Field Notes

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Amphibian populations are declining throughout the United States and worldwide from habitat loss, emergent diseases, and chemical contaminants in the environment. Habitat loss is an especially profound problem in Iowa, where 90% of wetlands have been lost since tile drainage was first brought to the state in the early 1900s. As habitat areas are converted for agricultural use and urban development, increasing amounts of chemicals are making their way into remaining habitat, including excess nutrients from fertilizers or animal waste, agricultural chemicals, and even petrochemicals from spilled gasoline. An estimated one to two percent of agricultural chemicals applied to a field eventually make their way into waterways.

Chemical contaminants and emergent diseases pose an even greater threat to amphibian populations already impacted by habitat loss. Exposure to atrazine (a common herbicide) or acidic waters can suppress immune systems and leave amphibians more vulnerable to diseases like chytrid (chytridiomycosis) which is a fungal disease that has already caused significant population declines or extinctions in more than 200 species of frogs worldwide. Tiger salamanders (*Ambystoma tigrinum*) and cricket frogs (*Acris crepitans*) are known to be declining in Iowa, likely as a result of these factors.

Programs are in place to help conserve amphibian habitat. The Conservation Reserve Enhancement Program (CREP) restores wetlands to intercept tile drainage runoff from agricultural fields to improve water quality, provide habitat, and help connect existing habitats. However, wetlands must be designed and maintained to support healthy amphibian populations or they may function as ecological traps which attract healthy frogs that subsequently die of disease, starvation, or predation. My study examines

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amphibian populations in five recently restored CREP wetlands fed mostly through subsurface tile flow, and five ‘reference’ wetlands that were restored from agricultural use prior to 2000 and receive mostly surface flow. I compared the presence of the amphibian chytrid fungus (*Batrachochytrium dendrobatidis*), contaminants in soil, water and frog samples, and the species richness, or number of different species found at each site.

I filtered water from several points within each of three CREP and three reference wetlands in 2012 and 2013 to check for the amphibian chytrid fungus. I recorded which frog species were calling within each of eight wetlands by setting up an automated frog call recorder. Tiger salamanders are silent, thus my call recorders did not allow me to detect tiger salamanders at my sites. I collected water contaminant samples three times and sediment samples once during the spring and summer of 2012. Five adult chorus frogs (*Pseudacris triseriata*) were collected in May from one CREP and one reference site, while five leopard frogs were collected in June from one CREP and two reference sites. Samples were tested for more than 100 chemical contaminants including 27 insecticides, 23 herbicides, 36 fungicides, and 14 degradation products.

In 2012, we heard an average of six species of frogs calling at CREP wetlands and 4.75 species calling at reference sites (Figure 1). In 2013, CREP sites averaged five species, while reference sites maintained an average of 4.75 species. Overall, CREP wetlands tend to have lost bullfrogs (*Rana catesbeiana*), while the composition of species at reference sites remained stable. Bullfrogs are not native to central Iowa, but have become widespread. They are voracious predators and will eagerly prey upon smaller frogs—if it fits in their mouth, they will probably try to eat it. During the drought of 2012, many wetlands in central Iowa dried up, which likely reduced bullfrog populations, as bullfrog tadpoles generally spend at least a year in the wetland before metamorphosing. Adult bullfrogs may also have moved to more permanent sites to breed, leaving bullfrog-less sites more attractive to other amphibians.

Overall, 15 contaminants were detected in water samples, 11 in sediment samples, and 12 in each of the frog tissue samples. Contrary to our expectations, CREP wetlands did not always have more contaminants than reference wetlands, even though they receive more tile drainage from agricultural fields. More chemicals were found in water and chorus frog liver samples from CREP sites than reference sites, but the opposite trend was true for sediment and leopard frog liver samples. Atrazine, a common herbicide, was found in every water sample from every wetland tested. The highest concentration, 19 ppb, was found in a reference wetland, and is not far from levels known to cause immune suppression in amphibians. This is alarming because the amphibian

![Rebecca patches up a leopard frog after implanting a microchip ID tag. (photo J. Oberheim-Vorwald)](image)

*Figure 1.* 2012 and 2013 breeding frog species richness at Conservation Reserve Enhancement wetlands (CREP) and reference wetlands (REF). Bullfrog presence at sites denoted by *.

continued...
Chytrid fungus was found in water samples from every wetland tested, and immune suppression from contaminants could lead to a higher prevalence of disease in the region. A breakdown product of DDT, a widely used pesticide that was largely banned because of its harmful effects to wildlife, was found in liver samples from both frog species, indicating that it is still present in the environment.

Contaminants also indirectly affect amphibians by changing food-web structure. Herbicides eliminate the algae that tadpoles eat, while insecticides reduce zooplankton and other invertebrate populations. Stress from contaminants reduces tadpole growth rates, thereby increasing the amount of time that it takes them to metamorphose. Increased time in the wetland increases tadpole exposure to predation and aquatic contaminants, and increases the risk that the wetland will dry before they can escape.

Overall, both CREP and reference wetlands expose amphibians to bullfrog predation and contaminants. Contaminant samples collected in 2013 are still being processed, but may paint a clearer picture of ways in which restored wetlands can be better habitat for amphibians.
There is nothing like the dawning sky's reflection onto a lake's still water or the silent, breathless gaze of a great grey owl (Strix nebulosa) in the wilderness of the Boundary Waters Canoe Area (BWCA) to remind myself a) yes, I did choose the right career path, and b) wow! I am one lucky lady.

My last summer field season as a forestry master's student at Iowa State University (ISU) was triumphant, yet bittersweet. I am continuously amazed at how much I have learned in my short time here. Of course, the more I learn, the more I realize there is to learn about this complex world.

I came to ISU in May 2012 from my home in the San Francisco Bay Area. Like most new graduate students, I was extremely scared, completely unsure of why I was chosen as a student, and in constant awe of the super smart people around me.

I was chosen by Dr. Peter Wolter to study the effects of a recent wildfire that occurred in the BWCA in northeastern Minnesota. This wildfire is the largest fire disturbance to happen in the area since 1894. There were also numerous other reasons why this research was a unique and rare opportunity. The Boundary Waters is a well-studied ecosystem; in the mid-20th century Forest Service ecologist Miron “Bud” Heinselman took on the tedious task of mapping out the origins of the entire forest all the way back to 1610. Heinselman found that nearly every stand in the BWCA was born from fire. However, throughout the 20th century, management of our forests didn’t allow for this natural disturbance to occur. With fire absent from this ecosystem for more than 100 years, and a changing climate, the Pagami Creek Fire torched through over 93,000 acres of wilderness in 2011. Historically fires have occurred in smaller, heterogeneous patches throughout the affected area, in various levels of burn severity. However, for the Pagami Creek Fire, all the conditions were right for the fire to burn hot throughout much of its range. But nature is an amazing, resilient thing, and from black death soon comes green life. Because fire has had a presence throughout time in the BWCA, the species found here are well adapted to fire, and some species cannot thrive without it. Jack pine (Pinus banksiana) and black spruce (Picea mariana) have cones which are serotinous, meaning they require an extreme environmental trigger, in this case fire, in order to open and reseed. Other species, such as aspen (Populus tremuloides) and paper birch (Betula papyrifera) can resprout from their stumps or roots after fire. Within a year this torched landscape became green again with a wealth of pioneer species. It was evident from my field season last summer that trembling aspen was the dominant tree species to return, blanketing much of the burned...
area, and reaching heights upwards of six feet. From this observation, Dr. Wolter and I deduced that it may be possible to isolate the aspen growth and create a map of its abundance and distribution throughout the burned area with remote sensing technology.

Dr. Wolter is a remote sensing savant, and his PhD dissertation work at the University of Wisconsin-Madison consisted of not only mapping the tree species throughout the entire BWCA, but also determining tree heights, canopy diameters, canopy cover and other structural information of these forests with the use of this advanced technology. What might seem an unfortunate occurrence to have a fire rip through the landscape where these trees once were was actually a welcome event for us, as having this pre-fire information would allow us to study how the ecosystem would respond with pre-fire cover as an explanatory variable.

So we posed the following questions:

1) How does aspen regeneration respond given the precursors of pre-fire forest composition, burn severity, and soil depth?

2) Would it be possible to map distribution and density of aspen regeneration across the entire burned area?

With these questions in mind, our project’s technician, Louis Hilgemann, and I set out into the wilderness collecting information on the vegetation regrowth throughout the burned area. From late May to early August we fought wind and rain to gather aspen regeneration data at over 80 random plots. In addition, we also noted soil depth, pre-burn tree species, other competing species types and abundance, and geographical information such as elevation, slope, and aspect.
And what fun is a field season without thrills and chills? Nothing made us feel more alive than when we narrowly escaped a wind storm where trees were coming down all around us. Or the many days where lightning storms and sheets of rain from downpours created stormy high winds on the waters in our little canoe. Or the intimate interactions we had with a pair of nesting hawk owls (*Surnia ulula*) and, even better, the aforementioned happenstance of coming upon the company of a great grey owl. I seemed to be living my childhood dreams of becoming a National Geographic explorer!

The season has finally come to an end. I miss the Boundary Waters, but I revere my warm, comfy bed, the company of others, and my two furry cat friends, Garfield and Mittens. The next step in my research will be to use my field data in combination with remote sensing images to expand abundance of aspen beyond my plots and throughout the burned area. My greatest challenge is before me, existing in the form of many long days and nights behind a computer in my basement office of the Science II building at ISU. But, I haven’t met a person who has made his or her career in the field of natural resources who isn’t fiercely passionate, and I am no exception.

I hope this research can be broadly applied to fire-adapted ecosystems and that forest managers will be able to make more informed decisions as a result.

Rayma Cooley is pursuing her MS in Forestry under the guidance of Dr. Peter Wolter. Her love for the natural world sprung from many summers fishing and hiking in the high alpine lakes of Montana wilderness with her family. She is a California native, but has scarcely remained still since joining the U.S. Navy following high school. She enjoys photography, hiking, botany, and farmers’ markets.

The Iowa State University NREM Department is saddened by the sudden loss of Bryce Gonzales, who died on December 28, 2013. Bryce had just graduated from ISU, completing his degree program in Forestry. His passion for forestry was inspiring to both NREM students and faculty alike.
You are driving along the highway when you see a herd of white-tailed deer (*Odocoileus virginianus*) grazing near a school or in a city park. You pass by never thinking twice about the impact that human development is having on deer populations in Iowa. Deer are a generalist species, meaning that they can easily adapt to changes in their environment and food supply. Therefore they can and do thrive in urban environments. Deer haven’t always occupied urban areas, but the abundant and readily available variety of food resources draw deer to these habitats, where elevated survival rates encourage high population densities. Compared to deer inhabiting rural areas, deer living in urban areas display limited movements and have smaller home ranges.

As urban areas continue to expand, the numbers of human and white-tailed deer interactions continue to increase. In Iowa, deer are often involved in vehicle collisions, property damage, and damage to agricultural crops. There is also concern regarding disease transmission as a result of the close human-to-deer proximity. Deer are a common carrier of blacklegged ticks, which are responsible for transmitting Lyme disease to humans. Issues like these have led to the establishment of urban hunts in 18 Iowa cities, in areas called “Deer Management Zones.” Every year the Iowa Department of Natural Resources (IDNR) uses models that predict population densities to determine the number of deer that can be harvested during that hunting season. A potential problem with these models is that they assume that urban deer herds are closed herds, meaning that the deer aren’t moving in and out of the area. But if deer are frequently moving between urban and surrounding rural environments, this may create challenges for the IDNR in determining accurate population levels, setting appropriate hunting quotas, and effectively controlling urban deer populations.

Deer social structure revolves around female philopatric groups; once a female fawn is fully grown, she stays with her mother and other related females, while young males are chased away from the family unit. These young bucks often form bachelor groups and remain with their groups until the arrival of breeding season. During this time bucks will disperse to find groups...
of potential mates. The more frequently males disperse between populations, the more genetically similar those populations will be. To determine the frequency with which males disperse and breed with other populations, we can use the amount of genetic similarity between populations to calculate an estimate of the number of bucks moving between populations with each generation.

For the past year, I have been working on a project with NREM PhD student Lynne Gardner Almond that examines the population genetic characteristics of urban deer populations in Iowa. The objectives of our study are to characterize the genetic diversity and genetic structure in urban deer populations and compare them to rural populations. We also plan to estimate the degree of genetic similarity between urban deer and surrounding rural deer populations. If we can get an estimate of the amount of genetic similarity or gene flow that is occurring between urban and rural populations of deer we can help inform the IDNR’s management strategies to control population densities of urban deer.

During the hunting seasons of 2010-2011 and 2011-2012, the cities of Davenport and Cedar Rapids collected 50 tissue samples from hunter-harvested, urban white tailed deer. I extracted DNA from these tissue samples and genotyped them at 10 microsatellite markers. Next I will do the same to the rural deer samples that I have received from around the two cities. I also will start sampling urban and rural deer from the cities of Dubuque and Ottumwa. These data will enable me to infer the level of genetic similarity between urban deer and their rural counterparts. The two possible scenarios that we may observe from these data are that there will be a high amount of genetic similarity or a low amount of.

PCR of deer samples can be verified by running an electrophoresis gel. (photo W. Briggs)
genetic similarity between urban and rural deer. If we find there is a large amount of genetic similarity it will indicate that there is a high rate of movement between urban and rural populations. If this is the outcome the IDNR may need to manage urban deer populations at a larger scale that includes the surrounding rural populations. But, if there is a small amount of genetic similarity, it may indicate that the urban deer have a low rate of exchange with surrounding rural populations. If this is the case, the IDNR may need to manage urban and rural deer herds independently. Ultimately these data will provide greater insight into the ecology of urban deer that will assist the IDNR in devising appropriate management strategies for these populations.

**Whitney Briggs** is a senior majoring in Animal Ecology with an emphasis in Pre-Vet and Wildlife Care and minoring in Microbiology. Currently she is participating in Science with Practice with Dr. Julie Blanchong, under the supervision of PhD student Lynne Gardner Almond.
Dr. Michael Weber is the new (although he joined the department almost a year ago) Assistant Professor in Natural Resource Ecology and Management. His research interests are in fisheries management and ecology and have focused on mechanisms that regulate fish populations, food web dynamics, and community structure. Although Michael spent a brief period of time in Ames during the mid-1980s, he spent most of his childhood growing up on the Missouri River in Chamberlain, South Dakota.

Prior to arriving at Iowa State in December 2012, he completed his PhD at South Dakota State University in 2011 where his research focused on common carp population dynamics, food web effects, and potential population control through commercial harvest. Michael obtained his MS in 2008 from the University of Illinois where he evaluated yellow perch recruitment failure in Lake Michigan and his BS in 2005 at South Dakota State University where he completed an undergraduate research project on larval fish dynamics in Missouri River reservoirs. Michael and his wife Megan have two children, Gavin (4) and Grace (18 months), a llewellin setter (Sage), and recently built a new house on the north side of Ames.

Since starting, Michael has been working with the Iowa Department of Natural Resources to quantify walleye escapement from Lake Rathbun and to evaluate the effectiveness of a sound-light-bubble barrier and an electric barrier for reducing fish escapement. Currently, he is working with Carlos Camacho (MS student) and Dr. Clay Pierce evaluating Asian carp population ecology in tributaries throughout Iowa. The goals of this project are to look for similarities and differences in population dynamics across the state and to determine if these invasive species are reproducing in Iowa’s rivers. Michael will also be starting an EPA project this spring with Dr. Tim Stewart and a MS student evaluating the condition of wetlands in north-central Iowa and refining techniques to sample wetland invertebrates.

Michael is currently teaching Fish Management this fall where students in the course initiated a smallmouth bass mark-recapture research project on the Skunk River near Hines Farm in Ames. This long-term project will provide insights into population dynamics, exploitation rates, and survival rates while introducing undergraduate students to ecological research for an urban bass population. This spring, Michael will be leading a study abroad trip to New Zealand and is developing a new course (A ECL 333 Fisheries Techniques) for fall 2014.
Pete began working in NREM in the fall of 2013 as an Adjunct Assistant Professor, specializing in geomorphology. He comes to NREM from across the Science II prairie, where he was most recently a postdoc and lecturer in the Department of Geological & Atmospheric Sciences. He has extensive teaching experience, including past lecturer and visiting appointments at ISU, Grinnell College, St. Olaf College, and Lafayette College. He has taught introductory geoscience and environmental science courses as well as upper-level courses in geomorphology and sediment transport. At ISU, he expects to contribute to various existing NREM and ENSCI courses and to develop new courses in non-renewable resources and quantitative skills.

Pete has an MS and PhD in geology from Iowa State University and a BA in geology from Carleton College. Throughout his traditional geology training, Pete’s interests have always been with the shape of the land and how it gets to be that way. As an undergrad in the late 1990’s, he spent a summer in Iceland studying terraces on glacial outwash rivers, investigating how river hydraulics and sediment transport changed during channel incision that accompanied glacier retreat. During his graduate work and postdoc at ISU, he studied glaciers in arctic Norway and Sweden and the sediments they carried, aiming both to understand how the sediment affected glacier dynamics and how those dynamics were reflected in the deposits left behind after glaciation.

Today, Pete continues his work on glaciers, advising geology PhD student Theresa Dits in research on melting of debris-covered glaciers and ice sheets. This work includes mathematical modeling of heat flow and sediment movement on top of ice as well as a field study on the northeast face of Mount Rainier. In recent years, however, he has developed a strong interest in the processes by which stream networks grow and shape landscapes, moving sediment in the process. A primary thread of his future research in NREM will be erosion, transport and storage of sediment in stream systems and effects on landscape and aquatic ecosystems.
“Be careful with the tags as you handle those study skins. The information on them can be extremely valuable! If the tag gets lost it’s just another dead animal…” Those words from the first day of vertebrate zoology lab years ago echoed loudly in my head as I looked at the muskrat skin in my hands. I was preparing specimens for a lab section of Mammalogy (A ECL 459) that I was teaching in the 2013 Spring Semester, and was digging through the rodent cabinet looking for good examples to use in class.

I admit that I’m somewhat of a specimen tag junkie. I love reading the old notes left by wildlife biologists past—looking at those dates and places, some places I know well today, and thinking about how the landscape must have looked when the animal was alive, what changes humans have wrought over the years. The colorful notations are the best – offering clues about how science was practiced in the past (e.g., the tag on the bat specimen that reads “shot over the Skunk River,” or the badger study skin that reads “nearly killed the dog”). Sometimes the name of the collector will be one I recognize, someone who now works for the Iowa Department of Natural Resources (IDNR) or someone who’s taught at this university for years. Well, looking at the tag on the muskrat skin in my hands I sure recognized the collector “P.L. Errington.” The date was “Dec 14, 1936” at “Clay Co, Ruthven IA, (Round Lake).” Hmmm… Muskrat… 1936… Round Lake… all the puzzle pieces added up. I was holding a muskrat trapped by Paul Errington from some of his original work on the population dynamics of muskrats.

Errington, an Iowa State University (ISU) professor in what was then the Zoology department, is considered one of the “four great pioneers of animal ecology”, and any Iowa State ecology student today will recognize that name from classes that cover population ecology, predator-prey dynamics, wildlife management, or conservation of wetlands. The Paul L. Errington Memorial Lecture is held each fall at Iowa State University to highlight outstanding efforts in conservation and pay tribute to Errington’s contributions to the field of ecology. If you pop into the Forestry Reading Room on the third floor of the Science II building on campus, you’ll see Errington’s canoe hanging from the ceiling. So what was this muskrat study skin doing in a backroom drawer along with dozens of others in the ISU teaching collection?

My curiosity piqued, I began looking through all the tags on the muskrat skins, soon finding seven more muskrats that had been trapped by Errington in Iowa marshes, with dates ranging from 1936 to 1938. Most of them had small metal tags attached to the back of the skin, between the shoulders. They were similar to the numbered ear tags you might use for a mark-recapture study of fox, raccoon, or some other medium-sized mammal. I’d never seen tags like that on the back of an animal, though. I wasn’t sure if they were...
extra identification markers placed on the study skins during preparation or if the muskrats had carried them while they were alive. After a little online searching, I found the answer in an October 1937 publication of *Journal of Wildlife Management* – a paper by Paul Errington and Carolyn Storm Errington, titled “Experimental tagging of young muskrats for purposes of study.” Apparently, ear tagging for wildlife research was just coming into use, but the aluminum ear tags available at the time were too large for the tiny ears of young muskrats. Errington tried out his innovative method of attaching them to other areas of the body on 463 muskrats, between 1935 and 1936 on Mud and Round Lakes, two marshes near Ruthven, Iowa.

Although Paul Errington is often remembered for his contributions to the fields of population ecology and wildlife management, he also wrote several popular science books and was a strong voice for the preservation of wetlands and wild natural areas. Errington worked closely with Aldo Leopold while a graduate student at the University of Wisconsin, and Leopold’s influence can clearly be seen in Errington’s interpretation of the natural world. Both men came to the science of ecology from a background of hunting and trapping, with a deep connection to the land around them and an intimate knowledge of wildlife gained from countless hours in the field. I find myself agreeing with many of Errington’s views, and I think that park and wildlife managers today would do well to heed his strong pleas for leaving natural areas “untampered” without excessive habitat manipulation or predator controls. One of my favorite Errington quotes is from a 1947 essay, “A Question of Values,” published in the Journal of Wildlife Management:

“To me, with gun in hand or without, the appeal of the out-of-doors seems chiefly conditioned by the relative diversity and completeness of its native fauna and flora and the naturalness of its topography.”

Errington, an Iowa State University professor in what was then the Zoology department, is considered one of the “four great pioneers of animal ecology”

For a more thorough discussion of Errington’s life and works check out “The Landscape of Paul Errington’s Work” in the Wildlife Society Bulletin (2006) Vol. 34, No. 5, by ISU NREM’s James Pritchard. If you find yourself in an ISU Biology or Animal Ecology class studying muskrats, check the specimen tag carefully… you may just be holding an important piece of history.

*Pete Eyheralde is a NREM PhD candidate in the Ecology and Evolutionary Biology program, co-advised by Dr. Sue Fairbanks and Dr. Julie Blanchong. In his spare time you’ll find him with gun or bow in hand seeking out Iowa’s native fauna and flora, usually with kids and dogs in tow.*
Bryan Bakevich received his MS in Fisheries Biology from ISU in 2012 under the direction of Dr. Clay Pierce and Dr. Michael Quist. His research led to the identification of biotic and abiotic associations of the Topeka shiner, a federally endangered prairie stream fish. In December of 2012, he accepted a position with the New Mexico Department of Game and Fish as their Rio Grande Cutthroat Trout Biologist. His work consists of fish restoration projects, population monitoring, genetic testing, and post-wildfire surveys that occur in the remote high country of northern New Mexico and works closely with other government agencies, NGOs, and tribal nations to improve the conservation status of Rio Grande cutthroat trout and other native fishes. He and his wife Jennifer currently live in Santa Fe and are enjoying the hiking, hunting, fishing, culture, and food (red and green chile!) that their new home state has to offer.

Maria Dzul received her MS in Wildlife Ecology from Iowa State University in December 2011. Led by her inexplicable love of desert fishes and statistics, Maria recently accepted a fish biologist position working for U.S. Geological Survey at the Grand Canyon Monitoring and Research Center. She studies the federally endangered humpback chub, a fish that is native to the Colorado River. Most of her work involves building computer models that describe humpback chub growth, survival, and movement. However, she does occasionally get to travel down the Colorado River for weeks at a time to help sample Colorado River fishes. She couldn’t ask for a better job.

Zak Keninger earned his MS in Forestry in 2012. In graduate school, Zak was the Teaching Assistant for Photogrammetry and GIS for Natural Resources as well as GIS and GPS for Natural Resources. For his research, he assessed land cover map accuracy and used a GIS to model small forested stream catchments. Since graduating, Zak has received a job with the City of Ankeny, Iowa. His primary role is in the redesign of the GIS database to ensure long term functionality of the city’s assets. This includes working alongside civil engineers, reviewing construction and environmental design plans, assessing aerial photography, and spanning the city collecting GPS data. The information is used to ensure high quality data are being maintained within the system for future planning and modeling. He and his wife, Molly, welcomed their first child, a son named Brannon Edward, to the world in August of 2013.
Anna MacDonald graduated in 2012 with her MS in Wildlife Ecology under the direction of Lisa Schulte-Moore. She worked on the STRIPs (Science-based Trials of Row crops Integrated with Prairies) Project at Neal Smith National Wildlife Refuge for her Master’s research, studying how birds responded to the habitat created by planting small strips of diverse, native prairie in corn and bean fields. Anna began her current position in Madison County as the Badger Creek Lake Watershed Project Coordinator in April of 2013. The lake is impaired due to excessive sediment and phosphorus loading, and Anna’s job is to work together with farmers, landowners, and project partners to get conservation practices on the land to prevent sediment and nutrients from entering the lake. She is also responsible for monitoring water quality in the lake and its tributaries, and for outreach and education efforts. She has thoroughly enjoyed the new experiences and learning opportunities this position has offered.
Many people think of Canada geese (*Branta canadensis*) as pests, especially in urban areas. While this may seem true through the eyes of a lakeside landowner or a person walking who must gracefully avoid the piles of goose droppings decorating the sidewalks, Canada geese have had a rocky history in Iowa. Euro-American settlement in Iowa resulted in drainage of most natural wetlands, and wildlife was hunted without regulation. This led to the inevitable disappearance of Canada geese by the early 1900s. The Iowa Department of Natural Resources (IDNR) began efforts to reintroduce the species in 1964. Wildlife managers confined flocks of Canada geese to multiple lakes and reservoirs, and banned hunting of the birds within a wide range of the restored flocks. These efforts were highly successful, and by 1996 Canada geese were observed nesting in every county in Iowa.

Canada goose management is important because the Canada goose is one of the most harvested species of waterfowl in the Mississippi Flyway. Accurate population and production estimates are essential to goose conservation and management. Wildlife professionals manage and monitor the Canada goose population to keep it at a sustainable level.

Breeding ground surveys are one of the primary methods used in Canada goose management. In Iowa, these surveys are conducted by selecting 4227 km² (1632 mi²) plots at random, and counting Canada geese on the wetlands and streams in those plots via helicopter. Pairs, singles, and groups of geese are observed and recorded. From these counts, the...
population size of Canada geese in Iowa is estimated. For my research, I am interested in developing a model to predict Canada goose breeding pair densities in each section in Iowa. This model would be used to improve the design of the current breeding ground survey. It would predict breeding pair densities based on 1) five years of aerial survey data, and 2) the number and size of each wetland type in a section, obtained from the most recent National Wetlands Inventory.

Knowledge of reproductive success, also known as productivity, is also an important piece of waterfowl management. Low nest survival among Canada goose populations can be an indicator of bigger issues that may be affecting the larger population. Unpredictable precipitation patterns or extended drought conditions, for example, can have a major effect on waterfowl productivity, which ultimately affects population growth. Part of my research includes the study of nest survival of Canada geese at two sites in north-central Iowa within the Des Moines Lobe of the Prairie Pothole Region (PPR). The PPR is a region spanning Iowa to Alberta that is characterized by small depressional wetlands (called potholes or sloughs) that were created thousands of years ago by glacial activity. This region is extremely productive for Canada geese and other waterfowl species.

My nest survival study is being conducted at Rice Lake Wildlife Management Area (WMA) and Big Wall Lake. At Rice Lake WMA, Canada geese prefer to nest on islands. At Big Wall Lake, they nest on muskrat houses and feeding platforms. Nests were located by systematically walking all islands at Rice Lake WMA, and by canoeing around Big Wall Lake and searching through the thick stands of cattails. Once a nest was located, I saved its location in a GPS unit, and recorded the number and age of eggs in the nest. Egg age (in days) was determined by using a candling tube and an image by Alan Hancock (IDNR) that illustrates eleven embryonic developmental stages. Initiation dates for egg laying and incubation, as well as hatch date, can be determined by candling the eggs. This information is needed for estimating nest survival. Canada geese nest in April and May and incubate their clutch of eggs for 28 days. During the 2013 nesting period, 100 Canada goose nests were found at Rice Lake WMA, 21 of which hatched at least one egg. I calculated nest success at 18% for this site using the Mayfield nest survival model, a model that is used extensively for this purpose. This rate is considerably lower than the average nest success of Canada geese, but is high enough to sustain the population this year. Twenty-nine Canada goose nests were found at Big Wall Lake, 18 of which were successful. The nest survival rate of Canada geese at this site was 43%. This is much higher than nest success at Rice Lake WMA, but is still lower than average, compared to Canada goose nest survival studies at other sites. Nest success was likely low for Canada geese in north central Iowa in 2013 because of highly variable rain and

Euro-American settlement in Iowa resulted in drainage of most natural wetlands.... This led to the inevitable disappearance of Canada geese by the early 1900s.
snowfall patterns during the nesting season. When geese began nesting, Iowa was under drought conditions, but by the end of the nesting period, most of Iowa was under flood conditions. Effects of this were seen when some nests failed due to being flooded and washed out. In addition to dramatic changes in precipitation, Rice Lake water levels were drastically drawn down as part of lake restoration efforts. The low water levels at Rice Lake WMA allowed land predators, such as foxes and raccoons, easy access to islands where goose nests were located. This resulted in much lower nest success at Rice Lake WMA as compared to Big Wall Lake.

I look forward to studying Canada goose nest success at Rice Lake WMA and Big Wall Lake in 2014, and I hope to add a couple of new sites. In the meantime, I will be developing the model to predict breeding pair densities in each section in Iowa. My goal is to improve the breeding ground survey used in estimating the Canada goose breeding populations to enhance Canada goose population management.

This project is funded by the Iowa Department of Natural Resources, United States Geological Survey, and Iowa State University. I am very grateful to my advisor Bob Klaver, and Guy Zenner and Orrin Jones with the Iowa DNR for their guidance, as well as my fellow graduate students for helping me settle in at ISU.

**Brenna Towery** is currently earning a MS in Wildlife Ecology in the NREM Department, and is advised by Dr. Bob Klaver. She graduated with a BS from Southern Illinois University, and is originally from central Illinois. Prior to starting graduate school, she gained field work experience travelling from Maine to Wyoming, and everywhere in between. Her primary interests are wildlife management, waterfowl, and having fun.
Field Notes Photo Contest Winners!

Overall winner
*Otter Creek Marsh*
Dr. Bob Klaver

First place
Category: Animal
*Tallgrass Prairie Bison*
Pete Eyheralde

2nd place
Category: Animal
*Ravenous Raptor*
Brenna Towery

continued...
First place
Category: Plant
*Dandelion at Blue Mounds State Park*
Annamarie Oesterreich

2nd place
Category: Plant
*Layers of Life*
Katie Taylor

Co-First place
Category: People in Nature
*Tea Pickers of Sri Lanka*
Natasha Bures

Co-First place
Category: People in Nature
*Canada Goose Research*
Pete Eyheralde

First place
Category: Landscape
*Chain in the Porthole*
San Francisco, CA
Logan Halverson

2nd place
Category: Landscape
*Alaska Campfire*
Mario Pagni
On the cover:
Spring nest monitoring at Big Wall Lake. Wildlife Ecology MS student Brenna Towery candles a Canada goose egg to check for embryo development. Brenna is researching Canada goose nest densities in Iowa wetlands. (photo P. Eyheralde)

Note: Federal permits are required to handle wild bird eggs and nests.

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