APPLIED BIODIVERSITY SCIENCE

PERSPECTIVES SERIES

No. 4, October 2014

Texas A&M University

Ecology
Caribbean
Lizard Pursuits

Culture
Gardens &
Fisheries

Governance
Ecuadorian
Water Trusts

The Future of ABS

Outreach
Biodiversity &
Blogs

Cover Art

Background: Panorama of Central Andes Mountains, Salar de Arizaro, Argentina. The image transitions from the *Puna* (High Andes) to the *Sierra Pampeanas* and *Pampas*. Courtesy of NASA Earth Observatory

Foreground: Biodiversity has always been difficult to define. All of the contributors to this issue are inherently dedicated to researching and understanding the conservation of biodiversity. Each research project represented in this issue is studying and working with a multi-faceted definition of biodiversity.

janellwisecup
design, illustration & web

APPLIED BIODIVERSITY SCIENCE

Phone: (979) 845-7494
Fax: (979) 845-4096
Email: absigert@tamu.edu
Editor: wallen003@tamu.edu

Applied Biodiversity Science NSF-IGERT Program
Texas A&M University
2258 TAMU
College Station, TX, 77843

Applied Biodiversity Science Perspectives Series

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Our Perspective

Communicating Applied Biodiversity Science

You might have a favorite science writer. Mine are David Quammen, Bill Bryson, Carl Sagan, and Tim Flannery. Others may be more inclined to read Pulitzer Prize-winning and nominated authors like Jonathan Weiner, Siddhartha Mukherjee, or James Gleick, MacArthur-fellow Atul Gawande, or consummate greats like E. O. Wilson, Richard Dawkins, Stephen J. Gould, and Oliver Sacks. Or perhaps books aren't all you're interested in. In that case you may be a fan of Carl Zimmer's blogging or the stories and editorials from journalists/authors Malcolm Gladwell or Stephen J. Dubner.

It's likely you've read at least one of these authors. Like most readers you were probably impressed by how well they articulated the complexities and subtleties of their topic: everything from astrophysics to evolution, cancer, neurology, chaos theory, economics, and psychology. If you find an author who draws you into a topic that wouldn't otherwise gain your attention, particularly an unfamiliar scientific discipline, *take notice*. Take stock of what they have accomplished by gaining your interest and curiosity. As George Gopen and Judith Swan stated for their 1990 article for American Scientific, "*the fundamental purpose of scientific discourse is not the mere presentation of information and thought, but rather its actual communication*." Good communication requires gaining the reader's attention. Attention requires garnering interest and curiosity.

In our ever-connected world with vast communication and social networking ability, we have the ability to do just that. We possess the tools to communicate science to a diversity of people in a diversity of ways. A foundational component of the Applied Biodiversity Science Program (ABS) is to communicate across scientific disciplines with various institutional actors to facilitate broader impacts across the realm of conservation. In essence, the ABS Program seeks to produce applied scientists who can communicate effectively across disciplines. A natural corollary of this goal is the ability to communicate science outside the realm of science. The ABS Perspectives Series is intended to communicate more broadly and inclusively who we are, what we study, where we conduct research, how we conduct research, and why we are doing it. This, the 4th issue of the ABS Perspectives Series, features experiences from the Caribbean, the United States, Sénégal, Ecuador, Nicaragua, and Costa Rica. Contributions cover topics ranging from captive parrot re-wilding with pirates to blogging in the Nicaraguan forest with limited internet access.

Perhaps more importantly, the Perspective Series wants to reach out and share ABS student and faculty experiences with a diverse readership to raise awareness of biodiversity conservation issues. Outreach is an important axiom of actionable science, especially outreach that informs, improves and influences management and policy. I consider the ABS Perspectives Series an outreach initiative to communicate the ABS mission to the general public, communities where our research has been conducted, fellow academics and practitioners, and institutions that can provide logistics, infrastructure, and support. We must intend to make and practice making our research accessible and intriguing to everyone.

I would like to thank Texas A&M University and the ABS Program for their support. Most importantly, I must thank our marvelous contributing authors for their dedication and willingness to share their experiences and perspectives with the rest of us.

Kenneth E Wallen

Dr. Donald Brightsmith

Dr. Lee Fitzgerald

Dr. Amanda Stronza

Directors' Note

As I read through the essays of the ABS Perspectives series I feel truly honored to be a part of the Applied Biodiversity Science Program here at Texas A&M University. The program has brought together a unique group of faculty and students, united by their interest in conservation science. Upon arrival at Texas A&M University in 2006, I was immediately contacted by the program founders Lee Fitzgerald and Amanda Stronza and told of their plans to create the Applied Biodiversity Science Program through an NSF-IGERT training grant. When we heard that the grant was successful, I had no idea what it would mean for conservation science at Texas A&M University or for my professional development. The ABS program has allowed me to co-create and teach the Amazon Field School, an applied field course which takes ABS students out to the field in the Tambopata Region of southeastern Peru. The region is one of the most biodiverse on the planet and the primary site for my macaw research since 1999. The teaching of this course, along with Drs. Stronza and Fitzgerald not only has allowed me to share my knowledge with all of the ABS student cohorts; it has also allowed me to learn so much from these incredible students and from my co-instructors. In particular, I am eternally grateful to Dr. Stronza for providing me real-world insights in to the human side of biodiversity conservation.

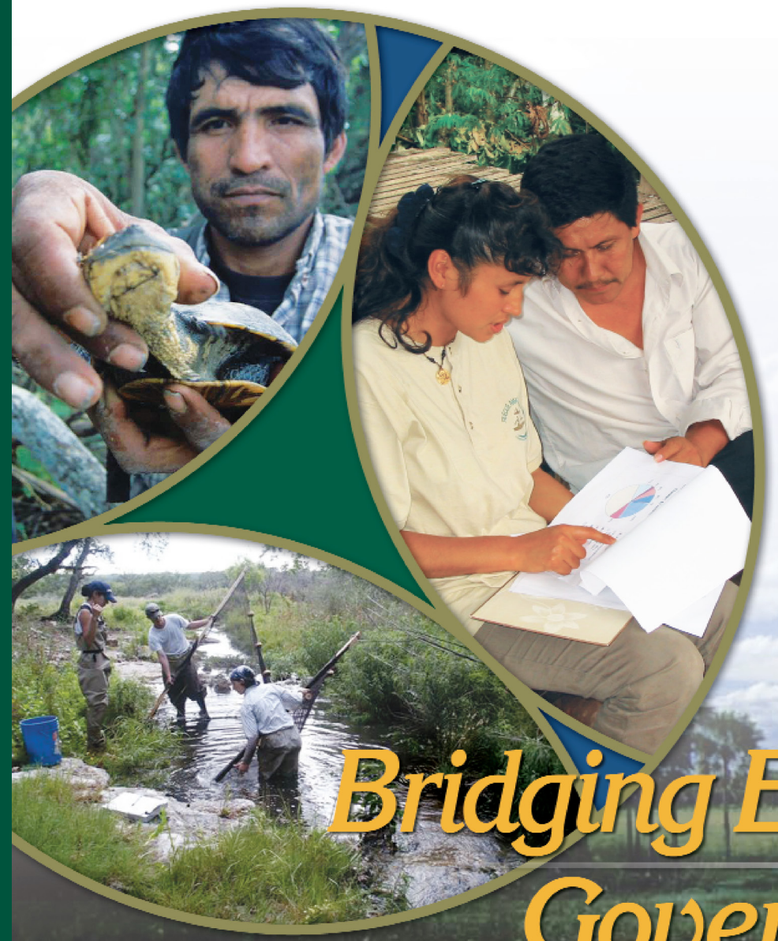
As a graduate training program, the ABS program was created, organized, and implemented by faculty. However, by bringing together so many incredibly bright and motivated students the program has taken on a life of its own. And nowhere is this clearer than in the pages of this the 4th edition of the ABS Perspectives. It is so encouraging to see the interdisciplinary collaborations we hoped to create as faculty take life through the students working in Central America and to see the perspectives and methods discussed during the ABS courses and the Amazon Field School reflected in research projects from across the Americas. It is also very rewarding that the students whose work graces the following pages have truly embraced the core principles of ABS. They know that their research must have impact beyond the scientific journals and must impact local stakeholders, general audiences, and those in positions to affect real conservation change.

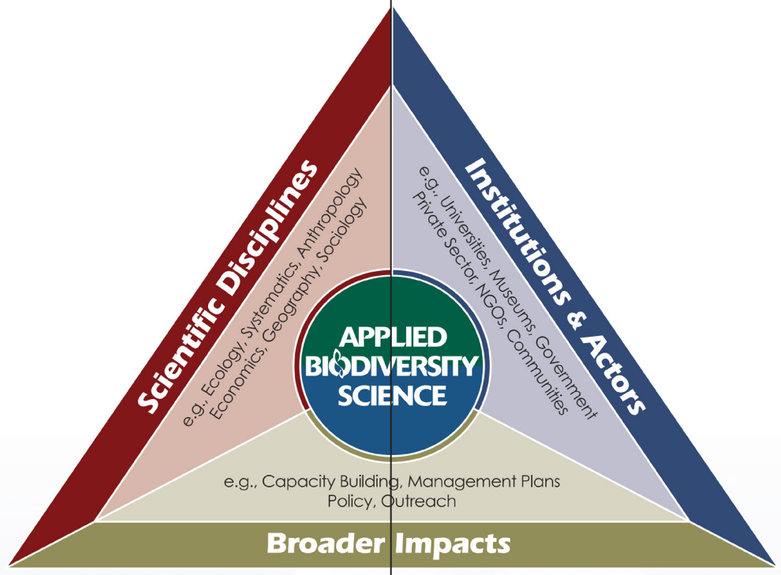
With this I would like to congratulate our editor Kenneth Wallen and all of the contributors for creating this 4th volume in the ABS Perspectives series.

Dr Donald J Brightsmith

APPLIED BIODIVERSITY SCIENCE

The vision of the Applied Biodiversity Science (ABS) Program is to integrate biodiversity research and on-the-ground conservation practices.





The ABS Program's Three Pillars

- Research in Natural and Social Sciences
- Collaboration with Conservation Institutions and Actors in the Field
- Application of Conservation Theory to Practice

Research teams of students and faculty collaborate with international partners in one of four regions of Latin America. They develop complementary dissertations related to:

- Ecological Functions and Biodiversity
- Communities and Governance

Bridging Ecology, Culture, & Governance for Effective Conservation

The Applied Biodiversity Science NSF-IGERT Program is open to all doctoral students at Texas A&M University.

ABS Program Integrative Activities:

- Multidisciplinary graduate curriculum
- Amazon field school
- Annual research conference
- Cross-cultural leadership training
- Seminar series and journal club
- Internships at host country institutions

Funded NSF-IGERT Traineeships Are Available

See the ABS website for application information and deadlines.

APPLIED BIODIVERSITY SCIENCE

NSF-IGERT Program

OFFICE
Phone: (979) 845-7494
Fax: (979) 845-4096
Email: absigert@tamu.edu

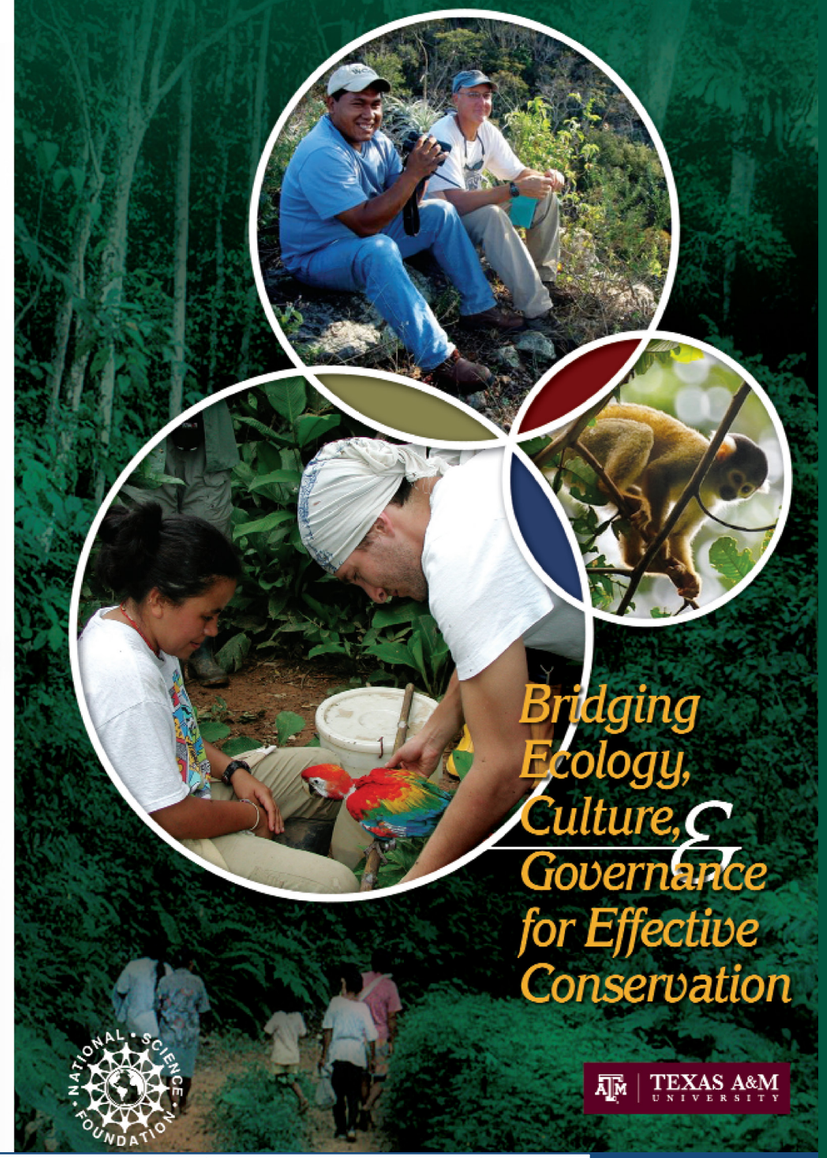
ADDRESS
Applied Biodiversity Science
NSF-IGERT Program
Texas A&M University
216 Old Heep Bldg.
2258 TAMU
College Station, TX, 77843-2258

WEBSITE
http://biodiversity.tamu.edu

APPLIED BIODIVERSITY SCIENCE

NSF-IGERT doctoral program

TEXAS A&M UNIVERSITY



Bridging Ecology, Culture, & Governance for Effective Conservation

NATIONAL SCIENCE FOUNDATION

TEXAS A&M UNIVERSITY

Caribbean Adventures and Experiential Education during Herpetological Surveys

By: Nicole F. Angeli
Texas A&M University
Wildlife and Fisheries Sciences
Email: nicoleangeli1@gmail.com

My fieldwork brings me to the Caribbean to study lizards. Mentioning 'Caribbean fieldwork' to most people will bring to mind colorful coral reefs, breaching sharks, and vast stretches of uninhabited beach. The reality is better reflected by imaging sunburns, dehydration, and skin rashes. Explaining this reality is difficult when your audience is predisposed to the Travel Channel or a cruise port of call. Local people at my field sites in the U.S. Virgin Islands and Puerto Rico spend their leisure time hiking on developed trails, cultivating fruit orchards, and swimming at sandy beaches. Lizards, on the other hand, seem to have no sense of trails, sandy beaches or manicured yards, but they are abundant. As I write from my office in Puerto Rico, I see three species of lizards indoors. At my field sites, I may see five or six different species of lizards at one time. It is overwhelmingly delicious for a herpetologist, and this diversity has brought North American scientists to these islands for hundreds of years.

What these scientists have found is that amphibians and reptiles comprise more than 70% of vertebrate species on Caribbean islands. Recently, the effects of agriculture, exotic predators, and increased storm events on species are studied in the context of biodiversity conservation. For ex ample, natural hurricane systems mediate lizard distribution and abundance on the small islands peppering these seas as much as agricultural land conversion. Human-linked climate change is a worry, too; we may start to see the real extinction of species in the hotter years to come. To persist worldwide, lizards will have to adapt or move to more suitable places. On islands, lizards cannot disperse like continental species, and the ability of some taxa to adapt to new environments is widely unknown. My research integrates spatial modeling of regional environmental characteristics and mapping biotic variables like predation and adaptive physiology to understand species' responses to changing environmental conditions.

I am passionate in my endeavor to understand the capacity of animals to adapt to changing conditions in the Caribbean. My passion for the science is often eclipsed by logistical constraints of fieldwork. The biggest need of graduate students in displaced and remote locations is field assistance. Over two, 6-month field seasons I have had the opportunity to host 6 students, 3 interns, 5 friends, and 2 family members in durations spanning 4 days to 11-weeks. The support, assistance, reflection, and perspective from this influx of visitors is the single factor that I attribute to the success of both field seasons. I forget about skin rashes and remember I am making meaningful contributions to conservation biology in the company and support of volunteers and friends.

I was motivated by them, but I wondered what Caribbean fieldwork was like for my visitors. I asked a subset of volunteers for whom it was their first time in the Caribbean to reflect. I asked them: "*Please provide no more than 200 words on your experience in Puerto Rico or the Virgin Islands. What did you do, what was your impression of the research program, etc. This will be included in my grant reporting, and circulated in my report to Texas A&M faculty and students*." Perhaps I biased their reflections by letting them know that faculty and students would be seeing their thoughts. But what the volunteers and students remembered was surprising. For example, it came out that one student had thought the field work so difficult that he might quit! After reading the reflections, I found two major themes in what they wrote— experiential education and adventure. I present to you here their reflections in their own words. I conclude with a short reflection of my own.

Continued on next page.

Experiential Education

KRISTINA

As an incoming Ph.D. student without prior graduate school experience, I was unsure of my ability to accomplish a doctoral dissertation. There was a lot of unknown graduate school territory, which I allowed to become inflated in my mind. A few weeks before I accepted the position at Texas A&M University as a graduate student under Dr. Lee Fitzgerald, Lee advised me to talk to another of his students, Nicole Angeli, to gain a better perspective of what was to come and to be expected.

In one Skype conversation, many of my fears of the unknown were quelled, as she explained the timeline of events in graduate school, the graduate culture at TAMU, and that the pressures were not as insurmountable as I had thought. She then offered me a position as a field assistant for her dissertation project in Puerto Rico 2014 to gain experience and better understanding of a graduate thesis.

Since I needed more experience in the field, I was grateful and excited to accept her offer to join the project. While there, I had not only learned techniques for herpetology research, but have had incredibly rewarding experiences as a conservation biologist. Nicole has introduced me to many scientists in the region, and shown me what collaboration with other scientists accomplishes.

Meeting, working with, and getting to know Nicole has given me a much more confident outlook on graduate school, and has reinforced my path into field research and conservation biology..

CAMERON

My love for field research has blossomed since I was able to participate in a real field study. In the spring of 2013, I received a $2400 grant from Lebanon Valley College to accompany Nicole Frances Angeli to Puerto Rico. Throughout the summer of 2013, we studied lizards of the *Ameiva* genus in Puerto Rico focusing on predation, phenotypic variation of populations, and physiology.

This research project with Nicole helped me make pivotal decisions in my life. The work was hard, it was hot, and thorns were everywhere. It was not a cakewalk by far, and I debating quitting several times. The other assistant actually did quit, but quitting wasn't an option for me. I had to ask myself, "If I can't do this for 2 months, who am I gonna be? If I can't push myself to do this, how can I expect to succeed in life?" So, I didn't quit and I continued to push myself and continued to learn. After this wonderful experience I realized I can do this and further my education. Now, I am attending Penn State for a PhD program in Ecology this fall. I also made connections, well mainly with Nicole. Without her, I don't think I would have even thought about grad school. I still consider her a role model, friend, and hopefully lifelong mentor, too.

KATHRYN

In the spring of 2013, I spent 12 weeks interning with the National Park Service on St. Croix in the US Virgin Islands, working on a project to evaluate the current distribution of *Ameiva polops* on Buck Island. Working with Nicole, I had the opportunity to learn how to evaluate habitat preferences using temperature models and micro-habitat assessments. Through this opportunity I gained valuable field experience and was able to experience the concepts I had learned in the classroom as an undergraduate being applied in real life. In addition to learning new field techniques, I was also able to see the importance of meticulous planning and time management in the implementation of a study and have been able to use these skills to improve my own work in wildlife biology today. The hands-on experience and practical application that this program provides are extremely beneficial, not only to the people who work on it, but also to the little known and endangered *Ameiva polops*.

NATHAN

In March 2013, I embarked upon a three month internship working on an endangered species

population assessment in St. Croix, U. S. Virgin Islands. As a prospective wildlife biologist, I was excited for this internship and the new experiences. My position required me to perform population surveys for an endangered ground lizard and manage for invasive plant species on Buck Island Reef National Monument for the U.S. National Park Service. This project involved working with various organizations such as Texas A&M and U.S. Fish and Wildlife Service to accomplish a comprehensive analysis pertaining to the endangered species. Team work and communication were always important between the six project team members. One of the team members was a Texas A&M graduate student whom worked in a very determined way to develop a great behavioral ecology study for the St. Croix ground lizard and its genus. Through this internship, I was able to learn new skills such as capturing lizards by noosing and proper herbicide treatment.

KAYCEE

My name is Kaycee Faunce and I spent part of my 2014 summer assisting Nicole Angeli with her research on Puerto Rican ground lizards (*Ameiva exsul*) in Puerto Rico and St. Croix. Most of the field days were long and hot and some were through rough terrain, but the opportunity to work alongside a biologist as she conducts and refines her research has been amazing. I've recently finished my undergrad with a B.S in Biology, so the field experience will be invaluable as I begin to look for jobs. Additionally, the opportunity to meet other biologists, Fish and Wildlife Service employees, and students during my trip has inspired me to begin pursuing M.S. programs related to conservation and wildlife biology

Nicole has been an excellent teacher and mentor, and through her I have learned so much more than anticipated. She has never hesitated to teach me as much as possible; we explored many of the ecological life zones present on Puerto Rico, and I learned much about island invasive species and how to identify many of the native flora and fauna both on Puerto Rico and on St. Croix.

MOM

When Nicole proposed that I go to Puerto Rico with her, I was surprised and honored. Granted, I understood that she was asking me merely because she didn't want to "pay" an intern to accompany her and that I would actually have to "do " things for her and let her "take the reins". OK, I was up for that!! Nicole made all the plans for the trip; of course, I paid my own way… OK, and some of hers, at least for food, etc. She told me what to pack, and especially to be sure to bring boots.

I felt I learned so much about lizards, their biology, and the island itself. Nicole showed me tracking and holding techniques. A week in Puerto Rico wasn't enough to see everything and to do the type of "scouting" she needed to do. Basically, she was able to meet the right people that could assist her with permits and introduce her to others who are doing similar work. For myself, I learned so much, and I was amazed and proud that my own daughter could be such an intellectual and be able to teach the information in a way that anyone could understand

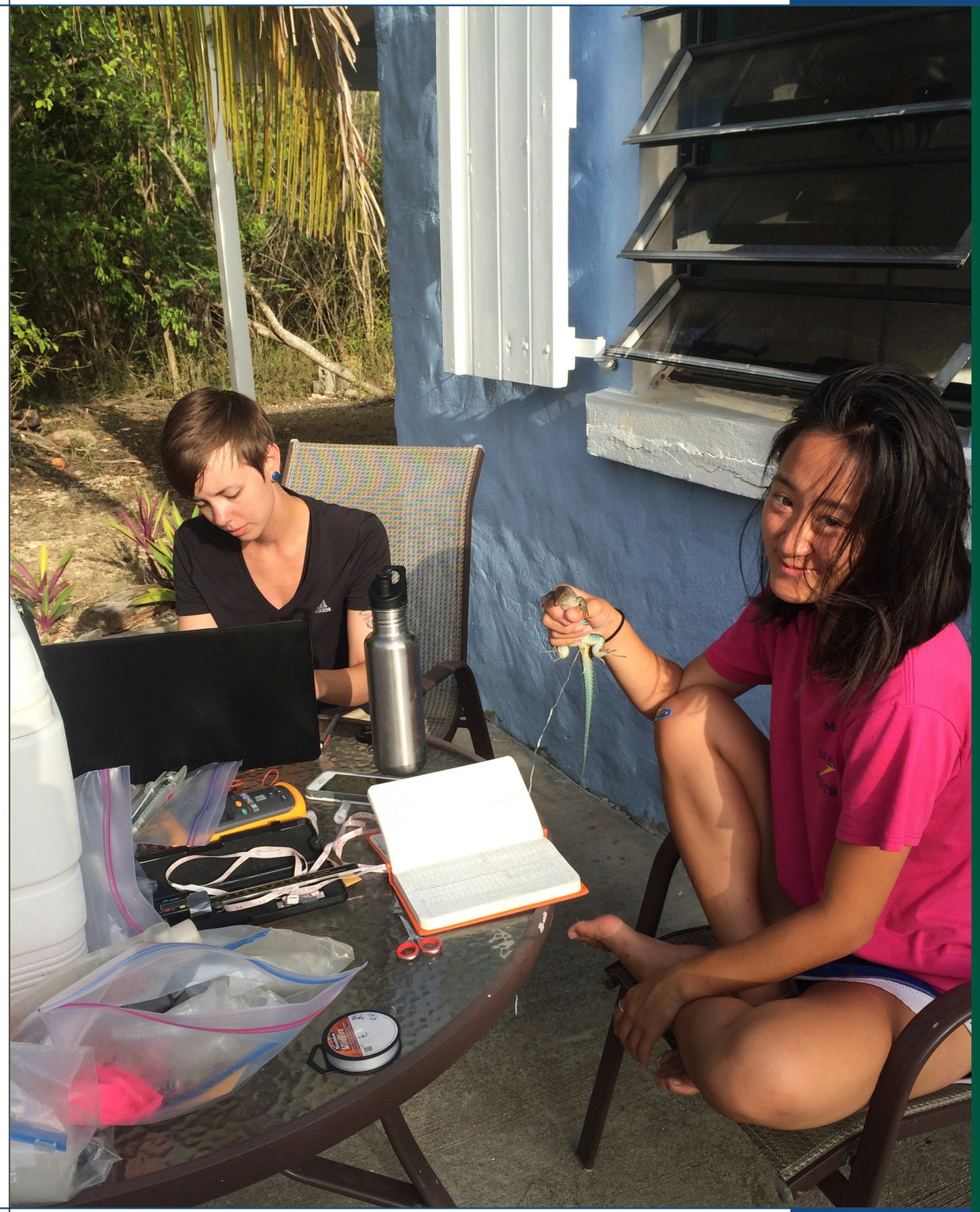
ARTHIKA

As I reflect on my experiences, I realize two things: one—that I knew absolutely nothing about the methods of this research until visiting and I can now speak on at least a cursory level about the endeavor, and two—that I could never have imagined how rewarding time spent problem-solving to trap lizards could be. The supportive, educational, and "team"-oriented environment that Nicole embraced while conducting these studies (as an honorary team member), made for an invigorating week in Puerto Rico, and a vacation I will never forget.

Adventure

KRISTINA

Though unrelated to the project, one of the most meaningful experiences, based on Nicole's connection to the scientific community in St. Croix, was being invited to watch Leatherback



Sea Turtle hatchlings emerge in a protected beach. She has had many continuing conversations with me about life as a graduate student, and advised me of classes I should consider taking.

NATHAN

Personally, the culture and people of St. Croix were quite diverse which I found very interesting. For the most part, it was a laid back atmosphere filled with beautiful landscape and ocean views. However, because of the high cost of living, it seemed many locals had a hard economic life. I very much enjoyed the opportunity to work on St. Croix with so many passionate people.

KAYCEE

I have gained an appreciation of the history and culture of the two islands (St. Croix and Puerto Rico). Experiences that stand out to me are spelunking in a state forest cave to see hundreds of Antillean bats emerge from their roosts for the night, seeking out elusive or rare herpetofauna such as the crested toad (*Bufo lemur*) and the blue-tailed ground lizard (*Ameiva wetmorei*), and snorkeling over coral reefs and seeing all the beautiful Caribbean reef life, including critically endangered staghorn coral (*Acropora cervicornis*) colonies.

ARTHIKA

My time in Puerto Rico was as much an educational and intellectual adventure as it was a cultural immersion. I was initially intrigued by the innovative, intricate, and demanding dispersion mapping techniques that Nicole was employing. Over the course of my first few days on the island, I quickly appreciated the incredible number of difficulties that Nicole had to confront and overcome in doing this form of research. First we struggled to get to the actual locations mapped out by what appeared to me to be an incredibly complex programmed algorithm. Next, we fought a losing battle against our elusive lizard subjects in our efforts to classify their optimal physiological thermal range

MOM

It was my adventure as much as it was hers. I never flew out of the U.S.A. before, or should I say, over the ocean. We flew into San Juan, Puerto Rico and then rented a car to go to Fajardo. We stopped along the road if Nicole was

already in their back yard looking at invasive species specifically the green iguana. The next day, we followed lizards into the brush near beaches and in the Agricultural Botanical Gardens. We drove around the island along the coast checking out spots like Luquillo, Maricao, Cabo Rojo, etc. Her love for her subject and research is palpable. She will be a credit to the scientific community.

Conclusion

My experience managing these doctoral dissertation projects has taught me both leadership and self-management skills. My first priority as a leader is safety in the field. There is always time to rest, drink water, and be safe. Safety was in my mind one of the first days of my first field season. A dehydrated volunteer wanted to continue their workday. It was 105° F at 10 a.m. in dense coastal forest, and the work involved using a machete to make a trail in the forest. Dehydration causes impaired judgment and motor skills; I saw no way for us to move forward with our original mission. Balancing their desire to work with their safety, I approached them in a collaborative spirit, asking whether the work could wait for the next day and if we could work on a different task that took us near a breezy, shaded coastal area. The final decision to change gears and pack up for the beach was both my own idea and their idea. The decision took just a few more minutes than ordering them to pack up, and we passed a pleasant day preparing tools for work in the weeks to come.

I find this sort of reflective period at the end of a field season is refreshing. I forget about small management choices I made until I reflect or hear the reflections of others. For example, I thought it might boost morale to spend one evening watching a bat emergence rather than processing lizard specimens. These decision-making skills are the tools that will bring me the most success in developing my future research programs. The big ideas and discoveries will come—I could realistically drive around the coast of Puerto Rico and catch lizards solo. But why? People appreciate inclusion and spending their time learning something new. Army crawling through thorny brush in 110° F heat to catch a lizard is the most fun that I have ever had, but it is hard. I would have crawled back to Texas defeated without support. Instead, I've developed new and strong relationships that motivate me each day. I am pleased that my assistants have felt inspired and learned a lot. I support reflection periods for any type of project, and I am glad that this series supports opportunities for bringing all sorts of 'perspectives' to the Applied Biodiversity Sciences community at Texas A&M University.

Acknowledgements

- Valerie Angeli – Mom, Director of Health Services, Lebanon Valley College
- Kathryn Auer – Virginia DNR wildlife biologist
- Arthika Chandramohan – Medical student, Duke University
- Kristina Chyn –PhD student in WFSC, Texas A&M
- Kaycee Faunce – Volunteer in Alouatta Sanctuary, Panama
- Nathan Schwartz – Gopher Tortoise (*Gopherus polyphemus*) researcher
- Cameron Venable – PhD student in Ecology at Penn State
- Zeth Westfall – Army National Guard

And of course, to all of the contributors who worked so very hard in the field!

Using Anthropology and Ecology to Aid Conservation Efforts

By: McCall Ransom
Texas A&M University
Email: mransom.d@gmail.com

At some point early on in our lives we are asked the inevitable question: "What do you want to be when you grow up?" Responses typically follow "teacher," "fireman," or "astronaut" but there seems to always be one child in the kindergarten classroom that throws in an outlier. Since that young age, my response could be described as an "environmentalist." As we grow, those initial dreams usually transform into a different career path. I could have never imagined that 16 years after declaring my dream occupation I would have the opportunity to give it a test run.

I was an extremely fortunate kid. My parents recognized early on my passion for wildlife and conservation and searched opportunities for me to explore my interests. When is was 14, I began volunteering at a wolf sanctuary and later became a lead volunteer. At 15, I began volunteering at the Houston Zoo for the public education department and the following year was selected to work with the elephants. It was here that my interest in wildlife ecology was sparked. A few years later I began my studies as a Wildlife Ecology major at Texas A&M University. Midway through my sophomore year I realized that studying wildlife and fisheries was not challenging or intriguing to me anymore and much to the shock of myself, family, and friends I changed my major to Cultural Anthropology. It took a year to realize why I chose anthropology (and to convince my parents that I was not wasting my education). A friend of mine encouraged me to meet with one of her professors who was working in Botswana with elephants and, because of my history with pachyderms, thought

it would be a great networking and learning opportunity.

"Why did you want to meet with me?" asked Dr. Amanda Stronza as I sat down in her office. I proceeded to tell her of my experiences with wolves, love of elephants, and that I had a few questions I wanted to ask her such as "Why did you choose this field of study?" and "How did you get to where you are today?" I wanted to glean any wisdom she offered about working in the environmental field, going through graduate school, her experiences in research, and more. She was able to use her anthropology and environmental backgrounds to work on her current project Ecoexist, a project aimed at reducing human-elephant conflict and fostering coexistence between the two species in the Okavango Delta region of northern Botswana.

Dr. Stronza encouraged me that I too could combine my passions for anthropology and ecology into a profession that could make a difference in the world. After that meeting, Dr. Stronza encouraged me to sign up for a new course offered to undergraduates through the Applied Biodiversity Sciences (ABS) program: Introduction to Biodiversity Conservation Research. Dr. Leslie Ruyle taught our class of five students and guided us through the process of finding out what our research interests were and how to go about the process of doing scientific research. It was there that I found my interest in Human Ecology, the interdisciplinary study of the relationship between humans and their environment. At the end of course, Dr. Ruyle put me in contact with Ph.D. candidate Katherine Dennis who was looking for an undergraduate to mentor in research.

At this time, my senior year began and I learned to balance undergraduate research on top of a full time school load, part-time job, and if that was not enough, training for my first half marathon. Katherine guided me through the process of sorting through vast arrays of literature, developing a research topic and proposal, and preparing for fieldwork. I will admit, initially I was not fond of the idea of seven months of prep-work before entering the field. I had a romanticized notion of what anthropological field

research was; going into the field with a note pad by my side, ready to record crucial observations and information while hiking through an unknown wilderness. I quickly realized that this notion was not just unrealistic, but it could easily be detrimental to the research I was trying to work on. This experience was supposed to be more than some twisted white-savior complex, it was to add to the scientific body of knowledge and help conservation projects become more sustainable. Soon after having this epiphany I was able to see the larger purpose of all the hours and work I was putting into pre-fieldwork research: it would determine my preparedness, productivity, and usefulness of my data collected once I was in the field.

March 7th: Today was the day of firsts: I would fly alone, travel to another country, and enter into an environment where my native tongue was foreign - all for the first time. Three connecting flights, a taxi, and three bus rides later (one bus broke down so Katherine and I grabbed the last available bus), we arrived in Santa Fe, Panama. Katherine had been in Central Panama for the past decade off and on initially serving in the Peace Corps and recently doing research for her dissertation. The first day, I met many people that I would be in frequent contact with throughout the remainder of my stay. Yet no amount of preparation could have reduced the headache I received from my brain continuously switching from thinking in English to Spanish. Nor could all the training for my half marathon I completed six days before landing in Panama prepare me for walking up and down the slopes of the mountains. My legs quickly learned that running and hiking were two very different activities. But after a few days, my Spanish came easier, my legs stronger, and my familiarity with Santa Fe grew.

Katherine's previous experiences in Santa Fe made my research possible. This specific area was chosen because it contained the headwaters of the Santa Maria watershed, which supplied water to three provinces including a provincial capital. The decisions made in this mountainous area concerning water affect everything and everyone downstream. We had six interviews scheduled, which I thought

was a low sample at first. But considering that each interview took an entire day to complete because we traveled on foot and our narrow time frame, it was the best we could have done. I interviewed three men and three women from the Santa Fe area.

Each successive interview left me in more awe than the previous from the amount of knowledge and awareness they possessed about their environment and its ecology. The locals were more than just rural farmers, they are the proponents of sustainability and fair trade; on the front lines of fighting against climate change, deforestation, watershed depletion. From my interviews, I learned these sustainable practices were ingrained into their everyday lives. Fences were made from living trees, land was terraced and trees were interspersed between crops to conserve soil and water. Many were also leaders in local and international organizations such as farmer's associations and trained others to carry out similar environmentally friendly practices. While their impact may seem relatively small, these people are environmental heroes and yet no one may ever know their names outside the mountains of Central Panama.

While this research experience may seem like an interesting opportunity for an undergraduate to gain experience, why was this research done? The ABS program is founded upon three pillars: "integrated research in biological and social sciences; cross-disciplinary research and collaboration with conservation institutions and actors in the field; and application of conservation theory into practice." As stated in their vision, the goal of ABS is to "produce scientists prepared to understand ecological functions of local ecosystems, and also the activities and needs of surrounding communities in wider social, economic, and political contexts." The work of a researcher should go beyond the pages of a scientific journal, they should be applicable to solving real-world problems. And that is exactly what I wanted to accomplish with my undergraduate research experience.

In their history, conservationists have learned a lot about how to ensure that their efforts are successful as possible. Aside from proper funding for conservation projects, having enough people, specifically local people, to carry these visions over the long term is crucial for the sustainable success of conservation projects. For example, saving the pandas will never work if the local communities that live in the environment of pandas do not want to be involved. Funding can only last for so long, and when it runs out, projects sustained by capital alone fail. When communities are intimately engaged in conservation efforts, success is more sustainable. But communities are not composed of uniform members.

There are numerous cultures with internal and external dynamics that have to be taken into consideration. Members that can affect or be affected by the actions of conservation projects are known as stakeholders. Depending on the culture of the community you are working with, some stakeholders are more easily identifiable than others.

Women as stakeholders can be easily overlooked and may have more important roles than researchers and conservationists realize. Women

are typically primary caregivers and can have considerable influence over their children who will become the next generation of stakeholders. I reviewed a few case studies in agroforestry (agriculture incorporating the cultivation of trees with crops) where women played a crucial role in the sustainability of conservation projects, but none of these were in Latin America. My interest was sparked and I wanted to know if women's participation and perceptions of agroforestry and watershed conservation had any affect on the success/ sustainability of these projects in Central Panama. My hope is that by better understanding this issue that knowledge can then be applied to conservation projects and economic development projects by highlighting the need to assess and involve women as essential stakeholders for sustainable success.

I began this research by collecting preliminary data through interviews and participant observation while in Central Panama. I interviewed women individually with semi-structured interview questionnaire that focused on three topics: 1) *a participant's knowledge of agroforestry and watershed conservation*, 2) *their degree and reasoning for participation in agroforestry*, and 3) *their relationships with others involved in agroforestry*. These observations and insights gave me valuable information of a woman's daily activities and those activities related to participation in agroforestry. Since interviews typically took a couple of hours to complete, Katherine and I compensated their time by helping the participants on their land for a few hours; I can now say I have a fair amount of experience on planting coffee seedlings.

After analyzing the data, I found that in most cases, household work was the primary factor that prevents women from participating in agroforestry related activities. When women do have the opportunity to participate, they can to the same extent as their male counterparts. I found that the more agroforestry related activities a woman participates in, the greater her knowledge and understanding of the subject. Agroforestry can do more than conserve water, it can empower women to be more than a housewife and can improve their quality of life. Their position as a mother to their children plays an important role in raising up the next generation. The women I interviewed noted that more youth are moving away from rural areas like Santa Fe to the cities for work. If any type of conservation and development project such as those aimed at long-term watershed conservation are to succeed there must be a group to carry on these practices into the future.

Most of the people I interviewed were in their 60s or older and they affirmed that a majority of those that are practicing agroforestry were older. When all stakeholders are taken into account, such as mothers that encourage their children to continue these practices, the chances of long-term success increase greatly. Agroforestry practices have been present in the Santa Fe region for over 30 years and will likely continue.

Though many of those I spoke with were concerned with the future of these practices and whether they would continue in the face of increased urban migration, there are still younger individuals who value what their parents are doing and want to conti-

-nue these practices. In essence, women are important stakeholders in conservation and development projects. Even when they do not participate in the same manner or to the same extent as their male counterparts, they are just as vital for the long-term success of conservation projects.

My experience has taught me so much. I learned that the research done before entering the field is crucial in determining the direction of the rest of your work; you can never over prepare and as with all research, there is always room for improvement. I was able to present my findings at the Texas A&M University 5th Annual Anthropology conference, a great and refining experience. I want to continue working and researching in the field of human ecology and strive to make tangible difference in the world. If it were not for ABS, my professors, or Katherine Dennis, I would have never had this opportunity of a lifetime to taste what it is like to be a researcher in the field of applied sciences. This experience has solidified my plans to join the Peace Corps and pursue graduate school thereafter.

Acknowledgements

I would like to thank the ABS program for funding and presenting the opportunity to carry out undergraduate research. Thank you to Dr. Amanda Stronza and Dr. Leslie Ruyle for inspiring and demonstrating that the impacts of research can reach for beyond the confines of a scientific journal. Thank you to Katherine Dennis for being an amazing mentor and friend throughout the past year. And lastly, I dedicate this to the wonderful men and women of Santa Fe, Panama whose conservation efforts shall not go unnoticed.

CONSERVATION OFF THE PORT BOW

By: Constance Woodman
Texas A&M Univeristy
Veterinary Pathobiology
Email: gryphus@gmail.com

Chris Biro has made a living for two decades by travelling around the United States, as a pirate (with a real cutlass) and a fully rigged pirate ship. His educational bird show, "The Pirate's Parrot" teaches general audiences about parrots in the wild and as companion animals.

During the shows, flighted birds have total freedom to fly, play, and interact with audience members. Chris recalls them back to him by using trained behaviors. During a recent show a concerned women, likely familiar only with wing-clipped parrots, asked "will they come back?" Chris, always the scallywag, shrugged and said "I hope so."

Chris' interest in bird training extends beyond shows. For many years he gave the birds he worked with opportunities to build their flight and survival skills in varied and interesting locations. He has worked to create behaviorally balanced groups of parrots who are autonomous, aware animals, while also being friendly and interactive.

Chris has created a scenario where birds can learn complex, wild-type behaviors, while under the protection of a human caretaker. His practices could have significant impacts on conservation.

Before I met Chris, I knew him as the

Photo by Scott Ripley, http://www.flickr.com/photos/ripleyphoto/

the pirate guy from the internet who taught me how to fly my pet parrot outside instead of clipping her wings. His "Freeflight List" on Yahoo Groups was my tutor in the early 2000s. I remember fourteen year old me receiving an e-mail from Chris, answering my questions. I spent hours dissecting the information then took my young parrot outside to practice flying. Years later, I met Chris in person when our paths crossed again. I was hired to film his birds in the Canyonlands of Utah.

During filming I realized that the birds Chris trains are incredible. Hand-fed pet birds are not supposed to avoid predators, mob predators, find food, excavate nest sites, navigate long distances, or respond in parallel to the alarm calls and activities of local wildlife when there is a predator threat!

Chris' parrots are like wild birds... But snuggly! This is very significant because of what science learned when conservation biologist Noel Snyder released captive parrots into the mountains of Arizona in the 1980s; parrots from the pet trade tend to get eaten, sicken, and starve, when released.

After filming, I worked with Chris to quantify his approach, and convinced Chris to enter the conservation world beginning with the zoo community and the aviculture (bird breeding) community. We wrote and presented our first paper in 2008. Today, Chris has expanded our initial one-page methodological summary into a ten hour course. Now, individuals in Australia, Europe, the U.S., and the Middle East have reproduced Chris' methods and continue to have excellent results with their own birds.

Our non-profit, Bird Recovery International, was founded to translate Chris' techniques into conservation tools. Current strategies to prepare captive-bred parrots for release involve an entire team of trained staff to manage the large colonies, translocations, and may require the presence of existing wild

flocks for integration. With Chris' method, only a single person is needed, and birds need minimal caging for sleeping and bad weather. There is no need for an expensive large aviary, large numbers of staff, and huge numbers of birds. The high survival rates of a managed flock as they learn wild skills would mean hundreds of birds don't have to be released to create enough survivors for reproduction. By utilizing the pet trade to produce birds rather than a specialized breeding project, existing expertise and facilities provide birds with no need to re-invent the wheel. The human overseeing the birds' education can recall the them from dangerous situations until they have the appropriate skills to deal with threats. So, even though there is not a wild flock to integrate them into, there is low risk to the parrots.

Having been accepted into the ABS NSF-IGERT program, I am currently writing a comparison paper to see what conservation can learn from free-flying birds compared to existing methods to prepare birds for release. For example, one standard currently used in conservation is to make parrots in a cage watch a hawk hurt another live parrot. In contrast, Chris allows his birds to develop habits and behaviors to avoiding predators through practice. The birds gain useful behaviors when pursued by benign but curious gulls, ravens, or turkey vultures. I personally prefer Chris' method.

My long term hope is to fly a flock of parrots here at Texas A&M in order to carefully study the process of wild skill acquisition. With the support of my advisor, Donald Brightsmith, I believe I will be able to bring these unique methodologies and results created by "Captain Chris the Pirate" into the conservation mainstream.

Photos of wild behaviors by hand-raised pet trade birds trained by Chris Biro
Below: Foraging with and responding to signals from local prey species. Multi-species flocking in response to threat. Excavating nests and laying eggs (which are not left outside to hatch, Chris is not interested in creating potentially invasive parrot populations.) Opposite: Predator evasion, wild foraging.

Research Blogs as a Tool for Applied Biodiversity Sciences

By: Michael A. Petriello
Recreation, Park & Tourism Sciences
Texas A&M University
Email: map242@tamu.edu

We are entering the age of what some consider Nature 2.0[1], a phenomenon emerging from thousands of individuals, conservation practitioners, environmental advocates, and invested aficionados alike, shaping the environmental and conservation information, data, and stories millions of web surfers receive. Nature 2.0 influences how Internet uses filter and digest increasingly popular conservation news, reports, and factoids, whether through official venues like the British Broadcasting Company's (BBC) nature page or quirky science memes exploding into full scale websites (e.g., I F#!@&ing Love Science).

We are similarly living in a geological epoch known to many as the Anthropocene, where ecological integrity is inextricably linked to human actions[2,3] spawning an array of scientific endeavors addressing both the social and biological

dimensions of contemporary conservation (e.g., the Applied Biodiversity Science [ABS] Program at Texas A&M University [TAMU][4]). For this reason, it seems logical that our awareness of humankind's connections to ecosystems and biodiversity would inevitably be filtered through of one of humanity's most impressive technological inventions: the Internet. However, unlike the past 15 years of scholarly attention dedicated towards conceptualizing and understanding the Anthropocene[2,3,5,6,7], researchers are just beginning to connect our socially-fueled digital world to our perceptions of and actions in our natural environments[8,9,10,11]. This is important because social media such as Twitter, Facebook, online conservation magazines, and independent research blogs (e.g., Yale Environment 360; Conservation Magazine; ConservationBytes; The Institute for Applied Ecology) are revolutionizing how conservationists communicate with each other and with the broader public[11,12].

Research blogs in many ways define this growing trend, drawing the attention of applied biodiversity scientists from across the globe. For example, Twitter is becoming a uniquely valuable tool for sharing simplified and easily understood bites of cutting edge research. At the International Congress for Conservation Biology, the Society for Conservation Biology promoted Twitter use to circulate current research to non-attendees[11]. Other conservation and development minded think tanks and research centers, including the Maryland based National Socio-Environmental Synthesis Center (SESYNC) and the Howard G. Buffett Foundation on Conflict and Development at TAMU, are using blogs and Twitter feeds to not only propagate current research, but to cultivate new opportunities via advertisements for funding and organizational workshops. However, some suggest this approach may not be fully supported in that "few practitioners would use a blog to access scientific information" (p. 4)[13]. Nevertheless, authors continue to cite blogs to inform peer-reviewed publications in highly reputable scientific outlets[14,15]. Interestingly, blogs are further shown to contribute to scientific progress and subsequent public outreach, with "blog citations" of scientific articles enhancing the likelihood other scientists and practitioners will apply those studies towards future research[12]

And conservationists can personally benefit as well; blogging through Twitter or a larger media outlet provides scientists with an opportunity to fine-tune strategies for writing to a non-scientific audience – a much needed and often underdeveloped skill for modern day conservationists addressing controversial issues (e.g., climate change) within social-ecological systems[16,17,18,19].

The purpose of this paper, however, is not to narrowly emphasize the academic utility and intellectual merit of blogs. ABS is rooted in community participation, capacity building, and public outreach – all of which can be initiated and enhanced through blogging. The World Conservation Union–Conservation Measures Partnership (IUCN–CMP) categorizes blogs and other websites as tools to promote education and awareness[20] among practitioners and the public. This is because blogs and micro-blogs (e.g., Twitter) offer previously unavailable platforms for conceptualizing, formulating, and disseminating complex conservation issues for multiple sectors of society. A scientifically accurate blog can act as a catalyst for local action to address natural resource dilemmas by framing an issue in context-specific terms while filtering out misinformation from Internet sources of "dubious quality" (p. 517)[17]. In addition, this information presents a springboard for developing partnerships with local communities and governance structures, which can aid in avoiding miscommunications about situational details important to planning community-based conservation projects.

All of the above represent the positive aspects of blogs reporting 'finished' study results rather than science in action, documenting ABS as an unfolding experience. Think of an active research blog, where the reader can follow the researcher while she or he develops research plans, frames concepts, reports on quirky field experiences, and crafts results during the life of a research project. Fortunately, like many men with a graduate education (the demographic that makes up over two-thirds of science bloggers[21]), I started a research blog to chronicle my ABS research this past summer in Nicaragua[22]. My goal here is to share my experience writing a research blog while simultaneously exploring

strategies for effectively blogging about the applied biodiversity sciences during the course of fieldwork.

Brief Project Background

From May 22 to August 13, 2014, I collaborated with residents of El Carmen, Nicaragua to understand natural resource conflicts affecting this community and how these conflicts influence local knowledge about endangered seasonal tropical dry forests. The project occurred in 3 interconnected phases (interconnected means rather than being sequential, all 3 phases were ongoing over almost 3 months): 1) *identify current environmental conflicts through everyday conversations, interviews* (photo 3), and observations; 2) *document these conflicts through photography using residents' photos from disposable cameras and camera traps we placed to document wildlife associated with these issues*; and 3) *apply all of the information from residents and my observations toward analyzing the relationship between knowledge and conflicts, with an emphasis on developing potential solutions towards these prevalent issues*.

In total, 42 community members contributed to identifying and documenting seven environmental issues through 28 disposable cameras, 15 interviews, 7 camera traps, 1 focus group, 1 community meeting, and hours upon hours of jovial conversation. Identified conflicts included drought, jaguar (*Panthera onca*) attacks on livestock, agricultural burning,and crop pests (e.g., raccoons, [*Procyon lotor*] and coatimundis, [*Nasua narica*] – all of which restrict or modify human well-being and interactions with the forest they depend on for their livelihoods. At the time of this writing, the project is now in the third and final phase. For this reason, as well as limited writing space, I cannot offer a deeper overview of what we found. But I can direct readers to the blog that is the focus of this paper for more details (*see below*).

Texas A&M Center on Conflict and Development Student Media Grants Program:
Natural Resource Conflicts and Conservation Narratives in Nicaraguan Forests

Top: Interviewing a resident of El Carmen, Nicaragua. *Middle*: Removing toads while digging out a mud-caked well to stimulate water flow to mitigate the effects of unrelenting drought *Bottom*: carcass of a horse symbolizes the return of the once locally extirpated jaguar (*Panthera onca*).

Top: some residents consider agricultural burning a commonly practiced and effective method to remove pests, while others see it as destructive. *Middle*: raccoon (*Procyon lotor*), known as a *mapuchin* by locals, photographed on one participant's farm *Bottom*: A group of pisotes (*coatimundis*, *Nasua narica*) selectively targeted by a participant's camera trap to illustrate a common pest for farmers.

Blogging in Action

To start off, I did not formally measure the "success" of my blog at communicating the research process or having a scientific impact. Yet, many of my friends, family members, and university colleagues anecdotally expressed their interest in and surprise with the blog's content, primarily how the posts were organized, writing style, context, and detail about a region and community unfamiliar to nearly all of the blog's readers. However, before I launch into the meat of this blog, there are 4 essential precursors I adopted for preparing to write about the applied biodiversity sciences. In my case, these steps eased anxiety over writing to the public, constructing a concise and understandable message, and informing my own thoughts and ideas about the project. Simply put, they are: 1) *scheduling*, 2) *organizing*, 3) *communicating*, and 4) *adapting*.

Scheduling

Whether in the same state or a foreign country, ABS fieldwork is logistically and personally challenging. The decision to write a blog adds another layer of complexity to an already convoluted endeavor. This is why *scheduling* is so important. For example, after organizing my travel (including flights, hotels, and plans to cross into Nicaraguan from its southern neighbor, Costa Rica), I had to figure out where I was going to live, how I would reach my new home, how I would haul food to my home stay, when and how to start conducting interviews, placing camera traps, and handing out disposable cameras, and form a consistent field schedule. This process in no way required Internet access (and there wasn't any where I lived). However, a blog did. Although blogging was not the only reason I needed to travel down (including supplies, checking emails, and a break), my blog became the main reason I needed to reacquaint myself with Nature 2.0. On that point, my advice is to commit to blogging on specific days. I regularly posted every weekend, both out of limitation and necessity. Knowing my blog was just over the horizon every time Saturday rolled around prepared me to keep the topic of my blog in mind as the public bus entered San Juan del Sur, where I would stay every weekend and

watch the parrots as I wrote.

Organizing

After committing to a timely writing schedule, I needed to *organize* my thoughts. Organization was key, both for structuring the flow of each individual post and constructing a clear narrative theme across the entire blog series. I elected to use the blog as a way to tell my audience (and myself) my purpose and goals (i.e., this blog post) while secondarily laying out "A look at what to expect for this summer" (i.e., this blog post). The second post outlined the subsequent format for the rest of the blog: each post would be dedicated to one natural resource conflict, with an eventual brief exploration of my results later in the summer. Human-jaguar conflicts (found here), the environmental and socio-economic effects of teak (*Tectona grandis*) plantations (found here) and snakes in the woods (found here) are some examples of my post.

Organization also involves choosing a general framework for each individual post. Here is why organization and communication (*see below*) come into play. The structure of each post was intentionally formulaic. First, I began each post with a personal story as a way to ease the reader into more detailed information, catch her or his attention, and offer inspiration for the remainder of the post. With this approach, I did not have to worry about having every scientific facts straight to start writing because I already knew the story I wanted to tell, helping avoid writers block on a continual basis. Second, the body of the text dove into the blog topic headfirst, presenting social, economic, financial, environmental, and psychological aspects in whatever order fit the posts' themes – basically most aspects of a social-ecological system that were available to me at the time. And third, I closed each post with a thought, question, or consideration relating the previously described conflict to local knowledge and the project as a whole. By doing this, I refreshed the study objectives in my mind and with

the audience, keeping everyone on track for the next post.

Communicating

A search for "Science public communication" in Google yielded 162 million hits. The word "public" is particularly relevant in this case. ABS and social-ecological systems research is filled with scientific terms that many would deduce to discipline-specific jargon. Although these terms are useful for communicating specific ideas, they can muddle an already nebulous subject. I chose to focus on communicating with the public for my blog instead of writing directly to other researchers. My decision was guided by concerns over organization (*see above*) and comprehension. Organizationally, starting each blog post off with anecdote-filled accounts of my time in El Carmen set the tone for a casual blog post. Also, following a systematic format for each post set expectations and provided clarity across the summer's worth of posts. In terms of comprehension, the relaxed but informative style broke down complex issues into more concrete descriptions. As the writer, you are the expert. But that does not mean you still might lack some understanding.

Writing for the public allows the writer to test her or his understanding of the material. If your blog is succinctly written and concisely organized, it will be understood. In line with that point, the goal of my blog was not to make everyone experts; rather, the point is to use these platforms as vehicles for education and awareness. This is why I recommend adopting a casual writing style for these types of blogs. Rather than overload readers with a mountain of dry and incomprehensible numbers and statistics, for example, sprinkle a dash here and there to support larger points. As stated before, limit use of scientific jargon to concepts that are absolutely necessary. And imbed links to references as words in the text in place of typing out the full citation.

Adapting

My last point of advice is to be flexible with your scheduling, communicating, and organizing. Navigating fieldwork logistics can be extremely difficult. Events that are out of your control will alter your blogging schedule. The Internet might time out at your favorite café. A thunderstorm could trap your bus for a few hours. The local army barracks might suspect you for drug trafficking, detaining you for a few hours, and draining your desire to write afterwards. Stuff happens and it may be more likely to happen when doing ABS research.

I would not be surprised if a blogging schedule gets derailed because of because of unforeseen circumstances. In that case, it may be worth your energy and peace of mind to skip your blog on that day. The previous example with the local army actually happened to me. My plan was to blog on Saturday,

Top: Teak plantations, called *teclares*. *Bottom*: Three community members found this boa in their home, managing wildlife "conflict from below"

until my 'visit' with the army sidetracked my trip into town by 3 hours. I blogged on Sunday that weekend.

I also adjusted the sequence of my blogs. Placing special attention on each individual conflict aided in clarifying my thoughts and breaking down how knowledge may interact with and emerge from natural resource conflicts. This topic eventually became the subject of another blog post: "Where does knowledge fit in the picture?" However, I would not have written that post if I stayed wedded to the write-one-conflict-per-post strategy. Adapting to my growing perspective allowed me to be flexible, thereby keeping readers and myself informed about my thought process.

Some Final Thoughts

For now, the Anthropocene is here to stay – a fact likely considered in the conception of the ABS program at TAMU. In the original proposal for the ABS program, "A reviewer…pointed out that 'biodiversity and conservation efforts… successful elsewhere in the world (e.g., Africa) have benefited from this type of approach [actionable and integrated science], more through trial and error than purposeful training'." To which the architects of the ABS program responded, "This ABS-IGERT is purposeful in this regard; it will prepare researchers of different disciplines to understand and coordinate with each other, linking interdisciplinary teams with institutions and actors in conservation"(p. 5)[23].

Although this quote is in the context of collaborative research, it can equally apply to public outreach and communication. Blogs, at least in my case and that of others (e.g., Central American ABS Blog), serve as mediums for purposefully exploring and disseminating ABS research in real time. As the influence of Nature 2.0 expands into our conceptions of and relationships with the natural world, blogs will continue to grow in importance both as sources of novel conservation achievements, resources for advancing ABS, and educational tools for an eager public. This article is one step towards establishing blogs as a significant cog in the ABS toolkit.

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COLLABORATORY BLOGGING: MANY MINDS ARE BETTER THAN ONE

By: Kelsey Neam & Margot Wood
Texas A&M University
Wildlife and Fisheries Sciences
Email: kelseyneam@tamu.edu
margotwood@tamu.edu

With the onset of the Information Age, a new breed of communication is gaining momentum. Since the late 1990's, the Internet has provided users with a novel framework for publishing content in the form of interactive weblogs (blogs). By enabling new patterns of use, blogs have the potential to transform the general realm of the Internet[1]. For the last decade, blogs have typically been solo endeavors, often concentrating on a specific topic. Recently, however, multiple-author blogs (MABs) have started to dominate the blogosphere. Group blogs consists of posts centered on a major theme and are written by multiple authors in a collaborative effort. The Central America Applied Biodiversity Science Blog is one example of multiple authors working together to share their knowledge and experiences from a variety of disciplines about a single common interest: conservation science.

While there are advantages of single-author blogs (e.g. total ownership), they are dwarfed by even greater benefits offered by multi-author blogging. We will discuss three primary reasons that group-blogging enhances the overall academic blogging experience, especially in the interdisciplinary field of conservation science.

Collaboration

Whether you are in the natural sciences or social sciences, the development of collaborations are imperative for sharing knowledge and fostering partnerships with scholars, institutions, and actors. Collaborations are essential for maintaining established relationships, and for promoting new idea transfer and encouraging interdisciplinary exchange. Multi-author blogging brings together researchers working on individual goals, and through shared experiences and learning, provides support through a common interest. Collaborative blogging improves interdisciplinary understanding and provides an avenue for moving away from silos towards synergy, in a more creative and accessible arena.

Diverse Perspectives

Multi-author blogs have various contributors, each with their own writing style, strengths, and unique personal experiences. It is expected that multiple authors are going to share different viewpoints and opinions. Consequently, the authors, as well as the readers, are exposed to diverse perspectives from a variety of different topics. In the sciences, such as conservation science, this is critical because actors within the field hold widely varying viewpoints and perspectives.

Time is Precious

Producing fresh, stimulating content on a regular weekly basis is quite onerous for anyone, but especially for scholars who are already swamped by the demands of academia. If posts are not published routinely enough, you risk losing the attention of readers. By cooperating through multi-author blogging, academics are able to contribute a reasonable level of submissions without sacrificing valuable time.

In addition to creating networks among scientists, blogging has the capacity to promote "broader impacts" by enhancing communication between academics and the general public[2]. Scientists are obligated to disseminate the findings of their research to the public, especially with recent skepticism and negative public sentiment towards science (e.g., climate change). Scientists must try harder to convey why science and research is important. Blogging is one avenue that academics can use to provide the public and fellow scientists with accessible information on leading edge research. Collaboratory blogging may be used as a channel for communicating scientific knowledge and generating topical discussion with a broad audience, while breaking free from the restrictive, esoteric means of exclusively conveying data to other scientists in the same field.

Other Collaboratory Conservation Blogs

Stirling Conservation Science, Stirling University

Applied Conservation Lab, University of Victoria

Cool Green Science, The Nature Conservancy

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Above. Kelsey Neam and Margot Wood collecting vegetation data at a reforestation site in Costa Rica. *Opposite*. Several authors of the Central America Applied Biodiversity Science Blog (pictured from left to right): Mike Petriello, Margot Wood, and Kelsey Neam.

Closing Dissertation Fieldwork: *Ecuador 2014*

By: Audrey Joslin
Texas A&M University
Geography
Email: joslinau@tamu.edu

Since 2012, I have spent a total of 21 months living and working in the Ecuadorian Andes to complete my doctoral dissertation research. The goal of my investigation is to study the process of translating a water trust fund into on-the-ground conservation intervention to protect the high-altitude humid grassland called *páramo*, an ecosystem that is home to many endemic species and vital to human communities for its services of purifying and regulating water supplies. The water trust fund is called FONAG, short for *Fondo para la Proteccion del Agua* (Fund for the Protection of Water), and began in 2000 through a partnership between The Nature Conservancy and the public water utility company of Ecuador's capital city, Quito. The fund has grown to over US$12 million from the initial investment of US$ 21,000, and its interest and outside donations are applied towards páramo conservation in Quito's surrounding watershed.

More than a financial mechanism, however, FONAG is also an organization that designs and implements conservation interventions in rural communities that hold areas of páramo. Since its inauguration, it has served as the model for at least 32 other water funds that focus on conserving vital ecosystems within watersheds[1].

My approach to studying FONAG has been to follow the commodity chain of ecosystem services that moves from the producers to the buyers. With a group of constituents paying into the fund that, in addition to the founders, now include two private beverage bottling companies, Quito's public electric utility company and another international NGO, FONAG can be understood as an urban buyer of ecosystem services that transfers funds to rural communities for adjusting their land uses and accompanying labor practices for the sake of conserving páramo. In this way, these communities become the human proxy for 'producers' of ecosystem services. As a benefit (i.e. payment) of putting labor towards redirecting land uses in the páramo, FONAG supports communities with what it calls ecological-productive activities in an in-kind exchange, leading supporting international organizations such as the constituent member The Nature Conservancy and donor U.S. Agency for International Development to discuss the water trust fund as a program of market-based conservation called Payments for Ecosystem Services[2].

Despite the financial successes of FONAG and its prolific replication throughout the Americas, there has been little analysis on the interaction of FONAG within the communities. The evaluation of economic impacts, for example, have proven complicated particularly in separating the impacts of FONAG from other influential variables, such as other NGOs working in the community[3]. One objective of my dissertation research therefore focuses on the experiences of the communities that are targets of FONAG's projects. Specifically, I investigated FONAG's interaction with enrolling communities, the labor practices that communities were asked to provide as a part of these programs and the spatial (re)arrangements at the sites in the communities that required labor for FONAG's projects. During the months I spent in Ecuador, I conducted interviews, worked alongside community members on a FONAG project, observed meetings and other interactions between community members and FONAG officials, and walked transects through communities to document FONAG's spaces of intervention.

When preparing to go into the field to conduct my closing work over July and August 2014, I recalled conversing with a participant in one of the rural case study communities in 2012 and how she had expressed frustration with previous researchers that had come and gone without returning anything. My aim during my final field season, then, was to return preliminary results of my study as well as to get feedback from those who had provided data. I wondered: *Did I understand the participants correctly*? *Was I missing anything from my interpretation*? *How would the participants reflect upon the presence of FONAG, a year or two later from my first visit*? The process of research, particularly when working with human subjects, is one in which data is being co-created by the researcher and the participant.

To initiate these discussions, however, my challenge was how to put my results in a form that would be accessible, useful, and interesting to the participants. With the majority of adults in the case study communities holding a level of formal education in primary school or below[4], a variation in reading abilities would be expected, and participants of the communities were not likely to respond well to a written paper. I wanted to create something that was interactive, enjoyable, and demonstrated appreciation to participants.

My thoughts turned to the photographs I had taken during the course of my fieldwork. With permission, I had photographed people and properties as community members worked on FONAG projects or gave me tours of FONAG intervention sites. As I visited with participants in their homes, they would occasionally bring forth treasured old photographs of their families and show them to me with pride. Typically rural farmers from lower socio-economic backgrounds, they frequently did not have many photos because cameras were

expensive to purchase. A particularly poignant moment occurred in which a woman wistfully told me of how her daughter's only baby photo had been lost in a fire.

I decided to make small albums for the groups and individuals that had participated in the study. In lightweight plastic binders, I put together the photos that pertained to them, drew maps of the community and the sites of FONAG interventions, and wrote brief summaries of what I had learned from the case study community to which the participants pertained. Then, I went to visit. In the four case study communities, I gave the albums to a leader in the group that was working closest with FONAG after visiting with individual participants after discussing the album and giving them copies of any individual photos.

While this process may appear relatively simple, there were a few challenges in this task. When I began my study in 2012, I had extremely limited funding and did not know that I would be able to return to the four case study communities in the future. When interviewing individuals, I often did not retain full names, and sometimes assigned codes immediately without a name, which meant that I would occasionally get a name wrong when looking for an individual. After some explaining on my part, the confusion would be cleared up and invariably I was teased about my mistake.

The responses to the visits were heartening. I was able to visit 12 participants of the study, and roughly 60% of the participants recognized me immediately, and the other 40% remembered me after a brief reintroduction. Depending on the time I located the individual, I was frequently invited to lunch, and would often pass the day helping with chores like shucking corn or moving cattle between pastures. Participants clarified any questions I had from my previous visits, and on several occasions I was given a tour of new changes in the community or property. Participants met the photos I presented to them with smiles and comments. They regularly added detail to my maps and my explanations.

The use of the albums was an effective method to return feedback to participants directly involved in the study, and provided me an opportunity to validate my findings. Furthermore, the physical copy of the album is also an artifact that participants can show and discuss with other community members. This addresses complaints that researchers rarely share the results of their study, which may contribute to participant research fatigue and reluctance to engage with researchers in the future.

This work in July and August 2014 has been but one small segment of my dissertation work. However, my overall hope is that the knowledge generated from my research will have both theoretical and concrete applications for academics and conservation practitioners regarding market-based watershed conservation connecting the urban and rural spheres.

As a trainee, the program Applied Biodiversity Science at Texas A&M has played a strong role in my formation as a researcher and in the development of my dissertation by consistently encouraging my research addressing biodiversity and natural resource management in the Andes, and offering a supportive community of individuals from a variety of disciplines and perspectives.

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Fishermen and Market Gardens in Sénégal: *Implications for Integrated Conservation and Development Projects*

By: Aby Sène-Harper
Texas A&M University
Recreation, Parks & Tourism Sciences
Email: abysene1@tamu.edu

In the delta of the Senegal River in Senegal, West Africa, resource managers have drastically curtailed fishing activities in the Djoudj National Bird Sanctuary (*Parc Nationaal des Oiseaux du Djoudj*, PNOD hereafter) impacting small-scale fishermen who inhabit the region since before the protected area was established. Fishing resources in this biosphere reserve is the primary source of food for African and Eurasian migratory birds, and the primary source of livelihood for a significant number of local people. Since 1994, as part of Integrative Conservation and Development Projects (ICDPs), environmental NGOs have mostly looked to ecotourism, to provide an alternative source of revenue for these fishermen with the goal to alleviate poverty and reduce the pressure on fishing resources. However, these ICDPs, have yet to deliver impactful and positive results for the livelihood of the fishermen and for resource conservation. Fish stocks have declined over the years, negatively impacting the population of migratory birds, while fishermen continue to struggle in the search of sustainable livelihoods.

The case of PNOD and its local communities supports an important question that has long been on the radar of conservationists: Are externally conceived models of ICDPs congruent with the local conditions of West Africa? Here, I refer to externally conceived models of ICDPs, as projects that have been elaborated by actors, mainly western-based, that are not representative of any social group in local communities. Ecotourism is central to ICDPs, among other market-based schemes that seldom complement traditional livelihoods. There is now significant evidence that ecotourism is not the ideal conservation tool in West Africa because of its low tourism potential (compared to Eastern and Southern Africa) and that weak market institutions among other political economic conditions impede the success of ICDPs[1,2,3]. This latter argument combined with my observations during my field study in villages in proximity to PNOD led me to think of the following point: What if, instead of focusing on externally conceived models of ICDPs to provide alternative sources of revenue, resource managers start paying more attention to and build on the livelihoods strategies that rural households craft themselves in the face of resource fluctuations? To support my contention, I use the cases of Diadième and Rone, two villages in proximity to PNOD where fishermen are increasingly adopting market gardens as a seasonal livelihood diversification strategy.

The broader goal of this paper is to demonstrate that, when faced with resource fluctuations, rural households have the capacity to conceive and implement livelihood strategies that, under the right conditions, meet their socio-economic needs while leading to sustainable exploitation of natural resources[4,5]. However, the people who design ICDPs often overlook the latter key aspect. Therefore, I invite project designers to think of alternative models of ICDPs in which the focus shifts from poverty alleviation to livelihoods as a whole, in which the economic activity being promoted is context-specific, and builds on the assets and the capacity of rural households to adapt their livelihoods as conditions dictate.

In this essay I examine the adoption of market gardens among fishermen in the two villages as a seasonal livelihood diversification strategy. I also explain how this livelihood strategy can potentially lead to better conservation outcomes than the ICDPs that are currently in place, and the social and economic benefits of market gardens. Finally, I explain how the adoption of market gardens among fishermen in Senegal calls into question the "standardization" of externally conceived ICDPs that is often reflected in the economic activities that are being implemented.

Why Market Gardens?

A market garden (MG hereafter) is a horticultural activity focused on the production of fruits and vegetables, typically on a 1-hectare or smaller plot of land, to be sold at nearby markets or within communities. If well managed, MG can be a lucrative venture for producers. I became interested in MG activities in Diadiéme and Rone during my preliminary study in Senegal. I was first interested in evaluating ICDPs, but during informal conversations with villagers I found that they were more excited when discussing their MG projects. In fact, when I decided to look further into these MG, I felt that I had finally gained the attention and support of the villagers. I had the honor of being escorted by the village chief of Diadiéme, to visit all of the garden plots that were being exploited under the arduous sun of the Sahel. I started receiving the voluntary phone calls of a community leader from Rone every time he obtained information on their MG that he thought could be of interest to my study. I was even called upon to take photographs of harvesting events. All of this showing the great interest and pride that these folks attached to the projects that came about as a result of their agency and efforts that these gardens represent for them.

The adoption of MG by fishermen in Diadième and Rone

Similarly to many rural communities in West Africa, MGs originated in Diadième and Rone at a much smaller scale as fruits and vegetables were grown mainly for household consumption. It was an activity that was delegated to women as part of their household assignment to provide items to complement the daily meals. Women had very little opportunity to sell their produces for extra cash. Men worked collectively as fishermen, both for subsistence and for income generation to meet livelihood needs. However, today, the commercialization of fish is taking place at a larger scale with improved access to markets.

When the park was established in 1971, people who lived within the protected parameters were expelled and relocated in settlements at the periphery. Diadième and Rone are part of those settlements and have grown to now represent villages with all of their constituents. Each newly relocated village had a perimeter dedicated for small-scale cultivation activities. Fortunately for Diadième and Rone, their borders were located on the banks of multiple lakes with some of the most fertile soils in the region, which are ideal conditions for gardening. Women took advantage of this opportunity to expand their gardening operations and started to sell their products to nearby villages, as they were now able to produce more.

In 1986 the Diama Dam was built and national economic policy was put in place to transform the delta of the Senegal River into an irrigated agricultural region dedicated to the production of rice. As a result, in the late 1980s and throughout the 1990s, portions of arable land in Diadieme and Rone became subsidized for rice production. During this time, fishermen had an opportunity to supplement their revenue from fishing activities. The cultivation of rice offered an alternative source of revenue to fishermen during seasons when fishing resources were low. However, today villagers explain that since the early 2000s the production of rice is no longer as profitable as it used to be and that in more recent years many of them fell into serious debt as a result of poor government policies. Consequently, many of them found themselves looking for alternative economic activities during the low fishing seasons. A few men decided to try their hands at this horticultural activity that was delegated to women.

For reasons related to issues of gender[A], these men had more opportunities to expand their initial gardening operations into market gardens. Many of these fishermen/gardeners hire workers from the southern and central region of the country for their expertise in MG operations to produce fruits and vegetables for much larger markets at the national level. Over the past decades, MGs have taken a more central role in the income diversification process of fishermen, surpassing rice production for many. This trend is in fact valid for several small-scale fishing communities in the delta of the Senegal River covering the countries of Senegal and Mauritania. During my interviews, the fishermen explained that over the past decade MG have become a more lucrative business than rice production. Most importantly, they also explain that the harvesting season usually starts in conjunction with the low seasons for fishing resources, precisely when an alternative source of revenue is most needed.

Since 2008, the numbers of MG plots that are exploited in Diadiéme and Rone have increased by an average of 80% and there are currently 33 parcels (~0.6 hectares exploited/parcel) that are exploited in Rone and 21 parcels (~0.5 hectares exploited/parcel) in Diadiéme. This growth in MG operations prompted village leaders to begin a more formalized land tenure system. Before, it was on a "first come, first serve" basis, whereby the parcel belonged to the first person to clear the small portion of land. There was no legal document to show ownership of the parcels. Today, every household has been given a parcel (whether they plan to cultivate the land or not) formally recognized by the village and legally documented at the local government level.

Can market gardens lead to better conservation outcomes than current ICDPs in Diadième and Rone?

ICDPs implemented for PNOD and its local communities, include ecotourism

Above. The issues of fisheries and market gardens encapsulate a vast ecosystem, all of which are in some was subject to the dynamics of local water sources for ecological function and human wellbeing.

activities and the production and sales of arts and crafts. However, the success of these projects remains elusive as fish stocks continue to decline and fishermen are still struggling to build viable livelihoods. The tourism season takes place between October and May. Therefore, no ecotourism revenues are generated from May to October, the low fishing season. Additionally, profits from ecotourism are procured by a small group of individuals leaving the rest of the villagers with limited benefits. Without a sustainable ecotourism industry that benefits locals or viable low season alternatives to fishing, NGOs and resource managers of PNOD need to pay more attention to market gardens as potential ICDPs.

Fishermen in inland African lakes tend to diversify their income portfolio as part of their own strategy to sustainably manage fishing resources and build livelihood security[4]. The fishermen in our case, as it is in many other small-scale fishing communities, deliberately engage in complementary activities that allow them to continue fishing as a specialization and yet mitigate the risk on their livelihoods associated with their primary activity[6]. However, some maintain that conservation programs with development component, too often seek to replace their primary activity rather than complement it, which can turn out to be counterproductive from a social and ecological standpoint[7]. Further, the diversification of livelihood sources can take the pressure off of sensitive resources and provide alternative options while fish stocks recover[6,8]. In Diadiéme and Rone, the adoption of rice cultivation as a complementary activity among fishermen used to be a pillar in the diversification process. Today, MG are rapidly taking an important position in the livelihood portfolios while potentially facilitating the restrictive management of fishing resources in the park. This is partially attributed to the MG seasons starting as early as February, with fishermen able to collect revenues starting in April and continuing through July. Throughout these months, MG provide an alternative source of income to fishermen during the fisheries low season, thereby giving fish stocks an opportunity to recover.

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Although further research is needed to examine the impacts of MG on fishing practices and efforts in Diadieme and Rone, the accounts that I received from fishermen not just in those two villages but also during my visits in other fishing communities in Senegal and Mauritania, provide some insights in this direction. According to an elder fishermen in the village of Tagrediet in Mauritania, where MG is well developed[B]:

"*We are first fishermen, however during the time fish resources are low, it is not profitable to fish; the fish are too small to sell, so we have to find other activities. We tried market gardening and it worked so well and now almost every one has a market garden […] When the fishing season starts again you will notice that the fish have all grown and there are a lot more of them*."

Based on this testimony, it can be argued that MG has played a strategic role in securing their livelihoods and their fishing resources. I received similar accounts throughout the villages I visited in Mauritania, and other regions of Senegal where small-scale agriculture was practiced among fishermen.

Economic and Social Benefits of Market Gardens

Based on my interviews and conversations with local villagers in Diadiéme and Rone, there are economic, health, and social aspects of MG that make this horticultural activity worth pursuing: In terms of economic benefits, based on data collected over my preliminary study from April to August, in Rone the average revenue generated from the production of onions alone was 750,000 West African Francs (CFA) (~ $1,500) on an average of 0.6 hectares exploited per parcels. The highest revenue generated was 1,568,000 CFA (~ $3200). In Diadiéme, the average was estimated at 850,000 CFA (~ $ 1700) on an average of 0.5 hectares exploited per parcels. As I outlined earlier, each household was given a parcel of one hectare, but because of a lack of capacity, only about half of it is exploited. Additionally, this only accounts for the production of onions and doesn't take into account other important produce such as tomatoes, carrots and cabbages that are grown during different periods within the season. Nevertheless, onion remains the single most important production currently taking place.

As for the health benefits gained from MG, they are a substantial source of nutritional supplementation and provide essential dietary staples. For instance, Diadiéme and Rone are relatively isolated and access to the market for produces is limited to people who have cars or motorcycles (which very few people do). Therefore, many villagers often walk to the MG parcels to seek fresh vegetables and fruits. During the harvesting time, women offer their assistance in exchange for a bag of onions, cabbage, carrots and other produces. As a villager explained to me once:

"*If it was not for the MG in this village some of us would not have all the nutritional ingredients we need for our meal…it would be just plain rice and fish…not everyone has the means to go out to Ross Béthio [nearest town located 18 km away] to shop for our meals*"

Market gardens also has positive impacts on issues related to property rights; in fact MG helps secure property right by turning those unexploited land into cultivated ones at a relatively lower cost. In rural communities of Senegal, agricultural land is allocated to villagers, however the state has the right to take it back if it remains uncultivated for too long. In other words, the only way to secure property rights is to turn an idle land into a productive one. In Rone, I heard several accounts where head of households lent their MG parcels to relatives mainly to keep the land productive – regardless of the beneficiary – for fear of losing their land. In Diadiéme on the other hand, there were many more parcels that remained unexploited for reasons that are beyond the scope of this paper. As a result, given the increasing demand for land by private agricultural companies in that region, villagers are beginning to fear that they will lose their parcels if they remain unproductive for too long.

More than socio-economic benefits, securing land rights for rural communities can also lead to positive environmental outcomes. Sub-Saharan Africa's access to land is central to the livelihood diversification process[6]. Landless households tend to rely more on common pool or open access resources thus accelerating the rate of exploitation[9]

Above. A perspective of community members as they transition from their fisheries to the tending and harvesting of their market gardens.

Access to land is particularly important for fishing communities in the African inland communities, since research shows that fishermen engage in agricultural activities during the reproductive season[5,6]. Thus, in this case, securing land rights through MG can lead to positive environmental outcomes in the long term because it gives the opportunity for fishermen to engage in seasonal agricultural activities while fish stock recover. Given the very limited opportunities for non-farm income in the delta region of the Senegal River, fishermen who have lost their land to cultivate will more likely continue to fish during the off season in order to meet their daily household needs.

Implications for Integrated Conservation and Development Projects

ICDPs are a popular mechanism for reconciling rural development and conservation goals but the results of such programs remain elusive. In a world in which policy makers and resource managers are heavily informed and influenced by cookie cutter models, this often time shapes the design of ICDPs. As a result, income generating activities that are conceived by external actors and often unconnected to traditional livelihoods are central to these programs. I believe that it is time for project managers to pay more attention to livelihood strategies that emerge from within the communities as a response to resource fluctuations. Whether or not these strategies, like income diversification through the adoption of complementary activities, are sustainable, research show that they have become an important attribute of rural livelihood. Therefore, recognizing this phenomenon and analyzing the factors that support or constrain its sustainability, both social and environmental, would be more productive in the direction for future natural resource management and economic development projects.

The case study of Diadiéme and Rone illustrate how the adoption of an activity, as a livelihood strategy, has the potential to be more effective and more accepted than ICDPs that are centered on ecotourism, socially, economically and environmentally. While further research needs to be carried to validate the suggested social and environmental outcomes of the diversification process presented in this paper, MG are gaining a foothold in the transboundary delta region of the Senegal River, and calls for an evaluation from project managers. This evaluation will inform them on how to integrate MG with ICDPs currently in place to maximize livelihood security and conservation outcomes.

Notes

A. If, like myself, you are interested in further understanding issues of gender associated with the adoption of market gardens or any emerging economic activity in rural Africa, I propose an insightful and well written account by anthropologist S. Wooten, Ph.D. in the following article: S. Wooten (2003). Women, men, and market gardens: gender relations and income generation in rural Mali. Human Organization, 62(2): 166-177.

B. I had the opportunity to visit Mauritania and other regions of Senegal only towards the end of my field study. Travelling to those regions was not part of my plan at first, but I felt compelled to find out more as villagers in Diadieme and Rone made several references to those places as "model" of seasonal diversification through MG. The villages that I visited in Mauritania are also at the periphery of a protected area, Parc National du Diawling (sharing the same transboundary biosphere reserve as PNOD), but with very different management style which has arguably impacted the development of MG around the park.

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Interdisciplinary research is a demanding taskmaster
Or, a mind-bending year in Bodoland

By: Dhananjaya Katju
Recreation, Park, and Tourism Sciences
Texas A&M University
Email: dkatju@tamu.edu

Having spent close to two decades approaching biodiversity conservation from a largely ecological perspective, I made the decision to engage with interdisciplinary research and joined the Applied Biodiversity Science (ABS) program in 2009. After close to 3 years of intensive training in the social and biological sciences and taking courses in 5 affiliated departments, I was pronounced ready to embark on my first independent research journey. Since I had elected to examine the sociopolitical and ecological dynamics mediating the governance of one of India's premier tiger reserves, I found myself in the state of Assam in Northeast India beginning the summer of 2013.

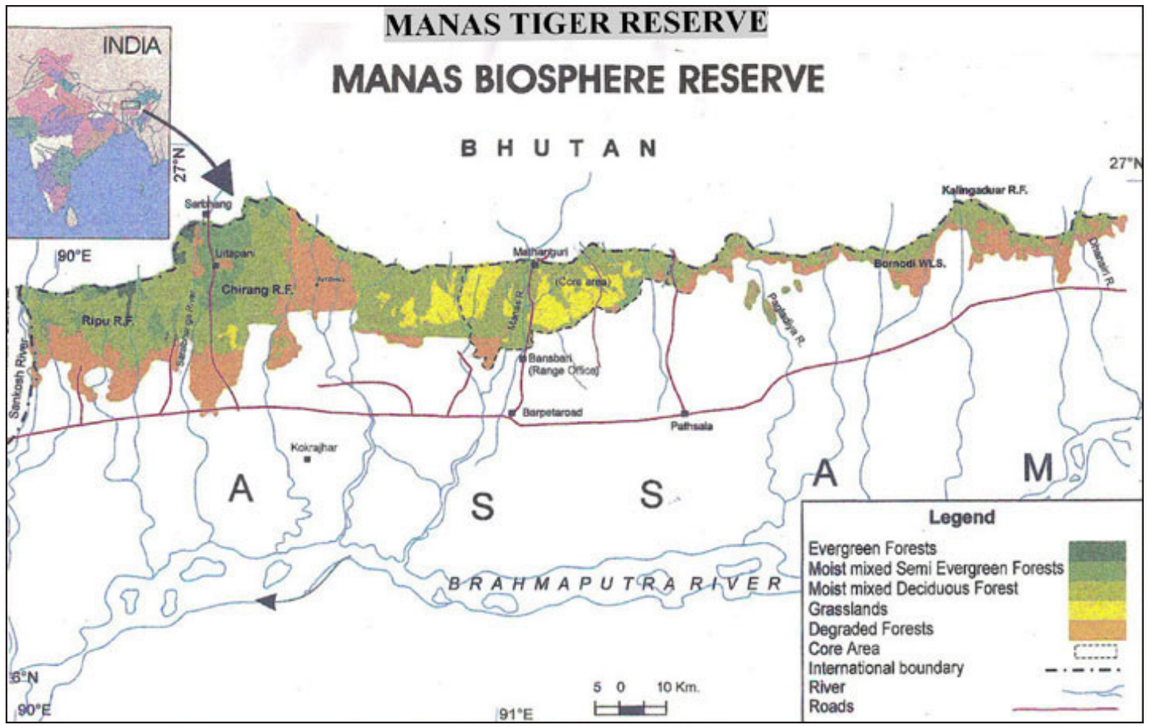
The Manas Tiger and Biosphere Reserve (MTBR) is located in the northwestern corner of the state of Assam and covers an area of 2840 km^2. MTBR falls completely within what is informally known as Bodoland, a semi-autonomous political unit within the state of Assam formed in 2003. This was the result of a decades-long struggle for political autonomy by the Bodo community. Bodos are a so-called tribal group and are part of a "greater Tibeto-Burman linguistic and ethnic community" considered to be the earliest inhabitants of present-day Assam[1]. Approximately 20% of MTBR comprises the Manas National Park (MNP) within which any and all forms of human-use are effectively deemed illegal. The rest of the MTBR is divided into a number of Reserved Forests (RFs) of varying sizes. Certain types of anthropogenic activities are permitted within RFs but only after a lengthy, complicated process that is virtually inaccessible to those most in need of such resources. I chose to focus exclusively on three of the largest RFs within the MTBR. Precisely, I chose these areas because they form what UNESCO's (United Nations Educational, Scientific, and Cultural Organization) Man and Biosphere Reserve Programme explicitly describes as zones

for the maintenance and development of "ecological and cultural diversity… securing ecosystem services for human well-being" for "management of complex social-ecological systems."[2]

The Outsider

Conducting ethnography (the systematic study of people and cultures) within a zone where the local people speak at least eight different languages became a challenge from the outset. Though a vast majority of people spoke either Hindi (India's national language), which I am fluent in, or Assamese (Assam's state language), which my research assistant was a native speaker of, it was still discomfiting to not be able to get responses in a person's first language. Though training in qualitative research methods in the social sciences had prepared me to accept the reality of being an outsider, the day-to-day experience would occasionally be a challenge. The curious glances, the suspicious looks, the whispered gossiping, and the wide-eyed stares would begin to grate during long days of spine-jarring off-road travel in the hot, humid weather. During such times I would find myself wistfully reminiscing of days as a wildlife biologist. In those days, interaction with human was not as intensive or extensive; research would consist of following a primate troop or sitting by a fig tree taking notes as a diversity of birds gorged on its fruit. My fellow human are much more complicated.

My ethnographic situation was further compounded by the fact that I was often perceived as a foreigner by Bodoland residents (although I was born and raised in India). For them to then hear me speak fluent Hindi would be a source of much bemusement and amusement. Interestingly, if I happened to mention during the course of a conversation that my wife is from Assam, I was then usually referred to as a "son-in-law" of the state and hitherto apprehensive attitudes would give way to an almost "he is one of us" conviviality.



The Importance of Context

My fieldwork thrust me into a system that was alive with a bewildering array of dynamics – socio-cultural, political, economic, and ecological. It was challenging to wrap my head around them as they interacted, influenced, and produced each other. These dynamics were often manifested in unpredictable ways that defied the flimsy theoretical boundaries I attempted to place around them in my effort to comprehend them. However, such engagement brought to the forefront the importance of context, both contemporary and historical. The words of one of India's foremost political ecologists came frequently to mind during the course of my year in Manas. "You have to get a sense of the history of place and that's where archival research becomes invaluable. I know it can be painful, often downright boring work but there is no escaping the archives!" he said with a slightly weary been-there-done-that smile. A year later, I sifted through photographed copies of yellowed documents, often disintegrating in neglected archival buildings lacking even basic environmental control. The pain and boredom paid off and the current opinions and attitudes of livelihood issues from members of a certain, so-called tribal began to make sense when placed in context of the political and cultural history of their economy.

A Diversity of Narratives

The cultural and political diversity of the Manas landscape was suitably matched by the diversity of environmental discourses I encountered. Listening and subsequently mulling over what I'd heard both in terms of the structure of particular arguments as well as the use of specific words reminded me of a favorite description of the core distinction between the biological and social sciences – "The social sciences ask how we know what we know?" For example, it was fascinating to hear bureaucrats refer to members of a community who have historically practiced and continue to practice a largely subsistence form of agricultural production as being "lazy" and "lacking in enterprise"[3]. Such statements seemed to either willfully ignore or be ignorant of elements of local geology that form the ecological framework for a particular mode of agricultural

Above. Instances of timber harvesting in Bodoland. Along with Reserve Forest Rangers, my field technician and myself observe the results of selective harvesting and clear-cutting in MTBR.

production. Similarly, narratives pertaining to inter-ethnic conflict were produced through an overall invalidation of the other through particular constructions of migratory history, land-use, cultural norms, and demography. These perspectives served to order ethnic groups into causal structures that are instrumental in achieving specific political goals[4].

A Dynamic Landscape

Rising from the foothills of the Eastern Himalaya of Bhutan, the MTBR is a dynamic landscape. The rivers emanating from the mountains of Bhutan are the very embodiment of caprice; they frequently change course, periodically flood their banks, and are occasionally subsumed under the sandy-gravelly land substrate, only to surface many miles further south. Local communities have historically adapted to this capriciousness by practicing shifting cultivation. Such systems of agricultural production are in constant flux, not only in response to hydrology but to additional factors such as ongoing urbanization (creating a labor shortfall through urban migration), struggles for political autonomy, and novel agro-technologies (such as high-yield varieties of rice, pesticides, and herbicides).

Given this constant flux, Indigenous ethnic groups have historically used forest resources as a means of managing livelihood risk and uncertainty. Thus extraction of forest resources (e.g. timber) has been an integral part of local economies for centuries[5]. Recently, ongoing illegal timber extraction from the RFs of Manas have begun to flourish into an informal economy that fuels local militant groups vying for a homeland separate from Assam. This informal, often illegal economy lines the pockets of various arms of the Indian bureaucracy, feeds local political coffers, supplies expanding urban economies in other parts of Assam, and provides a source of livelihood to residents of an area that, as of yet, has very limited industrial infrastructure and a severe paucity of urban job opportunities.

In summary, any form of biodiversity conservation and management in the RFs of the Manas Tiger and Biosphere Reserve has to articulate with notions of ethnicity, exigencies of transforming economies, livelihood issues, as well as hydrological and geological realities. During my conversations within the Manas landscape people rarely talked about the environment or nature. Instead, they spoke on issues that, though not traditionally thought of as environmental, are every bit so. Quite simply, they are "translated through lenses that are far more urgent in people's day-to-day lives."[6]

References

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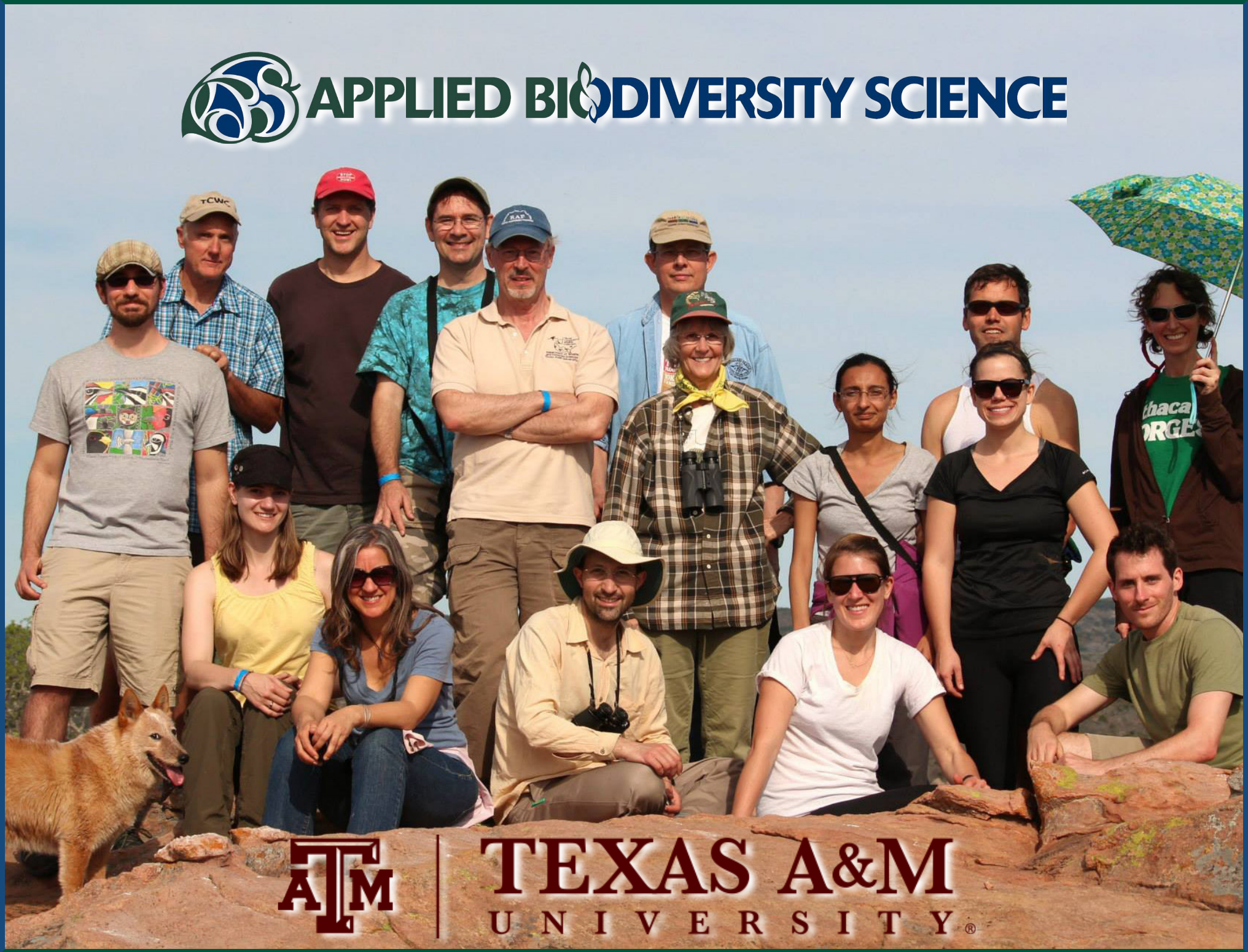
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