for wildlife, but may have reduced arthropod abundance, which can lower habitat quality for birds. We investigated habitat quality and reproductive success of Eastern Bluebirds (*Sialia sialis*) nesting on golf courses and in nearby fields (reference areas) in Wisconsin, USA. We found that golf courses had significantly lower arthropod biomass, but were more productive than reference areas in terms of

number of broods and young that fledged. This difference in fledging success was due in part to reduced nest predation by raccoons (*Procyon lotor*) on golf courses. When foraging, bluebirds made more successful prey captures on golf courses than in reference areas, but individual foraging success did not influence fledging success or number of broods. The results of this study suggest that because of lower predation rates, golf courses can provide valuable habitat for bluebirds. MS Thesis Research, Peter Dunn, Major Professor.

Seasonal Variation in Call Perch Choice in *Hyla versicolor* – Abiotic (Temperature) or Biotic (Predator) Effects?

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Gray Treefrogs (*Hyla versicolor*) at Byer's Pond call while floating in the water during the beginning of the breeding season, but switch to calling from trees later in the season. Early in the season, water temperatures remain higher at night than air temperature, while later in the season air temperatures are higher than water temperatures. In addition, Bullfrogs and Green Frogs, which are predators of Treefrogs only appear in the pond later in the season. We used behavioral observations in the field as well as lab-based experiments to determine whether

the observed switch in call perch choice of Gray Treefrogs is due to temperature preferences, or to the presence of predators. We found that Treefrogs prefer to be in the warmer environment, which is the water early on, but the air later in the season. The presence of a predator did not affect where the Treefrogs settled down, but it did affect whether they started to call. With a predator present, the frogs called less frequently. Undergraduate independent study project, Gerlinde Höbel advisor.

Genetic Structure of an Invasive Plant in its Native and Introduced Ranges

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Invasive, exotic plants threaten natural ecosystems and can be problematic agricultural weeds. Genetic changes in exotic plants are driven by processes such as founder effects, genetic drift, mixing of plants from widely-separated populations, and hybridization, but more research is needed to develop a general theory of how these forces may stimulate invasiveness. We are investigating genetic variation in the tall goldenrod (*Solidago gigantea*), a species native to North America and one of the most problematic invasive species in Europe. We have extracted DNA from 293 specimens of *S. gigantea* (from both Europe and North America), and from closely related species in *Solidago* subsection *Triplinervae*. We evaluated a small set of microsatellite

loci developed for the seaside goldenrod (*Solidago sempervirens*), and found that four loci were consistently amplifiable and interpretable in *S. gigantea*. However, many samples exhibited more than the maximum number of alleles possible at a locus given its known ploidy (more than 2 alleles at a locus in a diploid, more than 4 alleles at a locus in a tetraploid, or more than 6 alleles in a hexaploid). This is likely a result of gene duplication at these loci in *S. gigantea*. We are thus currently developing additional microsatellites for *S. gigantea*, which should enable us to evaluate the genetics of *S. gigantea* in its introduced and native ranges using our existing collection of plant material. Funded by the Research Growth Initiative, UWM.

Susceptibility of Five Wetland Community Types to Invasion by Glossy Buckthorn (*Frangula alnus* Mill.)

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In order to establish a population within a novel community, an invasive plant species must successfully reproduce and exert sufficient propagule pressure to overcome ecological resistance of the recipient habitat. *Frangula alnus* (glossy buckthorn) is an invasive shrub that is able to grow in various wetland community types. The objective of this study was to examine how several wetland communities that support glossy buckthorn differ in biotic and abiotic characteristics, and compare the propagule pressure and germination success of glossy buckthorn within the community types. The results will help clarify the role of propagule pressure and biotic and abiotic resistance of different communities and help evaluate which of these communities are more susceptible to invasion by glossy buckthorn.

To compare biotic and abiotic characteristics among communities, surveys of trees, shrub



cover, microtopography, and determination of surface water nutrient availability were

conducted in the Cedarburg Bog. To quantify propagule pressure within the communities, seed traps were used to measure glossy buckthorn seed deposition. Germination plots were sown in each of the five community types to measure germination rates, with unsown plots monitored to quantify natural germination in each community.

Differences in biotic and abiotic characteristics among communities were observed to differentially affect glossy buckthorn establishment. The only community in which trees formed a dense canopy was the cedar swamp. There were fewer glossy buckthorn adult individuals in the cedar swamp than in other communities, however the taller glossy buckthorn plants also produced greater cover than adults in the other communities where large trees are not dominant. Glossy buckthorn propagule pressure was also highest in the cedar swamp, which may relate to the larger adults producing

more cover. Natural germination of glossy buckthorn seeds was highest in drier communities that experienced intense propagule pressure. Sown seeds also germinated at relatively high rates in these sites. However seeds also germinated well in the wet flark community that typically experiences low propagule pressure, suggesting that higher propagule pressure can overcome the community resistance related to wet conditions.

The results indicated that glossy buckthorn establishes more successfully in the relatively dry community types found in the Cedarburg Bog. Furthermore, the number of adults is not the only driving force behind propagule pressure; adult morphology can also be important. Propagule pressure is too low in some communities to provide the amount of seeds necessary to establish a population. M.S. Thesis research, Dr. Erica Young and Dr. Gretchen Meyer, advisors.

Hine's Emerald Dragonfly Conservation Genetics Study at Cedarburg Bog, WI

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Hine's emerald dragonfly (*Somatochlora hineana*) is an endangered species that has been protected under the US Endangered Species Act since 1995. Although the species was historically distributed in several Midwestern states, habitat destruction has left the dragonfly largely confined to the vicinity of Chicago, IL, Door and Ozaukee Counties, WI, three counties in Michigan and one county in Missouri. The Cedarburg Bog site in Ozaukee County, WI, represents a potentially important site that is geographically intermediate between the remaining robust populations in Illinois and Door Co, WI. The goal of the project is to determine levels of genetic variability and to estimate genetic connectivity between dragonflies in the remaining occupied sites. Adults are captured with aerial nets and two small wing clips are taken for genetic samples. Once

additional site and specimen data are taken, the dragonfly is released. The process takes less than two minutes per captured dragonfly. DNA is extracted from the wing clips and genetic variability is assayed at 10 microsatellite loci. Collection efforts at Cedarburg Bog were made on several occasions in 2011 by Lesley Brotkowski of BHE Environmental beginning 22 June and lasting until 3 Aug. Hine's emerald dragonflies were seen in flight at Cedarburg Bog and 25 adults were captured, 13 on 1 July and 12 on 6 July. One road-killed specimen was collected on 3 Aug. All wing clips from 2011 will be extracted and genotyped at 10 microsatellite loci at the University of South Dakota over the winter. Funded by Illinois Toll Highway Authority, I355 Extension Hine's Emerald Dragonfly Study and the Illinois Department of Natural Resources.

Wildlife Ecopassage Monitoring

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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. Little data are available for evaluating the conservation effectiveness of these structures. This project installed wildlife cameras and is conducting surveys of 6 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 continued data collection in 2011. This project is funded by a C.D. Besadny Conservation Grant, Natural Resources Foundation of WI, and the Wisconsin Department of Transportation.

Reproduction in Cedar Lake Blanding's Turtles

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This radio telemetry study is monitoring female Blanding's turtles to determine nesting sites and collect data on reproductive success in Washington County, WI. Study objectives are to build upon past data defining critical habitat needs for this population, and specifically identify nesting areas and collect data on nesting success. Prior studies in this area have documented activity

ranges, unsuccessful nesting, and important foraging and over-wintering sites. In 2011 two adult females were tracked throughout the season and into hibernation. One nest was found and successfully hatched. Funded by Cedar Lakes Property Owners Association, and Cedar Lakes Conservation Foundation.

HerpNET

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HerpNET is a collaborative effort by natural history museums to establish a global network of herpetological collections data, funded by the National Science Foundation and a GBIF DIGIT grant. Currently, 64 institutions are participating in the HerpNET community, with an open ended invitation to institutions who would like to join. Sixty-four institutions are available on the specimen searching portal, with data from over 5.5 million specimens available for searching.

The mission of HerpNET is to bring the accumulated knowledge from more than four million specimens in world wide museum collections into currency for science and society by creating a distributed database with access from various portals. HerpNET will connect large repositories of information with smaller collections that have regional specializations. Similar efforts (e.g. MaNIS, FishNetII, MaPSTeDi, ORNIS) are being accomplished for other taxa and regions and

the herpetological community is poised to make its own contribution to the study of biodiversity. HerpNet will bring together researchers from diverse institutions and will initiate and strengthen collaborations among natural history collections, conservation biology, phylogenetics and biodiversity informatics. HerpNet is funded by the National Science Foundation and a Global Biodiversity Information Facility DIGIT grant to the University of Kansas Center for Research Inc. This award to the Milwaukee Public Museum is to bring MPM herp collections data online. A database was posted in 2008 and georeferencing completed in 2009. Incorporation of georeferencing

to the posted database began in 2010. Funded by a grant from the National Science Foundation.



Salamander Larval Stage

Wisconsin Herp Atlas

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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 450 new county records have been

confirmed by the project. The data collected helps to map species distributions, document rare species occurrences, analyze distribution trends, examine habitat requirements, and plan conservation priorities. In 2006 the Atlas was abandoned by the financially troubled Milwaukee Public Museum, and in 2007 it was re-established through the UWM Field Station, where it now resides, and currently houses 61,541 occurrence records for Wisconsin.

Wildlife Monitoring in Ozaukee and Washington Counties, Wisconsin

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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 2011 we continued herp and bird monitoring. We hosted a training workshop on wildlife

monitoring and continued data analyses on herp and bird detection probabilities for use in modeling trends and determining species richness on OWLT properties. We continued disseminating project results through project reports, lectures, conference presentations, and workshops.

Effects of Climate Change on Spider Assemblages in Cedarburg Bog, Ozaukee County, Wisconsin

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Climate change has been shown to have effects on the environment as well as on many organisms. Spiders have been found to be greatly influenced by climate, which makes them a good study organism. Spiders are mobile enough to respond to climate changes but not mobile enough that environmental changes cannot be seen. Many plants and animals reach their southernmost range at Cedarburg Bog so we expect to see a response due to climate change much more quickly than in other areas. Spiders were collected from May 2000 to May 2001 from Cedarburg Bog and will be compared to spiders collected from May 2011 through May 2012 to look for changes in species assemblage that could be attributed to climate change. The 2000/2001 sampling included the use of beat sheets, sweep nets, and brush samples

along with pitfall traps being reset each month and litter samples being collected and run through Berlese funnels. Samples were collected in five different habitats consisting of a cedar swamp, shrub carr, bog birch, an island forest and a string bog. The same techniques and schedule will be followed as closely as possible to compare assemblages after eleven years' time. Adult spiders will be identified to species level and the three data sets will then be compared for differences in habitat preference, phenology, abundance and presence or absence. We will also examine the climatological record to see if changes have occurred during this period, which could account for any shifts in the spider communities. Spiders have been collected from May to December currently and all of the pitfall trap spiders have so far been identified.

Analysis of Phosphoglucose Isomerase (PGI) Within and Among *Habrotricha rosa* metapopulations

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The study described in this abstract is part of a larger project that looks at the influence of environmental heterogeneity on the dynamics of ecological communities and the close interplay between processes at both local and regional scales. I am using the community of microbes and small invertebrates that inhabits the rainwater-filled pitcher shaped leaves of the carnivorous plant *Sarracenia purpurea* as a natural microcosm for these studies. This abstract describes a study of *Habrotricha rosa*, an asexual bdelloid rotifer associated with *S. purpurea*. I will be analyzing its genetic diversity at multiple temporal and spatial scales, and will attempt to correlate variations with phenotypic characteristics. The results of this study will provide insights into the role of genetic variation in the survival

of animal species living as metapopulations - populations that are subdivided among habitat patches connected by dispersal.

During 2008-2010, I isolated over 30 *H. rosa* clones from samples of pitcher fluid taken from randomly selected plants growing on the string bog at the Cedarburg Bog. The sampling scheme was designed to provide clones from within habitats (pitchers), between habitats (pitchers on the same plant) and among locations on the bog (between plants). Another way of stating this is that I am looking for differences in alpha, beta and gamma genetic diversity respectively. 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.

Our studies are currently focusing on the enzyme phosphoglucose isomerase (PGI), a dimeric enzyme that catalyzes the reversible isomerization of glucose-6-phosphate and fructose-6-phosphate. This enzyme plays a key role in glucose metabolism and the resupply of ATP. PGI variants have been correlated with habitat migration in metapopulations of the endangered Glansville Fritillary butterfly, and in metapopulations of the terrestrial rotifer *Macrotrachela quadricornifera*. The bdelloid rotifer *Habrotrocha rosa* exists as a metapopulation in the leaves of the northern pitcher plant *Sarracenia purpurea*. We hypothesize that variation in *H. rosa* PGI isozymes may correlate with its life history - these rotifers must migrate to a new leaf habitat patch before the old leaf dies. Contrary to the data in the literature for other invertebrates, we found

that the *H. rosa* clones from Cedarburg Bog exhibited identical heterozygous genotypes for phosphoglucose isomerase. This strong stabilizing selection poses the question of whether this rotifer travels from one habitat patch to another phoretically, and therefore does not rely upon high ATP demand for migration. We are now testing for reproducibility of isozyme patterns by collecting rotifers from four other bogs located in Wisconsin, Michigan, and Indiana. We hypothesize that *H. rosa* clones from these other bogs will show different PGI isozymes from those at Cedarburg Bog, but there will be no variation in the PGI isozyme within each site. This will further lend support to the hypothesis that this rotifer is changing habitat patches by phoresy on one of the other motile inquilines of the pitchers. We are also investigating how this phoresy might take place.

Influence of Larvae of the Midge, *Metriocnemus knabi*, on Population Dynamics of the Bdelloid Rotifer, *Habrotrocha rosa*, in Leaves of the Northern Pitcher Plant, *Sarracenia purpurea*

D. Liane Cochran-Stafira

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The inquiline community that lives in the pitcher-shaped leaves of the northern pitcher plant, *Sarracenia purpurea*, has been used for many years as a model system for experimental studies in community and population ecology. This study described here is intended to contribute to our understanding of the basic ecology of the system. The midge, *Metriocnemus knabi* (Coq.), is closely associated with *S. purpurea*; females lay their eggs exclusively in the rainwater-filled vase shaped leaves of this carnivorous plant. The decomposition of prey within the pitcher provides the energy to support an inquiline community that consists primarily of microbes, protists, small invertebrates and dipteran larvae including the rotifer, *Habrotrocha rosa*, flesh fly, *Fletcherimyia fletcheri*, the pitcher plant mosquito, *Wyeomyia smithii* and *M. knabi*. Midge larvae share a positive food processing chain commensalism with *W. smithii* larvae in which the midges help to physically break down the prey carcasses

in the pitcher leading to higher numbers of bacteria that serve as food for the mosquito larvae. The relationship between midge larvae and *H. rosa* is unknown, but by fostering bacterial growth, they may also provide food for rotifers. However, *M. knabi* may also negatively impact *H. rosa* populations by feeding on their eggs. Beginning three days after hatching, each rotifer produces a single egg daily. In the lab, these eggs are "glued" to the sides of culture tubes or the bottom of petri dishes, and midges have been observed eating them. It is not known if eggs are attached to the inside of the *S. purpurea* pitcher or the detritus within the pool of water, but if rotifer eggs are attached to the prey carcasses or other debris, it is possible that midge larvae may consume them as they crawl through the sediment at the bottom of the pitcher. I am working on a series of experiments that will permit me to determine whether midge larvae play a significant role in regulating *H. rosa* populations, along with *W. smithii* and *F. fletcheri*.

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

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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. This mismatch hypothesis predicts that reproductive success is maximized when animals synchronize their reproduction with seasonal peaks in food supply. Using data from tree swallows breeding at five sites over 24 years (37 site-years), we tested the assumptions of the mismatch hypothesis in tree swallows, whose timing of egg-laying has shifted earlier by nine days since the 1950's. Contrary to the mismatch hypothesis, the start of egg-laying was strongly related to food abundance (flying insect biomass) during the laying period and not to timing of the seasonal peak in food supply. Overall, initial reproductive decisions in this insectivore appear to be based on the food supply

during egg formation and not the nestling period. Thus, the mismatch hypothesis may not apply in environments with relatively constant or abundant food throughout the breeding season. Although climate change is often associated with earlier reproduction, our results caution that it is not necessarily driven by selection for synchronized reproduction. This research was supported by funds from the College of Letters and Science, UWM.



Sexual Selection and Immunity in Common Yellowthroats

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Female preferences for particular male ornaments may shift between populations as a consequence of ecological differences that change the reliability and detectability of

the ornament, but few studies have examined how ornaments function in different populations and what they signal about male quality. We examined the signaling function of male plumage ornaments in a warbler, the common yellowthroat (*Geothlypis trichas*), breeding in New York (NY) and at the UWM Field Station in Wisconsin (WI), USA. Males have two prominent ornaments: a black facial mask pigmented with melanin and a yellow bib pigmented by carotenoids. Previous studies in WI indicate that the size of the mask, and not the bib, is primarily related to female choice and male reproductive success. In NY, however, the pattern is reversed and attributes of the bib (size and



color), and not the mask, are the target of sexual selection. We found that brightness of the yellow bib was the best signal of humoral immunity (immunoglobulin G) in NY and mask size was the best signal in WI, after controlling for breeding experience and capture date. Thus, similar aspects of male

quality appeared to be signaled by different ornaments in different populations. This project was supported by grants from the National Science Foundation (to P. Dunn & L. Whittingham).

MHC Variation in Common Yellowthroats

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As part of our studies of common yellowthroats, we are attempting to better understand the genetic benefits of extra-pair mating. One hypothesis is that extra-pair sires provide offspring with superior genes of immunity, in particular the major histocompatibility complex (MHC), which is a major component of the vertebrate immune system. Genes in this complex encode proteins that recognize foreign pathogens. Birds have between one and seven confirmed MHC class II B genes, and the greatest diversity appears to occur in passerines. We used multiple primer sets on both genomic DNA (gDNA) and complementary DNA (cDNA) to characterize the range of class II B genes present in a passerine, the common yellowthroat (*Geothlypis trichas*). We confirmed 39 exon 2 sequences from

gDNA in a single individual, indicating the presence of at least 20 class II B loci. From a second individual, we recovered 16 cDNA sequences belonging to at least 8 transcribed loci. Phylogenetic analysis showed that common yellowthroat sequences fell into subgroups consisting of classical loci, as well as at least 4 different clusters of sequences with reduced sequence variability that may represent pseudogenes or nonclassical loci. Data from 2 additional common yellowthroats demonstrated high inter-individual variability. Our results reveal that some passerines possess an extraordinary diversity of MHC gene duplications, including both classical and nonclassical loci. This project was supported by grants from the National Science Foundation (to P. Dunn & L. Whittingham).

Survey of Insect Species Feeding on *Rhamnus alnifolia* and *Rhamnus lanceolata*

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In summer, 2011, I began a long term project whose goal is to find and culture insect species feeding on alder-leaved buckthorn (*Rhamnus alnifolia*) and lance-leaved buckthorn (*Rhamnus lanceolata*) in northern Illinois and southern Wisconsin. Both tree species are restricted to fens and are under competitive pressure from *Rhamnus cathartica*. With the help of two students, I began the search in wetland habitats in Illinois, in locations where the trees had

previously been reported. Failing to find either species, we expanded our search to southern Wisconsin and visited the Cedarburg Bog in August. There, we found a healthy population of *R. alnifolia*. Although some leaves showed evidence of previous herbivore feeding, we found no living insects feeding on the plants. We intend to check these plants regularly beginning in spring 2012.

New Sponge Records from the Citizen-Based Monitoring Program

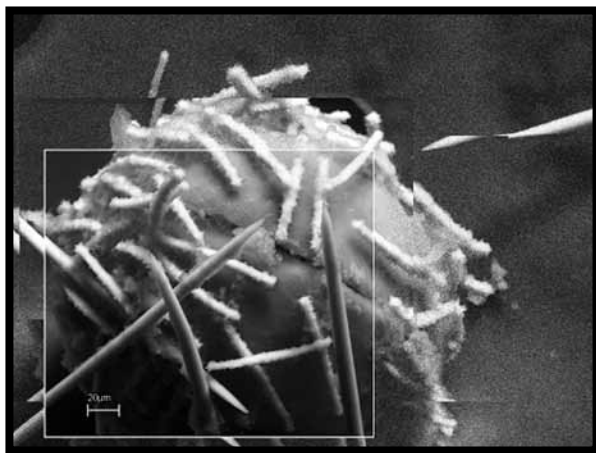
Joan P. Jass¹ and Jody Barbeau²

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In 2011 MPM received funding from the Natural Resources Foundation's C.D. Besadny Conservation Grant Program to use scanning electron microscopy to verify identifications of freshwater sponges collected through the Citizen-Based Water Monitoring Network, a University of Wisconsin-Extension program. A number of the specimens studied under this grant were collected in the UWM Field Station's upland beech-maple forest by Jody Barbeau as part of the Wisconsin Department of Natural Resources (WDNR) Ephemeral Ponds Project. Their identities and collecting data are given here.

During the 2009 season, sponges were first seen in ephemeral ponds in late May-early June and were no longer visible by early September. The species *Eunapius fragilis* was collected from 2 depressional woodland basins on 27 June. The first site is WDNR

Verified Ephemeral Pond (VEP) #24 at N43° 23.197 W088° 02.004 ± 27.5 ft. LatLong. The second is VEP #28 at N43° 23.305 W088° 01.848 ± 29.5 ft. LatLong. The seasonally produced, seed-like gemmules are needed for making species determinations of freshwater sponges, and these specimens did include them. Features of the gemmule and spicules (=gemmoscleres and megascleres – microscleres are absent in *E. fragilis*) were examined by light and scanning electron microscopy. These are the first records for this species in Ozaukee County, bringing the total number of Wisconsin counties reported for this sponge up to nine. In the southern part of the state, it is also known from the adjacent counties of Washington and Waukesha.



Distinctive traits for *E. fragilis* are the spine-covered gemmoscleres attached to the outer pneumatic layer that forms a coat over the gemmule and the smooth fusiform shape of its megascleres.

Germination of Cultivars of Burning-bush (*Euonymus alatus*) under Field Conditions

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Euonymus alatus is an introduced, commercially important species that has the potential to become invasive. The purpose of this study is to determine the relative establishment ability of some of the most common horticultural varieties that have been developed in different hardiness zones to assess whether some varieties pose less risk of becoming invasive than others. This project was initiated in 2010. Six blocks were set out in the research garden of the UWM Field Station. Each block consisted

of 6 plots, 5 of which contained 150 fruit from one of five *Euonymus alatus* cultivars and the remaining plot was blank. The 5 cultivars of *Euonymus alatus* studied are 'Compactus', 'Nordine', 'Select' (Fire Ball™), 'Timber Creek' (Chicago Fire™), and 'Tures'. By the end of the 2011 field season no fruit had germinated. It was found that colleagues in Connecticut had similar results and their seeds took two years to germinate. The updated timeline for this project is to assess seed germination in spring 2012.

Increased Relative Abundance of an Invasive Competitor for Pollination, *Lythrum salicaria*, Reduces Seed Number in *Mimulus ringens*

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When exotic plant species share pollinators with native species, competition for pollination may lower the reproductive success of natives by reducing the frequency and/or quality of visits they receive. Exotic species often become numerically dominant in plant communities, and the relative abundance of these potential competitors for pollination may be an important determinant of their effects on the pollination and reproductive success of co occurring native species. Our study experimentally tests whether the presence and abundance of an invasive exotic, purple loosestrife (*Lythrum salicaria* L., Lythraceae), influences reproductive success of a co-flowering native species, monkey flower (*Mimulus ringens*

L., Phrymaceae). We also examine the mechanisms of competition for pollination and how they may be altered by changes in competitor abundance. We found that the presence of *Lythrum salicaria* lowered mean seed number in *Mimulus ringens* fruits. This effect was most pronounced when the invasive competitor was highly abundant, decreasing the number of seeds per fruit by 40% in 2006 and 33% in 2007. Reductions in the number of seeds per fruit were likely due to reduced visit quality resulting from *Mimulus* pollen loss when bees foraged on neighboring *Lythrum* plants. This study suggests that visit quality to natives may be influenced by the presence and abundance of invasive flowering plants.

Gene Flow and Adaptation in *Lonicera japonica*

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Little is known about the genetic and adaptive dynamics of biological invasions. Here we use Japanese honeysuckle (*Lonicera japonica*), a horticultural vine invading North America, to assess population genetic processes and adaptive change in an invasion. *Lonicera japonica* plants from 17 populations in the core of the invaded range (100-150 years old) and 14 populations in the range margin (65 years old or younger) were compared to determine genetic structure at multiple scales, whether divergent evolution has occurred during invasion, and the potential for populations from these sources to invade novel areas.

There was little genetic structure in *L. japonica*'s invaded range. Genetic variation was distributed over short spatial scales, with most variation accounted for within populations and within patches in populations, but not between core and margin regions. Four genetic groups were identified, suggesting multiple introductions, and admixture is ongoing, with 17% of samples of mixed origin. Genetic diversity did not affect patch-level reproduction, but increasing local conspecific cover resulted in more fruit production, indicating the presence of Allee effects. These findings show that

human dispersal of invaders can lead to high levels of local genetic variation, which may increase population growth rates and spread in this self-incompatible species.

Adaptive evolution was found within *L. japonica*'s invaded range. After three years growth in core and margin gardens, margin plants had 36% greater biomass and 30% greater survival than core plants, regardless of planting location or genetic group. Margin plants also were larger and had 54% greater survival after two years in gardens beyond the range edge. Size influenced survival, suggesting that margin plants had higher survival because they grew more rapidly. Across latitudes, winter mortality increased with increasing latitude, and core plants had 39% higher winter mortality than margin plants. Increased performance of margin plants indicates that range expansion has selected for plants with greater ability to establish and this reinforces selection by short growing seasons for rapid growth rates at the margin. In total, evolution in margin populations suggests that adaptations promoting colonization can drive invasions and increase the likelihood of further spread, especially as global temperatures increase. Dissertation research of F. Kilkenney.

Evolution of Marginal Populations of an Invasive Vine Increases the Likelihood of Future Spread

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Biological invasions are homogenizing the Earth's biotic communities. To predict future invasions we must understand how evolution of invasive species interacts with anthropogenic environmental change. This study compares Japanese honeysuckle

(*Lonicera japonica*) plants from the core (100-150 years old) and the margin (65 years old or younger) of the invaded range in North America, to determine whether recent evolution increases the probability of future expansion. Plants from multiple populations

in the core and margin were compared in two habitats beyond the northern range edge to assess the potential for populations from these sources to invade novel areas and continue range expansion. We compared these data to data from other work in this system, to assess the effects of latitudinal climate on *L. japonica* spread. Beyond the northern range edge, plants from the northern margin reached greater size and had 54% greater final survival than plants from core populations. Across the range, winter mortality was predicted by latitude,

temperature and the origin of individuals. In particular, winter mortality increased with increasing latitude and decreasing temperature, and across the range, core plants had 39% higher winter mortality than margin plants. These results show that prior evolution in this invasive species may increase probability of further spread northward of margin populations, especially with the anthropogenic rise in global temperatures. Dissertation research of F. Kilkenny.

Web-building Behavior and Vibrational Cues: Do Spiders Eavesdrop on their Prey?

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Flexible foraging behavior is crucial for predators, which need to locate and capture moving prey. Even web-building spiders, which are sit-and-wait predators, use cues from their surroundings to make foraging decisions, which are manifested as web-building behavior. Here I focus on substrate-borne vibrational cues, which are commonly used by insects for communication along

assess local prey availability, and modify their web-building behavior accordingly. I test this hypothesis in the laboratory by exposing spiders to different vibrational playback treatments and comparing silk investment and rates of web relocation. Among the spider species used in this study, *Argiope trificiata* is found in abundance at the UWM Field Station, and will likely be collected from there during the 2012 field season. Spiders collected in 2011 were used for preliminary data and experimental design. M.S. Thesis research, Dr. Rafael Rodriguez, Major Professor.



plant stems. What isn't fully understood is the extent to which spiders utilize these cues in making foraging decisions. That is, how does the presence of vibrational cues specifically affect spider web-building behavior? In this study, I test the hypothesis that web spiders exploit vibrational cues to



Determinants of Alternative Mating Tactics in *Hyla versicolor*

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Advertisement calls are used by male *Hyla versicolor* to attract potential mates. Males unable to effectively compete using attractive calls will resort to alternative mating tactics, otherwise known as satellite behavior. Satellite males will position themselves near an attractive calling male and attempt to intercept females attracted to the caller. During the 2009 – 2011 breeding seasons, I investigated the factors that mediate the expression of alternative mating tactics in *H. versicolor*. Satellite males will sometimes call when the calling male is removed. If both males called, then the caller/satellite male pair vocalizations were recorded to analyze phenotypic traits between males. Otherwise, only the calling male was recorded. Random calling males and the nearest calling neighbor were also recorded. I found that satellite males were smaller than calling males but did not differ in body

condition. When comparing call traits, I found that satellite males had significantly reduced calling effort, higher frequency calls, and smaller frequency amplitude differences than callers. There were no differences between calling males with a satellite, random calling males, and calling neighbors. Two choice mating trials were conducted to determine female preferences in frequency and frequency amplitude differences. Females preferentially discriminated against frequencies of satellite calls and satellite frequency amplitude differences, which suggests that males utilize satellite behavior when they are unable to attract females. I will continue to investigate alternative mating tactics in gray tree frogs in the 2012 field season at the University of Wisconsin-Milwaukee Field Station. M.S. Thesis research, Dr. Gerlinde Höbel, Advisor.

Identification of Contributing Areas for Groundwater Supply to Protect Critical Habitat at Cedarburg Bog

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Cedarburg Bog is a groundwater dependent ecosystem. Groundwater affects the Bog's water supply, which in turn affects its plant communities and the populations of many rare plants and animals. Land use and development in areas where groundwater is recharged have the potential to change the quality and quantity of water reaching Cedarburg Bog. Determining how groundwater flows to and through the Bog and identifying the groundwater recharge areas is essential to protecting this critical habitat. Supporting scientific studies to protect Cedarburg Bog is a major goal of the Friends.

The first phase of this project consists of developing a local scale water table map and mapping the stratigraphy of the Cedarburg Bog area to understand local

groundwater flow. To do this we examined well logs and previous hydrogeologic studies in the area. A second phase will refine these maps using a variety of methods and then examine the relationship of groundwater flow to surface water features and to known rare species habitat. Groundwater dependent rare species of particular interest are the Hine's emerald dragonfly and the eastern prairie white-fringed orchid.

The project is funded by the Friends of the Cedarburg Bog through a grant from the Wisconsin Coastal Management Program, and support from the Wisconsin Geological and Natural History Survey, Wisconsin Department of Natural Resources, Ozaukee and Washington Counties, and the University of Wisconsin-Milwaukee.

Long-term Monitoring of the Eastern Prairie White-fringed Orchid, [*Platanthera leucophaea* (Nutt.) Lindl.] at Cedarburg Bog

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P. leucophaea is one of the largest and showiest of the native North American orchids. Loss of wet prairies and fens, where the orchid was once widespread, greatly reduced the orchid's range and led to its listing as a Federal Threatened and a State Endangered Species. This ten-year study began in 2001 when the orchid population at Cedarburg Bog was recognized as one of the largest in Wisconsin.

Populations rely on pollination by several species of sphinx moths for long distance out-crossing. This strategy is most effective where many orchids grow over a large area. Insuring the stability of these highly viable populations is a major objective for recovery of the species throughout its range and for removal of its threatened and endangered status. The Cedarburg Bog population is recognized as one of four highly viable populations in Wisconsin and the only highly viable population in a peatland plant community throughout the species' range. Suitable habitat at Cedarburg Bog is about 40 hectares. The number of flowering plants varies from year to year and has ranged from 3 to 24 plants per hectare during the study period.

The orchid occurs in two distinct habitat types within the string bog. In the 'open' string bog, where the linear hummocks of trees and shrubs are relatively far apart and the canopy is open, the plants are more abundant, compared to in the 'closed' string bog, where linear hummocks of woody plants are closely spaced. Monitoring in both habitats included an annual census of flowering plants, and tracking the demographics of individual plants for life span, flowering history, pollination success and impacts of herbivory. Since 2006 orchid occurrence has been monitored also in

relationship to clones of giant reed grass (*Phragmites australis*), a native but occasionally invasive species at this and other high quality wetlands in the Great Lakes region.

Threats to the orchid population at Cedarburg Bog include the invasive shrub, glossy buckthorn (*Rhamnus frangula*), giant reed grass, and lack of formal legal protection to the State Natural Area. Glossy buckthorn seedlings thrive at the edge of hummocks in full sun, which coincides with typical orchid habitat. Within two years buckthorn seedlings overtop the leaves of young orchids and the increased shade puts the young orchids at a disadvantage. The typical growth form of native giant reed grass in clones with low stem density appears to have little effect on orchid establishment. As stem density increases however, orchid establishment within the giant reed grass clones is reduced. This exclusion reduces the extent of habitat otherwise available for the orchid. This project was funded by WDNR and Conservation Strategies Group.



Condition Effects on Female Mate Choice in an Anuran

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Understanding the mechanisms behind female mate choice is critical in developing a holistic framework from which to assess its impacts on sexual selection. Many mechanisms affecting mate choice variation are currently being explored related to life history traits or prior experience. In a system in which mate choice is costly or requires great investment it could be argued that female condition is the most important. If variation in condition is linked to variation in mate choice, then this can be a source for maintenance in variation in strength and direction of sexual selection and ultimately variation in male traits.

Using Grey treefrogs, *Hyla versicolor*, I designed two experiments to quantify the effects of condition on female mate choice, one using the natural variation in female condition and a second manipulating female condition. The first experiment simply assessed preferences of females in their natural state. For the second experiment, 60 females from experiment 1 were randomly

assigned to food treatments designed to alter their condition and retested to relate manipulated condition to any changes in female choice. The 2009 field season



produced data for 92 females assessing natural variation in condition with mate choice. Experiment 2 gathered data for 11 females assessing preferences relative to manipulated body conditions, in which better body conditions correlated to the high food treatment. The project was continued in 2011. M.S. Thesis research, Dr. Gerlinde Höbel, Major Professor.

Atlas of North American Amphibians

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This is a book project with the University of California Press. The Atlas of North American Amphibians will present detailed distribution maps and brief species descriptions of each of the 298 currently recognized amphibian species in the United States and Canada. The intended audience will be professionals, including researchers, teachers,

land and wildlife managers, natural resource technicians and administrators, nature center staff, zoo staff, wildlife health staff, various federal and state agencies such as forest service, park service, environmental quality and agricultural departmental staff, and amateur naturalists. Project funded by Indiana University School of Medicine.

Determining the Migratory Routes of Tree Swallows Using Geolocators

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In order to more fully understand the ecology of migratory organisms, it is important to know where different populations spend the breeding and wintering seasons. Determining this 'migratory connectivity' for many species is now underway for this purpose. Despite many decades of study on the breeding grounds, the migratory connectivity of Tree Swallows has only been anecdotally addressed. In this study, we are attaching light-logging geolocators to Tree Swallows at their breeding grounds in Saukville, WI, in an effort to understand where this population spends the winter season. This is part of a much larger collaborative effort by many Tree Swallow researchers across North America and Canada. Geolocators were attached at 6 breeding sites across its breeding range in the summer of 2011, and these devices will

be retrieved in 2012. At that point, we will have an unprecedented look at the migration routes of birds across the breeding range, providing an individual-level look at the migratory connectivity of this species.

Understanding the migratory movements and routes of Tree Swallows is an important step in understanding the population dynamics exhibited across the breeding range of this migratory bird. This species is undergoing a steady decline in the north-eastern portion of its breeding range, while apparently expanding in the southwestern portion. Studying events on the breeding grounds only have not explained these phenomena, and only by studying the full annual cycle of these birds is it possible to begin to address such questions. Funded by National Science Foundation grants to C. Taylor and D. Winkler.

Genetic Studies of the Hine's Emerald Dragonfly Population at Cedarburg Bog

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Previous studies have examined the mitochondrial DNA of Hine's Emerald Dragonfly from populations along the Des Plaines River, Illinois, and from wetlands in Door County, Wisconsin. Only one genetic variant was recovered from several individuals sampled from Door County, and the Door County variant was not found in Illinois, despite the fact that this latter population contained a number of other variants. The population of Hine's Emerald at Cedarburg Bog is located between those in Door County and the Des Plaines River valley. Genetic analysis of a single specimen recovered from the Cedarburg Bog area found the same haplotype as seen in Door County, suggesting possible

recent contact between these areas. Four additional samples collected as 'road kill' specimens from the area of the Field Station were analyzed in 2010. Three samples had the same Door County variant. The fourth sample had a genetic variant matching a museum specimen from a site in Ohio where Hine's Emerald is now extirpated. These results support the connection between Cedarburg Bog area and Door County and also indicate an historic connection to populations in Ohio that was likely disrupted by modifications to the landscape. Including additional samples from Cedarburg Bog area is likely to improve our knowledge of genetic diversity and dispersal patterns of Hine's Emerald Dragonfly in this region.

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

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The Neda Mine, an abandoned iron mine located near Iron Ridge in Dodge Co., 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 (*Pipistrellus 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 the number of bats entering and leaving the mine on a 5-minute interval 365 days per year. We have been collecting temperature data since 1996 using

18 battery-powered temperature dataloggers spread within the mine and 2 dataloggers 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. We are currently collecting data on nocturnal aerial insect abundance at the Field Station to determine the relationship between night-time temperatures in spring and insect activity. These data will help us to interpret patterns of bat activity in the spring by providing information on how their aerial insect prey is affected by spring temperatures.

Breeding Bird Survey of the Cedarburg Beech Woods SNA

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As part of an ongoing series of breeding bird surveys started decades ago by Dr. Charles M. Weise, I conducted a survey of the Cedarburg Beech Woods State Natural Area on June 12, 2011. Twenty-two species were recorded, as follows: Wild Turkey 4, Yellow-billed Cuckoo 1, Red-bellied Woodpecker 7, Downy Woodpecker 1, Eastern Wood-Pewee 8, Acadian Flycatcher 6, Great Crested Flycatcher 6, Red-eyed Vireo 23, Blue Jay 3, American Crow 6, Black-capped Chickadee 6, White-breasted Nuthatch 1, Wood Thrush 4, American Robin 2, Ovenbird 9, Cerulean Warbler 1, Eastern Towhee 2, Scarlet Tanager 5, Northern Cardinal 2, Rose-breasted Grosbeak 1, Indigo Bunting 1, American Goldfinch 1.

Noteworthy species found were the threatened Acadian Flycatcher (*Empidonax virescens*), and Cerulean Warbler (*Setophaga cerulea*). These species are

typical of the high-quality southern mesic forest at this site, which is dominated by beech and sugar maple. The Acadian Flycatcher has been found here during most summers, while the Cerulean Warbler is not present every year. During this survey, typical "edge" species such as Northern Cardinal and Indigo Bunting are not commonly found, because the survey is conducted in the core area of the forest, away from "edge" habitat. Other species more frequently observed in interior-forest habitat are usually found here each year, including the Yellow-billed Cuckoo (*Coccyzus americanus*), Red-eyed Vireo (*Vireo olivaceus*), Eastern Wood-Pewee (*Contopus virens*), Great Crested Flycatcher (*Myiarchus crinitus*), Wood Thrush (*Hylocichla mustelina*), Ovenbird (*Seiurus aurocapilla*), and Scarlet Tanager (*Piranga olivacea*).

Mud Lake Bird Migration Point Counts

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Point counts were conducted by canoe and/or kayak on Mud Lake to determine the bird species using the lake and surrounding habitats during spring and fall migration. Mud Lake is 245 acres in size and is the largest lake within the Cedarburg Bog. All bird species seen or heard were counted at six points around the Lake. Birds observed while walking to and from the canoe landing and paddling between points were also counted. Playback for secretive wetland species was utilized three times and the Least bittern was the only species to respond. In 2011, counts were conducted at least once



Pied Billed Grebe

per week in spring (April 9 - June 16) and fall (August 22- October 18). We documented 138 bird species that utilized the lake and surrounding habitats during spring and fall migration.

Although the goal of the counts was to detect species utilizing Mud Lake during migration, we were also able to observe interesting breeding species. Two Ruddy ducks were seen with five ducklings on June 16. This species is an uncommon Wisconsin breeder and has not previously been documented as breeding in Ozaukee County

(Atlas of Breeding Birds of Wisconsin. 2006. Cutright, N. J., B. R. Harriman and R. W. Howe). Other notable sightings included probable Least bittern breeding evidenced by juvenile birds in mid-August and a regular presence of Red-shouldered hawks and Northern harriers suggestive of possible breeding. A flyover of seven Cattle egrets (a rare species in Wisconsin) was observed on June 3.

The counts demonstrated that Mud Lake is an important spring migration staging area for waterfowl, cranes, and rails. The Lake and surrounding habitats provided habitat during migration for a number of bird species of conservation concern. Thirty-six species of birds (26.3% of the total) are listed as being at risk in national, regional or Wisconsin conservation plans. Twenty-six species are listed as being of conservation concern in national or regional (U.S. / North American) Landbird, Shorebird, Waterbird or Waterfowl Conservation Plans. These species included Pied-billed and Horned grebes, American and Least bitterns, Tundra swan, American black duck, Mallard, Northern pintail, Redhead, Lesser scaup, Virginia rail, Sora, Black-bellied plover, Killdeer, Greater and Lesser yellowlegs, Least sandpiper, Dunlin, Wilson's snipe, Willow flycatcher, Wood thrush, Blue-winged, Golden-winged, Bay-breasted and Canada warblers and Rusty blackbird. Twenty-two species are listed as Bird Species of Greatest Conservation Need in Wisconsin. Twelve species are listed as being at risk in both national/regional and state conservation plans.

Brian Marquez and John Hill also assisted with the migration counts in 2011. The Mud Lake migration counts will continue in 2012.

Cedarburg Bog and Upland Woods Bird Migration Point Counts

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Point counts were conducted in the Cedarburg Bog and Upland Beech Woods to determine the bird species using these habitats during spring and fall migration. All bird species seen or heard were counted at six points in the Bog and six points at the edge of and within the Upland Woods. Birds observed while walking between points were also counted. In 2011, counts were conducted at least once per week in spring (April 18 - June 14) and fall (August 23- October 18). We documented 110 bird species that utilized the Bog habitats during spring and fall migration and 76 species that utilized the Upland Woods. A total of 123 species utilized either the Bog or Upland Woods during migration. The importance of these habitats to birds during migration is indicated by the number of bird species of conservation concern that were detected. Twenty-two species of birds (17.9% of the total) are listed as being at risk in either national or Wisconsin conservation plans. Twelve species are listed as being of conservation concern in national (U.S./North American) Landbird, Shorebird or Waterbird Conservation Plans. These species included the Least bittern, Virginia rail, Sora, Solitary sandpiper, Wilson's snipe, American woodcock, Wood thrush, Blue-winged, Bay-breasted and Canada warblers, Henslow's

sparrow and Rusty blackbird. Seventeen species are listed as Bird Species of Greatest Conservation Need in Wisconsin. Seven species are listed as being at risk in both national and state conservation plans. We thank Carl Schwartz, Marilyn Bontly, Peter Overholt and Gail-Epping-Overholt for assisting with the migration counts in 2011.



Wood thrush, a species of conservation concern that utilized the Bog and Upland woods during migration.

Environmental Influences on the Expression of Genetic Variation

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My objective is to test the hypothesis that the expression of genetic variation of individuals is influenced by the social environment to which an individual is exposed both during development and as an adult. To this end, *Enchenopa binotata* treehoppers (Hemiptera: Membracidae; 100 mated females) and suckers from *Viburnum lentago* host plants at the UWMFS were

collected (20 plants, 5 suckers per plant) and brought back to the lab to be propagated. The treehoppers and host plants are being established to address four questions: 1) how phenotypic variation of male signals and female preferences is influenced by the host plant's phenotype, 2) how male signals and female preferences covary across host plant phenotypes, 3) how phenotypic variation

of male signals and female preferences is influenced by the phenotypes of other individuals, and 4) how male signals and female preferences covary across others' phenotypes. The mated females collected are being used to establish full-sib families

for these experiments, and given promising results from the previous years, most likely more females and plants will be collected in subsequent years to continue this research project. Ph.D. Dissertation research, Rafael Rodríguez, Major Professor

White-nose Syndrome Surveillance in Wisconsin

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White-nose syndrome (WNS) is a devastating cave-bat disease caused by the fungal pathogen *Geomyces destructans*. Since its discovery in 2006 in New York, the disease has spread to 16 states and four Canadian provinces and has killed 90 to 100 percent of the bats in the hibernacula it contaminates. The U.S. Fish & Wildlife Service estimates that 5.7 million to 6.7 million bats have already died from the disease. Voracious insect eaters, bats keep mosquitoes and crop and forest pests in check – a service one recent national study estimated at 658 million to \$1.5 billion alone for Wisconsin's agricultural industry.

Monitoring Wisconsin's bat populations is crucial for WNS management for two reasons: establishment of pre-WNS baseline data and early disease detection. Baseline data on population densities, hibernacula locations, movement patterns, and health is necessary for ongoing research on WNS. WDNR field crews have surveyed more than 90% of Wisconsin's 120 potential hibernacula, recording information on species, estimated number of bats present,

temperature, and general site conditions. This information helps determine where *Geomyces destructans* could survive or spread, prioritize future monitoring, and identify potential hibernacula for a recovering bat population. Early WNS detection gives managers and researchers the earliest opportunity to develop and experiment with control methods focused on stopping or slowing the spread of the disease. During the Department of Natural Resources 2011 WNS surveillance season, the bat field crew investigated 120 underground hibernacula throughout the state. All known sites were checked. The largest three hibernacula in the state include Maiden Rock Mine, Neda Mine State Natural Area, and Bay City Mine. These three locations have approximately the same number of bats and hold the largest proportion of Wisconsin's bat population. No signs of the disease causing fungus or the disease itself were found during the 2011 surveillance season. Funding support from US Fish & Wildlife Service, Wisconsin Department of Natural Resources, and private donations.

Landscape Genetics of Wisconsin Marsh Turtles

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Freshwater turtles are highly sensitive to environmental change, and populations of many turtle species are currently declining due to continuing wetland loss and increasing human encroachment on remaining

habitat. I am currently obtaining genetic samples from three co-occurring marsh turtle species (the endangered Blanding's Turtle, *Emydoidea blandingii*, as well as the relatively common Snapping Turtle,

Chelydra serpentina, and the Painted Turtle, *Chrysemys picta*) from across the state in order to gauge the effect of landscape factors on gene flow and population structure in each species as well as on the assemblage as a whole. The UWM Field Station (Cedarburg Bog) was originally chosen as a possible field site, although collection was ultimately performed at a nearby site in Washington County due to the presence of a more robust Blanding's Turtle population at this alternate site. Over the course of the field season, samples were collected from approximately 150 Blanding's Turtles, 125

Snapping Turtles, and 500 Painted Turtles. Preliminary analysis indicates the presence of at least 3 genetically distinct Blanding's Turtle populations in Wisconsin, although sampling is still inadequate for the eastern half of the state. Further work will assist in the management of genetic diversity as well as identify landscape and species-specific factors that promote or hinder gene flow in these species. PhD Candidate, M. Zachariah Peery, Major Professor.

Comparison of the Distributions of Pre-settlement and Present Day Tamarack Swamp in Southeastern Wisconsin

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Larix laricina (Du Roi) K. Koch is an important species for wildlife and for its influence in providing diversity and structure in swamp forest communities of Southeastern Wisconsin and, with a Coefficient of Conservatism of 8, its presence is an indicator of some of the highest quality wetlands in the region. This study aimed to: 1) describe the past and current distribution of tamarack in the portion of the Southeast Glacial Plains Ecological Landscape (SGP) in Wisconsin that had tamarack (SGP-T), 2) to quantify the amount of tamarack still living today, and 3) to investigate the importance of soil type in the persistence of tamarack in the landscape. We used pre-settlement original vegetation data from the General Land Office (GLO) Public Land Surveys (1830s-1860s), Robert Finley's map of the Original Vegetation of Wisconsin, current Natural Resources Conservation Service maps of hydric soils, and the current Wisconsin Wetland Inventory to conduct our analyses.

Overall there has been an estimated loss of 106,329 hectares of tamarack swamp, or 85% of the area of tamarack swamp that was found in the pre-settlement SGP-T

landscape; only 19,400 ha of tamarack swamp remain. Pre-settlement tamarack was much more common on organic soils (present on 91% of area) than on mineral soils (26%). While we estimate that 38% of the wetland has been lost from the SGP-T, there has been a disproportionate loss of mineral soil wetland area (62%) compared to organic soil wetlands (17%). In addition, tamarack has been disproportionately lost from the mineral soil wetlands that remain, so that only 4.5% of the original mineral-soil tamarack swamp persists today, compared to 17% of the original organic-soil tamarack. Using the area and proportion of hydric soils as boundaries for pre-settlement wetlands in combination with the General Land Office (GLO) original vegetation data provides a new method for describing the pre-settlement wetlands of southeastern Wisconsin. The results that show the disproportionate loss of tamaracks on mineral soils provide restoration opportunities on the margin of wetlands where mineral soils are more common. MS Thesis research, James Reinartz, Major Professor. This project was funded by a grant from the State Wildlife Grant Program.

Past and Present Land Use and Wetland Characteristics as Predictors of the Persistence of Tamarack Swamps in Southeastern Wisconsin

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Tamarack is now present in less than 15.4% of the wetland area it dominated prior to Euro-American settlement. The objective of this study was to determine the important factors, both intrinsic and extrinsic, that contribute to the persistence of tamarack swamps from pre-settlement times with the intent to use these findings to help conserve tamarack swamps in southeastern Wisconsin. We conducted a landscape-scale analysis of intrinsic wetland characteristics, including area, shape index and percent of organic soils, and of extrinsic factors, specifically the relative amount of eight land use categories surrounding wetlands in the Southeastern Wisconsin Regional Planning Commission (SEWRPC) seven county region. Pre-settlement data from the General Land Office Public Land Surveys (1830s-1860s), current Natural Resources Conservation Service maps of hydric soils, current Wisconsin Wetland Inventory and land use from SEWRPC (1963 and 2000) were used to conduct this analysis. Pre-settlement Original Tamarack Swamps (OTS) where tamarack persists today had 17% more organic soil area, were

almost twice as large, and had 20% more shape complexity compared to those OTS from which tamarack has been extirpated. Furthermore, OTS that had lost tamarack had, on average, more current land use in development and transportation, and less woodland area in 800 m wide buffer areas surrounding each polygon. Surprisingly, OTS where tamarack persists had a higher percentage of agricultural land use in their surrounding buffer. A logistic regression model using both wetland characteristics and surrounding land use correctly predicted tamarack persistence in 70% of wetlands, and tamarack loss in 77% of the OTS, without any information on direct historical disturbances inside the boundaries of the wetland itself. The four main factors that contribute to tamarack persistence-shape index, percent organic soils, percent woodlands and percent agriculture can be used to prioritize conservation and restoration strategies in the SEWRPC region. MS Thesis research, James Reinartz, Major Professor. This project was funded by a grant from the State Wildlife Grant Program.

Evaluation of Five Site Preparation Treatments for Germination and Establishment of Tamarack Seedlings

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Despite the conservation importance of tamarack, successful approaches for tamarack restoration are lacking for this species at the edge of its range in southeastern Wisconsin. To develop practical methods for tamarack regeneration, we conducted field experiments to compare various site preparation techniques for direct seeding and planting of bare-root tamarack seedlings in the Cedarburg Bog Wisconsin

State Natural Area in Ozaukee County, Wisconsin. For the direct seeding experiment, six seedbed preparation treatments were applied before seeding of tamarack in three different locations with varying hydrology and vegetation. Planting of bare-root seedlings was conducted in seven locations comparing cleared and closed canopy treatments. Complete removal of woody vegetation overstory (shading) was

required for successful establishment of tamarack either from seed or with bare-root seedlings. Good stocking rates of seedlings were achieved with most treatments after removal of the shading tree and shrub canopy and sowing seeds at a rate of 300 seeds/m². Four treatments that further reduced competition with burning, herbicide, or raking (soil disturbance) additionally increased establishment success. Planted 2-3 year-old, bare-root tamarack seedlings

also required a cleared, un-shaded, habitat for high survival; and were found to have a high survival rate (> 60 %) in a wider range of hydrologic conditions than seedlings produced by direct seeding methods. These methods provide a variety of restoration strategies using both direct seeding and direct planting. MS Thesis research, James Reinartz, Major Professor. This project was funded by a grant from the State Wildlife Grant Program.

Ecology & Evolution of Vibrational Communication, Sexual Behavior, and Cognition of Insects and Spiders

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To assess the evolutionary significance of the patterns of genetic variation that exist in natural populations, we collected *Enchenopa binotata* treehoppers (Hemiptera: Membracidae; 200 mated females) as well as 5 suckers from 20 exemplars of their host plant, *Viburnum lentago*.

We also collected other treehopper species (*Publilia* spp.; ca. 50 individuals.) and

species of spiders (*Frontinella communis*, 20 females; *Argiope argentata*, 10 females) for observations of their behavior. These preliminary observations will set up future experiments on cognitive ecology and eavesdropping of vibrational signals by web spiders.

Use of Small-scale Disturbances to Restore Native Plant Communities in an Abandoned Agricultural Field

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Small-scale disturbances in plant communities create open patches that may allow new species to invade or suppressed species to become more abundant. We evaluated whether small-scale disturbances in an abandoned agricultural field dominated by exotic grasses could be used to increase abundance and diversity of native plants. Coverboards made of plywood (2 X 122 X 81cm) were laid out on a 15 meter by 15 meter grid in the South Hayfield at the Field Station in 2008 for a study on the Butler's garter snake. The boards were kept in place until March 2010, creating many small-scale disturbances. We utilized these disturbance plots to ask the following questions: 1) how does disturbance alone alter the plant

community, 2) can seeding experimental disturbances with native species increase the abundance and diversity of native plants, and 3) is it better to seed with native forbs, native grasses, or a mixture of forbs and grasses to establish native species. We used multiple species of both forbs and grasses in the seed mixes in order to determine which species were most likely to successfully establish. The plots were seeded in July 2010, and vegetation was sampled August - September 2011. Percent cover of all plant species was estimated for each disturbance plot, plus a nearby, undisturbed plot that measured the background vegetation of the field. Results to date show that the disturbance treatment dramatically

increased the amount of bare ground and reduced thatch (dead plant material); these changes led to increased species richness, with seeded plots gaining more species than

those that were not seeded. Data analysis is continuing. Undergraduate independent study project, Gretchen Meyer, advisor.



Intercomparing Multiple Measures of the Onset of Spring in Eastern North America

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Measuring the onset and progress of vegetative growth during the spring season in temperate climates can be accomplished using multiple ground and satellite-based techniques. While all these measurements are valid (i.e., record a real characteristic related to plant development), they typically are poorly inter-correlated due to incompatible levels of spatial representation and differing methodologies. Given recent and likely future impacts of climate change on spring plant growth, the need to reconstruct past patterns, and the lack of standardized vegetation growth measurements around the world, more work is needed to determine the relationship between the various measures,

and the degree to which they may serve as substitutes for each other.

We use measurements at two phenology “super-sites” in eastern North America (one is the UW-Milwaukee Field Station) and several other supporting sites to evaluate the relationships among multiple spring vegetative growth measures, and explore strategies to standardize their inter-correlation. The results show that correlations among satellite-derived start of season (SOS) measures are generally high, and correlations among ground phenology measures are also high, but when ground phenology and satellite SOS are compared,

there are few strong correlations, even at sites with extensive native species phenology available. Modeled phenology, based on daily temperature data (Spring Indices first bloom date) does as well as any of the direct native species measures, and is better suited to facilitate inter-comparisons. In order to effectively compare ground-based

and satellite-derived SOS measures, it is clear that employing limited numbers of individual plants will be less effective. Given that satellite-derived measures are areal and at a scale of 250 m and larger, we suggest collecting ground phenology data at the same areal scale to make effective comparisons.

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

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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 both in autumn (starting in 2007) and in spring (starting in 2008). 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.

An Urban Cooper's Hawk Nesting Study in the Metropolitan Milwaukee Area

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The objectives of this study are to gather baseline data on the reproductive success of Cooper's Hawks (*Accipiter cooperii*) in the urban metropolitan Milwaukee area, to describe urban nesting habitat, and to compare these data with other Cooper's Hawk studies in Wisconsin. Long-term objectives are to determine Cooper's Hawk nest site fidelity, breeding population mortality and recruitment, population growth trends, immigration and emigration patterns, and natal dispersal patterns for the same urban population. In 2011, 23 of 29 nesting attempts were successful (79.3% nesting success). For 28 of these nests, 22 laying pairs produced 78 young to a bandable age (ca. 16 days; 2.79 young/laying pair, 3.55 young/successful pair). Seventy-eight nestlings (38 males, 40 females) were banded. One nest was successful and produced at least three

young (but productivity was not determined). No second nesting attempts (i.e., re-nests) were found (i.e., for first nesting attempts that failed). Twenty-five adult (i.e., breeding) Cooper's Hawks (12 males, 13 females) were trapped, banded, measured, colormarked, and processed for additional analyses at 17 different nest sites. The nest at Downer Woods (UW-Milwaukee) failed in 2011; however, both adults were visually identified as the same adults that nested successfully in 2010 (based on alphanumerically coded colored leg bands). The adult male was a four-year old bird (age: 5Y, in its fifth year of life), and the adult female was at least eight years old (age: A8Y). This project was supported, in part, through the Wisconsin Society for Ornithology (WSO) Small Grants Program.

Citizen-based Herptile Monitoring Program in Historic Riverside Park, Milwaukee

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We established a long-term citizen-based monitoring program for amphibians and reptiles in Riverside Park, Milwaukee. The program includes annual snake mark/recapture surveys using plywood cover boards, and tracking individuals of the state-threatened Butler's gartersnake (*Thamnophis butleri*) to determine life history parameters and population trends. Northern brown snakes and common gartersnakes have also been recorded. We also conduct

annual turtle visual basking surveys and mark/recapture surveys using traps. To date northern map turtle, painted turtle, common snapping turtle and spiny softshell turtles have been recorded. Calling frog surveys are also run. Funded by: Citizen-based Monitoring Partnership Program, Prairie Biotic Research Program, Milwaukee County Zoo, and E.P.A. Great Lakes Restoration Initiative, to Urban Ecology Center.

The Impact of Interpopulation Crossing Distance on Offspring Fitness in *Impatiens capensis* Meerb. (Balsaminaceae)

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Restoration, reintroduction, and hybridization rescue are important tools for the conservation of wild populations. There remains a great deal of uncertainty regarding the selection of appropriate source material for the conservation and restoration of plant populations. Of special concern are possibly detrimental genetic impacts that crossing between distinct populations may have on often small remnant populations. The potential for hybrid vigor and outbreeding depression limit our ability to apply many of these important conservation tools. Despite these concerns, little research has been conducted using wild populations to explore the relationship between interpopulation crossing distance and the level of hybrid vigor and/or outbreeding depression expressed in the offspring. In this experiment, thirteen wild populations of the common annual plant *Impatiens capensis* Meerb. (Orange jewelweed) are used to examine the effect of interpopulation distance on two generations of offspring fitness. The research design includes the

production of first and second-generation offspring by randomized crossing between each of three local populations and two replicate populations from distances of 50, 100, 200, 400 and 800 kilometers. Fitness impacts were assessed by comparing the fitness of individuals produced by crossing within each parental population (P) with the fitness of first generation (F1) and second generation (F2) offspring produced by crossing between populations separated by increasing distances. Fitness measures included lifetime seed production and final dry weight. Fitness trials were conducted at the UWM Field Station by growing experimental cross-types in one of the three original local parental environments and in a more benign shade lattice environment. Fitness trials showed a positive correlation between F1 heterosis and interpopulation crossing distance with 400km F1 and 800km F1 producing significantly more seed than the expected mid-parental (MP) value. Due to F2 breakdown, only the 800km F2 continued to produce significantly more seed than the

MP. These results support current theories in conservation genetics used to guide biologists involved in habitat restoration, population reintroduction, and hybridization

rescue efforts. PhD Dissertation research, James Reinartz, Major Professor.

Extra-pair Mating in Tree Swallows

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In 2011 we completed the 14th year of study of the reproductive ecology of tree swallows at the UWM Field Station. Our work has primarily focused on extra-pair mating and the effects of food and temperature on reproductive performance. In this socially monogamous species females engage in mating with males on other territories (extra-pair mating), which results in many young that are not sired by the social mate (extra-pair young). Almost 90% of female

swallows engage in extra-pair mating in our study population (based on genetic analyses of paternity) and unlike most other species, each female may have several different extra-pair sires in her brood. Our recent work suggests that this multiple mating may benefit females by increasing the proportion of eggs that hatch (Whittingham and Dunn 2010). This research was supported by funds from the College of Letters and Science, UWM.

Changes in Tree Species Composition in Downer Woods from 1999-2011

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Downer Woods on the UWM campus is a small remnant forest that was once part of the larger Wisconsin and midwestern deciduous forest. To monitor change in the species composition of the woods over time, a tree survey was conducted in 2011 using methods identical to those of a baseline survey that was carried out in 1999. Trees were sampled in 100 m² circular quadrats centered on 56 marked sample points. Within each quadrat trees greater than 1 cm in dbh were identified to species and number, diameter at breast height (dbh), and whether the tree was dead or alive was recorded. White and green ash were combined for analysis because of difficulties in species identification. Basal area was calculated from dbh. The study revealed that large changes have occurred in the tree composition of the woods over the last 12 years. In 1999, white/green ash had the

most basal area in the woods and basswood was second, followed by white oak, red oak, hawthorne, and box elder. By 2011, both basswood and box elder showed large increases in basal area (35% and 29%, respectively), while basal area of both white/green ash and hawthorne had declined (by 7% and 81% respectively). In 2011, basswood had the largest basal area in the woods, followed by white/green ash, white oak, red oak, and box elder. Hawthorne represented only a minor component of the woods in 2011. Ash yellows has been documented in Downer Woods and may account for at least some of the decline in ash. The emerald ash borer, an introduced insect that attacks and kills ash trees, has not yet been definitively recorded from Downer Woods but has been found in Milwaukee Co. and is likely to cause more ash mortality in the future. The hawthornes in Downer Woods

likely became established when the site was more open. Parts of Downer Woods had been used as pasture before its donation to the university, and hawthorne is known to establish on former grazing lands. The

hawthornes are likely declining in Downer Woods because of their age and increasing shade in the woods. Undergraduate independent study project, Gretchen Meyer, advisor.

A General Survey of Wisconsin's Beetle Diversity (Insecta: Coleoptera)

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During the 14 week period of 25 July to 27 October 2011, a single Malaise trap was run at the Field Station, with samples collected weekly. The trap was located just inside the old growth beech-maple forest west-southwest of the Station at 43.38567°N/-88.02638°W (WGS84). Of 103 beetle families known or presumed to inhabit Wisconsin (Young unpublished), these preliminary results establish the presence of 45 families from the single Malaise trap, as

well as six additional families from miscellaneous collecting I conducted at the Station 1983-1985. Samples included representatives of all three beetle suborders expected to occur in Wisconsin. New County Records were confirmed for 17 species from six beetle families. One New State Record was discovered for a species of the scarabaeoid family, Geotrupidae. All these new records will be reported in an upcoming volume of the Field Station Bulletin.



Recent Publications and Theses

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Recent Theses

Abroe, Betsy. 2005. Do more attractive males have more sons in the common yellowthroat *Geothlypis trichas*. M.S. thesis.

Holmquist, Karsten G. A. 2005. The effect of floral display and pollinator behavior on pollen-mediated gene dispersal in *Mimulus ringens*. Ph.D dissertation.

Hovick, Stephen M. 2005. Restoring forest in wetlands dominated by reed canary grass: the effects of pre-planting treatments on early survival. M.S. thesis.

O'Brien, Heather L. 2005. Assessment of white-tailed deer (*Odocoileus virginianus* Zimmerman) density and browse damage at University of Wisconsin-Milwaukee Field Station. M.S. thesis.

Redell, David N. 2005. Behavioral ecology of bats using the Neda Mine hibernaculum. M.S. thesis.

Garvin, Julia C. 2006. Male ornaments, extra-pair mating, and immunocompetence in the common yellowthroat. Ph.D dissertation.

Bott, Terry. 2007. Morphological diversity of the northern pitcher plant (*Sarracenia purpurea* L.) in two contrasting wetlands. M.S. thesis.

Hapner, Jill A. 2007. Factors influencing plant community development and wildlife use in small conservation wetlands in southeastern Wisconsin. Ph.D dissertation.

Kapfer, Josh. 2007. The ecology of bullsnakes (*Pituophis catenifer sayi*) in upper midwestern prairies. Ph.D dissertation.

Maurer, Joan K. 2007. Detection of avian blood parasites in the common yellowthroat (*Geothlypis trichas*): A comparison of multiple methods. M.S. thesis.

Mitchell, Dan. 2007. Attractive males provide less parental care in two populations of the common yellowthroat. M.S. thesis.

Vasquez, Eric C. 2008. The effects of enemy exclusion and enemy damage on exotic and native plant species: a test of the enemy release hypothesis. M.S. Thesis

Flanagan, Rebecca J. 2009. Exploring the effects of competitors for pollination on the reproductive success of *Mimulus ringens*. Ph.D. dissertation.

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*). MS.Thesis

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



Dr. James Reinartz received the Wisconsin Wetland Association award for Wetland Enjoyment

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 aids in development of stewardship plans and natural area management.

5. Invasive Plants Association of Wisconsin. This non-profit organization works to stop the spread of invasive plants in Wisconsin. Reinartz serves on the Board of Directors and is editor of the IPAW newsletter, "Plants out of Place".

6. Riveredge Nature Center. Gretchen Meyer and Jim Reinartz both serve on the Riveredge Research and Stewardship Committee. Reinartz also cooperates

with Riveredge to organize and direct the Riveredge Speaks Out monthly lecture series.

7. 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.

8. National Oceanic and Atmospheric Administration - Milwaukee office. Weather records are provided monthly and frost depth data are collected in winter.

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

10. City of Mequon – Mequon Nature Preserve. Jim Reinartz serves on the MNP science and stewardship planning committee.

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

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

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

14. Wisconsin Task Force on Invasive Species. Reinartz serves on the task force and on the Science and Research Subcommittee of the task force.

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

Station cooperated with SEWISC to develop and conduct invasive plant management workshops for parks personnel and for right-of-way workers.

16. Wisconsin Phenological Society. Meyer serves on the Board of Directors.

17. Phenology 2012 Conference. The second interdisciplinary international conference on phenology will be held in Milwaukee in 2012. Meyer is serving on the organizing committee

2011 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. Ten workshop topics were offered in 2011. Most of these workshops were filled to the capacity of 20 people.

Workshop	Instructor	Date
Ecology and Physiology of Plants in Winter: Surviving the Big Chill	James Reinartz	January 7 & 8
Writing About the Natural World	Mary Linton	April 22 & 23
Introduction to Bryophytes	Virginia Freire	May 24 & 25
Wildlife Inventory and Monitoring	Gary Casper	June 3 & 4
Vegetation of Wisconsin	James Reinartz and Marc White	June 13 - 18
Aquatic Invertebrates	Gretchen Meyer and Robert Clare	June 24 & 25
Ecological Geology	Roger Kuhns	July 11 - 15
Grasses: Identification and Ecology	Robert Freckmann	July 29 & 30
Aquatic Vascular Plants: Identification and Ecology	Tim Gerber	August 6 & 7
Composites: Taxonomy and Evolution	Alison Mahoney	August 12 & 13

Class and Group Use

Winter - Spring 2011

Number of Student Hours

Ecology and Physiology of Plants in Winter Workshop	360
Creative Writing Workshop	360
Bryophyte Workshop	360
Winter Ecology Hike and Friends Chili Dinner	540
Friends of Cedarburg Bog – Owl-prowl hike	60
Friends of Cedarburg Bog – Spring frogs and woodcock	80
Friends of Cedarburg Bog – The Bog in Spring	60
Friends of Cedarburg Bog – Ecology of the Bog	70
Friends of Cedarburg Bog – Meetings	90
Riveredge Nature Center Master Naturalists Bog Tour	70
Riveredge Nature Center Master Naturalists Training	70
Riveredge Nature Center – Birding tour	80
Schlitz Audubon Center – Fifth grade class	50
Girl Scouts – Nature study	40
Wisconsin Phenology Club	50
Lac Lawrann – Bog Tour	40
Natural Resources Foundation – History of the Bog	80
Southeastern Wisconsin Invasive Species Consortium	60
Wisconsin Wetlands Association – Frogs of the Bog	70
Milwaukee Area Technical College – Natural Landscaping	50
Marion College – Biology Club field trip	240
Carroll University – Aquatic Ecology	60
UWM – Plant Systematics	70
TOTAL	3,010

Summer 2011

Wildlife Inventory Methods Workshop	360
Aquatic Invertebrates Workshop	360
Vegetation of Wisconsin Workshop	1,240
Ecological Geology Workshop	900
Grass Identification Workshop	380
Aquatic Plants Workshop	360
Composites Workshop	360
Friends of Cedarburg Bog – Late Migrant Bird Walk	50
Friends of Cedarburg Bog – Plants on the frontier	60
Friends of Cedarburg Bog – Summer Solstice Walk	70
Friends of Cedarburg Bog – Breeding Birds	80
Friends of Cedarburg Bog – meetings	70
Riveredge Nature Center – Explorers Summer Camp	80
Riveredge Nature Center – Teacher Naturalist class	60
Wisconsin DNR – Hine's Emerald Dragonfly survey	30
Southeastern Wisconsin Invasive Species Consortium	60
UW – Oshkosh – Ecology Field Trip	300
UW-Madison – Plant Ecology	180
UWM – 21st Century Study Retreat	60
TOTAL	5,060

Fall 2011

Number of Student Hours

Friends of Cedarburg Bog – Annual Meeting & potluck	160
Friends of Cedarburg Bog – Northern Cross stargazing event	140
Friends of Cedarburg Bog – Mushroom hike	80
Friends of Cedarburg Bog – Owl Prowl	70
Friends of Cedarburg Bog – Fall Bog tour	80
Friends of Cedarburg Bog – meetings	80
Biological Sciences/Field Station Picnic	130
Kettle Moraine Lutheran High School	60
Greendale High School – Ecology	60
Riveredge Nature Center – Teacher training	70
Riveredge Nature Center – Christmas Bird Count	60
Alverno College – Wetland Ecology	50
University of Illinois-Chicago– Ecology field trip	630
Marion College – Ecology Club field trip	220
UW – Platteville – Geology	240
UW – Whitewater – Ecology class	60
UWM – Conservation and Environmental Science	400
UWM – Geography – Soils	180
UWM – Geology – Hydrogeology	120
TOTAL	2,890

TOTAL 2011 Class & Group Use Hours 10,960



Meteorological Data for 2011

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/m²)

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

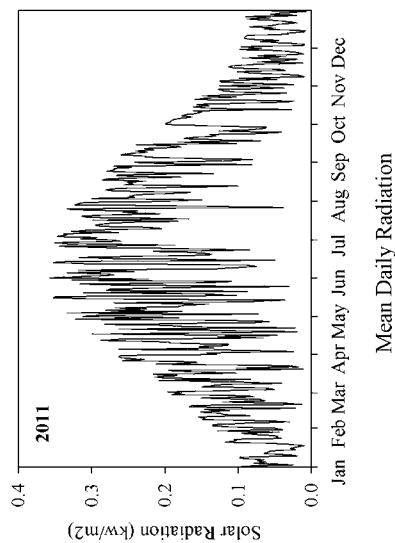
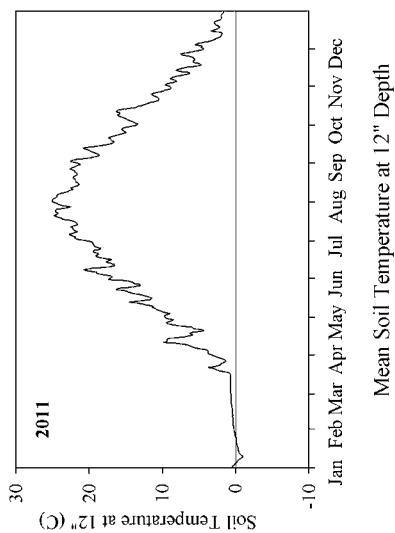
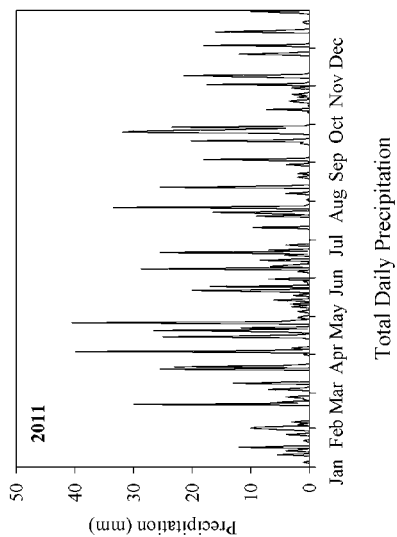
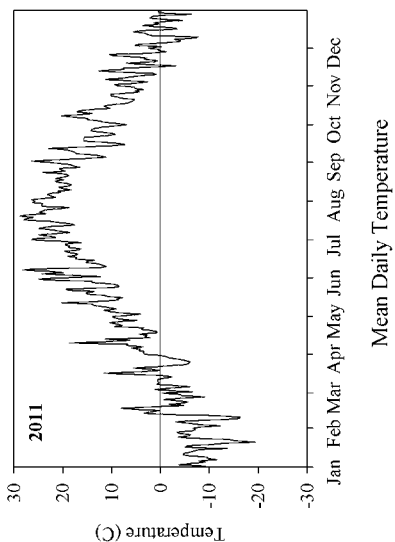
Mean Speed (m/s): Monthly mean of all 30-min means

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 2011

Temperature (C°)	Average Daily Maximum	-4.6	-0.9	3.7	10.4	16.9	23.0	28.8	26.3	19.7	16.4	8.7	3.3
	Average Daily Minimum	-11.9	-8.8	-5.3	1.7	7.5	12.5	17.5	15.0	9.3	4.7	0.8	-4.0
	Daily Average	-8.1	-4.7	-0.7	6.0	12.4	17.8	23.4	20.7	14.7	10.3	4.8	-0.1
	Highest (Date)	7.0 (1)	11.2 (17)	15.9 (17)	27.6 (10)	31.6 (30)	34.9 (7)	34.9 (20)	30.6 (24)	30.3 (2)	27.5 (8)	17.0 (13)	11.1 (15)
	Lowest (Date)	-23.2 (20)	-23.4 (10)	-13.2 (3)	-1.8 (2)	0.4 (4)	7.3 (13)	11.1 (8)	8.5 (29)	1.4 (16)	-3.7 (30)	-5.5 (30)	-13.2 (10)
Degree Days	Sum at 5°	0.0	3.3	8.4	60.0	230.2	383.5	571.2	487.1	290.5	167.8	49.4	0.8
	Sum at 10°	0.0	0.0	1.5	12.1	95.0	233.5	416.2	332.1	146.5	64.2	4.3	0.0
Radiation (kW/m²)	Mean	0.06	0.11	0.15	0.15	0.21	0.23	0.27	0.23	0.16	0.13	0.06	0.05
	Maximum	0.54	0.69	0.91	0.96	0.98	0.99	0.99	0.95	0.83	0.70	0.51	0.44
Relative Humidity (%)	Hour 00-06 mean	84.2	83.0	86.4	84.4	83.6	89.0	90.5	93.6	92.7	87.8	80.0	82.6
	Hour 06-12 mean	78.9	74.9	75.3	75.9	69.4	73.5	70.2	70.9	76.8	70.4	74.9	79.3
	Hour 12-18 mean	71.4	66.8	66.8	66.2	61.8	64.7	58.6	59.6	64.8	57.4	67.5	68.8
	Hour 18-24 mean	81.6	80.0	82.1	78.8	75.2	82.0	81.4	88.8	90.5	81.8	77.7	79.1
	Number of Days	8	10	6	17	15	12	9	10	10	14	11	7
Precip. 0.25mm or more	Max Temp 32° and above	0	0	0	0	0	2	4	0	0	0	0	0
	Max Temp 0° and below	30	19	6	0	0	0	0	0	0	0	1	8
	Min Temp 0° and below	31	26	28	9	0	0	0	0	0	6	14	25
	Min Temp -18° and below	3	4	0	0	0	0	0	0	0	0	0	0
	Pressure (mbars)	Mean	1015.89	1015.36	1019.54	1010.20	1013.51	1013.26	1014.90	1013.59	1016.16	1015.49	1014.64
Precipitation (mm)	Total	34.0	67.5	74.5	177.4	74.5	90.9	75.7	45.0	153.6	22.4	69.0	55.5
	Greatest (24 hrs) (Date)	12.0 (17)	30.0 (20)	25.5 (20)	40.5 (26)	20.0 (22)	28.8 (8)	33.5 (27)	25.5 (12)	31.9 (25)	7.4 (13)	21.5 (9)	18.0 (3)
Wind	Mean Speed (m/s)	1.7	2.0	1.8	2.3	2.1	1.5	1.1	1.1	1.4	1.7	2.0	1.8
	Maximum Speed (m/s)	5.3	6.6	6.1	7.1	6.6	4.8	4.6	4.0	6.5	6.1	6.1	5.9





Field Station

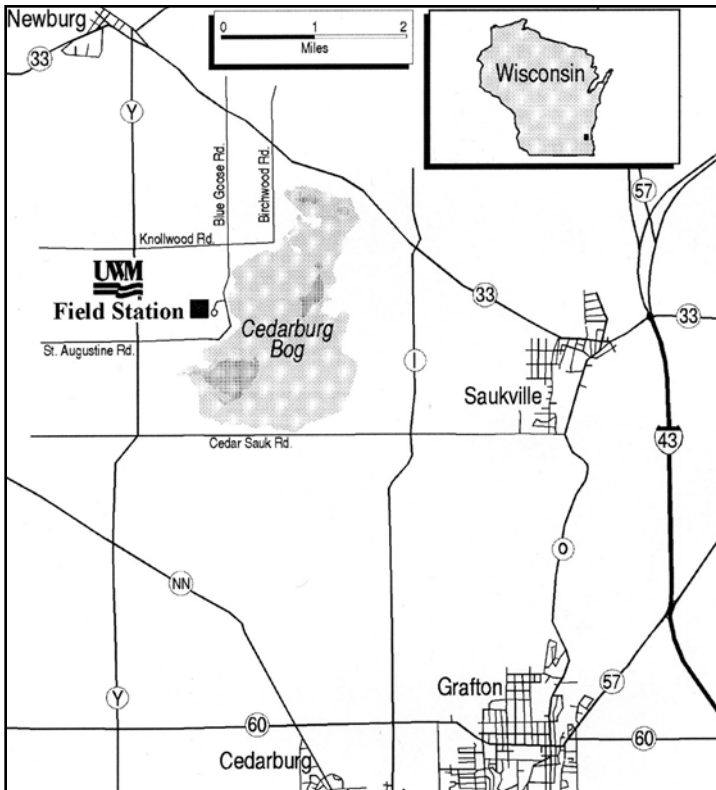
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