MSU Fisheries & Wildlife

SPOTLIGHT

Spring 2018

Produced by Graduate Students in the Department of Fisheries & Wildlife at Michigan State University

HOW MUCH WOOD COULD A WOODCOCK WANT?

CHANGING PERSPECTIVES: THE SOCIAL LANDSCAPE OF WILDLIFE CONSERVATION

ENGAGING LOCAL COMMUNITIES IN RESEARCH: BONEFISH CONSERVATION IN THE BAHAMAS

ALSO INSIDE: Alumni Corner, Pattullo Essay, Dr. Hayes Lab Profile and more!

SPOTLIGHT

Spring 2018
Issue 14

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

MAGAZINE COMMITTEE

Coordinator
Paige Filice

Assistant Coordinator
Allie Shoffner

Copy Editor
Kathryn Frens

Design Director
Samantha Stanton

Editing Subcommittee
Sophia Chau, Jon Cook, Tyler Firkus, Ashley Huinker, Kelly Kapsar, Emily Liljestrand, Anne Scott, Leslie Skora, Sam Thiede and So-Jung Youn

Design Subcommittee
Sarah Burton, Christopher Hoving, Yingjie Li and So-Jung Youn

Special thanks to our contributing authors and the Department of Fisheries and Wildlife for financial assistance provided toward printing this magazine.

For electronic copies of current and past issues, please visit
msufwgso.wix.com/fwgso

480 Wilson Road
East Lansing, MI 48824
www.canr.msu.edu/fw

Cover photo: Chris Henderson's photo of boats at Isle Royale National Park

Contents

Photo credit: Chris Henderson

Letter from Dr. Scott Winterstein

In the late 1960s there was a television western starring Walter Brennan called The Guns of Will Sonnett. So what, you are probably asking, does a western from my youth have to do with the 2018 edition of Spotlight? Well, the tag line for the show was "no brag, just fact." The year-in and year-out outstanding quality of Spotlight is further proof that the Department of Fisheries and Wildlife graduate students are indeed the best of the best – innovative, professional and dedicated. No brag, just fact.

Everyone involved in putting this issue together deserves a round of applause. Particular recognition goes out to Paige Filice (Coordinator), Allie Shoffner (Assistant Coordinator), Kathryn Frens (Copy Editor), Samantha Stanton (Design Director) and the multi-membered Editing and Design Subcommittees.

A cross-section of the wide variety of meaningful research conducted by the Fisheries and Wildlife graduate students is on display in this issue. Allie Shoffner recounts the first year of her multi-year doctoral project on woodcock in Michigan, the goal of which is to improve woodcock reproductive success. Christopher Hoving's essay provides a personal reflection on his experience using fire to reclaim wildness. How can you not read an article that begins, "Everything was going great until the fire engine pulled into my driveway…?" The recreational bonefish fishery is an important part of the Bahamian economy. Georgiana Burruss reflects on efforts to limit bonefish habitat degradation through secondary school education programs, collaborative research and outreach to industry. Chris Henderson's article, Changing Perspectives: The Social Landscape of Wildlife Conservation, examines the complex and nuanced impacts of changing societal norms on conservation. Joel Betts guides us on a journey through the social, political and economic pressures imperiling protected areas in southeast Nicaragua. Each issue of Spotlight highlights the Pattullo Fellowship awardee's winning essay. This year's Pattullo Fellow is Talitha Pam from the Department of Community Sustainability, whose entry, The Birdsong, is an environmental coming of age story.

Dr. Julia Colwell (M.S. 2013 and Ph.D. 2016) is interviewed for the Alumni Corner. Dr. Colwell is currently a Visiting Professor at Drexel University. This issue's Lab Profile highlights the wide-ranging projects that Dr. Dan Hayes and his students are conducting. You can find the FW Photo Contest Winners on the back two pages. In this issue, you will also find profiles of some of the department's fellowship awardees. Through a host of endowments, created and supported by alumni, stakeholders and friends of Fisheries and Wildlife, the department is able to recognize deserving graduate students. Congratulations to all the award and fellowship recipients.

Please enjoy this issue of Spotlight. After you have read it, pass it on to a friend or a stranger – don't worry, I can always get you another copy. In addition to leaving them in administrative offices around campus, I have also left copies in my doctor's office and given them to people on airplanes. Everybody should know how good we are. No brag, just fact.

- Scott Winterstein

Ph.D., 2016

Julia Colwell

What did you work on while you were a student at MSU?

For my Master's, I worked in India understanding how fishermen adapt to multiple and sometimes conflicting regulations at the community, district, and state level. My Ph.D. work was also in India, where I studied the unintended consequences of an annual closed fishing season on peoples' livelihoods, resource use patterns, and fish populations. As part of my graduate work, I studied a year of Hindi and four years of Tamil under Foreign Language and Area Studies (FLAS) fellowships both in the US and in India to learn the language necessary to do qualitative fieldwork.

Where are you now and what do you do? Is it what you intended to do after MSU?

I am a Visiting Assistant Professor at Drexel University, teaching in their Center for Interdisciplinary Inquiry within the Honors College. I develop and teach courses on two themes: water and community. When I started at MSU, I had no idea what I wanted to do, so teaching wasn't on my radar! All I knew when I came to MSU was that the jobs I saw people doing that I found interesting required a Ph.D.

What motivated you to apply for your current position?

My Ph.D. was interdisciplinary, with focus areas in fisheries management, sustainable livelihoods, natural resource governance, and gender, justice and environmental change. When I saw the post for a visiting scholar to teach interdisciplinary courses around the theme of water (I know, super broad!) I thought it was an awesome opportunity. Additionally, since most courses are co-developed and co-taught with faculty from different departments at Drexel, I've learned a ton about teaching, course planning, and development from experienced teachers.

What's your favorite thing about your current position?

The Center I work for is supportive of trying new and alternative teaching pedagogies, and there is a budget for developing field programs and bringing in guest speakers, which makes the courses dynamic both for students and me! Most recently, I developed a field course with the help of another FW grad, Jason Smith. Throughout this program, we learned from MSU professors, state and tribal government officials, and tribal representatives, in addition to doing active field research with the Natural Resource Department of the Little Traverse Bay Band of Odawa Indians.

What experiences at MSU best prepared you for your current position?

First, being a Teaching Assistant gave me great teaching experience and I'm not sure I would have qualified for my current position without it. Secondly while at MSU, I spent three months in India studying Tamil under a FLAS fellowship, and another nine months there for my dissertation research on a Fulbright scholarship. Now, I work closely with the fellowships office here at Drexel, mentoring students on their applications for different grants. Third, working with the communities in India has prepared me well to teach courses around the theme of community. Finally, becoming familiar with others' work at MSU helped me understand topic areas I teach now.

Do you have any advice to share with current fisheries and wildlife students?

Yes! MSU has amazing opportunities and you should take advantage of them. It's easy to get bogged down with your work, but take time to branch out and learn about others' work as well. All of the experiences you gain will shape your trajectory forward.

WILD FIRE

Everything was going great until the fire engine pulled into my driveway with red lights ablaze and sirens screaming. In retrospect, it is not hard to see why. Four of the eight acres of old field that comprise my property were on fire, and the column of smoke stretching into the clear blue sky was truly impressive. Not only that, but it was clearly visible from the nearby interstate. As the stern looking firewoman descended from her truck, I explained that the fire behind me was a prescribed burn. I had a plan. I had a permit. After assuring herself that I had the situation under control, that this was not a wildfire, she and her crew of firefighters left.

Photo credit: Chris Hoving

This autobiographical sketch could be an introduction to the story of the loss and restoration of Michigan's prairie and savanna ecosystems and the important role of periodic fire. But it is not. Instead, I want to use the fire and its aftermath to illuminate a deeper and more fundamental issue in modern wildlife management. Is wildness itself a realistic management goal, and if so, how can conservationists manage wild systems (terrestrial and aquatic) in ways that increase rather than decrease wildness?

I turned around an emergency vehicle using a plan, a permit, and the assertion that there was no wildness in the fire that I had set. That plan and permit represented many hours of thought and planning to ensure that the fire and smoke would not endanger me, my friends, or the drivers on the nearby highway. And yet, the fire was my attempt at reintroducing a little bit of wildness to an otherwise thoroughly ordinary old field that had a long history of mowing and pasture. My property is surrounded by neighbors who mow their acres, as if living on a golf course were their highest ambition. In that context, the fire and the jumbled expanse of grasses, Canada thistle, and tall goldenrod on my property were an island of wildness in a sea of smooth lawns, straight lines, and rectangles. They mow. I burn.

by Christopher L. Hoving

Photo credit: Chris Hoving

The last flames exhausted themselves just after sunset. Twilight was falling. As I watched the tendrils of smoke rise here and there from the blackened earth, I began to relax. I realized just how tense I had been. (The fire engine had not helped.) Grass fires produce less heat than forest fires, but they can still be deadly. Aldo Leopold, the father of modern wildlife management, died in a grass fire in his beloved sand hills of Wisconsin. I had not appreciated how difficult orchestrating a prescribed fire could be until it was over.

Thoreau once said that "in wildness is the preservation of the world." The challenge today is reversed: how to preserve wildness in a crowded world. Preserving wildness is itself fraught with contradiction. Rodrick Nash, in his seminal book, Wilderness and the American Mind, notes the paradox that is wilderness management. Preservation of wilderness requires plans and rules, and yet plans and rules are anathema to wildness.

The day after burning half my property, I set to planting. The seeds of native grasses and wildflowers have difficulty germinating in the thatch of dead grass that builds up over time in an unburned grassland. This scorched earth was a chance for me to return to the seedbank species that had been absent from my neighborhood for over a century: big bluestem, silphiums, and coneflowers, among others. I even planted several young burr oak trees. Of the many types of oak savanna that comprised roughly 8% of Michigan's landscape in the early 1800s, burr oak savannas were the first to be lost. None remain. They are entirely extirpated from the state. What I was attempting that morning was something closer to a community level de-extinction project than a savanna restoration.

Order seems to emerge spontaneously from wild nature. This emergent order surprises and intrigues us. If we think back to our start as scientists, for many of us it was this enigma of pattern that started us on this professional path. We want to explain pattern. Perhaps it was a pattern in a landscape, or the markings on a mollusk shell, or a line on a plot of data. Wild patterns are something between the order of an engineered artifact and the chaos of true randomness. Wildness is that which is not imposed by design. It bubbles up and self assembles independent of human construction. It is the wildness of Darwin's tangled bank, a profusion of diversity of pattern arising by some internal process. Wildness is emergent self-organization, and both emergence and self-organization are signatures of complex adaptive systems.

Complexity theory, I think, is the key to the understanding and conservation of wildness. Human design is to attempt to control the pattern at the scale or level of the pattern, but complex adaptive systems emerge from many interactions of diverse agents at a lower level. Thus, understanding (and if necessary conserving) processes and conditions of interactions is necessary to conserve the wildness of a system. Wildness itself can a viable goal, but the approach is less like planning; it is more emergent, more like cultivation.

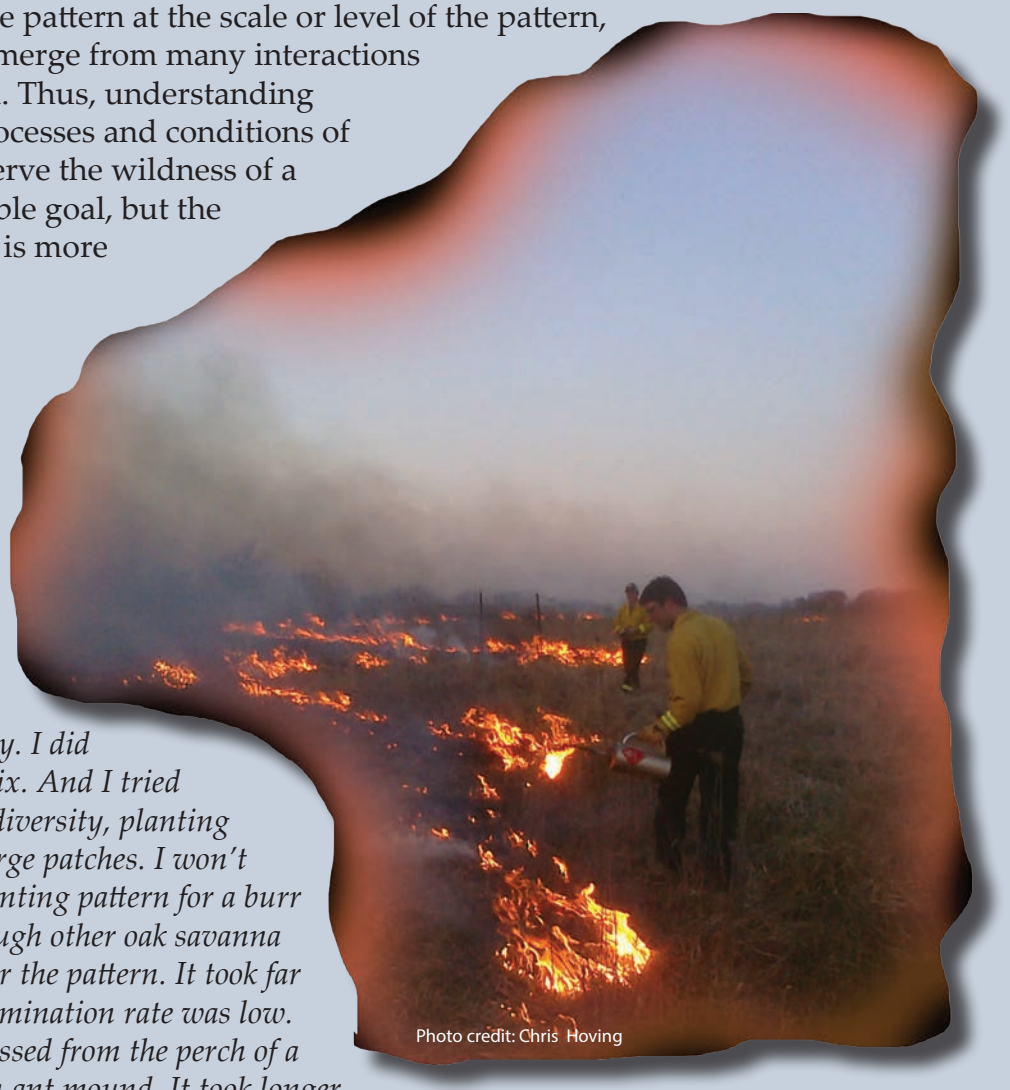


Photo credit: Chris Hoving

As I planted seeds into the blackened earth of my property, I considered pattern. I could have planted the field with a tractor pulling a seed drill. All of the seeds evenly mixed together and planted evenly in rows. That would have been the way I was trained. It would have been efficient. Instead, I scattered the seeds of each species individually. I did not mix my seeds into a uniform mix. And I tried to mimic natural patterns of plant diversity, planting in many small patches and a few large patches. I won't pretend I knew exactly the ideal planting pattern for a burr oak savanna, but I have visited enough other oak savanna remnants to develop an intuition for the pattern. It took far more time than a seed drill. My germination rate was low. But I found things I would have missed from the perch of a tractor: a burned over duck nest, an ant mound. It took longer. It was much less efficient. But I hope that in some small way, I added a bit more wildness to my emerging savanna.

This essay won an Honorable Mention for the Pattullo Fellowship in 2017. Christopher Hoving is a Ph.D. Candidate studying Fisheries and Wildlife under Dr. William Porter. He can be contacted at hovingch@msu.edu.

Department of Fisheries & Wildlife Fellowship Awards

The Hal and Jean Glassen Conservation Medicine Fellowship recognizes a student committed to the study of fish and wildlife disease ecology and conservation medicine.

Arthur Bienvenu Muneza

Advisor: Dr. Robert Montgomery

Graduate Program: Fisheries and Wildlife, Ph.D.
Graduate Research: Examining the effect of Giraffe Skin Disease on giraffe-lion interactions.
Motivation to apply: My interest is to better understand Giraffe Skin Disease, which has been neglected by the scientific community; yet giraffe populations have declined by 40% in the last two decades. The disease manifests as chronic and severe scabs, wrinkled skin, and encrustations that can afflict the limbs or upper regions of giraffe.
Benefits of Fellowship: My Master's research revealed that the disease has been recorded in protected areas in 7 countries in sub-Saharan Africa and is prevalent in zoos across the world but more research is required to understand the disease. This fellowship provides financial support to collect data to assess the severity and seasonal variation of the disease.

The Dr. Howard A. Tanner Fisheries Excellence Fellowship recognizes students who are committed to fisheries research related to the Great Lakes or connecting waterways.

Ryan Andrews

Advisor: Dr. Daniel Hayes

Graduate Program: Fisheries and Wildlife, M.S.
Graduate Research: My research focuses on understanding the effects of flow on thermal dynamics of streams to improve aspects of Michigan's Water Withdrawal Assessment Tool. I compare different threshold detection methods for potential use in defining thermal habitat of Michigan stream fishes. I also model downstream temperature change as a function of stream discharge to predict the impacts of flow reduction on downstream warming rates. I am comparing results of the threshold and downstream warming models with currently-used methods to improve the flow-fish response relationships.
Motivation to Apply: This fellowship supports students focused on fisheries research in the Great Lakes Basin. I was motivated to apply because my research will improve a critical tool used to protect thermal habitat of Michigan stream fishes.
Benefits of Fellowship: I am honored to represent Dr. Tanner and the Department of Fisheries and Wildlife by performing research to benefit Great Lakes fisheries.

The Janice Lee Fenske Excellence in Fisheries Management Fellowship honors the first female fisheries biologist with the Michigan DNR, Jan Fenske. It is designed to facilitate interactions of a graduate student with professionals from an agency through the implementation of a fisheries project.

Erin Tracy

Advisor: Dr. Dana Infante

Graduate Program: Fisheries and Wildlife, M.S.
Fenske Mentors: Gary Whelan, Michigan Department of Natural Resources (MNDR), Dr. Joe Nohner, Midwest Glacial Lakes Partnership (MGLP) and MDNR.
Motivation to Apply: I was motivated to apply to the Fenske Fellowship because of my interest in natural resource management and the opportunity to work closely with agency mentors. Gary Whelan and Joe Nohner have devoted a great deal of time and attention to guiding me through my project and have been very open in talking about their own careers as fisheries managers.
Fenske Project: My project is to evaluate the development and implementation of a decision support tool initiated by the MGLP to aid in managing and restoring lakes throughout the Midwest. This project will allow me to gain a deeper understanding of how managers are currently using decision support tools and if we can better tailor them to management needs through evaluation and incorporation of user feedback.
Lessons Learned: Through this project, I have a better understanding of the management challenges my mentors encounter on a daily basis and the advantages of forming agency partnerships to pool the collective knowledge of managers across the Midwest to address these challenges.
Application Beyond Fellowship: The Fenske Fellowship has provided a firsthand look at the inner workings of the MDNR and the MGLP, the development of new skills, and the opportunity to continue making valuable connections with the Midwest natural resource management community.

The Robert C. Ball and Betty A. Ball Fisheries and Wildlife Fellowship provides graduate students with the opportunity to study fisheries, limnology, or water research.

Laura Twardochleb

Advisor: Dr. Phoebe Zarnetske
Graduate Program: Fisheries and Wildlife, Ph.D. and Ecology, Evolutionary Biology and Behavior Program
Graduate Research: Climate and land use effects on freshwater ecological communities, from local species interactions to continental biodiversity patterns.
Motivation to Apply: I was motivated to apply for the Robert C. Ball and Betty A. Ball Fisheries and Wildlife Fellowship to fund my field and experimental research at Kellogg Biological Station. My lab did not have a grant to support my research, and thus I sought small grants to cover my expenses.
Benefits of the Fellowship: The Ball Fisheries and Wildlife fellowship provided funding for my field and experimental research at MSU's Kellogg Biological Station, where I investigated how predator-prey interactions of freshwater organisms will change with climate warming, and how rising temperatures will alter the structure of freshwater food webs.

Joel Betts

Advisor: Dr. Jerry Urquhart
Graduate Program: Fisheries and Wildlife, M.S.
Graduate Research: I am investigating the impacts of illegal deforestation and fishing on water resources in the forest reserves and indigenous territories of Southeast Nicaragua. I will be assessing the response of stream macroinvertebrates, shrimp, and fish communities to chemical fishing practices and in-stream habitat degradation. I hope that my results can be used for advocacy and fundraising efforts towards improving food security for the Rama-Kriol people and protecting the region's rich biodiversity.
Motivation to Apply: Prior to applying I had no funding for my research so I applied for this fellowship and every other small grant I could find.
Benefits of the Fellowship: This provided funding for my research supplies and last summer's field work! I conducted a pilot study which prepared me for a 10 month stay. I am thankful to the Ball family and fellowship committee for this opportunity!

The Vera M. Wallach Fellowship is awarded to students studying wildlife management, ecology, or natural resource management or conducting Arctic and Antarctic research with emphasis on the protection and preservation of wildlife.

Kelly Kapsar

Advisor: Dr. Jianguo (Jack) Liu
Graduate Program: Fisheries and Wildlife, Ph.D.
Graduate Research: I study coupled human and natural systems and their telecoupled relationships with distant locations. My dissertation research is focused on the Bering Strait region of Alaska.
Motivation to Apply: I want to structure my research questions so that they will provide useful information not only for academia, but also for managers, practitioners, and communities in the Arctic. To this end, I applied for the Wallach Fellowship in order to travel to Alaska to learn about current research and how my dissertation can contribute to the existing body of knowledge.
Benefits of the Fellowship: The funds allowed me to meet face-to-face with fifteen plus professionals working in or researching fields related to my dissertation. In-person communication is highly effective, and I learned about collaborations, social networks, and projects that exist outside of the sphere of academic literature. Furthermore, I am developing community-engaged partnerships for my research initiated through these meetings.

Jacalyn Beck

Advisor: Dr. Robert Montgomery
Graduate Program: Fisheries and Wildlife, Ph.D.
Graduate Research: My research focuses on the ecological drivers of human-wildlife conflict in Tanzania. Specifically, I aim to better understand how the behavior of individual lions leads to negative interactions with livestock and herders.
Motivation to Apply: The Vera M. Wallach scholarship is for MSU students studying ecology or natural resources with special emphasis on those working to protect and preserve wildlife. This perfectly suits my research efforts as I hope that the results of my study will lead to improved herding practices and a decrease in lion killings across the region.
Benefits of the Fellowship: This award helped me to purchase equipment necessary for my first field season in Tanzania. I am honored to have been chosen for the Vera M. Wallach scholarship and know that it was integral to my success this year.

Engaging Local Communities in Research: Bonefish Conservation in The Bahamas

By Georgiana Burruss

Photo credit: Georgie Burruss

The angler, balancing on one leg, slips the other silently forward, toes first, in the silty water and progresses slowly across an expanse of shallow water on a well-known Bahamian flat. Just ahead, a small school of bonefish cruises through the water, stopping occasionally to nose into the sediment for worms, crabs, and shrimp. The school's movement generates a bow wave that gives away their position to the angler whose well-placed fly gently lands right in front of the school. The lead fish turns on the fly and gulps the treat. Setting the hook, the angler whoops loudly, but the celebratory noise spooks the schooling bonefish, who scatter. The reel spins to life. The rod bends. The fish breaks off. And, with a sigh, the angler straightens, and the chase continues.

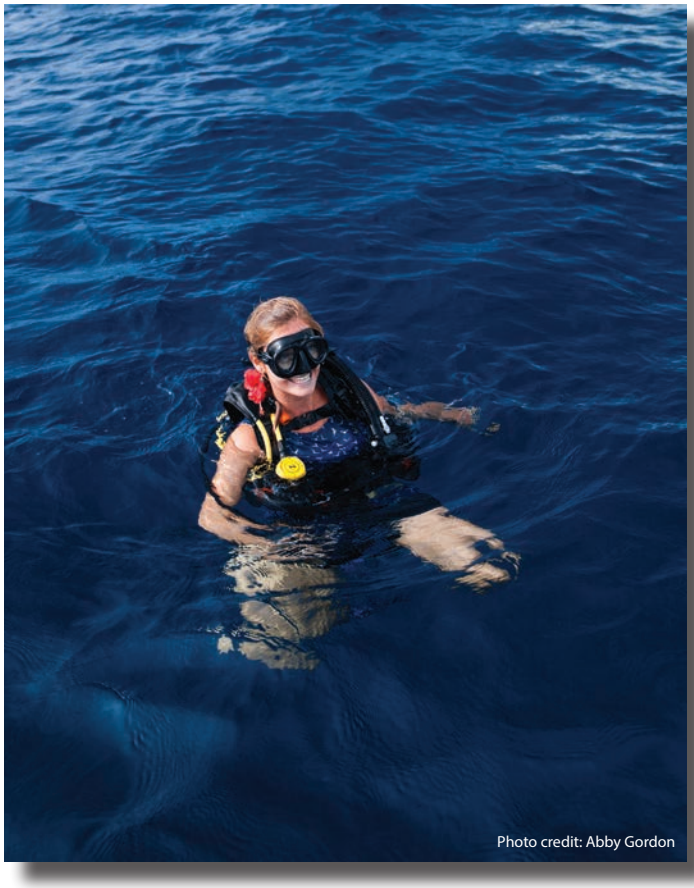


Photo credit: Abby Gordon


Photo credit: Christina Darville

This recreational catch-and-release fishing industry generates over $141 million USD annually for the Bahamian economy.

Anglers from around the world travel to the shallow waters of The Bahamas for a shot at catching a bonefish. This recreational catch-and-release fishing industry generates over $141 million USD annually for the Bahamian economy. Much of the revenue is generated on the Family Islands of The Bahamas, where this industry constitutes up to 80% of the local economy. Tourists stay in bonefishing lodges and hire local guides to escort and advise tourists on ideal fishing locations and techniques. Unfortunately, bonefish are listed as Near Threatened. In The Bahamas, unchecked coastal development and illegal netting are the largest threats to this nearshore species. Bonefish spend most of their adult life stage in the nearshore environment, in tidal flats and mangrove creeks, making them particularly susceptible to habitat loss through coastal development. Illegal netting and harvesting of bonefish occurs throughout The Bahamas. The aim of my research is to increase protection, conservation, and effective management of bonefish. To accomplish this, our research team developed and conducted outreach initiatives designed for local schoolchildren and industry stakeholders.

To increase local knowledge of the importance of bonefish, we designed hands-on research programs for local secondary school students. We took a holistic ecosystem-based approach to this initiative, with the aim of teaching students the importance of mangrove creeks as fish habitat and how these habitats matter to students directly. The students' knowledge of mangrove ecology was assessed before a short lesson on fish nursery grounds and ecosystem connectivity. We then block seined a mangrove creek: this technique uses a 100 m long seine net to block off the mouth of a mangrove creek at high tide. At low tide, we worked together to corral the megafauna in the creek, encircling juvenile sharks, turtles, and fish species with the net. The students then assisted with tagging bonefish and juvenile green sea turtles, adding to long-term mark-recapture datasets. By using this hands-on approach, students engage closely with the animals and developed an appreciation for mangrove creeks and their inhabitants. As a group, we discussed the threats to mangrove creeks and how the students and community members


Photo credit: Christina Darville

can mitigate these threats. The students walked away from the event with an understanding of the importance of these habitats in their backyard as well as how science can help with their protection and conservation.

The Fisheries Conservation Foundation, the North Riding Point Club, and H20 Bonefishing hosted the Bahamas Bonefish Conference to engage industry partners, to share scientific knowledge with stakeholders, and to facilitate discussions on bonefish management and conservation. I was invited to present on my ongoing project related to tracking bonefish spawning migrations. Bonefishing guides were particularly interested to hear about high predator abundance at prespawning aggregation sites, where clients are sometimes taken to fish. They quickly understood that fish are less likely to survive after release in these areas of high predator abundance. Guides also helped identify knowledge gaps that they believe are important for safe and sustainable catch-and-release angling of bonefish. Guides are out on the flats daily with these fish and, therefore, have a more intimate knowledge of the fishery than scientists. Sharing knowledge in a formal capacity is critical to creating holistic, effective management plans for the fishery.

At the conference, we discussed current knowledge gaps, issues with fishing regulations, and efforts to engage local youth in the bonefishing industry. The Ministry of Tourism is partnering with local guides to generate school programming that encourages students to consider guiding as a career path. I discussed with this group how to incorporate our interactive, hands-on approach which has been tested on Eleuthera, into a program that will be implemented in schools across The Bahamas.

Protection of habitat will play a critical role in the conservation of bonefish. In a small island nation, a first step towards limiting habitat degradation is building local awareness of the importance of fish habitat to the livelihood of the island's residents. Whether by doing fieldwork hand-in-hand with local students or collaborating with industry partners, developing effective management plans will arise from connecting science with stakeholders.

In a small island nation, a first step towards limiting habitat degradation is building local awareness of the importance of fish habitat to the livelihood of the island's residents.

Photo credit: Christina Darville

Georgie is a Masters student working with Dr. Amber Peters. With acoustic telemetry she tracks migrations of bonefish, *Albula vulpes*, locates reproductive habitat, investigates environmental cues for migration, and understands predator/prey dynamics at spawning aggregations. She can be reached at burrussg@msu.edu.

The Birdsong
By Talitha Pam

Mama said I was born with the hands of a fisherman—just like papa and grandpa: strong and wired.

All my life, all I wanted was to be a fisherman and do a fisherman's job. The silence of the boat as we glided on the lily-covered water calmed me. The melodic symphony of the birdsong comforted me. The frenzy of the catch as we hauled in the fish excited me, and the smell of roasting fish satisfied me.

Papa liked it too when I came with him to catch fish. He said he needed the extra hands because he had to go deeper and further into the big water. Ever since the oil companies came, the rivers and creeks had a film of black oil on them. We constantly had to go further from home to get a good catch because of the black poison in our river...

...That evening, Papa's face was long and solemn. We had been on the river for hours, but there had not been much to catch. The birds had not sung either; it was as if they were sad, too. Papa ate his dinner slowly. Mama sat beside him on the colorful mat made from the raffia that was harvested from the forest around us and woven by Mama herself. Mama and the other women harvested raffia, snails, leafy edible vegetables, and roots from the forest for market.

"The water is polluted and the fish are dying," Papa said. "I urged for caution when things started getting out of hand, but no one listened. We have been deceived by the oil companies. Underneath their petty projects they are simply polluting the land."

"Frankly speaking, they are doing more harm than good," Mama interjected.

Papa grunted in agreement. "And to think that instead of cleaning up their mess they have the audacity to tell us to leave our land. Where will we go? This is my land, my inheritance!"

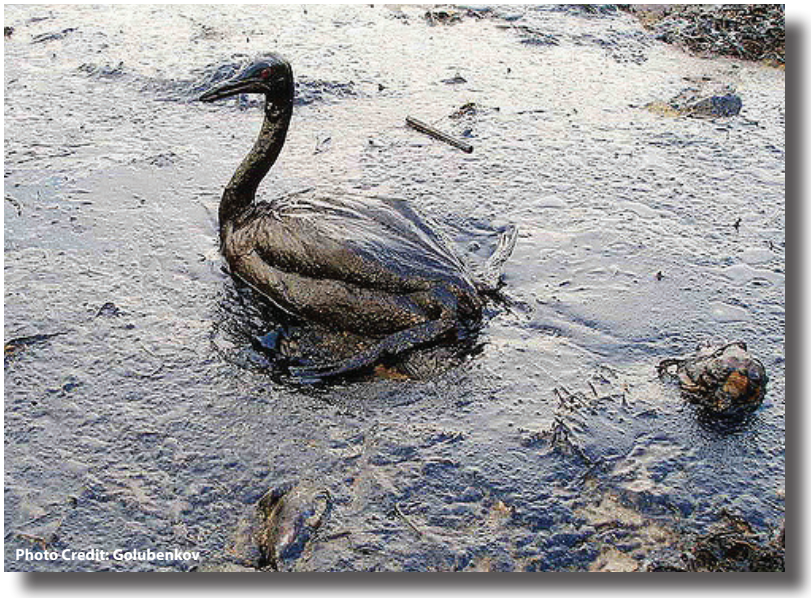


Photo Credit: Golubenkov


Photo Credit: Martin Van Dijl

Silence followed.

"Our elders are weak," he spat out. "They have soiled their greedy hands collecting bribes from the men that come in the night with big bags of money from the oil companies and they are all silent now. But as for me, Ayeba the fisherman, I will not be silent!" Papa's voice was deep and low as he talked on. You could hear the sadness in his voice.

"They cannot pollute my land and ask me to shut up. No, no… no!"

I sat in the corner and covered my head. I was tired of listening to the sad talk, of regrets and laments. I did not want to listen to the doom any longer. I felt helpless and useless. Everybody knew what happened when you challenged the oil company: you disappeared, permanently. From where I sat I looked at Papa's face, a portion of it visible from the kerosene lamp. My father had spent his entire life on the river and being away from it would kill him, literally. I watched the tears roll down his eyes, and the lamp flickered and promptly died. It was then that I cried, warm drops of salted water flowing from my eyes…

…Papa walked past Mama, beckoned me with his hands and we left the house for the open ocean. As we sailed from the small rivers to connect to the ocean, Papa turned to me and said, "Can you hear the birdsongs, Pere?" I nodded. He continued, "That's the best sound in the world." There was a comfortable silence.

"You know, Pere, the world is changing, and one day the people will need men and women to stand up for the community and challenge the people that exploit us." I smiled. "Not only can one not earn a decent living from being just a fisherman these days, but we need more, much more."

"I will do that Papa. I will stand for my people, no matter the cost."

"Good, I am proud of you, Pere, never forget that. Things will get worse before they get better but stay strong and focused. I know that someday our people will need someone who understands the situation and will stand in the gap."

"Everyone here already knows, Papa."

"I know they do, but what are they doing about it? You will intercede for the land," he said gently. "You, my son, will stand in the gap for the good of the land."

Papa smiled broadly, trying to mask the tears in his eyes. I looked away. I could not bear to see Papa in so much pain. Even the joy of going to fish in the big water did not cheer us up. In the distance, I could still hear the birdsongs from deep in the forest grow louder as we drifted further from the river where we usually fished. It was then that I realized that the birds did not like the polluted river either.

At the end of our fishing expedition that day, we walked up and down the bank picking up pieces of plastic and other debris. If only we could clean up the oil spill that easily, I thought. We sat by the river bank to sort out edible sea-fish from junk that entered our net. Papa and I shared stories, laughing and singing. I used the chance to tell Papa the scientific names of some of the fish I had learned in school. When I was done Papa gave me all the names in Ijaw. It made me wonder if Papa was actually a marine biologist or a fisherman…

…Years passed and things got worse. The boats from the river and the baskets from the farms and forest came back empty and the people cried louder. Survival was impossible, and people were dropping like flies. I went to the university and studied law but deep down I was simply a fisherman. The forces that pushed me and fueled my passion were stronger than me. It was time for me to take my place and stand in the gap. It was time for me to speak for my people as papa said, and I did. I demanded the oil companies stop degrading the land, and I demanded mutual agreement for all future drilling.

Papa passed away. He loved going to the river, and seeing it polluted as it was killed his spirit and eventually his soul. The community was in mayhem and conditions continued to deteriorate. Some young men, desperate and hungry, became violent. They formed militant groups and committed acts of violence. The oil companies retaliated in their own way and still did not clean up the river. Relentless, I pushed and spoke and wrote and fought and rallied support from other communities, all for my land.


Photo Credit: Gaven Newman

I think of Papa now as I stand in front of the company gates. The security personnel stand with their guns and we hold our placards. "Silence would be treason" is written boldly on mine. Behind me men and women from the community hold their placards crying and singing, "Give us back our land!"

In the distance I hear the birdsong and I smile.

The Ambrose Pattullo Fund for Environmental Issues Graduate Fellowship is awarded to students interested in current environmental issues and who have written about these issues for publication in a literary outlet.

Talitha Pam

Advisor: Dr. John Kerr

Graduate Program: Community Sustainability

Graduate Research: Writing for community engagement and sustainable development; the nexus of poverty, economic livelihood, and natural resource management in Nigeria.

Motivation to Apply: I appreciate the utilization of creative non-fictional writing to share relevant and important stories that the world needs to hear.

The above piece is an abridged version of Talitha's essay for the 2017 Pattullo Fellowship.

How much wood could a woodcock want?

Addressing woodcock population declines with research

By Allie Shoffner

Last March, I began searching for American woodcock across the state of Michigan. Woodcock are a short-distance migratory bird species that has been experiencing a long-term population decline since the late 1960s.

Woodcock have many regional monikers, ranging from hokumpoke to timberdoodle. They are unique-looking with long bills to forage for earthworms, and are frequently described in somewhat unflattering terms, such as "plump", "chunky", "stout", and even "improbable." They are present in Michigan from March to October.

Males perform courtship displays in open fields to attract females, and females nest in young forest surrounding these fields. Most nature enthusiasts only see woodcock from early spring to summer when males are displaying in open areas. You can go see for yourself –www.eBird.org is a great resource to find out when and where woodcock are displaying near you. You can also hunt woodcock in the fall. They can be difficult to locate and shoot, but most upland bird hunters enjoy the challenge. As woodcock numbers have declined, so have hunter participation and harvest. Michigan has more active woodcock hunters than any other state, and about a third of the total national harvest occurs here each year. A series of more restrictive

American woodcock chicks can be banded very young. This chick and its siblings hatched the day before this photo was taken.


Photo credit: Randy Strouse


Photo credit: David Williams

Left: Gina pointing a woodcock hen. Michigan's volunteer woodcock banders and their pointing dogs were essential to our capture efforts. Right: Woodcock are well-camouflaged and can be very difficult to spot in the field with your bare eyes alone. Did you notice the chick?

hunting regulations enacted in the 1990s had no effect on their decline

Because woodcock recruitment, or the number of juveniles per adult female each year, has also been declining over time, we are investigating the impact of habitat on woodcock reproductive success.

This project involves the cooperation of the Michigan DNR, the Boone and Crockett Quantitative Wildlife Center at Michigan State University, me, and Ashley Huinker, a Master's student. We worked with Michigan's volunteer woodcock banding program to find birds for our study. Bird banding allows for identification of an individual bird over time and banding data has been used for research and management of bird populations in the United States for over one hundred years.

In Michigan, trained and permitted volunteers have been banding woodcock since the 1970s. Today, there are approximately 100 active banders in this organization; as a result, more woodcock are banded in Michigan than any other state. Volunteer banders are typically hunters who attend annual training and work with their dogs who scent and point woodcock chicks in the spring. Unlike many other bird species, woodcock chicks can be banded as young as the day they hatch.

Finding, capturing, and monitoring woodcock presents some unique challenges. They are a cryptic species that primarily rely on their camouflage to avoid predators. The size and shape of their eyes means that they can simultaneously see in front of, above, and behind themselves. Their eyes are very large – so large,


Photo credit: David Williams


Photo credit: Dennis Gulau

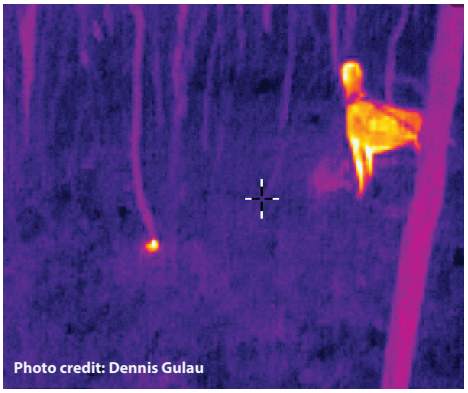


Photo credit: Dennis Gulau

Bottom left: Banding woodcock chicks is a labor of love. Right: Infrared technology makes it easier to see camouflaged birds, making it quicker and safer for them to be captured, banded, and released.

in fact, that their brains are actually upside-down to accommodate them. When a predator comes near a woodcock, the woodcock's instinct is to freeze, rather than fly away. Though this means that they are very challenging for humans to spot, their behavior is helpful for us because birds will typically stay in one spot even when they are being pointed by a nearby dog. Then all we have to do is look around carefully until we can see them too, and then we can proceed by netting them – or just picking them up. Because these birds are so well-camouflaged, we sometimes use infrared technology to better see where they are.

Once we captured birds, we placed radio transmitters on them in addition to bands to be able to track their movement and survival during the rest of their time in Michigan. Unlike bird banding, which allows us to learn about population trends and migration, radio telemetry is a method that allows us to study seasonal survival and movement patterns. Transmitters must typically weigh just 2-5% of a bird's body mass to make sure that they do not harm the bird by affecting their behavior or survival. Because woodcock chicks start out very small, we had to use very small transmitters! Woodcock chicks grow quickly, though – they typically follow the hen off the nest within a few hours of hatching, and can fly by the time they are about two weeks old. We located chicks with transmitters once a week, and though many of them succumbed to predators, we were able to watch most chicks thrive in Michigan habitats and achieve independence.

We also searched for woodcock nests to monitor. Woodcock nest on the ground, and like the birds themselves, their nests and eggs are incredibly well-camouflaged. We placed trail cameras on woodcock nests to observe their nesting behavior and to determine whether the eggs hatched or not. We observed many interesting visitors at nests, but often these individuals were uninterested or perhaps even oblivious to the presence of the nests.

Ultimately, our goal is to improve woodcock reproductive success in Michigan by learning what habitat features favor woodcock survival. We have two more years of fieldwork ahead, and are excited to get out next spring to keep learning about this unique species!

Left: Oftentimes, capturing a woodcock chick is as simple as picking it up. Right: Ashley Huinker demonstrating hen transmitter attachment. Both hens and chicks were tracked with transmitters.

The chick transmitters could only weigh 2-3% of their body weight, so they were very small.

Allie Shoffner is a Ph.D. student in the Department of Fisheries and Wildlife. She is co-advised by Dr. David Williams in the Boone and Crockett Quantitative Wildlife Center and Dr. Dave Luukkonen at the Michigan Department of Natural Resources. She can be contacted at shoffne1@msu.edu.

Changing Perspectives: The Social Landscape of Wildlife Conservation

By Chris Henderson

Photo credit: Chris Henderson

The story of conservation in the United States is not only one of conserving wildlife, but also one of a social and political movement. It's a story about people with particular goals, ideas, and world views that change over time. It's a story we tell ourselves as conservationists about who we are, where we came from, and what we value. The science of wildlife conservation reflects the people that give it life, and therefore is subject to the slow, incremental changes, and abrupt, paradigm-shifting moments that affect all people in a society. By the time Aldo Leopold laid the foundation of the wildlife management profession in the 1930s, the population's mass migration to urban centers had already begun molding and reshaping society in ways that no one anticipated 10 years prior.

The Anthropocene is ushering in new issues in conservation for which our institutions may be totally unprepared. Diverse sets of values, beliefs, and attitudes result in dynamic interactions between people and the natural world. The nature of these interactions depends in large part on broad social trends that affect the dominant ways we view our place in the environment. Changes to this framework that have occurred since the middle 20th century are pushing people away from traditional outdoor activities like hunting and fishing.

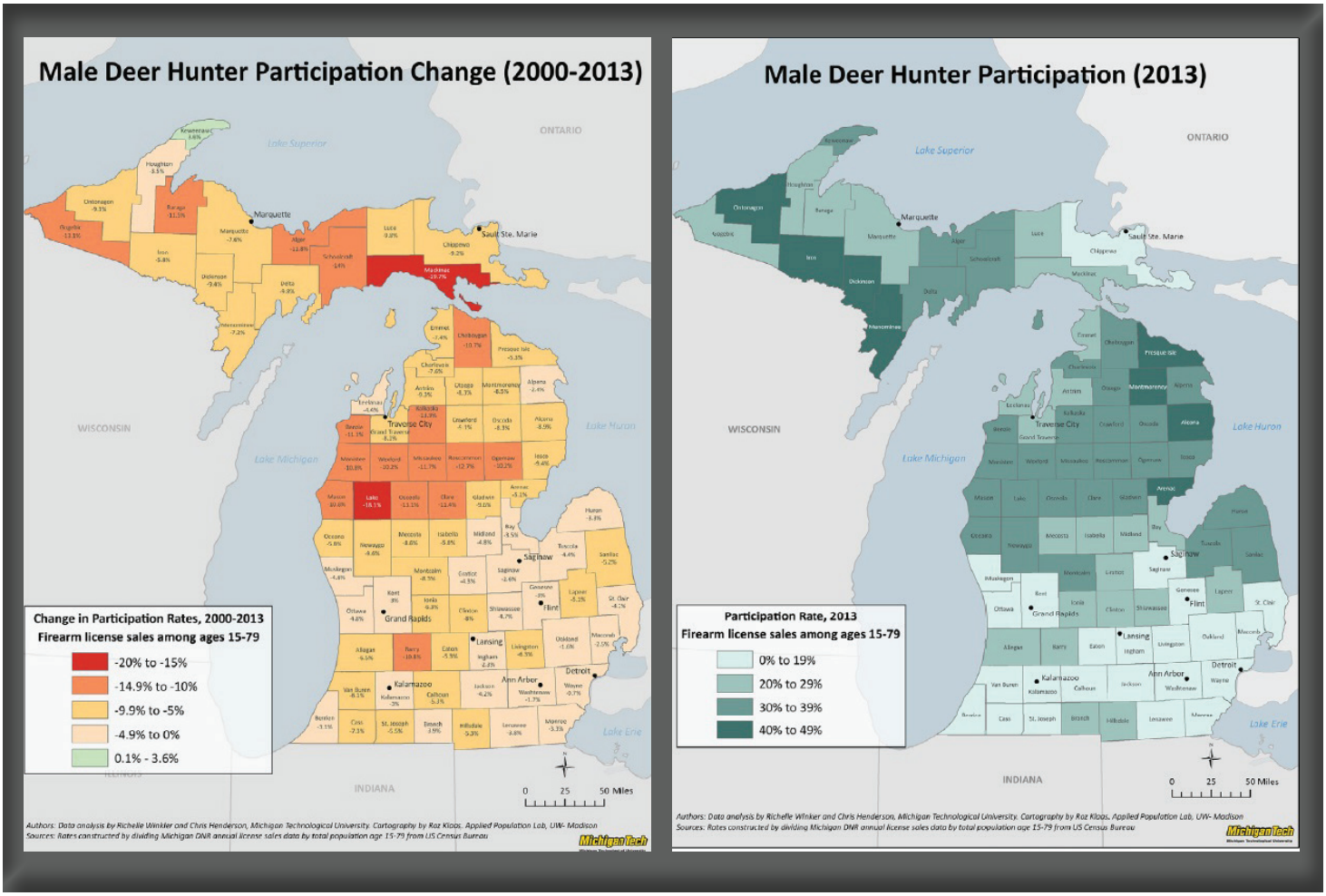
Human dimensions of wildlife management and conservation refers to a broad field of scholarship, as well as a lens through which to integrate social

> ***"…Sportsmen and zoophiles have a common enemy of vastly greater importance to both than any real conflict of interest over hawks, ducks, or the legitimate uses of gunpowder. That enemy is public indifference. The basic issue in wildlife conservation is whether machine-made man, who outnumbers us five to one, really cares enough about wild things to steer the industrial juggernaut around our interests."***
>
> ***Aldo Leopold, 1935***

considerations with fish and wildlife science. Recent research in this area shows that not only are fewer people hunting, but that declining hunter numbers will most likely accelerate as Baby Boomers age, leaving state wildlife agencies with less revenue provided through hunting licenses and tax dollars. In Michigan, hunter numbers declined by over 150,000 from 1998 to 2013; they are expected to decline by at least another 20% by 2035. This portends a coming change in the processes underpinning our wildlife conservation efforts that have historically depended on the participation of hunters, and points to the need for new ways of engaging with an increasingly diverse set of recreationists, wildlife enthusiasts, and outdoor interests. My dissertation research builds on this foundation of knowledge to address the changing ways that conservation stakeholders interact with natural resources and the institutions charged with their management.

Wildlife conservation is carried out through state and federal institutions, such as the United States Fish and Wildlife Service, and state wildlife management agencies like the Michigan Department of Natural Resources. State wildlife management agencies formed in response to the rapid depletion of wildlife during the 19th century, and today are the primary caretakers of the nation's wildlife. Early conservationists sought to protect habitat, recover wildlife populations, and ensure equal access to wildlife resources among the public. The formalization of wildlife management was concurrent with a society that was still largely rural and agrarian. Although urban migration had begun by the early 20th century, most Americans were still intimately tied to the countryside and frequently engaged in hunting, fishing, and trapping for sustenance, enjoyment, and family tradition.

In Michigan, hunter numbers declined by over 150,000 from 1998 to 2013; they are expected to decline at least another 20% by 2035.



The wildlife management profession capitalized on this by relying on public hunting as one of the main tools through which wildlife populations were manipulated. The 1937 Federal Aid in Wildlife Restoration Act (popularly referred to as the Pittman-Robertson Act) codified this relationship by taxing firearms and ammunition to help pay for state conservation programs.

The post-World War II years marked an era of transformation in American society. The massive Baby Boomer generation grew up during a time of increasing affluence, better education, and rapid economic development. This generation sparked waves of social and political change throughout the 1960s and '70s that challenged the dominant traditional values of previous generations. Moreover, Baby Boomers grew up with unique cultural experiences that shaped their views of nature, and those experiences influenced them throughout their lives. Most were less than a generation or two removed from rural living and were exposed to hunting, fishing, and unstructured outdoor recreation as a normal part of growing up. As a result, members of the Baby Boom generation have been much more likely to be hunters throughout their lives than members of other generations.

In contrast, more recent generations, such as the Millennials, came of age during another massive societal transition – to a world completely dependent upon technology. The term "videophilia" has been coined to describe the effects of the generational shift away from direct contact with nature, instead opting for time spent with electronic media. Richard Louv, in his book *Last Child in the Woods: Saving Our Children from Nature-Deficit Disorder*, compiled evidence illustrating the negative physical and psychological effects that may be associated with a disconnection from nature. Other authors contend that there is still a strong interest in nature among Millennial youths, but a combination of several factors present insurmountable challenges to participating in outdoor activities. Embracing electronic media may be a way to foster interest in nature through environmental-oriented apps, games, videos, and podcasts.

The implications of these generational trends for the field of wildlife conservation are complex, and depend in large part on the ability of institutions to adapt to social change. The social and cultural differences in environmental experiences between generations represent different ways of engaging with nature. Thus, agencies and conservation organizations might face continual challenges using old tools to relate to new constituents. Society is becoming more racially and ethnically diverse, more urbanized, and more dependent upon technology, all of which affect attitudes toward nature and wildlife. Upcoming generations are less likely to hunt and fish, but may still care about wildlife, and hold the potential to support wildlife conservation in other ways. Research and practice will benefit from finding ways to recognize this potential. Success will require research that spans social and biological sciences, an emphasis on stakeholder engagement, and a commitment to an inclusive conservation community that bridges culture and ideology in order to live up to the wildlife conservation ideals of our unique North American system.

Chris is a Ph.D. student in the Riley-Gore lab. In his spare time he enjoys photography, hiking, and cross-country skiing with his wife Amanda and their two dogs Coltrane and Marlee. He can be reached at hende410@msu.edu.

Dr. Daniel Hayes is a Professor in Michigan State University's Department of Fisheries and Wildlife as part of the Partnership for Ecosystem Research and Management. He also serves as the Associate Chair of the department. His position at MSU focuses on cooperative research with the Michigan Department of Natural Resources on quantitative aspects of fish habitat and population dynamics. His principal research emphasis is on linking fish population dynamics with habitat quality. Some of his current research projects include a study of the effects of a rock ramp structure in Chesaning on fish, the effects of dams in general on fish habitat and populations, and limitations imposed on fish reproduction by zooplankton. Dan currently teaches an introduction to field techniques course in fisheries and wildlife, but he has also taught courses in introductory statistics, population analysis and management, and system simulation for natural resource management. To top off these teaching responsibilities, Dan has had the privilege of leading MSU's study abroad program to Antarctica four times.

Dan is an avid angler and hunter, and lives on Park Lake in Bath Township. He is involved with the local management of the lake, and chairs the township's Park Lake Advisory Board. As such, he is personally invested in finding cost-effective ways of improving the management of our lake and fishery resources.

Ryan Andrews' master's research focuses on supporting improvements to the flow-fish response relationships used in Michigan's Water Withdrawal Assessment Tool (WWAT). Using a fisheries survey database, Ryan is examining threshold detection methods to compare estimates of optimal fish habitat requirements. This information is useful when estimating potential impacts of water withdrawal on fish habitat, and when establishing limits on allowable withdrawals. Additionally, Ryan is using hydrologic data to estimate the impacts of water withdrawal on downstream warming rates in Michigan streams. By quantifying relationships between stream flow, stream temperature, and air temperature, it will be possible to better predict the response of stream thermal dynamics to alterations in flow regime. These relationships will support the downstream warming module implemented in the flow-fish response relationships of the WWAT. These studies will help improve management of water and fisheries resources in the interest of present and future stakeholders.

Elle Gulotty's research focuses on the efficacy of artificial habitat structures installed for resident trout and in-stream effects of these structures in the North Branch of the Au Sable River in the Northern Lower Peninsula of Michigan. After completing field work, Elle began working for the Michigan Department of Natural Resources, Fisheries Division, and is working toward completing her Master's thesis. Elle lives and works in Michigan's Upper Peninsula, where she provides technical guidance and policy assistance on habitat related issues across the state, including fish passage, hydropower compliance and licensing, and natural resources damage assessment and restoration. Elle is thankful every day for the experiences she has had in the Hayes Lab, and the support she continues to receive. Having worked for Fisheries Division for over a year, Elle is grateful for the opportunity to apply her energies to the conservation, protection, management, use, and enjoyment of Michigan's natural and cultural resources for current and future generations.

Samantha Stanton is a Master's student investigating the early invasion dynamics of New Zealand mudsnails in Michigan rivers. She received her bachelor's degree in Fisheries and Wildlife from Michigan State University. Samantha's fieldwork takes her to some of Michigan's premier trout streams. Through her research, she hopes to protect some of the state's most valuable natural resources by guiding management of this newly detected aquatic invasive. Samantha is interested in documenting the distribution and spread of the New Zealand mudsnail's infestation as well as developing and evaluating qualitative and quantitative sampling methods. Her professional interests include water resource policy and outreach. She incorporates those professional interests into her Master's work by engaging with local angling groups, grade schools, and local government organizations.

Mitch Nisbet is a Master's student researching microhabitat selection of juvenile salmonids in Bear Creek, a coldwater tributary of the Manistee River in the Great Lakes basin. With management agencies relying more on natural reproduction to offset costs associated with stocking, it is crucial to understand the habitat use of a highly-desirable commercial and recreational fishery. This work will fill a major knowledge gap for the region. After completing his research, Mitch hopes to continue working with coldwater species as a fisheries biologist in the Midwest. Before beginning his Master's research, Mitch received his bachelor's degree from Michigan State University in Fisheries and Wildlife.

Corey Higley is a Ph.D. candidate studying how course design influences student attitudes about the environment as an outcome of learning. Specifically, her research explores the role of experiential learning as an approach to environmental or natural resources education that helps build students' personal relationship with the environment. Traditionally, university courses tend to emphasize knowledge without consideration of the affective domain of learning, although attitudes about learning and about the subject of learning have long been recognized as an important component of a comprehensive education. In natural resources or environmental fields, attitudes become even more critical as we prepare future natural resource professionals to tackle unprecedented environmental challenges.

Trey McClinton is a new graduate student here at Michigan State University. He is being co-advised by Dr. Dan Hayes and Dr. David Luukkonen. His M.S. research consists of looking into factors affecting waterfowl and hunter use of Michigan's managed waterfowl areas. Although there have been periodic analyses of monitoring data, it has been many years since a comprehensive assessment has been completed. Trey is hopeful that his findings will aid with the state's adaptive management plan to promote waterfowl populations, and hunter use. He also looks forward to the knowledge and experience gained during this next step in his wildlife conservation career. Trey is originally from Tomball, Texas. He received his bachelor's degree in Wildlife, Sustainability, and Ecosystem Sciences from Tarleton State University, in Stephenville, Texas.

THE PUZZLE OF PROTECTED AREA CONSERVATION IN SOUTHEAST NICARAGUA

Indigenous land, illegal colonists, controversial politics, and a hurricane

Joel T. Betts

Nicaragua is off the beaten path for tourists and off the radar for most conservationists, but the country abounds with biodiversity in large protected areas. Unfortunately, being protected means little in terms of actual defense of the reserves, and a serious crisis has developed as the protected areas are being deforested at an alarming pace. Moving toward effective conservation in Nicaragua requires piecing together a complex situation where diverse peoples interact with diverse forests, all under an unenforced legal framework, in a nation rife with poverty, corruption, and impunity.

Nicaragua is losing 1330 square kilometers of forest a year, most of this within national reserves. The Indio-Maíz Biological Reserve, on the southern Caribbean coast of Nicaragua, encompasses around 2,600 square kilometers of mostly primary rainforest. It is a core area for animals like the endangered green macaw and Baird's tapir, and some of the rarest mammals in Central America, such as the giant anteater, white-lipped peccaries and the iconic jaguar. It is one of the most important areas of remaining high-quality habitat in the Meso-American Biological Corridor, a region of international priority for conservation which connects forest reserves and their animal populations from Mexico to Panama. The indigenous Rama and Kriol communities that inhabit the reserve see its conservation as essential to their millennia-old subsistence lifestyle and to their cultural survival. As a national biological reserve, part of an indigenous territory, and the core area of a UNESCO Biosphere Reserve, the conservation laws that protect the land are well-established, and are at least as strong as those governing the national wildlife refuges of the United States.

Forest Cover on the Caribbean Coast of Nicaragua

The forest damage (light green) along the coast of Indio-Maiz (red) is from Hurricane Otto, while the green and yellow matrix along the western and northern borders of the park is forest loss from cattle ranching.

In recent years, this rich reserve has come increasingly has now crossed the western edge of the park, and under threat. An agricultural frontier that has been moving from west to east across Nicaragua is moving inward (see map). This illegal colonization of indigenous titled lands is not new to the Rama-Kriol territory and brings other illegal activities with it. Between 2015 and 2016, Rama and Kriol forest rangers recorded over 271 instances of illegal activity, including deforestation, cattle ranching, poaching, and poisoning of rivers to catch fiwwsh—all within the heart of Indio-Maíz. In the Rama-Kriol Territory just to the north of Indio-Maíz, farmers and ranchers from outside the region have been settling and deforesting land without consequence for over a decade. Local fish and mammal populations have been over-exploited, and the rivers that drain the deforested land have become degraded, severely diminishing the Rama and Kriol communities' ability to thrive through subsistence harvest. The communities in Indio-Maíz fear a similar fate.

Who are these colonists and what motivates them to establish ranches and farms illegally? In much of Nicaragua, migrant farmers living below the poverty line are pushed into protected areas by growing populations, limited resources, drought, and eroded land.

Although some of these farmers clear land in Indio-Maíz, local investigation has shown that most of the deforestation is in fact by wealthier cattle ranchers, expanding their operations to make an extra buck from the "free", well-watered rainforest soils.

To address this impending threat to Indio-Maíz, multiple NGOs have partnered with the Rama-Kriol government to create an active conservation program for the reserve. They have conducted outreach near the boundaries of the reserve, research on mammal declines, and advocacy on a national scale. Their main effort is a forest ranger program, which was set up to patrol the reserve and record illegal activity, as well as to evict perpetrators. Although it is having an impact, it is not currently enough to address the increasing deforestation and settlement of the reserve. To this small group of conservationists, protecting Indio-Maíz currently seems like an uphill battle.

Given the national and international protected status afforded Indio-Maíz, how can so much illegal activity be permitted and so few resources allocated to conservation? This is the question the Rama and Kriol government and NGOs have been asking the Nicaraguan government—without answer. Recently, the Rama and Kriol government chastised the Nicaraguan government, stating that "the State has failed to comply with its legal obligations and agreements with us, it has failed to give us adequate support, and it has been effectively absent in our struggle to protect the shared area between the Indio-Maíz Biological Reserve and the Rama-Kriol Territory". The Nicaraguan government ignores this burgeoning crisis yet is well-aware of the risks of not intervening in situations like these. In Northern Nicaragua, on protected Miskitu indigenous lands in the Bosawás reserve, conflicts about similar colonization over the last decades have escalated into violence between colonizers and Miskitu communities, and many people have died. Some refer to these land conflicts as "Nicaragua's Hidden War".

The Rama and Kriol face a similar threat in their territory. In summer 2016, four masked men with machine guns came into the home of one of the Rama forest rangers and threatened his family, stole his ranger supplies, and warned that "the community of Indian River would suffer violent consequences if the GTR-K forest rangers continue conducting patrols and informing the National Army about the illegal colonization of Indio-Maíz." Yet despite these threats, the existing national conservation law, and numerous solicitations for aid from the Rama-Kriol government and NGOs, the government has been silent. Rama-Kriol leaders declared in a recent press release that "we have no choice but to conclude that the State is tacitly supporting the illegal colonization of our lands by Mestizo colonists and the destruction of our traditions, culture and autonomy".

Photo credit: Nick Hawkins

A Rama man fishing in the Indian River. He, like many, grew up in the reserve and now helps with conservation efforts.

Photo credit: Global Wildlife Conservation

A group of Rama foresters and workers installing signage to demarcate the reserve's boundaries.

Though seemingly extreme, this claim has warrant. Corrupt government activity has recently increased in the Rama-Kriol territory. In efforts to push its interoceaniccanal project directly through the reserves in the territory, the central government has replaced democratically elected Rama-Kriol leaders, bribed existing leaders to sign land concessions, and made improbable claims about potential conservation benefits of the canal. The canal and its reservoir would displace communities, disrupt crucial wildlife corridors, and allow easy access for illegal deforestation, hunting, and fishing in the territory—subverting local conservation initiatives and autonomy. The Nicaraguan president is also known to have ties to logging and cattle production companies that are active in the area.

To make matters worse, in November 2016, Hurricane Otto hit Indio-Maíz directly. Although these forests have evolved to regenerate after major natural disturbance, the hurricane makes the forest more vulnerable to illegal activity, such as salvage logging and clearing for cattle ranching, which were the demise of forests further north after hurricanes in 1988 and 2007.

Conservation of Indio-Maíz under these conditions may seem like an unsolvable puzzle, but we must not lose hope. Especially given the lack of State support of conservation initiatives, continued support and investment from outside sources will be critical to protect the future of Indio-Maíz and the Rama-Kriol communities living there. MSU FW grad, Dr. Chris Jordan, who helps coordinate conservation efforts in Indio-Maíz, described "In the face of disappointment and immense challenges, we do what we do best: fight with more resolve and face the world with more resilience than ever before". And that's what they are doing.

Recently, local conservationists have raised enough funds to install forest ranger stations and a scientific station, expand their patrol and research efforts, and film a documentary. They have also started new collaborations with universities, the Wildlife Conservation Society, and USFWS. It's time to fight for Indio-Maíz, and raise support to bolster ongoing efforts like the forest ranger and conservation outreach programs. Through increasing collaboration and support, it is possible to successfully put together the pieces of the conservation puzzle in Indio-Maíz and other reserves like it throughout the Meso-American Biological Corridor, to preserve our natural heritage and the rights of those protecting it, before they both are severely diminished.

To support this ongoing work, consider donating through Global Wildlife Conservation's Website, or ask the author how you can contribute your skills or resources.

Photo credit: Onda Local, from Mongabay

A typical cattle ranch in the region, with few trees left behind after the forest was cleared.

Joel Betts is a Master's student in the Department of Fisheries and Wildlife at MSU. He is advised by Dr. Gerald Urquhart. He can be reached at bettsjoe@msu.edu.

Photo credit: Joel Betts

Parachromis dovii, one of the many Cichlid species that is an important food source to Rama and Kriol People along the rivers.

Photo Contest
Second Place

Science and Communication
Fang Wang

Flora and Fauna
Fang Wang

Scenery
Sam Thiede

Winter Scene
Amber Goguen

Field Work
Fang Wang

FW SPOTLIGHT

DEPARTMENT OF FISHERIES & WILDLIFE
MICHIGAN STATE UNIVERSITY
480 WILSON ROAD
EAST LANSING, MI 48824
WWW.CANR.MSU.EDU/FW

Photo Contest Winners

Field Work
Linda Ortiz

Science and Community
Joel Betts

Flora and Fauna
Fang Wang

Winter Scene
Amber Goguen

Scenery
Chris Henderson