PERSPECTIVES SERIES

No. 5, October 2015

Texas A&M University

Endemic Parrot
Conservation in
Dominica

The Elephants of Botswana: Conflict and Coexistence

Putting the "Applied" in Applied Biodiversity Science

Cover Art

Front Cover: Panorama from a canopy tower at Posada Amazonas Lodge where students from the ABS Amazon Field School were listening to the diverse birdsong in the early morning. Courtesy of Erin Buchholtz

Back Cover: This year's issue focuses exclusively on international biodiversity conservation issues and efforts. However, Texas is extraordinarily biodiverse, with ten ecoregions and numerous endemic species, none more iconic than the assorted species of Bluebonnets found throughout the state (Lupinus texensis, subcarnosus, Havardii, concinnus, and plattensis).

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Communicating Action

Informing, improving, and influencing

Actionable science: scholarship with the potential inform decisions at the government, business, and household level; improve the design or implementation of public policies; and/or influence public and/or private sector strategies, planning, and behaviors that affect the environment (SESYNC, 2015).

George Gopen and Judith Swan wrote in their 1990 article for American Scientist that "the fundamental purpose of scientific discourse is not the mere presentation of information and thought, but rather its actual communication." Although the accessibility and dissemination of science depends on effective communication, designing and initiating actionable research further facilitates the communication of science. That is, actionable science is paramount for the successful implementation of research by both public and private stakeholders and decision-makers.

We must maintain an awareness of the importance of actionable research as we continue to see the role of science shift from an exclusively academic domain to that of an amalgamation of academics, activism, political debate, and mainstream traditional and social media (Abrams, 2015). While conservation science has and will remain a problem-oriented science, this shift places an imperative on researchers to broaden their expectations for applied science. As the role of science changes, so too has the perception of science as purely academic pursuit; there is more of an impetus on and call for scientists to provide relevant answers and useful solutions that do not fit neatly within one discipline. This requires multidisciplinary collaborations and interdisciplinary perspectives. As the articles in this year's issue can attest, the Applied Biodiversity Program at Texas A&M

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promotes such collaborations and perspectives.

Although a gap between the social sciences and natural sciences remains, both sides have worked towards closing it over the decades and create an atmosphere that fosters, rather than impedes, the actionable potential of science. Likewise, the bridge between the social and natural sciences and the engineering and computational sciences has steadily grown. With these issues in mind, today's conservation researchers and practitioners must cultivate an ability to effectively communicate not only their scientific findings but also the usefulness, relevance, and weight of those findings.

More and more, scientists are called upon to provide practical interpretation and guidance in conjunction with their results (Lupia, 2013) and access to data from publicly funded research (Arzberger et al., 2004). This stems not only from conservation science's founding as a crisis-discipline and maturation into a problem-oriented discipline, but also on the fact that our work is, at times, directly linked to communities and peoples' livelihoods. Developing research with actionable outcomes and outreach activities that aspire to give back to communities enriches this connection. Such an approach aids in the communication and dissemination of science, but also shows public and private stakeholders and decision-makers that conservation science is meaningful beyond the scientific domain. Perhaps it is cliché, but the enduring adage that our actions speak louder than words is worthy of our consideration as applied scientists.

Lenneth & Wallen

Welcome to ABS

New coordinator brings new stage to program



Dr. Patricia Baião

Patricia Baião has recently joined as the coordinator for Texas A&M Applied Biodiversity Science Program. She earned her Ph.D. from the University of Missouri-St. Louis (UMSL) in Evolution, Ecology and Systematics. For her graduate work she was interested in the extreme plumage polymorphism of the Red-footed boobies (Sula sula), that can range from mostly white to completely brown birds. She looked at the genetic basis of these phenotypes as well as selective pressures and evolutionary history events that could have contributed to the current distribution of these color morphs along the Pacific Ocean, but specially on the different islands of the Galapagos archipelago.

During her time at UMSL, she had the opportunity to work as an intern for the Missouri chapter of The Nature Conservancy (TNC) and decided that she would make a career choice in the conservation workforce, applying her strong science foundation to real conservation issues on the ground. After she graduated, she returned to her home country of Brazil and start-

ed working as the Amazon Program director for Conservation International (CI), based in Belem, Pará.

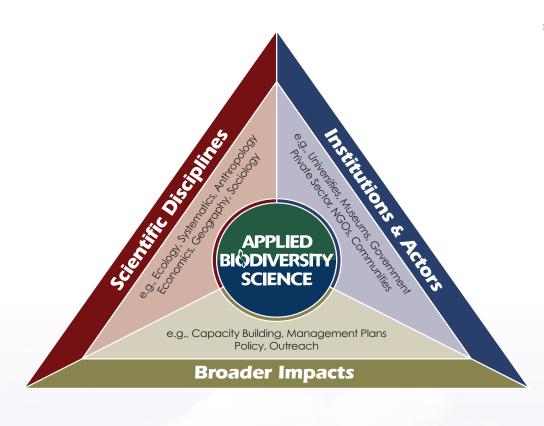
While in this position, Patricia worked closely with local governments and communities to develop sustainable development pathways. She believes that local development depends on conserving the natural capital (forests, ocean, savannahs, etc.), building strong local capacity that translates into local governance and leadership, developing sustainable economic chains that can provide income and improve livelihoods, and amplification of best practices through sound policy at all levels. These elements are only possible when there is an effective legal framework, with environmental friendly legislation that is enforced.

With CI, Patricia moved on to work as the director of the policy team to amplify best practices into public and corporate policies using CI's successful experiences in the field. In this position, she was responsible for liaising with national and local governments in Brazil, other NGOs, and networks and represented CI-Brazil in the United Nation Framework Convention on Climate Change (UNFCCC) and in the Convention on Biological Diversity (CBD).

Some highlights of her career are the implementation of the Amapa Biodiversity Corridor in northern Brazil, which covers more than 70 percent of the state of Amapa, the creation of the Observatory of the Brazilian Forestry Code, and the creation of the Kayapo Endowment Fund. She has published several scientific papers and has received various scholarships and awards.



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

USA & Mexico Meso America Western Amazon **Gran Chaco**



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



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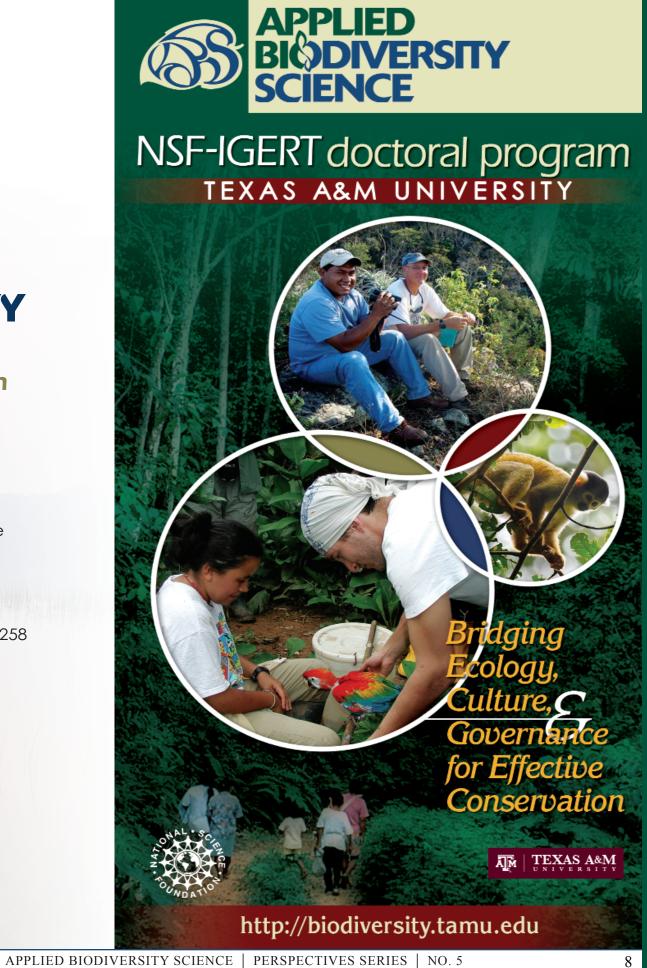
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Conserving Dominica's Endemic Parrots

Lara Kreuter & Stephen Durand Texas A&M University

The unique characteristics of islands provides ideal habitat for endemic species to evolve. Dominica is no exception. Regarded as the Nature Island of the Caribbean, Dominica's active parrot conservation program focuses on two of its most threatened endemic species, the Imperial (Amazona imperialis) and the Rednecked (Amazona arausiaca). This paper will focus on the historic population trends and current conservation status of these endemic parrot species, with a large portion devoted to the Imperial, the national bird of Dominica.

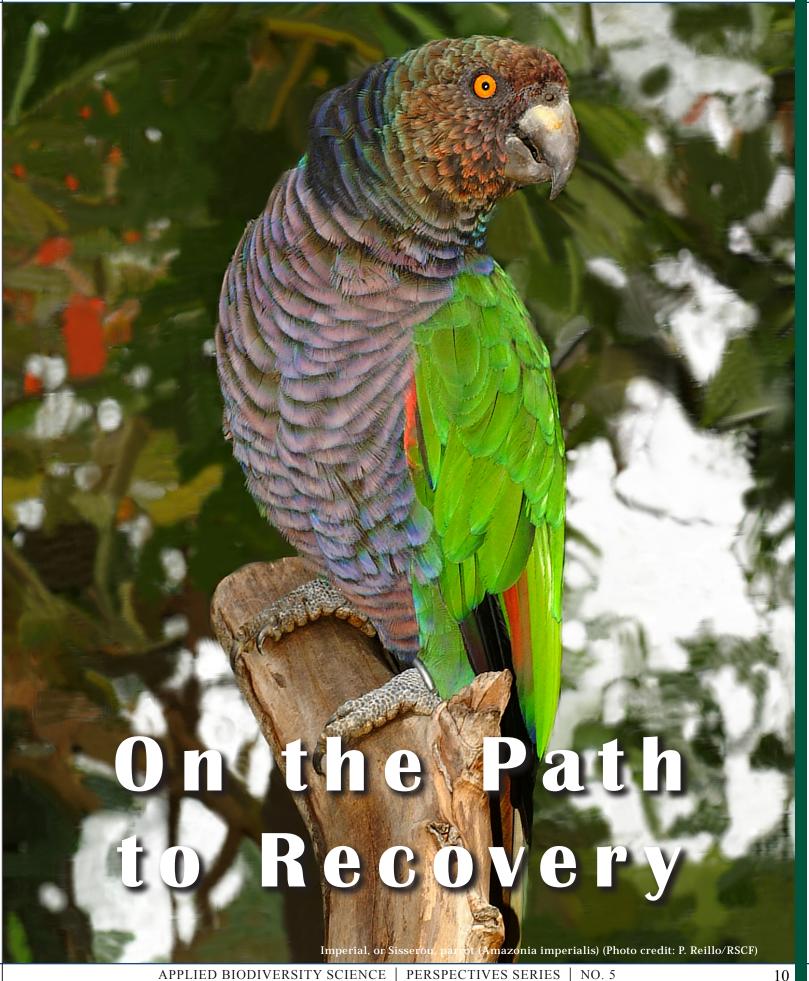
The Imperial, or Sisserou, is the largest member of the genus Amazona. They have distinct coloration with a deep-green back and a purple head, neck, and underbelly, with an average length of 46-51 cm. Their call is can be best described as a metallic trumpet sound. Due to the significant habitat loss following back-toback hurricanes and other compounding factors, Imperials have become the rarest of the Amazona genus. Their remaining habitats are remnant mature forests located at an elevation of 610 to 1,220 meters in central portion of the Morne Diablotin National Park (Durand, 2013).

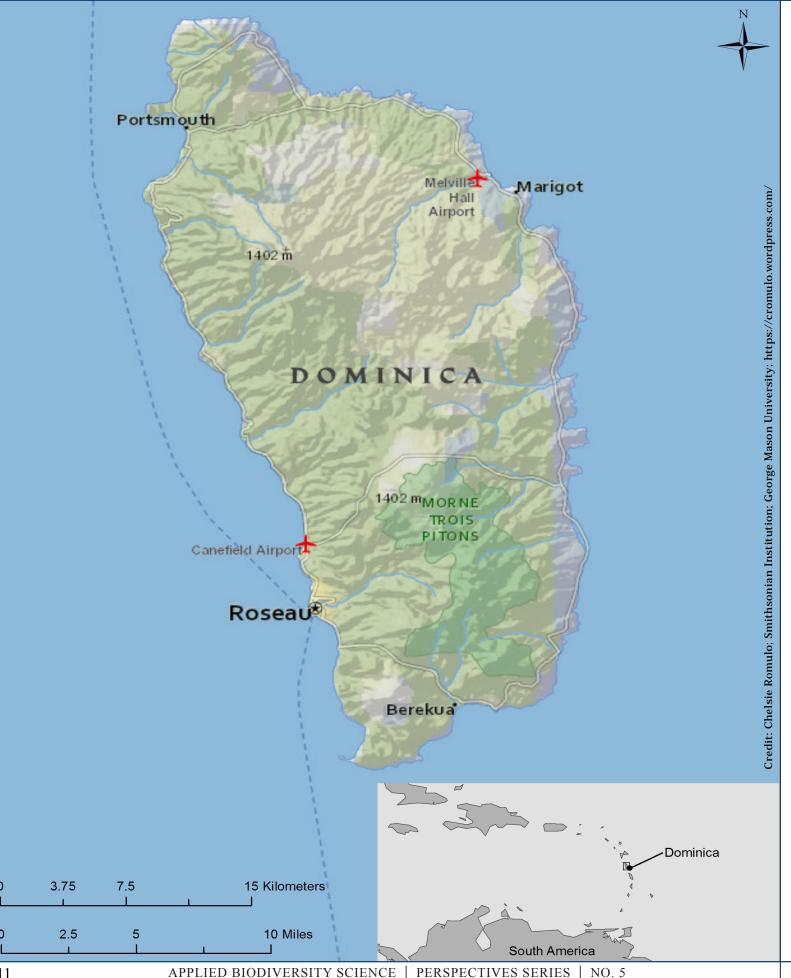
Dominica's other endemic parrot, the Rednecked, is also known as the Jaco. This species is much smaller than the Imperial, averaging 33-36 cm in length. The Jaco's plumage is primarily bright green with a bluish head, characteristic red areas on the neck and upper breast, with a distinguishing scarlet patch on its wings. Red-necked parrots have a high-pitched squawk and are distinguished in flight by their green tail and shallow wing beats. The distribution

of the Red-necked parrot is more widespread than the Imperial. They are also in the Morne Diablotin National Park but have spread to Morne Trois Pitons National Park, as well as the Northern and Southern Coastal areas. In contrast to the Imperial, their distribution is maintained due to their ability to tolerate humans and their aggressive behavior towards other birds (Durand, 2013).

In general, parrots are social birds and flocks tend to need and preside over large territories to provide feeding, nesting, and breeding habitat. However, with increased forest clearing for agriculture, lumber, and charcoal, their breeding and nesting habitats are quickly disappearing (Salinas-Melgoza et al., 2013). Including habitat destruction, there are four major threats to the Sisserou and Jaco. These include (1) natural and introduced predators, (2) hunting for trade or food, (3) interspecific competition, and (4) habitat destruction (Evans, 1991; Christian et al., 1996a). Predation decreases the number of offspring reaching adulthood and, in turn, decreases the overall population growth rate. These parrots are also targets for international trade. Those seeking to exploit this demand scour nesting trees to collect chicks for trade in a practice locally known as nest robbing. Wing shooting is another practice in which individuals target parrots' wings in order to injure adult birds for collection, although many times this results in accidental death. In the past, hunting was an issue but recently it has become extremely rare due to the high levels of protection and public education campaigns.

As for The Commonwealth of Dominica (Dominica, for short), it is a small island in the





Lesser Antilles with a land area of 790 km2. It is located about 870 km southeast of Florida at approximately 15° north latitude and 62° west longitude. The island is of volcanic origin and steep peaks and deep ravines characterize its topography. The terrain is very rugged but also very beautiful. The Atlantic side of the island is covered by windswept littoral (shoreline) forest able to withstand the strong winds and waves that constantly buffet the island. In contrast, the Caribbean side conveys what you think of in a tropical island: calm blue waters, palm trees, tiny coastal villages, iguanas, and parrots. In 1979, Hurricane David hit the island, and in 1980, the island was struck again, this time by Hurricane Allen. Hurricane David was considered one of the most devastating hurricanes in the Caribbean at the time, with sustained winds between 209 to 251 km/h. Soon after the storms passed, the impact of the hurricanes became very apparent. There was overwhelming devastation to the forest, beaches, farmlands, animal populations, and the island as a whole. Much of the breeding and foraging habitat for wildlife on Dominica was gone.

In response to these hurricanes and threats to their endemic parrots, The Division of Forestry, Wildlife and Parks of Dominica (FWPD) has several programs focused on conservation and restoration of the parrots and their habitat. In 2000, in partnership with the Rare Species Conservation Foundation (RSCF), the Government of Dominica created Morne Diablotin National Park, built specifically around Dominica's National Bird, the Imperial Parrot (Forestry, Wildlife and Parks Division, Dominica, 2009). As such, the rainforest on the northern most slope of Morne Diablotin is now the most important refuge of the Imperial (Collar & Juniper, 1992). However, the concern in Dominica is that both the Imperial and Red-necked parrot are confined to small, specific areas, and are considered in danger of extinction (Christian, et al., 1994). Both species are considered globally threatened by the IUCN; the Imperial is classified as Endangered and the Red-necked is classified as Vulnerable (www.birdlife.org).

Currently, the most insidious threat to Dominica's endemic parrots is due to forest clearing for agriculture, these practices bringing down the parrot's nest cavities high in the trees. Compounding these circumstances are natural disasters, such as hurricanes and volcanic eruptions, which threaten parrot habitat, specifically nesting cavities. As mentioned before, Hurricane David decimated Imperial parrot and Red-necked populations in 1979. In 1987, Evans (1991) estimated that the total populations for Imperial and Red-necked parrots, eight years after Hurricane David, were 60 and 200 individuals, respectively. Currently the Dominican Government's focus for conservation and recovery is the Imperial Parrot. This is primarily due to the Red-necked parrot being more tolerant of human disturbance with a broader habitat distribution while Imperials are more sensitive and have limited habitat tolerance. Another reason is due to fledgling



numbers. Based on field observation, Imperial parrots generally only have one fledgling every other year (Forestry, Wildlife and Parks Division, Dominica, 2009). Intra-cavity research methods have been developed and tested to allow researchers to examine the inside of parrot nests, providing the first video recordings of Imperial rearing and fledging, and quantitative analyses of bi-parental care and recruitment in both species (Reillo & Durand, 2008). This lower fecundity places increased importance on making sure the small number of offspring survive. The available nesting area is also a major factor. While Rednecked parrots are smaller, they are also more aggressive with competing bird species. In contrast, Imperials parrot tend to have more intraspecies competition, placing increased importance on managing limited nesting, breeding, and feeding habitats (Durand, 2013). The Red-necked parrot population has been increasing steadily since Hurricane David. They have extended their distribution far into the southern half of the island, while the future of the Imperial is still uncertain.

The remainder of this article will discuss recent survey work conducted on Imperial parrots with a grant provided to the Dominican Forestry and Wildlife Department. The purpose of these surveys were to help determine the location(s) of Imperial parrots in the wild, identify future avenues for conservation, and provide information to educate the public on issues of parrot conservation.

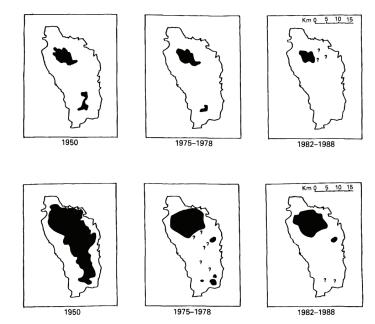
Surveying Imperial Parrots

In the summer of 2013, I (Lara Kreuter) was fortunate to spend three weeks on Dominica as part of a Texas A&M University study abroad class on Tropical and Field Biology. Two separate field excursions were organized for me to travel into the field with a group from the Forestry, Wildlife and Parks Division of Dominica. I was able to work with four Division staff members, Stephen Durand, Randolph (Ronnie) Winston, Matthew



Maximea, and Roy Paul. These professional and knowledgeable gentlemen taught me about their ongoing conservation work with the parrots of Dominica. They also provided me with training to track and record parrots not accessible through mere observation. Thus began my fieldwork. This consisted of hiking through the forests of Morne Diablotin National Park.

The main purpose of our fieldwork was to listen, spot, and mark the location of Imperial parrots. My main task was to mark the locations in a GPS device with descriptive names for later data analysis. During these hikes, Stephen Durand provided me with basic background information on Imperial parrots, such as population trends, management tactics, and preferred vegetation types. Stephen also taught Randolph Winston and myself how to use GPS devices to record observations (visual and auditory) of parrots. The other field biologists enlightened me with various facts about the forest, the parrot's behavior, and just about anything having to do with the monitoring these endemic species or the ecology of the island. When making field observations and GPS recordings, Stephen would write down the type of vegetation we were in, the elevation, and the weather conditions. We would also note if we observed multiple parrots, if they were flying, and any other information that might provide data for future census analysis.



Opposite, left: Me working with the GPS system with the help of Ronnie Winston (Left) and Matthew Maximea (Right). Photo Credit: Lara Kreuter

Above: Imperial (top) and Red-necked (bottom) parrot population distribution (Evans, 1991).

Population Trends

The survey work described above is just the tip of the iceberg in trying to understand the population numbers of the past decades. The work that Evans (1991) has done provides a great description of the species' population changes from around 1950 to 1990. Prior to this study, there was little work done to gather this of information. The following figure provides a visual of Imperial and Red-necked parrots observed between 1950 and 1990. These maps also show the importance of the devastation from both hurricanes to the island. Based on the conversations I had with Steven Durand in the summer of 2013, the parrot populations have greatly increased. In 1987, the Imperial parrot had declined to around 60 individuals and the estimated Red-necked population was about 200 individuals (Evans 1991). However, with the new data collected by Durand and the field team from the DFWP, there are now estimated to be about 500 Imperials and 2,500

Red-necked parrots on the island!

Current Conservation

The Rare Species Conservatory Foundation (RSCF) and the Dominican Government have developed numerous projects in order to protect the Imperial Parrot. These programs are complex. They are attempting to extend legal protection to all forests surrounding Morne Diablotin, develop management and conservation strategies, and coordinate support for ongoing research and education programs with public zoological facilities and non-profit organizations. In general, the Dominica government's parrot programs serve many functions. This includes monitoring parrot populations, collecting and analyzing ecological data, and recording life history information on the parrots and other wildlife, delineating forest habitat and land use, and simplifying strategies for wildlife and habitat protection (Reillo & Durand, 2008).

Additionally, the FWPD tries to maintain a good relationship with local farmers in order to gather information about the surrounding areas. Some farmers are willing to come forward with information about destructive human behavior to parrot habitat, such as poaching parrots that feed on their crops or harvesting parrots for the wildlife trade. However, others do not share information because they believe doing so might compromise their farming operations (Reillo & Durand, 2008). This may include people threatened by poachers or farmers indirectly benefiting from the decreasing parrot population, i.e., fewer parrot eating their crops.

Overall, Dominica has experienced enormous success in their efforts to restore their two endemic species. The current conservation programs are contributing to our ever increasing understanding of Imperial parrots. Still, much remains unknown. The survey work I participated in provides an opportunity to expand this knowledge. With Morne Diablotin National Park providing 9,000 acres of protected forest for both







Top: Day 1 FWD team from left to right, Matthew Maximea, Ronnie Winston, Stephen Durand.

Middle: Syndicate Trail, Morne Diablotin National Park

Bottom: Final hike back on the second day of surveying. Matthew Maximea (left), Roy Paul (middle) and Stephen Durand (right).

Photo Credit: Lara Kreuter

the Imperial and Red-necked parrots to forage and nest, conservation is moving forward, even after the difficult circumstances endured. Research on the Imperial parrots continues, new data is being collected, and these initiatives will allow their populations to continue to expand, guaranteeing a bright future for the national bird of the Nature Island island!

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INTERESTED IN CONSERVATION?



Unique biodiversity, such as the Pancake Batfish, can be found in the Gulf of Mexico. Photo by: Ken Lucas

Undergraduates of any level are invited to apply for the **ABS Conservation Scholars Program**

We seek applications for internship positions from undergraduate students interested in local issues related to the Gulf of Mexico ecosystems and energy development and on broader questions of the relationship between energy development, energy policy and natural resources.

Each intern will receive a small research stipend to conduct baseline research and associated travel related to a proposed summer internship opportunity, available over the Fall and Spring semesters. The student will then spend one month working in a state or federal agency, **fully funded by the program**, to gain hands-on experience on issues related to natural resource management and energy development.

Applications are due **September 30, 2015**. Please see our website for details! **All serious undergraduates are invited to apply.**



ABS CONSERVATION SCHOLARS PROGRAM

Dr Thomas Lacher; Texas A&M University

← Scan here for our website:

https://absconservationscholarsprogram.wordpress.com



Erin K. Buchholtz Texas A&M University

A great strength of the ABS program is the impetus and opportunities for students to not only do rigorous research, but to do research that is applied. As a first-year PhD student in the Wildlife and Fisheries Sciences Department, I was immersed in this aspect of the program during the summer of 2015 as I transitioned from two semesters of classwork into hands-on learning out in the field.

The ABS program focuses on developing students' disciplinary expertise that can then be applied to interdisciplinary problemsolving. To that end, I spent most of my first year in classrooms attending lectures and seminars in order to develop my disciplinary toolkit: building up my skills in ecological theory,

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GIS technology, and statistical methods. Spring semester included ABS I, a course that served as a springboard to thinking more broadly about the challenges of taking an interdisciplinary, applied approach to science. Class discussions brought in not only students' academic knowledge but also a variety of life and work experiences. Throughout the semester, we discussed many of the relevant challenges to biodiversity and conservation science and got exposed to many different trains of thought.

In May, the Amazon Field School brought ABS out of the classroom and into the field. While there would have been sufficient material to cover even if we just focused on the wildlife (or just the plants, or just the

people), in keeping with the ABS objectives we took a much more integrative and comprehensive approach. Numerous hikes through the Peruvian Amazon Rainforest and boat rides on lakes and rivers were complemented with dialogues with native communities, discussions with local guides and business-owners, and a trip to see the complex devastation associated with gold mining in the region. We got to play the roles of scientists as well as tourists while visiting lodges and learning about eco-tourism. Aspects of communities and governance structures were brought to light that otherwise may have been absent had we simply focused on the flora and fauna. Overall, it was a fantastic trip, which brought to light the conservation successes and challenges faced outside the world of academic journal articles and classroom discussions.

Four days after returning from Peru, I flew to Botswana, the location of my dissertation research. The overall goal for my time there was to better develop my understanding of the region in preparation for a full year in the field beginning January 2016. Moreover, the trip would be my introduction to the ground operations of the Ecoexist Project, under which I am a PhD Fellow. Ecoexist is a holistic organization working to reduce human-elephant conflict (HEC) and facilitate coexistence in the Okavango region of Botswana. They incorporate many different aspects in their endeavor, including ecology, conservation agriculture, land-use management, and economics.

My research focuses on elephant movements and landscape ecology, and how those tie into HEC in the Western Okavango Panhandle The basis of my elephant movement research comes from GPS data, transmitted from eight bull elephants with GPS collars. I'll analyze the GPS data in order to determine how landscape features influence elephant movements and to create a predictive model for elephant resource selection. This falls neatly into the discipline of landscape ecology. And yet, it seems incomplete to think about this research without





Above. part of the Veterinary Cordon Fence that has been recently trampled by elephants.

Top. My research assistant, Kerumotsemang, taking GPS coordinates in the field.

Photo Credit: Erin K. Bucholtz

acknowledging the useful application of the results: if patterns of elephant movements can be predicted, the regional Land Boards can begin to allocate fields away from those areas where elephants will be present, and thus reduce the opportunistic crop-raiding that occurs when elephants movements and agricultural areas overlap.

I was fortunate over the summer to be able to see several facets of the Ecoexist Project and the region, not just those that relate directly to my research. For example, Ecoexist hosted a Cultural Fair in July that featured performers



from 13 villages and performances related to elephants and human-elephant conflict. A particular crowd favorite was a skit where young adults acted out the way a farmer could protect his field from elephants, with the elephant played by a student in a hand-made elephant costume who had a convincing elephant alarm trumpet.

In order to better understand the perceptions and experiences of HEC in my study area, I also conducted some preliminary surveys this summer with local farmers. In addition to providing useful data, these surveys really drove home the difficulties that individuals face when elephants raid their crops or come onto their property. There is no way to overlook the true danger and destruction that elephants represent. The surveys also help me to design my research project so that it is not only well-grounded scientifically but that it is relevant and useful.

A highlight at the end of my trip was learning how to conduct an aerial survey for elephants. Along with my colleagues, we went up in a 4-seat airplane and flew transects over the Okavango Delta region, practicing counting elephants and other species. Aerial surveys are the best way to estimate a population of elephants and will hopefully be something I can implement for my research in the future.

It is nearly impossible to think about my research without the applied aspect of it. I can't help but connect the elephants and signs of elephants I see in the field with the impact they have on the local farmers, the implications there are for the tourism industry, and the ways that their day-to-day existence interrelates with the lives and livelihoods of so many people. While driving down the Samochima Veterinary Cordon Fence, which stretches approximately 100km from the Okavango River to the Botswana-Namibia border, I have seen countless elephant footprints and many areas where the fence has been damaged or knocked down. It triggers questions in my mind – How does this fence

impact elephant movements? Can breeding herds with infants cross it? How often does the Department of Agriculture have to fix the fence? Do many cattle get through where the fence is broken? How can farmers cultivate their crops safely here with so many elephants? These are the type of questions that the ABS Program stimulates and encourages. The questions come from my background and strengths in ecology, but are situated within the much larger context surrounding the issue of elephants in this region. They take into account not just the science, but how that science can be applied.

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Human-Elephant Conflict & Coexistence in Botswana

Anna Songhursta, Graham McCullocha, & Amanda Stronzaa, b The Ecoexist Project^a, Texas A&M University^b

In an area of Botswana known as the eastern Okavango Panhandle, roughly 15,000 elephants compete with 15,000 people for access to water, food, and land. The elephants are not confined to any park, reserve, or nation. They roam freely, often in places where people are planting fields, herding livestock, and walking their children home from school.

Each year during the dry season, the elephants begin to move in large numbers, heading southward to permanent waters of the Okavango Delta. Along the way,

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they pass through villages and settlements, using distinct pathways they remember and have followed for generations. With time, more and more elephants are coming into contact with more and more people. Wild lands are being converted to agricultural fields and the elephants' range is expanding, bringing people and elephants increasingly in conflict. Elephants will raid and trample crops, and people will clear land, often on critical movement pathways, for new farms. Sometimes the encounters result in death, for elephants and for people.



The Ecoexist Project is a collaborative effort of farmers, scientists, village leaders, policy makers, and business people, working together to find solutions to human-elephant conflict.

Human-elephant conflict — or HEC — is a complex challenge for elephants and people in many parts of Africa. In 2011, we began collaborating to find ways to tackle the root causes of HEC. Much of the work in other parts of the world to date had focused on the after-effects of conflict and on finding ways to alleviate and ameliorate it. Our work was to turn the HEC paradigm on its head and begin thinking creatively about not only reducing conflict, but also fostering coexistence between elephants and people.

We built a five-year plan in consultation with local and international stakeholders, and with people offering insights and expertise from academic, policy, community, and business sectors. We had a solid foundation for our holistic approach, with our connected but disparate backgrounds. Songhurst had worked for years in the region studying elephants and humanelephant conflict, building a critical and foundational understanding of HEC and its multidisciplinary dimensions in the project area. McCulloch, an ecologist with over two decades of field experience in conservation research and practice throughout Botswana, brought a deep understanding of policy incentives and disincentives and how they shape ecological and social landscapes on the ground. Stronza brought anthropological understanding of community-based conservation and development from over twenty of years of research throughout the tropics and also experience in conservation research and education from co-founding the ABS Program.

As a multidisciplinary team, combining our expertise in conservation biology, ecology, and anthropology, and working closely with local communities, policy makers, and organizations throughout southern Africa, to connect our science with practice, we see our work clearly reflecting the principles of the Applied Biodiversity Science (ABS) Program. Several of our students and colleagues are in ABS as well, including Prof. Lee Fitzgerald, Erin Buchholtz, Lauren Redmore, and Patricia Mokot-

As we have recruited graduate students in different disciplines to lead research with us on various aspects of HEC-including understanding elephant movements and ecology, human resource use and settlement patterns, household livelihoods, economic incentives and impacts, and agricultural dynamics, among others, we have assembled students to work collaboratively—each focused on a different piece of HEC, while together enabling us to get a big picture understanding of workable solutions.

In July 2015, we completed a short documentary film, The Ecoexist Project: Pathways to Coexistence, at the Mokolodi Game Reserve in Gaborone. The 18-minute feature includes voices and experiences of people who live every day with elephants and know first-hand the challenges of competing for space, food, and land with the world's largest population of free-roaming elephants.

The film's producer and director, Richard Hughes from Edge 2 Edge Films, a UK company, spent over a year working with us, gathering interviews and footage with farmers as they protected their homes and fields from elephants. Footage includes sequences of large elephant herds, passing through the villages. The film is intended for viewers in Botswana and around the world who are concerned about elephants, human-elephant conflict, and finding ways to support people who live with elephants. Though other films tend to shine a well-deserved spotlight on elephants, we have sought to illuminate the experiences of people who live close to elephants.

We hope our collective message in the film will contribute to improved management of HEC. Many people and organizations have been working together with our team to address the needs of local communities and elephant populations in the region. The film reflects the energy and goodwill of many people, working together to find solutions.

The film is available for streaming on the Vimeo link: https://vimeo.com/124473058
It will be screened at the Jackson Hole Wildlife Film Festival and is an official selection of the American Conservation Film Festival.

The Ecoexist Project: Overview

Ecoexist is a five-year program aimed at reducing human-elephant conflicts (HEC) and fostering coexistence. In areas of heightened competition for access to water, food, and space, the Ecoexist Project aims to find and facilitate solutions that work for both species. Moving from conflict to coexistence requires a portfolio of management tools and strategies that provide short and long-term solutions. We focus on applied research, land use planning, crop-raiding mitigation, agricultural experiment and innovation, and tourism development.

Our goal is to create an enabling environment for policies and on-the-ground programs to reduce HEC and foster coexistence between elephants and people. In achieving our goal, we will also address food security and economic development for rural communities, sustainable resource management, and regional HEC resolution. We will connect science with policy, supporting informed decision-making through our research and field based evidence, and we will strengthen the existing work of government agencies, local communities, regional stakeholders, and the private sector by facilitating collaboration, communication, capacity building, and information exchange.

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Top: The team: Ecoexist Community Officers in each village, interns, and graduate students. Middle: "Elephants are clever, like people. While we are thinking of new ways to protect our fields, they are busy thinking of new ways to raid our crops!", an elder in the Village of Gunotsoga. Bottom: Ecoexist PhD students study elephants to understand their movements and behaviors, all with the aim of finding strategies human-elephant conflict. Photo Credit: Amanda Stronza













Top: A breeding herd of elephants, photographed from the helicopter during the team's work in 2014 to collar 28 elephants and begin tracking their movements. *Middle*: Erin Buchholtz, ABS student and Ecoexist PhD Fellow, tracking elephants with Drs. Songhurst and McCulloch. *Bottom*: Dr. Songhurst and colleagues take measurements on a tranquilized elephant.

Photo Credit: Amanda Stronza

The Ecoexist Project: Focus

—*Improve* short-term strategies for conflict management by working with and for the government and communities to develop a Community Based Conflict Mitigation approach that incorporates shared responsibility, human-human conflict resolution, and a set of holistic and innovative mitigation techniques.

—*Improve* farmer resilience to the effects of elephant crop raiding by improving agricultural techniques, including cropping system innovations and conservation agriculture practices.

—*Inform* land use planning to consider elephant movement corridors and facilitate land use planning that will allow people and elephants to share resources and space.

—Facilitate private sector support for community-based tourism and other opportunities for people to gain economic benefits from living in close proximity to elephants.

—*Conduct* satellite collaring telemetry studies and population surveys of elephants to record elephant numbers and movements in northern Botswana, and inform national and regional elephant management strategies.

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Community Focused Integration & Protected Areas Management in the Huascarán Biosphere Reserve, Peru

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Integrating communities into conservation management has become a priority for national and international organizations concerned with natural resource management. Traditional conservation policies aimed to exclude local resource users by placing a boundary between the community and the area of interest, often in the form of national parks (Ascher 1995, Agrawal and Gibson 1999). Park management has often prioritized keeping local people out, following the view that human activities are incompatible with ecosystem conservation (Wells 2004). This "fortress" style of conservation has been heavily criticized as poor conservation outcomes following decades of intrusive resource management has forced policy makers to reconsider the role of community in conservation (Agrawal and Gibson 1999).

Many attempts to integrate conservation priorities with community development have been made, but their impact has been questioned. Attempts such as ICDPs (Integrative Conservation Development Programs) have been criticized for being managed by an external agency, often a protected area or an NGO (Wells 2004). In many of these arrangements, the project gains rarely persist past the duration of the project or the presence of the external agency (Wells 2004). Additionally, many conservation agencies rarely examine the concept of community, assuming a community as a small spatial unit, a homogeneous social structure, and a shared set of norms (Agrawal and Gibson 1999). Communities are complex interactions with different actors and institutions. Failing to recognize this complexity ignores how intra community differences may affect resource management outcomes, local politics, and interactions that affect multiple levels of community life (Agrawal and Gibson 1999).

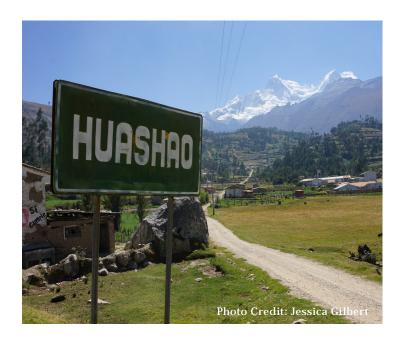
Rather than take a top down management approach, governments should transfer power to local authorities and decision makers to enable people as participants in conservation management rather than managed as subjects (Ribot 2002). This transfer of power "can provide local"

users the independence to make and enforce rules within a circumscribed scope of authority for a specific geographical area" (Ostrom 1998, Ollson et al. 2004). Design, implementation, and management by local people may ensure a more sustainable future for conservation, promoting more equitable distribution of resources and stewardship of natural resources. These issues are at the forefront of my ongoing research in the Central Andes of Peru near Huascarán National Park and the community of Huashao.

Huascarán National Park

Huascarán National Park (HNP) is a 340,000 ha protected area in the department of Ancash, Peru. HNP was recognized as a national park in 1975, a UNESCO Biosphere Reserve in 1977, and as a UNESCO World Heritage Site in 1985 due to its rich cultural and biological diversity. HNP is the 4th most visited natural protected area in Peru, with over 180,113 registered visitors during 2014 (MINCETUR 2015). Tourism is steady throughout the year as patrons are drawn to world class hiking, climbing and day trips to turquoise glacial lakes with striking mountain backdrops.

HNP ranges between 2400-6768masl over 340,000 hectares and comprises 45% grassland





34.5% moraine/rock, 14.8% glacier, 3.4% native forest, and 2.6% wetland (SERNANP 2009). It is home to over 901 species of flora and over 241 species of fauna, including endemic and endangered species (SERNANP 2009). HNP is a long, thin, north to south expanse of protected land surrounded by human settlements and cut laterally by roads that cross the demanding Cordillera Blanca mountain range. Parallel to the park runs the Callejon de Huaylas highway to the west and the Callejon de Conchucos to the east, providing multiple access routes into and across the national park between small, rural communities and larger cities in the valleys. Essentially, HNP is surrounded by people; people with needs and uses of the environment. The department of Ancash in which HNP resides is home to over 1,063,459 residents, of which 42.6% are considered to live in poverty and 17.2% in extreme poverty (INEI 2007). These percentages are much higher at the provincial level, and some of the territory in which HNP resides has a population residing in up to 73.5% poverty and 44.8% extreme poverty (INEI 2007).

Although the designation as a national park prohibits direct use within park boundaries, usufruct land rights were established with the creation of the park for registered campesino communities (peasant communities) with direct

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activity within them, especially in the case of cattle grazing. The master plan sets out a strict set of rules and regulations for these direct uses, however they are often unenforced and ignored, leaving the park susceptible to misuse and overuse. A major use of the national park is tourism, with specific areas designated for recreational use. The entrance to HNP through Huashao is one of the most heavily frequented by tourists, as the only road in the area passes the idyllic Laguna Llanganuco, a, 80m deep turquoise glacial lake at 3800masl surrounded by elfin Polylepis sp. forests and snow-capped peaks. Llanganuco receives approximately 60% of all tourism in the park, amounting to over 108,076 visitors per year to this sector (SERNANP 2015).

Huashao

The rural community of Huashao has been integrated into park management in a mutually beneficial agreement between community and park. Since its inception, this arrangement has been the complete design and implementation of the local community, without assistance from external organizations. This arrangement is considered an "historic achievement" by SERNANP (Servicio Nacional de Areas Naturales Protegidas), the governing agency that manages Natural

Protected Areas in Peru. This arrangement is heavily centered on harnessing the economic benefits of conventional tourism, opposing previous arrangements where local residents pay the social and environmental costs of conventional forms of tourism, but seldom partake fairly in the benefits (West and Carrier 2004, Stronza and Gordillo 2008).

Huashao is located in the district and province of Yungay, in the department of Ancash, Peru. The district of Yungay is home to over 20,075 residents, 50.4% which are considered to live in poverty and 20.2% in extreme poverty. The community of Huashao is home to over 844 residents of 211 families, separated between 7 community annexes (Huashao, Incapacollkan, Yuracoto, Jara Allpa, Humacchuco, Coptac, and Huarca), small clusters of houses that create mini metropolises and family units within the community area (Municipalidad de Yungay 2009). Huashao is derived from the Quechua word "huasha," which means far away. Huashao is a traditional, Quechua speaking community of small scale, subsistence agriculturalists and pastoralists that sell products in the nearby city of Yungay. The principal crops produced in Huashao are potatoes, wheat, corn, and peas, and in the past 5 years, flowers.

In 2009, I conducted a series of surveys to complete a community diagnostic of Huashao while serving as a U.S. Peace Corps volunteer. Using structured surveys and unstructured interviews, I looked at the level of participation that community members had within the park, perceptions of park management, and interest in improving relations or learning more about the national park. The majority of the community had direct uses within the national park from grazing, but did not benefit economically from tourism. Many community members viewed the park as a barrier preventing them from using land that traditionally should be theirs. Although Huashao has a significantly better relationship with the national park than other sectors, a feeling of resentment against the park remained for







Top. Members of the Asociacion de Boteros take a rest in between taking tourists on the lake. Middle. Boat tours on Laguna Llanganuco, hosted by Asociacion de Boteros. Bottom. Women from Asociacion de Artesanas wait for tourists to arrive. Photo Credit: Jessica Gilbert

some community members. Most community members were not interested in learning more about the park or even improving relations, essentially maintaining a separation between the community and the national park, with the exception of the few that benefitted there from tourism.

On my return visit in 2015, there was a notable improvement in perceptions of the national park by community members. Every community member I interacted with viewed the agreement between the park and the community as a positive improvement from the previous arrangement, and highlighted that the entire community benefits, not only a few. While interviewing the workers in the park, they were happy to contribute to the community as a whole, and viewed their daily salary as a fair amount to be paid for their efforts. Interviews revealed that community members and national park staff view each other as alliances, rather than impediments to development. Mutual trust, improved capacity, and local stewardship of the national park can make the community an invaluable alliance for conservation in this sector. In the following sections, I trace this shift from marginalization and disenfranchisement to integration and cooperation.



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Comunidad Campesina Unidos Venceremos de Huashao

The community of Huashao is officially titled the "Comunidad Campesina Unidos Venceremos de Huashao," which translates to the United We Stand Peasant Community of Huashao. The community of Huashao earned its designation and land title in 1974 under the agrarian reform of ex-President Juan Velasco Alvarado. Prior to 1974, Huashao was a hacienda in which community members worked and lived, but had no ownership over the land or the agricultural products they produced. As a registered and titled campesino community, Unidos Venceremos de Huashao owns and manages their territorial land, but is unable to disburse individual land titles to be bought or sold outside of the community. All lands are owned by the community as a whole, and community members, comuneros, may have a claim on them by owning a home or actively maintaining a plot for agriculture. The community is governed by an elected body lead by the community president who is then advised and checked by a panel of advisors and community group leaders. Community members of Huashao are direct and indirect users of the national park under a set of usufruct rights that were established during the creation of the national park in 1975.









Top. Vicuña (Vicugna vicunga) in grassland, one of many species found in Huascarán National Park. Middle. Huascarán overlooking mixed agricultural fields in Huashao. Bottom. Women from Asociacion de Vendedoras de Comida start the early morning food preparation before a swell of tourists during Fiestas Patrias. Opposite left. Woman preparing chiccharones, fried pork to sell during the lunch hours. Opposite right. Women peeling potatoes to prepare papas rellenas, stuffed potatoes. Photo Credit: Jessica Gilbert

The most ubiquitous of these uses is livestock grazing, particularly sheep and cattle. The majority of grazing is concentrated at the border of the park but other activity occurs in the heart of the park in less accessible forests and pasturelands, which are areas designated for recovery or strict protection.

Since 1975, HNP permitted a small group of families from the annexes closest to the park to provide goods and services to tourists within the park. This practice began as porters and guides for mountaineers, and later evolved into conventional tourism such as food sales, boat rides, and artisan craft sales to day tripping visitors. For decades, these few families controlled who could enter the park to sell goods and services, excluding other community members from working within the park. After moving to Huashao in 2009, I noticed a disparity between families working within the national park and those who had no relationship with tourism or the park. Those families that worked in the park often lived in better conditions than those who did not; they often had cook stoves rather than open pit fires, latrines or bathrooms, and owned small luxury items like televisions. All of the profits gained through tourism in the park remained within these few families, setting them apart from the rest of the community which had few opportunities other than subsistence agriculture and small scale construction for their livelihoods.

Huashao is no stranger to participating in development projects; high ranking development NGOs and government development projects have targeted Huashao as a location for project activities, with varying levels of success. Many of these projects are targeted towards outgoing community members that live in more accessible areas, a typical flaw in many development projects and planning (Chambers 1979). Past development projects from NGOs and local municipalities have failed to design effective projects that benefit the more geographically isolated annexes and individuals that may be more socially isolated, particularly women and the elderly.

Many of these organizations target numbers rather than impact or behavior change, and projects result in half completed, unused projects that are discarded in the community or are gifted to families that do not have a need for them. Multiple homes along the road have two bathrooms or two cook stoves that are waiting in storage, while families in distant annexes received no support. Some NGOs previously targeted the small group of families working in the national park, as they were easier to work with, had experience with outsiders, and were already organized. These external organizations and park management themselves failed to recognize differences within the community, but viewed the members that they worked with as representatives of the community as a unified whole. Many of these projects resulted in mistrust within the community, resentment towards outside organizations and challenges of power between family groups.

As tourism increased, and with it its impacts, HNP officials issued a series of requirements for this group of families to fulfill in return for access to the national park. This group was required to participate in trash cleanups along trails, manage trash that was generated by food sales, participate in reforestation events, maintain a nursery of native tree species (Polylepis sp.), and provide labor for work events, including construction or maintenance projects. Little by little, their participation decreased in these activities, and they requested that the park become less demanding of their requirements, particularly in reforestation that saw a decrease from 10,000 trees planted per year to only 1,000 trees per year. Some members of these families were found illegally grazing within national park boundaries, including reforestation areas, and fishing illegally in the lake.

As the relationship between the park and this group of families was souring, momentum was growing down the hill in the community of Huashao to take advantage of the economic opportunity of tourism within the park.

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Community members began to pressure the community president to propose an act to the park to establish equal access to sell goods and services at Laguna Llanganuco. After a few years of pressure from the community, reduced support by the participants from the previous arrangement, and infractions committed by members of the family association, the park removed the exclusive rights of access to the few families that had worked within its borders, providing equal access to the community as a whole.

On July 14, 2013 the Comunidad Campesina Unidos Venceremos de Huashao signed a formal agreement with SERNANP (Servicio Nacional de Areas Naturales Protegidas) to allow the community the exclusive right to provide goods and services to tourists in the Llanganuco Sector of HNP. This arrangement establishes a 5-year contract between the community of Huashao and the national park under series of guidelines and requirements that the community must fulfill in order for the contract to be considered for renewal in 2018.

Complete management of this arrangement is the sole responsibility of the community and its governing body, which consists of an elected community president and a team of advisors. Rather than a top down management strategy implemented by the national park, the community has complete ownership and independence to manage this arrangement. Currently, the community employs over 90 community members to work on a rotating basis in the national park. Each annex of Huashao works for one week, rotating to the following annex. For the assigned week, each community provides about 15 workers to sell typical foods, handicrafts, photographs, boat rides across the lake, and restroom services. The community organized a training program in which new participants were trained by experienced community members in order to ensure consistent quality of goods and services. Once trained, a person is assigned to one of the associations: the association of boat rowers,

artisans, and food sellers. These associations exist to maintain quality control of the products sold within the park, restock supplies, keep records of sales, and report needs to the community president.

For each day of work in the park community members receive S/.25 (\$7.76USD) per day during regular periods and S/.35 (\$10.86USD) per day for holiday periods (Semana Santa or Fiestas Patrias). This may not seem like a large sum of money, but it is a significant increase for those who do not generally have an income, especially single mothers and stay at home mothers. During interviews, most community members were content with this payment, stating that it provides their "pan del dia," their daily bread. Some remarked that without this payment they would be paid nothing, and make little from selling agricultural products.

This arrangement is both an economic and cultural exchange between community members and national and international tourists. All of the community members in the park wear their traditional clothing and sell products that are typical to the region, including dishes such as fried guinea pig, a lupine bean salad, and fried pork. In every interview and photo I took, everyone made sure they were wearing their best typical clothes; the shiny, lacy blouses and colorful skirts for the women and the neatly pressed pants and shirts for the men. This is a huge step from the past, as many Quechua speakers hid their language and culture for fear of discrimination from nonindigenous Peruvians. Now when visiting HNP you might meet someone who wants to give you a lesson in Quechua, teases you about speaking it poorly (personal experience), and lends you a traditional shawl to warm you from the cool winds blowing off the lake.

After paying all of the workers and replenishing stocks, the community is left with a sizable profit to be managed at the discretion of the community. In the past arrangement,

all of these profits were shared between the few families benefitting from tourism in the park. Now, these profits are funneled into a community bank that is used for development projects and materials that are purchased with the intention of benefitting the community as a whole. To date, the community has purchased 4 computers for the combined primary and secondary school, a copy machine for the health post, and a truck to transport agricultural products and transport workers to the park each day. A long awaited dream, the community is currently building a locale communal, a local meeting house to hold monthly community meetings. Previously, the community would hold these mandatory meetings in a central location for all of the annexes; a large clearing at the upper reaches of the community alongside a ridgeline that was exposed to strong winds and rain during the wet season. Additionally, the community provides a modest pension of S/.500 (\$155.15USD) per month to elderly community members that have no family members to care for them, and provides grants to community members that fall ill and incur high medical expenses.

In exchange for access to the park, the community must fulfill specific requirements as terms of the contract. For each visitor that enters the national park at the Llanganuco sector, the community must pay a tax, which is increased each year of the contract. During the first year, the community was required to pay S/.0.10 (\$0.03USD) for each visitor. This tax increases by S/.0.10 per year, ending in a maximum of S/.0.50 (\$0.15USD) per year during the fifth year of the contract. This may not seem like a sizable amount, but considering the influx of tourists during high tourist seasons such as Holy Week and Fiestas Patrias, this amount accumulates rapidly. In addition to receiving this tax, the national park is receiving S/.10 per visitor for conventional tourism as an entrance fee. Some community members argue that this should be a fixed tax, and are concerned that the park is earning money from both tourists and the community.

In addition to this tax, the community is obligated to provide the park with two communal park guards to work alongside the state hired park guards. The community provides a salary to the volunteer park guards who work during 26day increments alongside the official park guard counterparts. HNP is constantly challenged by a lack of time and resources of the official park guards, as a majority of their focus is directed towards tourism rather than monitoring for illegal activity within the park. The communal park guards serve the same roles and duties as the official park guards however, enforcement of rules becomes complicated if a fellow community member is committing the infraction. Generally, the enforcement will be the responsibility of the official park guard, reducing the risk of marginalization within the community due to a breach of trust between community members. The local park guards create a direct connection between the community and national park enforcement, helping to smooth the dialogue between park management and community members with a person that is connected both to the community and to the park.

In the past, resentment and anger has been felt against park management or staff from outside departments who attempt to enforce rules upon community members. Community members have viewed them as distant from their own reality and culture, trying to impose a set of unrealistic guidelines on them from an outsider's agenda. Increasing the interaction between the community park guards and official park guards has noticeably improved this relationship, as friendships and alliances have been created through mutual understanding and aligned priorities. I had the opportunity to interview two of the volunteer park guards this summer who have been working in the park since last year. They both exhibited a strong sense of pride to work in the park, and they embraced their identity as park guards.

As a term of the contract, Huashao is

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responsible for promoting the conservation and sustainable use of natural resources in this sector. First, the community must remove 250 heads of cattle from within the national park boundaries. In this region, the cows do not produce milk and are rarely slaughtered for beef, but are rather viewed as a sort of bank. The cows maintain a direct claim within the protected area, a living, breathing object of property that depends directly on the resources within the national park. In most sectors of HNP, including the Llanganuco sector, communities are exceeding the permissible amounts of cattle within the park, which are not accounted for due to the lack of time and resources of the park to monitor less accessible, higher altitude areas. Cattle are a serious concern in the park, contributing to overgrazing, reduced regeneration of native grasses, soil compaction in wetlands and peat lands, and water contamination (Lozada 1991, Byers 2001). Additionally, the community will be constructing new tree nurseries to provide seedlings of *Polylepis sp.* to be used for reforestation activities.

Although this arrangement is in its nascent stages, it shows long-term promise for the community of Huashao and HNP. SERNANP is currently exploring the possibility of creating partnerships such as this in other natural protected areas. Although this arrangement seems to be working in Huashao, it may not be applicable to other regions that are lacking an existing tourism destination and market. Huashao is unique in that it receives such a huge quantity of tourists each year and is a strong, self-defined community, which may pose a challenge in other locations. The alliance between community and park, mutual trust, and capacity of a community to design and implement projects independently are considerations that should be taken by conservation organizations in the future. Constructive ways of involving local stakeholders in the conservation and sustainable use of biodiversity in and around the most significant protected areas remains one of the most important challenges and priorities for nature conservation at the beginning of the

21st century (McShane and Wells 2004). Viewing local people as capable allies of conservation may strengthen some of the shortcomings of previous conservation attempts, and provide sustainable solutions to natural resource problems in the future.

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