SPRING 2011

MSU FISHERIES & WILDLIFE

# SPOTLIGHT

Produced by Graduate Students in the Department of Fisheries & Wildlife at MSU

## Conserving Michigan's Last Rattlesnakes

Panama's Poison Dart Frogs

ALSO INSIDE: Tiger Conflicts in Nepal, Michigan's Local Water Policy & More!

FISHERIES & WILDLIFE
SPOTLIGHT

**Spring 2011**
**Issue 7**

FW SPOTLIGHT is a magazine written, edited and designed by graduate students in the Department of Fisheries and Wildlife at Michigan State University.

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This tiger was photographed by a trail camera within Nepal's Chitwan National Park. *Photo by Neil Carter*
See **page 17** for the full story.

# SPOTLIGHT ON



## COVER PHOTO CREDITS

Massasauga rattlesnake
Photograph by Ryan Webb

Poison dart frog
Photograph by JP Lawrence

# FEATURES











# Letter from... DR. MIKE JONES

When I meet with prospective graduate students to talk with them about coming to the Fisheries and Wildlife program at MSU, one of the first things I invariably say to them is "you would be hard pressed to find another graduate program to join that is as diverse as ours." Most graduate students are still at a stage in life where their vision of their professional future is still forming. Because of this, I think our diversity is among our greatest strengths. Graduate students in Fisheries and Wildlife have an unparalleled opportunity to explore possible futures in research, teaching, conservation and management. And there is probably no one place where this diversity is more immediately evident than in SPOTLIGHT magazine.

Our diversity starts with the exceptional variety of our students' research projects. In this issue we learn about eastern massasauga rattlesnake conservation in Michigan from Robyn Bailey, strawberry poison dart frog conservation in Central America from J.P. Lawrence and Nepalese tiger conservation from Neil Carter. These three projects are great examples of one of our core emphases: wildlife ecology and conservation. These stories are complemented by two very different (from each other as well as from the three I have already noted) Michigan-based research projects that have "water" as a common theme: Mustafa Mazher's project aimed at improving our understanding of how soil characteristics influence microbial water pollution and Stacie Auvenshine's investigation of the impact of local policy instruments on inland lake water quality. As I'm sure all our readers know, this snapshot of graduate projects barely scratches the surface of the variety of research that engages our graduate students (yikes, there aren't any "fish" projects highlighted!), but you can't help but be struck by the variety, not to mention the passion that our students evoke as they tell us about their work.

Of course this diversity is not limited to research. In these pages you can also read about outreach experiences of our graduate students. And – woo hoo – these stories are about fish and fishing! I had the great pleasure last year of participating in a community event organized by a group of our fishery graduate students to raise awareness of global fishing issues by showing the film "The End of Line" followed by a panel discussion that I moderated. As you will read, the organizers' efforts were rewarded with a great turnout. You'll also read about an outreach effort to encourage women to participate in fly fishing by Abby Lynch and Corey Higley. Abby also writes about her experience working with DNR Fish Division Chief Kelley Smith on her Fenske Fellowship, underscoring another example of diverse opportunities for our students: active engagement and experience with our many partners.

This issue of SPOTLIGHT also introduces our readers to our newest lab in FW, led by Dr. Bill Porter. Bill joined us as the first MSU Boone and Crockett Professor of Wildlife Conservation. As you will read, he already has built a vibrant and diverse lab, and I have no doubt that it won't be long before Bill's students and postdocs will have enough stories to tell to fill an entire issue of SPOTLIGHT on their own! And of course add to the diversity of experiences available to all of us here.

This is our seventh issue of SPOTLIGHT, and the third one to which I have contributed as FW Chairperson. The entire magazine is put together by an editorial team of our graduate students, led currently by Bret Muter. They really do an outstanding job, and I am extremely proud to welcome you to this latest issue. Enjoy, and pass it on to prospective students!

# Students Making HEADLINES

**Yen Doung** received a Dissertation Completion Fellowship for fall 2010.

**Jacqueline Fenner** and **Kiira Siitari** received the John Robertson - Theodore (Teddy) Roosevelt Conservation and Environmental Leadership Fellowship from the Department of Fisheries and Wildlife on November 14, 2010. This award will provide support for participation in the Great Lakes Leadership Academy: Emerging Leaders Program during 2011. Through the GLLA, this award will provide an opportunity to achieve a level of professional and personal growth in preparation for leadership roles in the natural resource and conservation arena.

**Emi Fergus** received an outstanding student oral presentation award for her presentation titled "The effects of land use disturbance on wetland relationships with lake TP and water color" at the 2010 American Society of Limnology and Oceanography/North American Benethological Society joint meeting in Santa Fe, NM.

**Lissy Goralnik** was selected as a 2010 -11 recipient of an MSU "Excellence in Teaching Citation." Her achievement will be recognized at the MSU Awards Convocation ceremony on February 8, 2011 at the Wharon Center.

**Jan-Michael Hessenauer** was awarded the 2010 Michigan AFS Midwest Fish and Wildlife Student Travel Grant.

**Michelle Lute** and **Eric MacMillan** were finalists for Janice Lee Fenske Memorial Award at the 2010 Midwest Fish and Wildlife Conference in Minneapolis, MN.

**Abigail Lynch** received the Clark Hubbs Research Assistance Award from the American Institute of Fishery Research Biologists to attend the 2010 American Fisheries Society meeting in Pittsburg, PA.

**Eric MacMillan** was awarded the 2010 Howard A. Tanner Fisheries Excellence Fellowship.

**Andrea Miehls** received a travel award from the Great Lakes Fishery Commission in May 2010 to attend the Society for the Study of Evolution Conference in Portland, OR.

**Bob Montgomery** received the 2010 CANR Excellence in Teaching: Graduate Student Award.

**Bob Montgomery** and **Chris Jordan** received National Science Foundation Graduate Research Fellowships in 2010.

**Bret Muter** was awarded Honorable Mention for his poster entitled "Evaluating efficacy of risk communication materials related to management of bovine tuberculosis in the Midwest United States" at the 2010 Wildlife Disease Association Annual Conference in Puerto Iguazu, Argentina.

**Bret Muter** was second-runner up in the national "Wanna Be Like Jack Hanna Contest." He won a three-day VIP and behind-the-scenes tour of the Columbus Zoo in Ohio.

**Emily Norton** received an outstanding student poster presentation award for her presentation titled "The effects of lake shoreline development on painted and northern map turtle populations" at the 2010 American Society of Limnology and Oceanography/North American Benethological Society joint meeting in Santa Fe, NM.

**Julia Novak** received the 2010-11 Foreign Language and Area Studies (FLAS) Fellowship from the MSU Asian Studies Center. This award supports Julia's study of Hindi language in preparation for fieldwork.

**Kim Peters, Brian Langseth, Aaron Berger** and **Katie Droscha** were recipients of the summer 2010 GSO travel grants.

**Marisa Rinkus** received a Fulbright Fellowship to conduct research on public participation in sea turtle conservation in Brazil beginning in 2011. The Fulbright Program is administered by the Institute of International Education with sponsorship from the U.S. Department of State and the Bureau of Educational and Cultural Affairs with the goal of supporting educational exchange through advanced research, study or teaching around the world.

**Darren Thornbrugh** received the 2010 Robert C. Ball and Betty A. Ball Fisheries and Wildlife Fellowship.

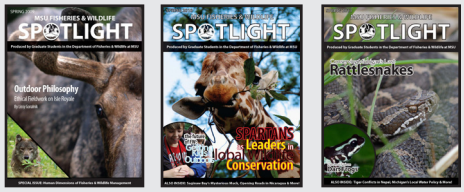
**Mao-Ning Tuanmu** received the NASA Earth and Space Science Fellowship from the National Aeronautics and Space Administration for the 2010-2011 academic year.

**Adria VanLoan** successfully defended her dissertation, entitled "The Conservation Reserve Enhancement Program (CREP) and Grassland Bird Conservation in Michigan," on December 10th, and will receive a dual Ph.D. in Fisheries and Wildlife and Ecology, Evolutionary Biology and Behavior.

**Chiara Zuccarino-Crowe** and **Corey Higley** received the 2010-2011 Janice Lee Fenske Excellence in Fisheries Management Fellowship from the Michigan Chapter of the American Fisheries society to work with the Great Lakes Fishery Commission and Michigan Department of Natural Resources, respectively.

## Read SPOTLIGHT Online!

Check out our website to find an electronic version of all our past issues.

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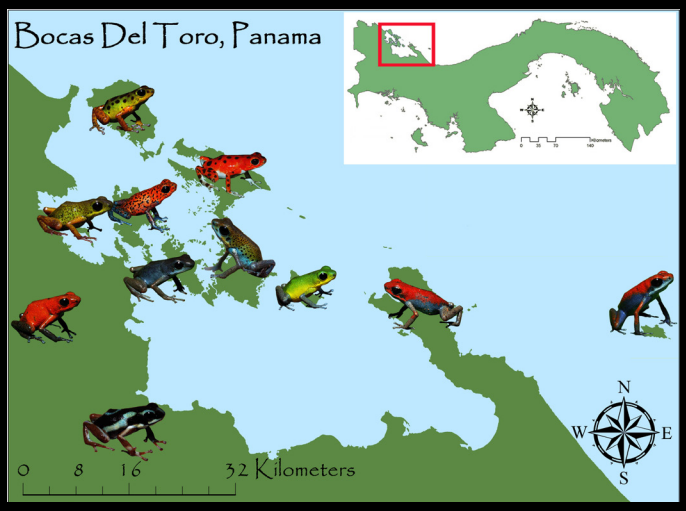
## Strawberry Poison Dart Frogs

Popular among hobbyists, the strawberry poison dart frog (SPDF) is extremely variable in color, with over 20 different morphologies and more discovered each year. Its scientific name, *Oophaga pumilio*, literally means strawberry egg eater and refers to its unusual parental care—oophagy—whereby females feed tadpoles infertile eggs. From most of Nicaragua to eastern Panama this species is red with blue legs; however, in the Bocas del Toro region of Panama the species exhibits a substantial divergence in color ranging from dull blacks and browns to vibrant oranges and reds. Despite the extreme color variability, molecular and behavioral evidence suggests these frogs are the same species.

SPDFs are incredibly abundant in lowland rainforests and are listed as a "Species of Least Concern" by the International Union for the Conservation of Nature (IUCN) Red List of Endangered Species. Unfortunately, this designation does not acknowledge the incredible variability throughout the Bocas del Toro archipelago, so individual populations are not legally protected. Increased demand as a result of commercial trade has raised the price for an individual frog to as much as $300, which places significant pressure on the species.

Collectors consider rare color patterns more desirable, and often individuals exhibiting these color patterns come from extremely small and isolated populations. One unique population of SPDFs occurs on a single island that is less than one square mile (i.e., about one-tenth of MSU's campus). Because SPDFs are relatively abundant throughout much of their range, the isolated populations of Bocas del Toro receives little attention from conservationists. Current protections also ignore the population-level diversity observed in the region. As such, unabated collection of populations of interest by importers may cause future declines.




Bocas del Toro archipelago is a relatively small group of islands that has separated within the last 9,000 years, with some islands separating in the last 1,000 years. Since then, these frogs have diverged in color, size and behavior incredibly rapidly. This divergence has been of great interest to researchers for the last two decades.

# Here today, gone tomorrow

## The Impact of the Pet Trade on Global Amphibian Conservation

Story & Photos By: J.P. Lawrence

Amphibians are facing an unprecedented global extinction crisis. Nearly one-third of the world's amphibian species are currently either threatened or in decline as a result of habitat destruction, disease, pollution, global warming, and increasingly, human exploitation. Throughout the last decade, frogs, toads, salamanders and even lesser-known caecilians have become hot commodities in a growing multi-million dollar pet trade industry.

Many wildlife species – from macaws to geckos – are negatively impacted by the pet trade; however, amphibians are particularly vulnerable to overexploitation due to their uniqueness and relatively narrow geographic ranges. Among vertebrates, amphibians have unique biphasic life cycles, vibrant color patterns, and interesting ecologies. For example, Kaiser's Spotted Newt, a species found only in Iran, has suffered drastic declines as a result of online trading and was recently listed under the Convention on International Trade of Endangered Species (CITES) strictest regulation (Appendix I).

Recent technological advances have accelerated and magnified the detrimental impacts of the pet trade. Improved shipping and transportation networks provide access to remote regions where unique species can be collected and shipped across the world in a matter of days. In 2006, a poison dart frog, *Excitobates captivus*, was rediscovered in Peru after it was thought to be extinct for over 80 years. Within months the species was available online in Japan and it was available illegally in Germany one year later. For now, this species has escaped drastic decline due to conservation efforts by private indi-

After the tadpoles hatch, the female Strawberry Poison Dart Frogs will transport their offspring to a small water source [green frog, **Top Right**], which is typically a bromeliad. The author's research introduced straws as a water source for the frogs. After this transport, the males will defended the territories from intruders [green frog, **Left**]. This supplemental resource can help populations that may be experiencing declines [black and white frog, **Center Right**] or populations that are popular in the pet trade [blue-green frog, **Bottom Right**].

viduals and the Peruvian government, as well as the fact that its range is largely found in potentially hostile indigenous tribe territories. Unfortunately, not all amphibian species are so fortunate; the rarity of endangered or threatened species generates special interest, which results in greater commercial demand, thereby exacerbating their vulnerability to overexploitation and extinction.

Demand for amphibians has increased collection pressure so dramatically that populations may disappear before researchers even know they exist. In 2004, the Global Amphibian Assessment determined that as many as one in three amphibian species are relatively unknown and likely threatened. As a result, unsustainable collection for commercial trade may already be going unnoticed.

There is a critical need to investigate the mechanisms that drive species-level patterns of abundance and distribution, baseline biological data that are necessary to evaluate the impact of commercial trade on amphibian conservation and to affect informed management policies. Although the legal pet trade can be a powerful force supporting the protection of amphibians by instilling a conservation interest among hobbyists, without legal protection, collection can quickly spiral out of control and negatively impact the species they intend to protect.

## Field Work

My master's research will estimate strawberry poison dart frog (SPDF) population size and determine how leaf-litter volume and tadpole rearing site quality influences SPDF abundance. I used standard transect methods to estimate the size of nine geographically isolated populations, walking ten 100m transects along forest edges and counting the frogs spotted along the way. I noted the approximate distance of each frog from the transect so I could estimate population density. I also recorded the distance of each located frog along each transect to evaluate how SPDFs interact with forest edges. These data will inform effective management of SPDFs subject to increasingly fragmented habitats. Interestingly, the preliminary evidence suggests that SPDFs do not exhibit the negative edge effects that many animals do exhibit. This suggests that they are very tolerant of disturbed habitats, and as such, would make an excellent candidate species for in situ conservation in these disturbed and fragmented habitats throughout the archipelago.

The second part of my research manipulated leaf litter and tadpole rearing site density to determine the influence of habitat quality on SPDF abundance within 10m x 10m forest plots. I assigned each plot to one of six treatments: (1) no leaf litter, (2) additional leaf litter, (3) additional rearing sites, (4) additional leaf litter and rearing sites, (5) no leaf litter and additional rearing sites, and (6) a control (i.e., no manipulation). To mimic natural tadpole rearing sites, I attached 250 large-diameter (13mm) drinking straws to trees and vines in plots 3, 4 and 5. I observed significantly more frogs in plots with additional rearing sites than sites where rearing sites were not manipulated, which suggests available tadpole rearing sites may be limiting these populations.

My research provides baseline biological

Small frogs face large problems including habitat loss, disease and the pet trade. In order to preserve the diversity of this species, conservation needs to happen at the population-level.

## About the Author...

J.P. Lawrence is a master's student in the Department of Fisheries & Wildlife at Michigan State University. Since participating on study abroad programs to Costa Rica and Panama as an undergraduate, he has developed a keen interest in Neotropical herpetofaunal communities, and especially issues concerning the amphibian biodiversity crisis. Since then, he has traveled to Central and South America on ten separate occasions and has done amphibian and reptile research in Panama, Costa Rica, Nicaragua and Ecuador. He is actively engaged in herpetofaunal conservation at both a local and global scale.

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information on current population densities of SPDFs and will be used by Panama's Autoridad Nacional del Ambiente (ANAM, or the National Authority of the Environment) to develop population-level conservation strategies for populations of SPDF subject to excessive collection pressure. This information will allow ANAM to more efficiently allocate resources to protect at-risk populations. Additionally, this research suggests that improving rearing site density may be an inexpensive and effective tool for protecting threatened populations.

The Robalo River Basin population, on the mainland of the archipelago, represents a population that could benefit from the addition of rearing sites. During a visit to this population in 2005, my adviser, Dr. Gerald Urquhart, found only a dozen frogs. In 2009, I visited this population twice to conduct transects sampling. The first time we did not find any SPDFs, but the second time we found a single pair. The limited success precluded the use of transect methods as a population measure, and as a result, I had to infer population size and possible decline based on man hours of searching for these frogs.

Compared to Panama's other SPDF populations, this population had extremely low density. Although small population sizes cannot be directly attributed to collection for the pet trade, it is reasonable to suspect that the collection of just a few individuals could have profound effects on a small population, which led me to conclude that this population could benefit from the addition of resources. My research suggests that the simple addition of artificial rearing sites such as straws can help resurrect the population and keep it from being lost. Given the trend of smash-and-grab importation, the pet trade will certainly make it difficult for amphibian populations like this one to persist over time without greater protection or attention.

## Conclusion

For decades, population level conservation programs have been used to protect rare bird and mammal populations, but their use to protect amphibians is in its infancy. My research has developed tools that useful in protecting populations of poison dart frogs that are nest-site limited, and emphasizes the importance of suitable breeding sites for amphibian conservation. Nonetheless, population-level conservation does not ensure that these particularly vulnerable populations will be able to recover.

Among local populations of tropical amphibians, the negative impacts of the pet trade may be exacerbated by deforestation, disease and climate change. Many tropical species have very small and restricted ranges, so removal of habitat, even at seemingly small spatial scales, can be a significant detriment for the survival of those species. In addition, Chytridomycosis – a fungal disease that affects the ability of amphibians to use their permeable skin – is causing catastrophic mortality in amphibian species around the world.

Other factors such as pollution and global climate change also significantly impact amphibian populations. Collection, both legal and illegal, can have a profound negative effect on local amphibian populations and species, as evidenced by the Kaiser's Spotted Newt in Iran. Legal protection of individual populations from over-exploitation may not be the "end all, cure all" solution to the long-term survival of the SPDF, but is an important step in conserving the wealth of biological diversity found within their isolated populations.

# The Role of Soil in Microbial Pollution of Water

Story By: Mustafa Mazher

The combination of a rapidly growing global population and the pollution and consumption of our finite water resources raises many concerns for the future of fresh water availability. Although it is a global issue, we do not have to look beyond the borders of Michigan to realize the pertinence of water quality to each of us. And of course in Michigan, fresh water use is not limited to drinking and food preparation, but includes recreational activities that can contribute to pollution such as boating and fishing, as well as industrial and agricultural needs. Preserving our privileged use and access to fresh water depends on our ability to decrease pollution in the Great Lakes. This is an area of environmental policy that concerns a diverse set of stakeholders and is vital to water quality research.

My part in this intricate puzzle has been helping to understand the pathways of microbial contamination due to agricultural practices. Assisting me in this task are soil hydrologists Dr. Hyen Chun, Dr. Alvin Smucker and statistician Dr. Sasha Kravchenko in the Plant and Soil Sciences Department. Specifically, our research group was looking at the potential for bacterial pollution based on soil type and agricultural management style. The unique and concerning aspect of microbial pollution is that pathogens such as *Escherichia coli* O157:H7 [*E. coli*] can cause the onset of acute illnesses, such as gastroenteritis, and in extreme cases may lead to death. These microorganisms can reach our water from a variety of sources, including the controlled discharge of wastewater plants and the leakage of faulty septic tank systems.


*About the Author:*
Mustafa's initial interest in research was sparked at Auburn University, where he completed his undegraduate degree in microbiology. He joined the FW Department in 2008 to pursue his master's degree. He is currently working at the Center for Disease Control and Prevention.

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Aerial view of Kellogg Biological Station [Image obtained from: http://lter.kbs.msu.edu/ ].

The author taking samples for National Geographic's Bioblitz [Photo by Asli Yilmaz ].

However, agricultural effluent, which affects 18% of rivers and 14% of lakes assessed nationwide, has been rated to be the primary source of non-point pollution.

It is important from a water quality perspective to understand how bacteria move through soil in order to offer better management strategies. However, the difficulty with characterizing microbial transport in non-point pollution sources is that the medium the microbes move through—the soil—adds a dimension of complexity. The environmental conditions (precipitation, temperature, etc.) of the soil and the type of bacteria present can impact how much, or whether, microbial pollution impacts the watershed. For example, microbes found in manure-based fertilizers, when applied to dry fields, are usually retained in the soil layer, which leaves the underlying water table relatively impervious to pollution. However, after excessive rainfall or intensive irrigation, the microorganisms in manure can percolate through the surface soil layer and eventually reach a ground water source. In these conditions, bacteria that are larger in size and that can attach to soil particles are retained in the soil, while smaller and less "adhesive" bacteria are carried off more readily with the moving water.

Agricultural management practices add another dimension of complexity to the movement of pathogens in soil. The aggressive grinding of soil through tillage and the treading of heavy machinery over the soil surface can cause drastic changes in the soil structure. Pore channels, which are formed by insect burrowing or plant root growth, dictate the flow of water through the soil. In a healthy soil ecosystem, there should be mix of small pores to retain water in the top soil for the plants to grow and large pores to allow water to drain and recharge the groundwater when there is excessive rainfall. Pores play a major role in carrying waterborne bacteria from the top of the soil all the way to the ground water. When the soil is tilled these pores are destroyed or restructured and thus the water flow through the soil system is altered, making it difficult to predict the degree pollution is reaching water resources.

In an attempt to reconcile the knowledge gaps in soil-microbial transport and the potential for water quality impairment, our research group designed experiments to understand the variables in soil that affect transport. We specifically focused on observing transport in soil aggregates. The aggregates are the structural subunits (soil clumps) that are millimeters in diameter. These tiny clumps associate to form the surface layer of soil. Bacterial transport has not previously been investigated at such a small scale, and this scale could expose microbial interactions that may not be apparent in larger field-scale experiments.

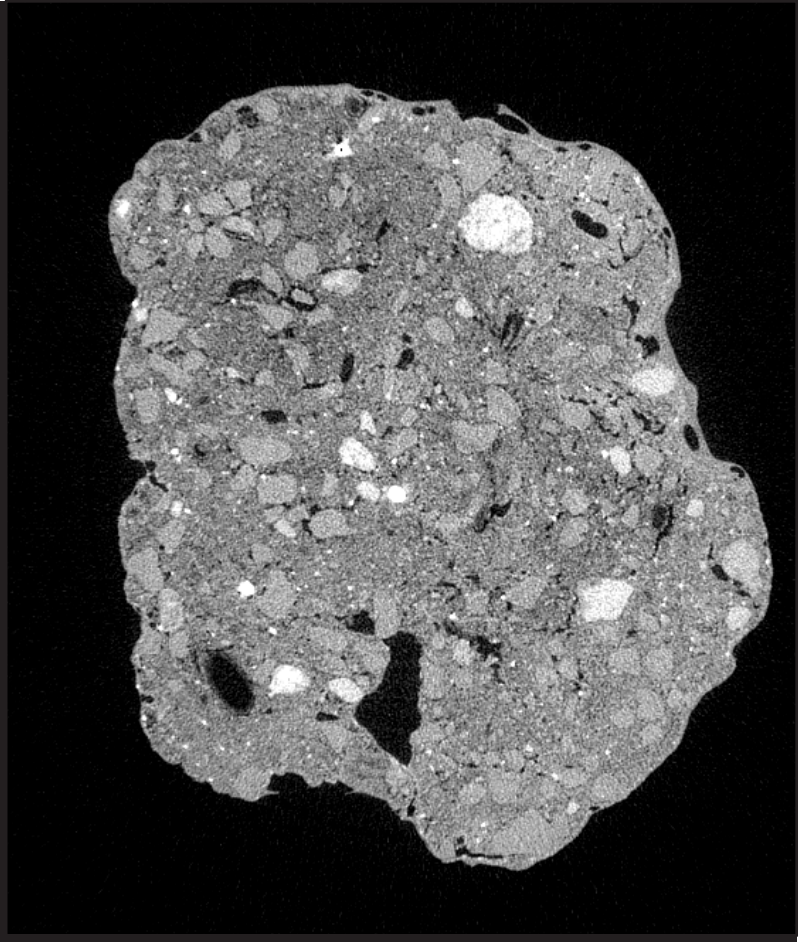
Size ratio of a soil sample [Photo by author].

*"Our ability to tackle these problems at home can have a rippling effect on the global community."*

We obtained soil samples from the Kellogg Biological Station with three agricultural management treatments: 1) tilled with addition of Nitrogen fertilization, 2) non-tilled with addition of Nitrogen fertilization and 3) a soil with native plant growth, (i.e. no tillage or fertilization). To address the variability different bacterial species contribute to microbial transport, we used the widely accepted waterborne-fecal pollution indicators *E. coli* and *Enterococcus faecium*. Both species are characteristically different, as *E. coli* can actively move in water by rotating its flagella (tail) like a motor and have a thinner cell wall, while *Enterococcus faecium* is passively carried with the water and has a thicker cell wall. The soil hydrologists within the research group designed a flow column where the bacteria would be added in solution to the aggregates. Then they applied a vacuum to this column, flushing bacteria through the column to simulate what would happen after a rainfall event. This allowed them to capture the bacteria that could transport out of the soil at the bottom of the chamber. To understand how soil moisture affects transport we added both bacterial species to dry soil and pre-wetted soil aggregate in each treatment.

The results were interesting. When the aggregates were wet, both bacteria came out of the soil very readily. Although the tilled soil had significantly more bacteria leaching out of the aggregates then the non-tilled and native vegetative aggregates, the amount of bacteria coming out fluctuated between replicates. This illustrated the often unpredictable effect tillage has on soil in regards to bacterial transport. When the soil was dry, the opposite occurred. Very little bacteria came out of the non-tilled and native vegetative aggregates, and in tilled aggregates no detectable bacteria leached out. This supported the agricultural best management strategy of discouraging large scale addition of manure (which is usually colonized by pathogenic bacteria) to wet soils.

At the scale of our experiments, *E. coli* appeared to leach out of the soil more readily than *Ent. faecium*, but the statistics did not capture this result . The bacterial species did not impact transport nearly as much as the tillage and the soil moisture did. Still, using soil aggregates, variables that are often explored at field-scale studies to understand soil-microbial interactions, could be found. Our research team has used these soil aggregates for other experiments, exploring the spatial distribution of the bacteria within the soil aggregates at each agricultural management treatment and comparing how these treatments affect the pore structure using X-ray microtomography.



X-ray image of a soil sample [Photo by Wei Wang].

Since it's a relatively new strategy, it would be very useful to continue exploring the potential of microbial pollution through the aggregate model. Our ability to understand the movement of bacteria through these soil subunits can give us more insight into the complex nature of bacteria interactions when diffusing through soil. With such information, we may enhance our best management strategies for agricultural microbial pollution. Furthermore, with Michigan's strategic location within the Great Lakes Basin, generating similar research will allow us to display our leadership in water conservation and sustainability. Issues of chemical contamination, microbial pollution and the spread of invasive species are not just local problems, but worldwide phenomena. Our ability to tackle these problems at home can have a rippling effect on the global community.

# Hookin' Women into Fisheries Conservation

## Story & Photos By: Abigail Lynch & Corey Higley

Fly image above from www.davewhitlock.com

*Gazing out over the North Branch of the Au Sable River in the early morning light, fly rod in hand, Tom Sadler beams. A dense fog shrouds the river and fish rise, making soft plinking sounds on the surface—perfect conditions to teach a beginner's class. Sadler, an internationally-recognized fly fishing instructor from Charlottesville, Virginia, is here to teach his fourth annual cohort of MSU Fly Gals. His new students are all women with different disciplinary and recreational backgrounds from the MSU Department of Fisheries and Wildlife, Michigan Department of Natural Resources, and even the U.S. Fish and Wildlife Service (USFWS). They assemble at the shore for their first lesson.*

**Small Fry: the beginnings of MSU Fly Gals**

Dr. Bill Taylor met Sadler through the Sport Fishing and Boating Partnership Council, an advisory committee for the USFWS whose mission is to promote the conservation and awareness of valuable aquatic resources that support and enhance recreational fishing opportunities. Taylor and his long time friend and colleague, Bill Demmer, the executive Vice President for Conservation and Education of the Boone and Crockett Club, had been discussing ways to get more women actively involved in outdoor recreational activities. They hoped that Sadler could help them make this dream a reality.

USFWS recently estimated that recreational anglers spend $40.6 billion annually on trips, equipment, licenses, and other related items. The State of Michigan uses this fisheries-related generated revenue (from excise taxes and license sales) to manage and conserve the state's fisheries, an important natural and economic resource.

Therefore, Taylor and Demmer hoped to increase local participation in fishing, as well as raise awareness of fisheries resources and conservation funding, by launching the MSU Fly Gals program. "We wanted to provide those who were not raised in the tradition with an opportunity to experience fly fishing," says Demmer. "MSU Fly Gals instills a love and sense of advocacy for the resources," adds Taylor.

What better place to learn than on the banks of the famed North Branch of the Au Sable River, a blue ribbon trout stream and the birthplace of Trout Unlimited? Demmer and Taylor invited Sadler and the inaugural class of Fly Gals up to Demmer's Big Creek Lodge for three days in the summer of 2007.

The first evening, the Fly Gals, many of whom had never held a fly rod before, arrived to a "trout opener" style party, a traditional celebration at the opening of the fishing season, where the Fly Gals quickly started to form friendships and professional networks that have persisted well beyond their three-day program.

On the second day, Sadler taught the Fly Gals initial lessons on fly rod anatomy, basic casting, tying knots, and essential fly

Learning to tie flies

2010 MSU Fly Gals

Au Sable brook trout

fishing gear. The group spent their final day on the river practicing their new skills. "Our vision of sharing the fly fishing experience and inspiring a new group of individuals into the sport was off to a great start," says Demmer. "It has brought great joy to me to introduce a love of my life, the sport of fly fishing, to a most appreciative audience!"

The participants shared his sentiments. "I've had an extremely positive experience," says Dr. Dana Infante, an Assistant Professor in the Department of Fisheries and Wildlife and a member of the Fly Gals inaugural cohort. "Fly Gals has moved me from a brand new fly fisher to someone who can actually catch a fish with a rod. It's made me confident enough to go into a fly shop, fish on my own, and even teach others."

**Keeping it Reel: the evolution of MSU Fly Gals**

Leaders and participants have both noticed some additional benefits of the fishing curriculum. "I came away from the experience with tips on both backcasting and surviving grad school," says Kiira Siitari, M.S. student in the Department of Fisheries and Wildlife and 2010 Fly Gal. The program brings together a group of women who share a curiosity and passion for the natural world and unites them with a shared goal—learning to fish—in a beautiful setting, away from the traditional academic environment.

Participants share ideas and grow together, learning as much from each other about fisheries issues as from Sadler about fly fishing. "There's an energy with MSU Fly Gals that arises when enthusiastic individuals, with a common interest in natural resource conservation, bond over the shared experience of fly fishing," says Andrea Jaeger Miehls, Ph.D. student in the Department of Fisheries and Wildlife and member of the 2009 Fly Gals cohort.

The program "links you into a professional network on a personal level," says Infante. Chiara Zuccarino-Crowe, Ph.D. student in the Department of Fisheries and Wildlife and 2010 Fly Gal, agrees. "The program presents an opportunity to build a network with relationships that are much stronger because everyone has this shared special experience that goes well beyond typical academic and professional associations."

The conservation legacy of Fly Gals has matured as new elements have been added to the program: float trips on the North Branch, guest speakers (most recently, Jim Martin, the Conservation Director of the Berkley Conservation Institute), tours of Fuller's historic North Branch Outing Club, and even an "instructor class" for early cohorts of Fly Gals to help teach the skills they've learned.

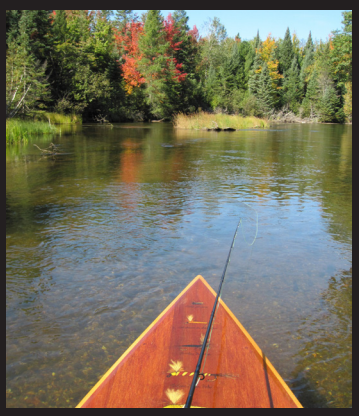
These experiences enrich the program with a sense of place and purpose. "This is not just fishing to fish," Taylor explains. "Through MSU Fly Gals, we are developing a passion and stewardship for our fisheries resources. These 'gals' will save the future of fisheries!"

**The Trophy Fish: the future of MSU Fly Gals**

According to a 2010 Recreational Boating and Fishing Foundation report, women currently make up 25.2% of all fly fishing participants and represent the fastest growing segment of the fly fishing industry. This statistic makes programs like MSU Fly Gals all the more valuable. "This program empowers women to know that they are capable, especially in a sport that has been historically dominated by men," says Jacqui Fenner, M.S. student in the Department of Fisheries and Wildlife and 2010 Fly Gal.

So far, 28 women have participated in the Fly Gals program and plans for the 2011 cohort of Fly Gals are well underway.

*As he gazes out over the newest Fly Gals' first casts, Sadler is proud. The weekend has been peppered with lively discussions and debates about natural resource issues around the dinner table, on the river's edge, and during fly tying sessions. He is impressed with the knowledge and passion the participants bring to the field of fisheries conservation. "We are building a cadre of fly fishers who know a lot more than just how to cast a fly rod. These Fly Gals will be a great asset wherever they wind up."*



North Branch float trip

Practicing catch and release

Casting lessons

# Striking Back!

## Conserving Michigan's Last Rattlesnakes

Story By:
Robyn Bailey

An eastern massasauga rattlesnake basks cryptically [Photo courtesy of Ryan Webb].

**About the Author...**
Robyn Bailey finished her M.S. in May 2010, under the direction of Dr. Henry Campa, III. She now works for Cornell University in Ithaca, NY.

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Native American tribes have taught us many lessons about the natural world by incorporating animals and plants into their traditional worldviews. Although specific beliefs differed among indigenous cultures, rattlesnake sightings were commonly held to be a warning of impending danger. Rattlesnakes were culturally described as avengers, for harming one would bring misfortune on the person responsible, unless that person contributed a peace offering to the snake. This belief makes sense in its simplest form, given that rattlesnakes do give a warning if something is disturbing them; continue to disturb one and you may suffer painful consequences.

However, I like to think that there is a richer interpretation of this tale. Rattlesnakes, and other species for that matter, can in fact "warn" us of ecological degradation. The small, relatively unaggressive eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*), the only venomous snake in Michigan, is now a candidate for federal listing under the Endangered Species Act. Current declining populations of the massasauga could be warning biologists that certain vegetation communities are disappearing, becoming fragmented into isolated "islands" of habitat.

The Michigan Department of Natural Resources (MDNR) partnered with Michigan State University, Potter Park Zoo, and Pierce Cedar Creek Institute for Environmental Education to learn how massasaugas are responding to management practices, which are designed to improve habitat. Therefore, my research objective was to concurrently evaluate massasauga habitat selection and use of managed vegetation communities.

The name "massasauga" comes from a Chippewa word meaning "great river mouth," and indeed the species' habitat includes wetlands surrounding water bodies. They can also be found in Michigan grasslands and prairies.

When glaciers retreated from the Midwest and Great Lakes region, they left behind prairies and open wetlands that were maintained naturally by periodic fire or other disturbances, such as flooding. Humans are thought to have occupied the eastern U.S. for virtually the entire post-glacial period, and many Native American tribes historically burned these vegetation communities to encourage berry production, facilitate travel, and drive game species. Many ecologists believe that conserving biological diversity must entail management that mimics long-term historical and natural disturbances.

Although it may seem contradictory, burning grasslands can actually increase the diversity of plant and animal species found in them, to the benefit of the ecological community. Modern fire-suppression policies promote the natural conversion of open vegetation communities into forested cover that the massasauga may not use (this process of forest aging is called "succession"). For example, an abandoned agricultural field may revert to a grassland which over time will be colonized by pioneering trees and shrubs (e.g., box elder); these would eventually be replaced by late-successional trees (e.g., maple), unless something happened to disturb succession. Forest succession is natural, but the loss of grasslands and wetlands can have negative impacts on the species that depend on them to survive.

I conducted my study at Pierce Cedar Creek Institute for Environmental Education, a non-profit organization that is trying to combat habitat loss by re-introducing fire to the landscape, along with manual shrub and tree removal. My research in southwestern Michigan looked at habitat relationships of the eastern massasauga rattlesnake by tracking their movements with radio telemetry. I found that the rattlesnakes prefer open wetlands and grasslands in Michigan, habitat that has declined throughout the snake's geographic range. The decline of preferred habitat is due to human disturbances, such as the conversion of wetlands and grasslands to alternative land uses (e.g., urban and agriculture).

My research revealed that the massasaugas in Michigan overwhelmingly preferred to inhabit early and mid-successional deciduous wetlands and uplands, similar to observations throughout their range. The rattlesnakes avoided forested areas, although they would cross through them if necessary. Surprisingly, radio telemetered snakes used roadside areas more often than we would expect just by chance, meaning the maintained roadside corridors are attractive to snakes. Although the mowed roadside areas can be used for basking and finding prey, clearly this is not safe for slow-moving snakes. In some studies, researchers have found massasaugas living almost exclusively along maintained roadsides or railroad tracks because there were no preferred alternatives. This supports the human responsibility to create and maintain suitable conditions in appropriate habitat to prevent concentration of snakes along roads, where they are in danger.

Several key findings from my research could help managers provide and maintain habitat for the massasauga through prescribed fire. No studied snakes used any areas that had been burned that same spring or that had been burned over four years ago, indicating that burn areas will be used the following growing season and for several years thereafter. One suggestion is a 5-year fire rotation to maintain conditions preferred by massasaugas. Importantly, the prescribed burning at my study area takes place before snakes emerge from their winter refuges (no later than April 15) making it less likely that snakes were above ground at

## What can you do to conserve the massasauga?

1

**If you see a massasauga, take its picture, not its life.**
It may be your last opportunity to see one in the wild. Although they are very unlikely to strike unless directly provoked, stay out of their "strike zone" (two-thirds the length of the snake's body in all directions).

2

**If you must remove a massasauga for safety reasons:**
sweep it into an overturned trash can using a stiff broom. Upright the trash can using a stick, and put the lid on it. Once you find a release spot away from your home, take off the lid and tip over the trashcan. The snake will move out once it feels safe.

3

**Massasaugas don't make good pets.**
Once captive, they cannot be released. It's unsafe as well as illegal to hold any Michigan reptile without a state permit.

4

**Report your sightings.**
The Michigan Natural Features Inventory or the Michigan Herp Atlas are good places to start.

The author uses radio telemetry equipment to track rattlesnakes that are equipped with transmitters [Photo courtesy of Stephanie Zimmer].

Professional snake-handling gloves help the author secure this young massasauga, whose venom helps it fend off predators [Photo courtesy of Wesley Anderson].

the time of the fires. It is also beneficial to burn small areas at a time (from 1 to 30 acres at Pierce Cedar Creek Institute) with a low-intensity fire, so that snakes can move somewhere else if their favorite patch is burned in a particular year.

Snakes used areas with shrub and tree removal only (i.e., not burned) to a greater extent, indicating that fewer woody plants makes for an attractive grassland or wetland to the massasauga. The vegetation data that I collected near snake locations revealed no meaningful difference between the structural characteristics of sites with prescribed fire and shrub removal and sites without these management practices. This could be because when using an area that has not been treated with woody stem removal or prescribed fire, snakes will select particular locations within the area that happen to have fewer shrubs.

What biologists can learn from studying massasaugas is a better understanding of the habitat management required for the species. With scientifically-informed habitat management practices, the outlook for massasaugas in protected areas is sure to improve. Maintaining early-successional vegetation types for massasaugas is like opening a big umbrella: we can conserve an interesting and integral part of Michigan's unique animal community and shelter other species who also share their habitat.

By maintaining habitat for the massasauga, biologists are helping communities of organisms that depend on these vegetation types. While searching for snakes during my study, I often saw native orchids, miniscule butterflies, uncommon turtles, and more species of frogs than I can count on one hand. Fortunately, the snakes that I studied were not subject to pressures such as killing or collection as pets, which undoubtedly would have a negative impact on populations.

Individuals can help the massasauga by discouraging urban development, intentional killing, and misinformation. Preventing the loss of open wetlands and grasslands is a complex but deeply important objective; strike back by listening to what Michigan's last rattlesnakes are trying to tell us. After all, if we fail to heed their warning, we may be in danger of losing more than just a snake.

## Rattlesnake Q & A

**Q: Are massasaugas endangered?**
A: Yes, they are considered state threatened or endangered throughout their range except in Michigan, where they are listed as Species of Special Concern. They are also a candidate for federal listing as threatened or endangered.

**Q: Why haven't I ever seen one?**
A: They are extremely secretive animals. They usually select vegetation that blends with their coloration as a substrate, and they remain still if approached.

**Q: Will they bite?**
A: Massasaugas are shy and generally prefer to remain hidden if encountered, but they will bite if handled or provoked. Behavior can vary depending on how vulnerable the snake feels; for example, a snake that is in its natural environment may feel secure if it has nearby retreat sites. However, if it is encountered while crossing an open trail or a mowed yard, it may feel threatened and coil up and rattle. If you leave it alone, chances are it will soon flee. Too often people get bit trying to kill the snake.

**Q: What happens if my pet or I get bitten?**
A: Remain calm and seek medical attention immediately; don't wait. Although there's a good chance the bite will be dry (no venom is injected), you should still seek treatment. Don't attempt to suck out the venom, or cut or ice the bite site. Knowing how to identify the massasauga goes a long way in preventing unnecessary panic (I have been called to the home of distressed pet-owners whose curious dog suffered a harmless bite from a non-venomous eastern milk snake).

# Tiger Tales

## Evaluating Wildlife Acceptance Capacity in Nepal

*It was a warm and hazy morning portending another sweltering summer afternoon in Chitwan, Nepal. Kids walked excitedly to school, farmers headed out to the fields with buffalo and goats in tow, and women were hunched over, meticulously sweeping dirt out from their homes made of dung, mud, reeds, grass and timber. A man stumbled drunkenly in the street. His hands were clasped and held high towards the sky while he mumbled prayers to the Hindu god, Vishnu. This was the man I had been seeking. I wanted him to tell me about the day he was attacked by a tiger.*

With alcohol on his breath, he recollected the day that he was walking with three other forest guards on patrol in Chitwan National Park. He described how a tigress unexpectedly erupted from the brush and lashed out at him. The man fell on the ground bleeding and in shock while the other forest guards ran away in fear. After a violent roar the tigress disappeared into the jungle. The drunken man directed his intense gaze at me, drew close and described how Lord Durga, the Hindu goddess of power often depicted riding a tiger, appeared before him while he was laying on the ground and bestowed a minute fraction of her great power onto him. Despite his new power, the medical bills were immense and, according to him, the National Park authorities he worked for would not reimburse the costs. He began to drink heavily and shortly after lost his job. To spite the Park authorities, he said that with Lord Durga's power he could kill tigers just by thinking it.

Stories like the one told by the tiger attack victim illustrates an underlying tension among local people toward tigers and Park authorities not uncommon among people living next to tigers. This tension, when acted upon, could have potentially devastating consequences for endangered and isolated tiger populations.

We have learned from history that a wildlife population can be quickly and dramatically reduced if local people no longer tolerate real or perceived impacts from that species. For instance, in the 1800s, eradication programs vastly reduced the population size and distribution of wolves in the United States to make way for settlers moving west.

Story & Photos By:
**Neil Carter**

Individuals within 2 km of Chitwan National Park were surveyed for wildlife acceptance capacity [above].

Similarly, beginning in the 1950s, tigers were subjected to uncontrolled hunting in China after Mao Zedong declared tigers a pest as part of the Great Leap Forward program. As part of my doctoral research, I am assessing factors affecting local attitudes toward tigers in Chitwan National Park.

Chitwan National Park, established in 1973 and located within the Terai (lowlands) of Nepal, is a tiger conservation priority region that harbors an adult tiger population of about 125 individuals. It is also a top 25 global biodiversity hotspot that is under considerable development pressure from surrounding human populations. Approximately 49% of the Chitwan valley forests were converted to cultivation from 1961 to 1977. The human population doubled from 1971 to 1991, while as much as 75% of the total Chitwan population was subsisting on products harvested from the local forests.This pressure has great consequences for the ecosystem.

The annual rate of human deaths in Chitwan from tiger attacks increased six fold after 1999. Coupled with the threats to livestock, human-tiger conflicts place an enormous economic and psychological strain on local communities. Negative local attitudes towards tigers, resulting from human-tiger conflict, could derail conservation efforts that require cooperation and support of local communities. For instance, local people may retaliate to attacks or threats from tigers by killing them, often documented in this region, or by assisting illegal poachers bent on selling tiger body parts in a lucrative black market for decoration and traditional Asian medicines.

Factors affecting behavioral intentions of local people to protect tigers and support tiger conservation programs are a function of values and beliefs, expressed as attitudes towards tigers. It is vital to understand the factors that affect local attitudes toward tigers in order to reduce human-tiger conflicts and foster coexistence. However, we lack baseline research on the processes that underlie and determine local attitudes toward tigers.

Wildlife Acceptance Capacity (WAC) theory was developed by social scientists in the late '80s to resolve human dimensions issues arising from increasing conflict with growing wildlife populations in the U.S., including deer in the east, moose in the Adirondacks, black bears in Michigan, and cougars in the American West. WAC research seeks to identify the threshold at which individuals no longer accept the impacts from a wildlife species. Previous research indicates that WAC is strongly influenced by human attitudes toward wildlife that are a function of the impacts of wildlife interactions. It stands to reason that WAC would be well suited for international applications.

In March 2010, my colleagues and I trained local people from Chitwan to administer a survey

It is vital to understand local attitudes towards tigers in order to reduce human-tiger conflicts.

Some local people worry that their goats and other livestock are threatened by tigers [left].

I developed to 499 individuals randomly selected from an area less than 2km from the National Park (an area with approximately 5400 households) to evaluate tiger acceptance capacity (TAC). TAC was specifically measured as the tiger population size preferred 10 years in the future compared to the current population size (i.e., much less to much more) by an individual respondent. Survey results suggest that respondents living nearest to tigers value tigers in many ways (e.g., ecological, existential, utilitarian, religious, cultural) and support tiger conservation broadly. Yet, stakeholders are intolerant to impacts tigers may have on their livelihood and wellbeing.

Additionally, respondents expressed dissatisfaction with the efforts of government authorities to address human-tiger conflicts. Model results indicate that TAC was significantly associated with multiple dimensions of risk belief, attitudes towards tigers, cognitive risk perception (i.e., perceived likelihood of human-tiger conflicts occurring), and risk intolerance to threats to livelihoods and human health and safety. Attitudes toward tigers (e.g., nuisance, cultural significance) had the strongest effect on TAC.

Areas with low TAC require management actions to reduce antagonism toward nearby tigers and tiger conservation actions. Education and awareness programs that emphasize benefits of having nearby tigers (e.g., by reducing crop-raiding ungulates, maintaining cultural heritage) may improve attitudes towards tigers while fostering collaborative relationships between wildlife management agencies and local people. Additionally, providing means and venues for local people to communicate concerns about tigers and human-tiger conflict may alleviate feelings expressed in the survey that government authorities were not satisfactorily addressing human-tiger conflicts. My colleagues and I plan to share the results from this research to local people and wildlife managers in Chitwan in order to develop policies and programs that effectively reduce human-tiger conflict and increase tiger acceptance capacity.

Future conflicts between the resource needs of endangered wildlife and the demands of rapidly increasing human populations are predicted to increase in developing regions around the world. Addressing these challenging conservation issues requires the integration of human dimensions research into traditional conservation planning. Local capacity to tolerate wildlife impacts is important for resolving issues of wildlife abundance but also addresses wildlife scarcity. The methodological framework used in my research on wildlife acceptance capacity can inform strategies and decisions about how to more effectively facilitate coexistence between humans and endangered wildlife in increasingly human-dominated landscapes.


**About the Author...**

Neil Carter is interested in studying human-wildlife interactions, endangered wildlife conservation, human dimensions of wildlife management, wildlife behavior and habitat, and other related subjects. He is currently a Ph.D. candidate in the Department of Fisheries and Wildlife at Michigan State University. His doctoral research at the Center for Systems Integration and Sustainability aims to evaluate and understand the complex relationships between humans and tigers in and around Chitwan National Park in Nepal in order to advance tiger conservation efforts.

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Farming is important to local communities [inset] around Chitwan National Park [below].

# The 2009-2010 Fenske Fellowship:
## Climate Change and the Climate of Management

By: Abigail Lynch

Jan Fenske was the first female Fisheries Biologist and District Fisheries Biologist in the history of the Fisheries Division. Paving the way for equality, Jan was a skilled biologist and selfless mentor to future generations of fisheries professionals. The Janice Lee Fenske Excellence in Fisheries Management Fellowship honors Jan's legacy. The program is now in its fourth year and has supported five fellows. For more information, please contact Dr. Dana Infante (infanted@msu.edu) and visit: fw.msu.edu/fellowships.htm.

"Be prepared. Things aren't going to stay the same," said Dr. Kelley Smith, Chief of the Fisheries Division, Michigan Department of Natural Resources (MDNR). "That much we can agree on when it comes to climate."

Kelley, as he told me to call him the first day I walked in his office, is a vocal skeptic of anthropogenic climate change; I disagree. But we both believe that changes in climate will influence Michigan's fisheries, therefore these changes are important, whatever their cause. Together, we are working on a project for the Fisheries Division to better understand the effects of climate change on Michigan's fisheries to be better prepared for the future. This collaboration was made possible by my 2009-2010 Fenske Fellowship.

**Fenske Excellence in Fisheries Management Fellowship**

Jan Fenske (1954-2005) was the first female Fisheries Biologist and District Fisheries Biologist in the history of the Fisheries Division. The Janice Lee Fenske Excellence in Fisheries Management Fellowship, which provides underserved graduate students in the Department of Fisheries and Wildlife at Michigan State University (MSU) with experience in a management agency to navigate them toward successful careers in fisheries management honors Jan's memory, courage, and dedication to aquatic resource management. The Fellowship recipient is paired with a mentor both from a management agency and from MSU to collaborate on a project of mutual interest to the agency and the student.

I was honored to receive the 2009-2010 Fenske Fellowship for a proposal I developed with Kelley and my graduate advisor, Dr. Bill Taylor. My project was designed to provide the Fisheries Division with guidance on potential changes to Michigan's fisheries due to climate change and to develop a means for communicating these changes to the public and stakeholder groups. Although Dr. Taylor and I share similar views on the causes of climate change, I knew that Kelley would bring a different perspective to the project, thus strengthening my Fellowship experience and the impact of the work.

**Climate Change and Fisheries**

As part of my Fellowship project, we recently published a peer-reviewed article in the Journal of Fish Biology discussing the potential influence of climate change on the ecology and management of several important Great Lakes fisheries. As Bill and I made statements about climate change, Kelley would ask for evidence to substantiate our claims. As a result, our positions were well-supported because these discussions led to a thorough review of the literature. Our literature review concluded that abundances of some species will increase, while others will likely decrease; new parasites and diseases will emerge; and suitable fish habitat will change. Overall, the projections are for colder water fishes to seek refuge further north and deeper in the lakes and for warmer water fishes to fill in the vacated habitat.

Although these predictions are tempered by other factors, such as lake levels or oxygen, it is clear that climate change will have a significant influence on fisheries management and the public's perception of

**"Mentoring between the agency and the university is essential to prepare a more effective fisheries professional. If you do it right, you will be thinking of your research and management problems from a different perspective."-Dr. Bill Taylor**

the value of their fisheries. And it is the role of the manager to conserve these fisheries and facilitate the communication of this process to the public. In the context of climate change, my Fenske project is designed to do just that. By writing a draft climate change chapter for the Fisheries Division Manual of Fisheries Survey Methods, I am helping the Division plan for potential changes in fisheries and aquatic resources and am directly involved in the management process.

**Managing What? No, Managing Whom.**

My work with Kelley has taught me that fisheries biologists manage more than just fish and effective collaboration with the public is essential to the job. And climate change, he believes, will be an ultimate test in "people management." How will biologists adapt to changes in fisheries due to climate change? How will they teach Michiganders to adapt to differences in their fisheries resulting from climate change?

Kelley's classic example is Chinook salmon in Lake Huron. Chinook salmon, a popular fish native to the Pacific Northwest, was introduced in the 1960s into the Great Lakes both to prey upon non-native alewife and to provide recreational opportunities. As Chinook salmon accomplished the desired goal of reducing the abundance of alewife, they also reduced their primary source of food. When the quagga mussels also impacted the alewife population, the Chinook's once abundant source of food became scarce. The Chinook salmon population, and consequently the recreational industry dependent upon it, crashed. Concurrently, populations of recreationally-viable, naturally-produced alternatives such as walleye, lake trout, smallmouth bass, and northern pike, have rebounded. These species, however, do not yet have the same perceived economic and recreational value to the public as Chinook salmon, even though the present populations of these fish would have been perceived as highly valuable 75 years ago when the lake's native species were all in severe decline due to habitat degradation and overfishing.

From Kelley's example, I am learning how important perceived value and expectations of management are to the public. Although a Chinook fishery was non-existent 40 years ago, people came to rely on its economic output and recreational potential as the industry grew. They began to set expectations for management of Chinook populations that were unrealistic for the Lake Huron ecosystem without alewife.

The situation also highlights what Bill believes is a "major fallacy of management…. [W]e try to keep things the same. We don't know how to deal with dynamic change. All our institutions are set up to maintain the status quo." The collapse of Chinook salmon in Lake Huron captures this sentiment because it was abrupt and the existing management infrastructure was not prepared for it.

Rather than these immediate and obvious effects on ecosystems and economies, climate change impacts will be gradual across the landscape. Some systems may experience change with little evidence of effect until they reach a sudden threshold or tipping point when conditions may become dramatically different. This lengthened time scale should give managers an advantage to prepare the public to accept anticipated changes.

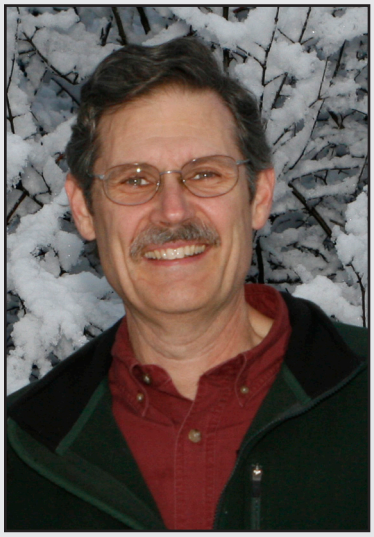
Through the lens of climate change, the Fenske Fellowship has changed my perspective on management. The issues are rarely clear-cut. Management is dynamic; a delicate balance between science, society, economics, and politics. Jan Fenske knew this and navigated it well. I can only aspire to such skill.


**Products of the Fellowship:**

Published Journal of Fish Biology article; MDNR Fisheries Division Manual Chapter; blog (please visit: fenskefellow.wordpress.com).

www.fw.msu.edu/~qwl

# Boone & Crockett Quantitative Wildlife Lab



Dr. Bill Porter
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I am delighted to join the department as the first Boone and Crockett Chair of Wildlife Conservation at Michigan State University. For someone with a passion for wildlife, this is an extraordinary position. The Department of Fisheries and Wildlife is among the finest in the world and the Boone and Crockett Club is the oldest conservation organization in North America. Both are dedicated to the conservation of all wild life in the sense of two words, rather than one, and the promotion of the highest ethical standards of hunting and fishing.

My students and I explore ecology of wildlife in relation to habitat, emphasizing the application of ecological knowledge to conservation policy. Most of our studies focus on larger vertebrates, including moose, wild turkeys, elk and white-tailed deer. More recently, we have ventured into the ecology of songbird communities. We often pair landscape-scale analyses with studies of local habitats to better understand ecological relationships and to offer new perspectives on management issues.

Together with postdoctoral Research Associates Drs. Amy Dechen Quinn and David Williams, and a new group of graduate students, we have established the Boone and Crockett Quantitative Wildlife Laboratory at Michigan State University. The mission of the lab is to aid the wildlife profession in adapting cutting-edge analytical tools to wildlife ecology. For example, we are using population modeling in conjunction with landscape ecology to better inform hunter harvest regulations.

In another project, we are applying occupancy modeling to evaluate the roles of climate change and land-use policy on biotic integrity of natural systems. A large study just now coming to completion employs recent advances in the analysis of movement behavior by animals and the implications to the spread of diseases in wildlife. Our goal is to use our local Quantitative Wildlife Lab in 17 Natural Resources Building as the cornerstone to a much larger program involving students and faculty in fisheries and wildlife programs at universities throughout the Midwest. Come and visit us.

## Nathan Snow

Nathan Snow is a new PhD student who hails from Michigan but comes to MSU via Colorado State University where his Master's thesis examined the effects of roads on the San Clemente Island fox. Nathan's doctoral research will investigate the landscape ecology of moose in the Great Lakes and Northern Forest. In particular, he will explore the roles land-use and climate change will play in altering the population dynamics of moose and, in turn, the impact those changes may have on moose-vehicle accidents.

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## Andrea Bowling

Andrea Bowling is a new PhD student who comes to Michigan State from the warmer climate of Florida where she did her Master's thesis on snail kites in the Everglades. Her research interests include population ecology and landscape ecology. Her dissertation work at MSU will evaluate the effects of habitat composition and configuration in conjunction with weather patterns to understand population fluctuations in wild turkeys. Andrea's work is intended to help reshape harvest regulations for wild turkey populations and enhance conservation of this species.

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## Dr. Amy Dechen Quinn

Amy Dechen Quinn completed a PhD in wildlife ecology last May at the State University of New York College of Environmental Science and Forestry in Syracuse. She has the distinction of winning a research award of more than $1 million that supported two doctoral students and three Master's students. This team deployed 100 GPS radio collars on white-tailed deer and produced a novel method for quantitatively assessing the use of habitat by deer and associated risk of spread of chronic wasting disease. Amy also holds degrees from Albright College and Penn State. Her research interests include the ecology and evolution of mammalian behavior, the influence of landscape structure on animal movements, and the ecology and management of wildlife diseases.

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## Dr. David Williams

David Williams is a post-doctoral Research Associate working in the quantitative wildlife laboratory. His Master's degree work was in marine fisheries at the University of Rhode Island and he completed his PhD in wildlife ecology last June at the State University of New York College of Environmental Science and Forestry in Syracuse. David brings a strong background in quantitative analyses. His dissertation explored new methods for describing how deer use space and he devised a method for quantifying the frequency of contact among deer. His research interests include animal movement ecology and the influences of landscape characteristics, modeling, disease ecology and modeling, and the development of quantitative methods for wildlife applications.

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## Marta Jarzyna

Marta Jarzyna is a new PhD student who is native of Poland where she earned a degree in engineering and environmental science. She comes to MSU via Penn State where her Master's work focused on the biodiversity of Albertine Rift Forests of Uganda. At MSU she is part of a larger team of engineers and ecologists who collaborate from the State University of New York in Syracuse, the Cornell Lab of Ornithology, and the National Aeronautics and Space Administration (NASA). This team is investigating the influence of climate change and land use dynamics on songbird biodiversity. The project involves using LIDAR to map vegetation in 3-dimensional space on a regional scale and using this information to develop land-use dynamics and biodiversity models.

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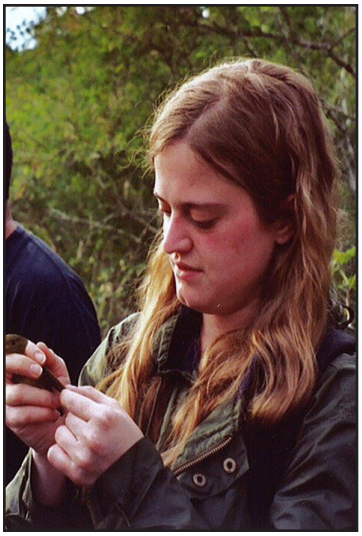

## Jodi Kreuser

Jodi Kreuser is a new Master of Science student who did her BS in Wildlife Ecology at the University of Wisconsin-Madison with a concentration on international agriculture and natural resources. Her interests include avian ecology, migratory bird behavior, occupancy modeling, and landscape dynamics. Jodi's research applies quantitative methods to evaluate the temporal and spatial landscape ecology of songbird communities in response to climate change. Her work takes advantage of the Breeding Bird Atlas program, a rare, complete statewide inventory of an entire taxon.

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# Alumni Corner

## with Jonathan Debora

**Spotlight:** What are you up to?

**Jonathan:** I'm a Research Fishery Biologist for the National Marine Fisheries Service (NMFS) in Woods Hole, MA. I'm the lead assessment biologist for Atlantic herring and Atlantic mackerel.

**Spotlight:** What is a typical workday for you?

**Jonathan:** I prepare data for a stock assessment model, develop a computer simulation of an Atlantic herring population, or prepare a manuscript. I attend seminars, talk with colleagues, read articles, and make almost daily trips to a phenomenal little bakery called Pie in the Sky, much like trips to the Dairy Store!

**Spotlight:** Who are the consumers of your research?

**Jonathan:** My target audience is managers, stock assessment scientists, and the broader scientific community. Typically, my research is published in National Marine Fisheries Service Reference Documents and peer reviewed fisheries literature, as well as conveyed directly to managers and management councils.

**Spotlight:** What classes at MSU best prepared you for your current position?

**Jonathan:** Jim Bence's Population Dynamics course and the lessons related to meeting facilitation and effective stakeholder communication in Mike Jones' Adaptive Management.

**Spotlight:** What do you wish you had done at MSU that you didn't have the chance to do?

**Jonathan:** I wish I had gone bowling at the Union.

**Spotlight:** What would help you now in your job or the kinds of collaborations you are currently involved in?

**Jonathan:** An infinite budget. More realistically, an intimate meeting of stakeholders and managers focused on one or two issues or fisheries would be helpful. NMFS holds many public meetings, but these often become shouting matches.

**Spotlight:** Is there anything in East Lansing you loved so much you want to recommend to new students?

**Jonathan:** FART, tailgating, Lugnuts Thirsty Thursday, Golden Harvest, Shoopers, GSO, road trips to Detroit, sporting events, the Dairy Store, and eating "Shicken" [Shikha's curry chicken].

**Spotlight:** What advice do you have for FW students who might want to follow in your professional footsteps?

**Jonathan:** Set aside time for doing things you love other than your job. My career is rewarding, but it can be demanding. Don't lose sight of family, friends, and hobbies.

**Spotlight:** Any Spartan stuff hanging in your new house?

**Jonathan:** Absolutely!! I've got a foam finger, a pom-pom, a cardboard helmet, and other odds and ends.

**Spotlight:** What are the biggest changes about the transition between school life and work life?

**Jonathan:** Making more money is good. Having real world responsibilities and hard deadlines is bad. Finding a long-term enjoyable occupation is good. Having limited vacation days is bad. The biggest relief has been learning that MSU prepared me extremely well for my career. Go Green!!!

Hamlin Lake near Ludington, Michigan.

# Does local policy affect inland lake water quality in Michigan?

Story & Photos By: Stacie Auvenshine


**About the Author...**
Stacie Auvenshine is currently finishing her masters in Fisheries and Wildlife at MSU. She began her career in natural resources management with a love for water and interest in protecting resources, which led her to the Resource Development program as an undergrad at MSU. She has now recently moved to Florida and is working for the Army Corps of Engineers.

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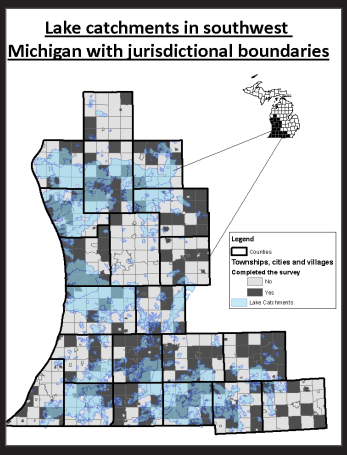
**Michigan is defined by water.** With 11,037 inland lakes, 3,288 miles of Great Lakes shoreline and 36,000 miles of streams, the state's aquatic resources require diligent management to preserve and protect both quality and quantity. Land use is a main driver impacting watershed ecosystem health. The local government in Michigan, which includes townships, cities and villages, each implement their own land use plans and ordinances, which consequently impact water quality. There are approximately 1,700 local jurisdictions in Michigan, which means there are 1,700 separate land use plans throughout the state.

Local government can also implement more stringent environmental regulations than required by state or federal agencies. This could include increased wetland protection, greater tree preservation, or bans on nutrients in fertilizers or detergents, such as phosphorus. Because of the vast number of government entities and independent policies, we would be remiss not to ask: Is local policy impacting water quality? Are local entities developing more stringent water quality policies than state standards, and if so, where and to what end? Finally, given the presence of several local government jurisdictions across watersheds, can we determine the effects of policy fragmentation on water quality?

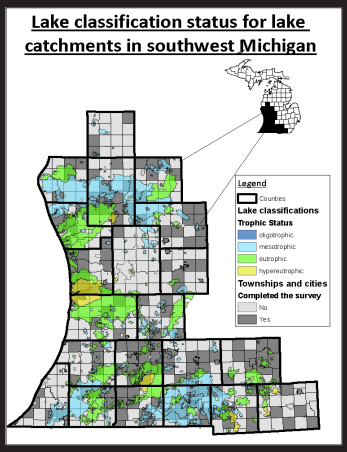
I have been investigating these questions as I examine whether and how local land use and local environmental policies are correlated with good water quality. The water quality response variable I am using is water clarity, which is determined with the predicted water clarity depths gathered through satellite imagery from the United State Geological Survey. Water clarity is a good indicator of water quality; for example, if water is clear, one can assume there is a limited quantity of algal bloom-causing nutrients, such as phosphorus and nitrogen. By correlating this data with descriptive information about local policies, I hope to determine which policies are improving water quality and which policies are not in order to provide evidence to policymakers about the characteristics of effective water policy.

To collect local policy data, I sent a survey to each local government in southwest Michigan, in which I asked for information pertinent to inland lake water quality, including: information about the zoning of the specific jurisdiction, open space requirements, and nutrient lawn care management programs (i.e. phosphorus bans). I will spatially show the answers to these policy questions for each jurisdiction by creating a map with Geographic Information Systems (GIS) to demonstrate where local policy is reflective of or stronger

Nordhouse Sand Dunes, Ludington, Mich. [far left]; stream near Kellogg Biological Station, Mich. [second from left]; Hawk Hollow, Bath, Mich. [second from right]; Hamlin Lake, Ludington, Mich. [right].




GIS map to show lake catchments in southwest Michigan jurisdictional boundaries.




GIS map to show lake classification status for individual lake catchment areas.

than state level regulations. Then, I will overlay the local policy layer with lake water quality and land use land cover to determine correlations between policy and clean water. I expect to see a correlation between strong policy implementation and good water quality within jurisdictions. However, because watersheds do not follow jurisdictional boundaries, it is possible that local policies may counteract each other and therefore will not greatly impact lake water quality. Thus, I will also look at the effects of this policy fragmentation. Our results may demonstrate a need for inter-jurisdictional collaboration to further increase the protection of natural features and water quality.

The map of lake catchments and jurisdictional boundaries demonstrates the significance of policy fragmentation in regards to the geographic locations of waterbodies. Because of the complex spatial scale of my research, GIS seemed to be the logical choice for analyzing and interpreting the data I collected. GIS has not previously been used as a tool to evaluate environmental programs and policies; rather, researchers generally utilize it for data analysis, problem identification or policy formation.

Recently, GIS has become widely available and used in environmental and natural resources management and is a valuable tool in understanding patterns of spatial variation and to simultaneously evaluate multiple factors such as land use, demographics, and landscape characteristics within a policy formation framework. I will use GIS as a tool to evaluate the direct effects of policy, rather than to create policy. My final evaluation will show where the local policy is strong, where water quality is good, where jurisdictional and watershed boundaries exist, and how these factors relate to the policy developed and its effectiveness in individual municipalities. In this study, the collection of policy data itself proved to be beneficial in understanding the degree to which the local government has environmental authority. Recognition of the importance of developing natural resource policy based on sound science is necessary for the effectiveness of policies. I examined the policy data using new approaches and also thought about the intentions, goals and outcomes of these policies.

***Policy has the potential to be proactive in helping to conserve our inland waters, rather than retroactive in trying to clean up a preventable mess.***

My research highlights a need for larger projects to track the policymaking process to its end product, and then re-evaluate and assess what should be done next. Policy has the potential to be proactive in helping to conserve our inland waters, rather than retroactive in trying to clean up a preventable mess. More research on the role of consumer behaviors and attitudes will be necessary to understand the larger picture, but my research fills an important foundational role in this needed convergence of policy and science.

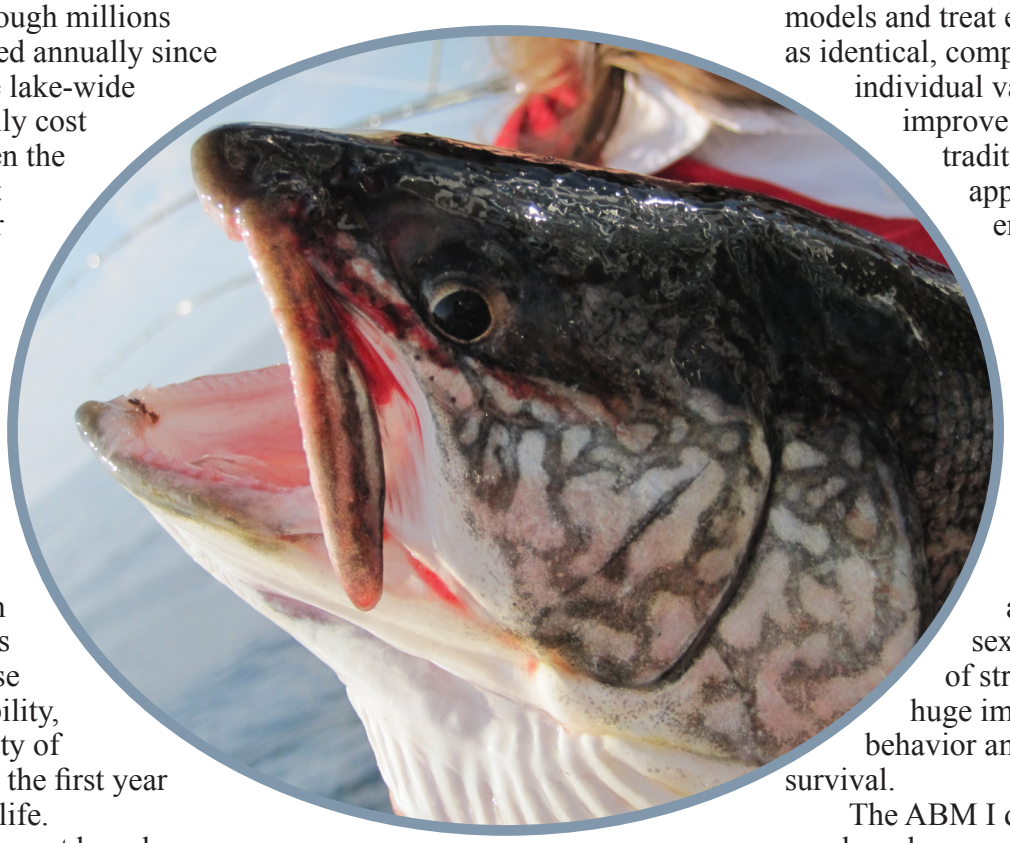
Because water is essential to Michigan, the Great Lakes region, and to the United States as a whole for recreation, health, aesthetic value, and local identity, protecting these resources with pro-active and science-based policies is necessary and important. Land use and environmental policy has the potential to greatly impact our inland lakes. Therefore, understanding the effectiveness of our policies on the quality of water is an essential step in making good policy in the future. Interdisciplinary research offers us the insight we need to move toward cleaner and healthier Michigan waters.

# Solving Ecological Problems Using Agent Based Simulation Models

By: Ben Schmitt

Since the mid 20th century, lake trout have had limited reproductive success in the Great Lakes and no one is quite sure why. Populations have not recovered from their decimation by sea lamprey predation and fishing pressure earlier this century, even though millions have been stocked annually since the 1960s. Since lake-wide studies are usually cost prohibitive, given the size of the Great Lakes, computer simulation is an attractive option to study the reproductive failure of lake trout. I am using an agent based model I developed for larval lake trout to explore which stressors, such as predation, disease and prey availability, cause the majority of mortality during the first year of a lake trout's life.

What is an agent based model (ABM)? Some might say ABMs are the key to unifying theoretical and experimental ecology. Others might say ABMs are data hungry monsters that produce nothing of value. I think the truth lies, as it often does, somewhere in the middle. One thing is certain; agent based modeling is gaining popularity. In the past decade, the technique has been used to explore the spread of pandemics, the fluctuations of markets and, in my research, to find out why young-of-the-year lake trout are not surviving to recruitment in the Great Lakes. Agent based models, in an ecological context, are similar to other population models where the system being modeled behaves according to some previously defined set of rules or equations and the output tells the modeler something about the properties of that particular system. The characteristic that sets ABMs apart from unstructured and biologically structured models is focus on specific traits of individual organisms, or agents.

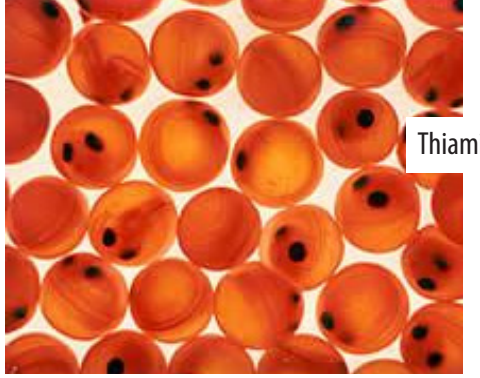


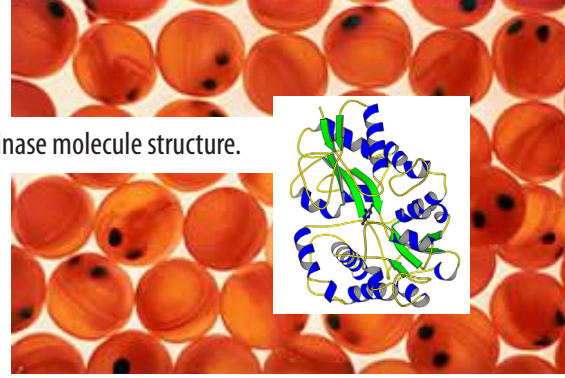
Recreationally caught lake trout from Lake Michigan [photo courtesy of Abigail Lynch].

In general, other ecological models are considered aggregate models and treat every individual as identical, completely ignoring individual variability. ABMs improve on these more traditional modeling approaches by embracing the differences between organisms. An individual's behavior is dependent on assigned traits specific to that individual. An individual's age, size, sex and level of stress can have huge implications for behavior and ultimately survival.

The ABM I developed was based on work by other ecologists, including my advisor, Dr. Cheryl Murphy, who have used these types of models to understand species interactions at various life stages of fish. Young fish experience high mortality from a variety of sources and the survival of newly hatched fish fluctuates widely from year to year.

Lake trout eggs.





Thiaminase molecule structure.

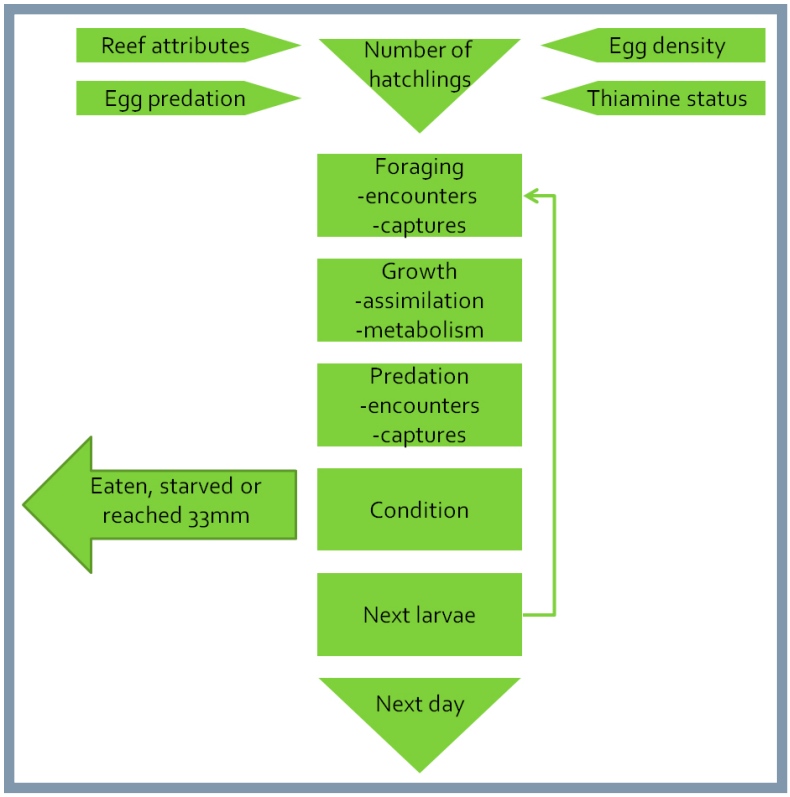
Using ABMs, fisheries managers can make more informed decisions about fishing regulations if they have a better idea of how many young fish survive each year when there are a given number of reproductive age fish.

I am particularly interested in the sub-lethal effects of low thiamine (vitamin B1), as a barrier to successful reproduction. Thiamine is essential in cellular metabolism. Some bacteria and plants can produce their own, but lake trout, like humans, must consume thiamine regularly. Low thiamine levels cause death or abnormal behavior in larval, juvenile and adult lake trout.

This condition, known as thiamine deficiency (TD), has been associated with adult lake trout's dietary uptake of the thiaminase enzyme, which degrades thiamine and is present in prey species at different concentrations. Alewives, an invasive species to the Great Lakes, have high levels of thiaminase activity and have induced TD when fed to lake trout in laboratory studies. Alewife were introduced to the Great Lakes via the Erie and Welland canals and have replaced the lake trout's traditional prey items, which have much lower levels of thiaminase activity.

The use of an agent based computer simulation is a novel and efficient way to explore the indirect effects of thiamine deficiency. The ABM simulates the daily activities of fish that make it to hatch and tracks their growth and survival until they become thiamine replete. Low thiamine affects larval traits like swimming speed, prey capture ability and growth rate which can be easily adjusted in the model

By varying average egg thiamine concentration, predation pressure and other model inputs, I can tease apart what effect these stressors have on survival. My ultimate goal is to use the ABM I created in conjunction with more field investigation to help pinpoint sources of mortality and aid lake trout restoration efforts throughout the Great Lakes.




Agent based model to investigate sub-lethal effects of low thiamine on lake trout [diagram created by author].

## About the author...

Ben Schmitt is a master's student in the Department of Fisheries and Wildlife working under the direction of Dr. Cheryl Murphy and Dr. Joan Rose. His research at MSU has been multidisciplinary and includes work on microbiology and toxicology projects, in addition to ecological modeling.

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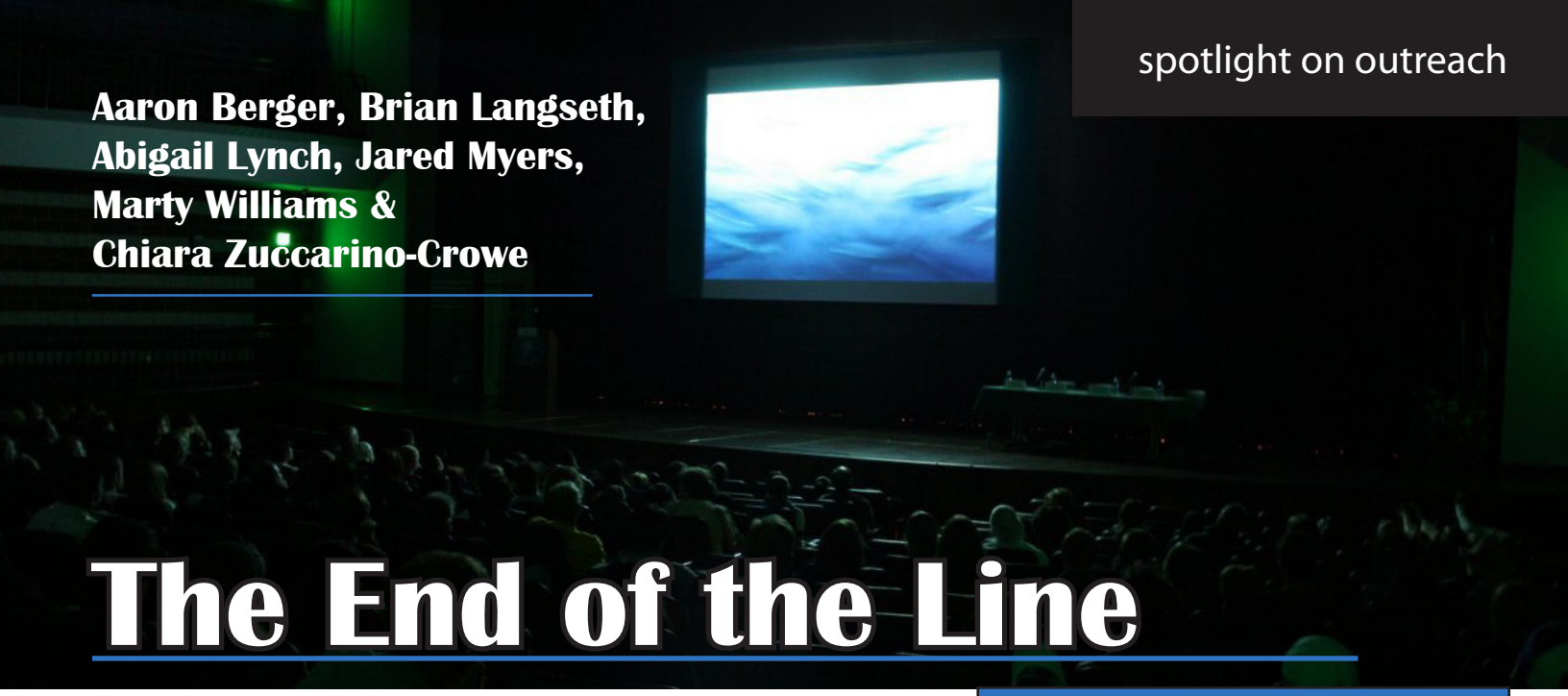
**Aaron Berger, Brian Langseth, Abigail Lynch, Jared Myers, Marty Williams & Chiara Zuccarino-Crowe**



# The End of the Line

Once considered inexhaustible, we know now that there is a limit to the oceans ability to meet the demands of humans. Overfishing is recognized as a major reason for the collapse of important fisheries and some scientists predict that harvesting fish at current rates will lead to catastrophic loss of marine species as early as midcentury.

The message that resonates from the environmental documentary film, *The End of the Line* is that the time to act is now. Directed by Robert Murray and based on the book by Charles Clover, *The End of the Line* weaves beautiful cinematography with persuasive scientific evidence on the state of the world's oceans. The value of the movie is not that it identifies mistakes, but rather that it offers realistic solutions.

The goal of our committee was to help the local community understand the issues associated with overharvest of marine resources. Although East Lansing is nearly 700 miles from an ocean, consumers still have a strong influence on the marine environment through their seafood purchases.

Generous contributions from our sponsors, the Department of Fisheries and Wildlife, the Fisheries and Wildlife Graduate Student Organization and the College of Agriculture and Natural Resources Alumni Association, allowed us to have an on-campus and off-campus screening of *The End of the Line* free of charge. Nearly 150 people attended the on-campus screening in Wells Hall and more than 350 people attended the off-campus screening at the East Lansing High School Auditorium.

We are hopeful that seeing *The End of the Line* will help members of the community see the importance of taking immediate action. As a community, the ball is in our court; and the time to act is now.


**TOP:** Community screening at East Lansing High School [photo by: Dan Linden]; **LEFT:** Event poster.

## FISH STATS

- **1 billion** – number of people who rely on fish as an important source of protein.
- **70%** – estimated portion of our global fisheries being fished close to, already at, or beyond their capacity.
- **1%** – estimated portion of the oceans designated as protected.
- **250%** – excess of global fishing fleets' size than the oceans can sustainably support.
- **1%** – portion of the world's industrial fishing fleets that account for 50% of the world's catches.
- **$9 billion** – annual worth of illegal fishing.
- **x 10** – increase in world tuna consumption over the past 50 years, from 0.4 million to over 4 million tons.
- **90%** – portion of the ocean's large fish biomass that may be fished out.

adapted from The End of the Line website at:
**www.endoftheline.com/campaign/fish_facts**

# How to be a savvy seafood consumer:

Though fish may help keep us healthy and happy, some methods of fish harvest are unhealthy for the environment and are depleting global fish stocks. As consumers, we have the ability to influence fishing practices and markets. By making educated decisions about which seafood we eat, we have the opportunity to curb overfishing of wild stocks and pollution from aquaculture.

***How can we be savvy seafood consumers?*** Overall, the best practice is to buy wild and buy local. Have you ever thought of how far your seafood has traveled to your plate? Take, for example, a fillet of salmon. While your neighbor may have recently caught a Chinook salmon recreationally on Lake Michigan, chances are the salmon you bought at the grocery store or ordered in a restaurant is farmed Atlantic salmon from Canada, or Norway, or even Chile. Often, the only way to tell the difference is to ask: Where did this fish come from? How was it caught or raised? There are many sustainable aquaculture operations operating in the U.S., but, especially in developing countries, fish farming can be a major environmental polluter and negatively impact wild fish species. Methods for wild harvest are also not all created equal. Trap nets, for example, are usually much more sustainable than gill nets because most of the fish caught in a trap net come up alive (so the unwanted 'bycatch' species can be thrown overboard with minimal casualties).

- **Buy local**
- **Ask where a fish is from, and how it was caught/ raised**
- **Tell your politicians to make savvy seafood choices**

There are many organizations, such as the Marine Stewardship Council and Seafood Watch, which provide up-to-date information on sustainable seafood practices, publically available for the savvy consumer. The educated consumer plays a vital role in promoting sustainable harvesting practices. We must all do our part!

# Species Profiles

## Atlantic Bluefin Tuna

**Market names**: Kuromaguro, Atun de aleta azul, Hon Maguro, Toro
**Demand**: global prized sushi
**Biology**: marine carnivore; highly migratory; slow growth; late maturity
**Population status**: worldwide decline (**overfished**)
**Management**: international

**AVOID**
- wild caught (worldwide)
- ranched (worldwide)

## Tilapia

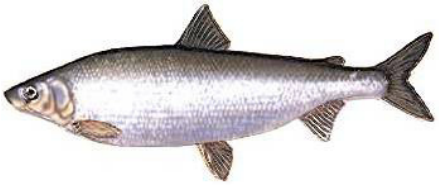
**Market names**: Tilapia, Izumidai
**Demand**: global mild white fish; important source of protein
**Biology**: tolerant freshwater omnivore; rapid growth; early maturity
**Population status**: farmed
**Management**: none (private industry)

**BEST CHOICE**
- farmed (United States)

**GOOD ALTERNATIVE**
- farmed (Central America)

**AVOID**
- farmed (China & Taiwan)

## Lake Whitefish



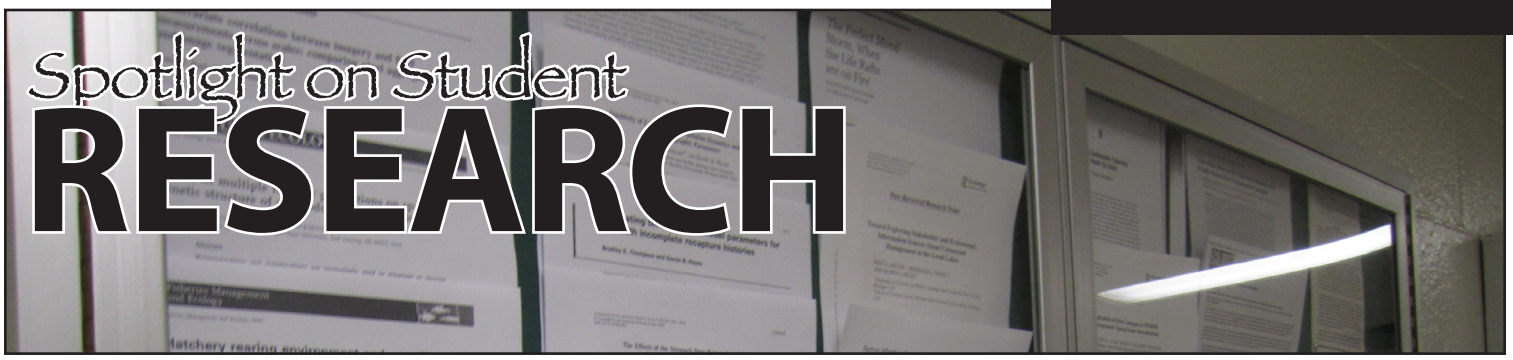
**Market names**: Whitefish, Sault Whitefish, Gizzard Fish, Grande Coregone
**Demand**: regional wild white fish
**Biology**: deep freshwater omnivore; long-lived
**Population status**: recovered in the Great Lakes from lows in the mid-1900s
**Management**: international

**BEST CHOICE**
- trap net (Lakes Huron, Michigan & Superior)

**GOOD ALTERNATIVE**
- gill net (Lakes Erie, Huron, Michigan & Superior)

*Source: Seafood Watch*
*Monterey Bay Aquarium*

# Spotlight on Student RESEARCH



Check out the brag board in the basement of the Natural Resources Building to see recent publications of our students, staff and faculty.

**Lissy Goralnik** coauthored a paper with Dr. Michael Nelson entitled "Framing a Philosophy of Environmental Action: Aldo Leopold, John Muir, and the Importance of Community," which is forthcoming in the *Journal of Environmental Education*. The essay juxtaposes the theory of environmental action implied by the works and life of John Muir with the philosophy of action suggested by Aldo Leopold's Land Ethic to illuminate the importance of a philosophy of action in determining one's approach to environmental decision-making. This discussion is important for environmental education and the ethics these experiences inspire because both philosophies advocate very different visions of environmental action.

**Lissy Goralnik** coauthored an article with Dr. Michael Nelson entitled "Anthropocentrism," which is forthcoming in *The Encyclopedia of Applied Ethics*. This article provides a framework for important theories in environmental ethics from the genesis of the field to the present. Through a discussion of anthropocentrism--the ethical belief that humans alone possess intrinsic value, while all other beings hold value only in their ability to serve humans, or instrumentally--the article articulates the importance of attending to how and what we value in the natural world, so that we can best honor these valuations with action.

**Lissy Goralnik** authored an article entitled "Ecofeminism," which is forthcoming in the *The Encyclopedia of Environmental Issues*. This short essay explains the basic history and present status of ecofeminism, the theoretical philosophy and activism that seeks to understand and address common cultural dualisms many scholars believe lie at the root of a problematic relationship with the natural world —mind/body, human/nature, male/female, rationality/emotion. Ecofeminism bridges the issues of feminism and environmentalism with the understanding that there are historical, theoretical and practical relationships between gender discrimination and environmental degradation.

**Abigail Lynch** coauthored an article entitled "The Influence of Changing Climate on the Ecology and Management of Selected Great Lakes Fisheries" that appeared in the 77th issue of the *Journal of Fish Biology*. This literature review concluded that abundances of some species will increase while others decrease, new parasites and diseases will emerge, and suitable fish habitat will change. Although these projections must be tempered by other factors, it is clear that climate change will have a significant influence on fisheries management.

**Bret Muter** coauthored a research note entitled "Toward exploring stakeholder and professional information sources about cormorant mangement in the Great Lakes" that appeared in the January 2011 issue of *Human Dimensions of Wildlife*. The paper revealed that social networks were the greatest source of information about cormorants for both professionals and stakeholders. Networks were viewed as more important than other information sources (such as the mass media) and were often cited as the first place people would go to get new information about cormorant management. These findings indicate a need to better understand how social networks function in the context of wildlife management.

**Mao-Ning Tuanmu** authored an article titled "Mapping understory vegetation using phenological characteristics derived from remotely sensed data" that appeared in the August 2010 issue of the *Remote Sensing of Environment*. This article reports an effective and practical remote sensing approach for obtaining detailed information on the distribution of understory vegetation across large spatial extents, which is essential for biodiversity conservation and wildlife habitat management. Using the phenological features of vegetation captured by high temporal resolution remotely sensed data, this approach overcomes the difficulty of isolating signals of understory species from those of overstory canopies. The generality, flexibility and extensibility of this approach further make it potentially applicable to different understory species and different geographic settings.

**Mao-Ning Tuanmu** coauthored an article titled "Range-wide analysis of wildlife habitat: implications for conservation" that appeared in the September 2010 issue of *Biological Conservation*. This article reports a habitat evaluation for giant pandas across their entire distributional range with an advanced remote sensing approach, which captures the information on both forest cover and understory bamboo for panda habitat characterization. This evaluation identified areas with significant ecological roles (e.g., corridors), identified areas suitable for giant panda reintroductions and established specific conservation strategies in different parts of the giant panda geographic range. The approach established in this study may also be used for assessing range-wide habitat status and thus facilitating the conservation of many other endangered species around the world. Also see the news on this study at http://www.examiner.com/science-news-in-detroit/joint-msu-chinese-research-finds-most-giant-panda-habitat-outside-nature-reserves.

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13 Natural Resources Building
East Lansing, MI 48824

**www.fw.msu.edu**

# FW SPOTLIGHT | Upcoming Events

## 6th Annual Graduate Student Research Symposium

### Friday, February 25, 2011

Learn about the diverse research being conducted by graduate students in the Department of Fisheries & Wildlife.

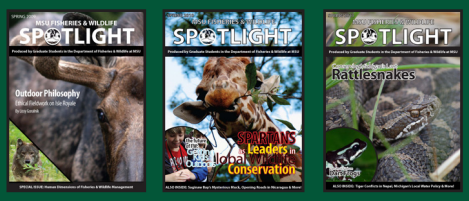
**MSU Union**
**All are welcome!**

Student Talks:
**9 a.m. to 5 p.m.**

Keynote Address: **5:00 p.m.**
Dr. Margaret Wild, National Park Service

For more information please visit:
**http://fw.msu.edu/gsosymp/**

## READ US ONLINE!




**www.fw.msu.edu/magazines/spotlight**

## 2011 MSU Bioblitz & 6th Annual Herp Survey

Come explore the natural areas on and near the MSU campus with local experts to learn about and search for amphibians, reptiles, birds, mammals and insects.

**Saturday**
**April 23**

**Meet at Commuter Lot**
SW Corner of Farm Lane & Mt. Hope

**06 AM:** Session I
**08 AM:** Breakfast
**09 AM:** Session II
**12 PM:** Lunch
**01 PM:** Session III

### For More Info:

https://www.msu.edu/user/fwclub/

### Sponsored By:

- MSU Herp Club
- Fisheries & Wildlife Club
- Graduate Student Organization