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About this Issue

Statement of Purpose

The Rhodes Journal of Biological Science is a student-edited publication that recognizes the scientific achievements of Rhodes students. Volume XXX marks the ninth year since Mark Stratton and Dr. David Kesler brought the journal back into regular publication in 2006. Founded as a scholarly forum for student research and scientific ideas, the journal aims to maintain and stimulate the tradition of independent study among Rhodes College students. We hope that in reading the journal, other students will be encouraged to pursue scientific investigations and research.

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Image Credits

The front cover for this year's edition of the *Rhodes Journal of Biological Sciences* was created by Lexi Perkins, an art major from Murfreesboro, TN. This image illustrates the subject for one of the featured articles in this year's edition which researched cownose stingray.

Rhino Conservation in Chitwan National Park, Nepal

Maddie Carwile

Chitwan National Park, Nepal, is home to 500 one-horned rhinos, a species endangered due to habitat loss, poaching, and human-wildlife conflict. The area around Chitwan National Park is highly impoverished, and relies on tourism for a substantial portion of income. My research trip to Chitwan focused on identifying the main threats to rhino conservation and investigating strategies that local people, conservationists, and government agencies employ to counter these threats. I found that while poaching and human-wildlife conflict have been significant threats in the past, the largest threat is the invasive plant species, Mikania micrantha, which covers the native grass species consumed by the rhinos. Another significant threat is the possible road and railway system proposed to cut through the National Park.

Introduction

In August of 2014, I took a research trip to Chitwan National Park, Nepal, to study rhino conservation. Nepal is a small, landlocked country about the size and shape of Tennessee. It is bordered by China to the north and India to the south. The geography of the country is divided into three distinct bands. In the north of Nepal are the Himalayas, including Mount Everest. The large, middle section of the country is covered by the “hills,” and the south of Nepal is the Terai, or lowland jungle. While the north of the country can certainly be cold, in the summer temperatures in Nepal can be above 100°F. A major event in recent history was a civil war between Maoist insurgents and the government fought from 1996 to 2006 (Whelpton 2). This civil war not only impacted Nepal politically, it also had a profound effect on the rhino population. Park rangers and soldiers were unable to police the park due to the conflict, and poaching numbers drastically increased (Pokheral, pers. Comm.; Poudyal et al., 2009).

My research took place in Chitwan National Park in the lowland jungles. Chitwan is home to many species of animals, including elephants, tigers, crocodiles, deer, wild boar, and, of course, rhinos. The one-horned rhino (*Rhinoceros unicornis*), also known as the Indian rhinoceros, is a species endangered due to poaching and habitat loss. One-horned rhinos are solitary animals that live in the grasslands and forests in India and Nepal (Poudyal et al., 2009). Chitwan National Park has around 500 rhinos, around a quarter of all those left in the wild (Chiran Pokheral, pers. Comm.).

Nepal is a very impoverished country. The per capita income is US\$700 per year, and a quarter of the population lives below the International Poverty Line of \$1.25 a day (USAID/World Bank, 2014). Around 80% of the population works in agriculture, and as the country becomes more urbanized and developed, habitat loss is a real concern for native species (USAID, 2014). While the effect of current population growth and agricultural impacts is

unknown, past increases in agricultural development have had significant impacts on wildlife populations. For instance, the Nepalese government’s Integrated Agriculture Program increased agricultural production in Nepal, but also caused large-scale clearing of forests and a significant decrease in the rhino population (Poudyal et al., 2009).

My research focused on the relationship between extreme poverty and wildlife conservation. How can local and national governments and local and international organizations help impoverished people make a living while at the same time caring for the welfare of animals? How can wildlife conservation be promoted in areas with high poverty rates? I looked at threats to rhino conservation in Nepal, and how community members, wildlife agencies, and government officials are combatting these threats.

It is interesting to note, that despite Nepal’s poverty, the country has a strong track record when it comes to rhino conservation. In the 1950s, the population numbered around 800, but poaching brought the population under to less than 100 by 1968 (Martin and Vigne, 1996). Current estimates using ID-based rhino monitoring place the population at over 500 individuals, largely due to a decrease in poaching and more effective monitoring (Chiran Pokheral, pers. Comm.). March 2014 marked an entire year without incidents of rhino poaching, and there has only been one incident in the last year, and two rhinos in the past four years (Republica). On the other hand, countries such as South Africa have upwards of 1000 rhinos poached every year. Conservationists consider the drastic increase in rhino population in Chitwan National Park an essential success story (Martin and Vigne, 1996). My research focused on reasons for Nepal’s success and conservation efforts, and I wanted to study whether these strategies could be applied to other countries.

Methods

I met with conservationists both in Chitwan National Park and in Kathmandu, the capital city of

Nepal. I spent most of the summer working for the United States Agency for International Development in their Social, Environment, and Economic Development (SEED) Office. At USAID, I learned about their Hariyo Ban environmental program. Hariyo Ban means “Green Forests,” in Nepali, and focuses on mitigating the effects of climate change and conserving native species. One major component of the Hariyo Ban Program is that it emphasizes community-based natural resource management and focuses on helping poor and marginalized groups build resiliency.

After preliminary research and interviews in Kathmandu, I travelled south to Chitwan. The area around the National Park is home to the indigenous Tharu people. Around 6.7 million people live in the Chitwan region, with 4.5 million cattle (Abdul Ansari, pers. Comm.). This part of Nepal is more impoverished than the country as a whole, with 50% of people living below the poverty level and an average income per capita of only US\$90 a year (Abdul Ansari, pers. Comm.).

In Chitwan, I interviewed members of the Community Forestry User Groups and Anti-Poaching Groups. I also visited the World Wildlife Fund Office and met with the director of the Terai Arc Landscape program, Mr. Abdul Ansari. I stayed at the Biodiversity Conservation Center (BCC) for the National Trust for Nature Conservation (NTNC), and participated in ID-based rhino monitoring. The NTNC is one of the foremost wildlife conservation agencies in Nepal, and it was a privilege to stay at their center. One highlight was a baby rhino that roamed free on the compound. He enjoyed sleeping under the stairs to my dorm, and liked to be pet as though he were a dog. When I sat on my stairs, he would stick his snout through the railing and suck on my fingers. The young rhino had claw marks on his face and leg, and was likely attacked by a tiger. The conservationists at the NTNC believe that his mother chased the tiger away, and was separated from her son in the process. As of January 2015, the rhino still lives at the BCC, and due to the improbability of succeeding in the wild he will likely move to the Central Zoo in Kathmandu. Since my research trip, the BCC has rescued another juvenile who was attacked and severely injured by a tiger. Tiger attacks are a major cause of death for rhino calves in Nepal (Martin and Vigne, 1996). The NTNC’s rehabilitation of injured and orphaned rhino calves is a ground-level approach to preventing rhino deaths that works in conjunction with larger-scale conservation programs.

The most enjoyable part of my research was participating in ID-based rhino monitoring. Each rhino has a distinguishing feature, such as a spot or a

ridge in their armor, and my guide was able to recognize different rhinos and tell me their ages, sex, and names. We went out on elephant back- it’s the best way to traverse the jungle and provides an elevated point for searching (Figure 1).



Figure 1. Rhino observations made using elephant transportation.

The BCC keeps their own elephants for monitoring and field work. ID-based rhino monitoring is a way for park officials to monitor the number of rhinos in the park, and helps determine if poaching is occurring (Chiran Pokheral, pers. Comm.).

I was lucky enough to see many rhinos while in Chitwan (Figure 2). However, spotting them can often be difficult due to the dense foliage and high grasses in the summer months. These problems were exacerbated by the fact that my research took place in August, which is monsoon season in Nepal. The rhinos are not skittish and once observed, can be approached easily.



Figure 2. Rhino spotted from elephant back. Photo by author.

Results

Tourism and Human-Wildlife Conflict

In order to address problems surrounding wildlife conservation, it is first necessary to understand the close relationship that the people in the Chitwan area have with the wild animals. The buffer zones that border the National Park have many small villages. It's not uncommon to have wild animals, particularly deer and boar, come into the villages and eat or trample crops. Elephants, also native to the region, have been domesticated and are used in logging, farming and for tourism (Figure 3). At the breeding center, government officials breed and train elephants for use in patrolling the park (Figure 4). Elephants are also used for elephant safaris for tourists (Figure 5).

Initially, I found three main threats to rhino conservation: poaching, habitat loss, and retaliatory killings. These fall into the category known as human-wildlife conflict. Rhinos are most often poached for their horns, which are used in Chinese medicine to treat ailments ranging from typhoid to arthritis to vomiting (Bronwyn Llewellyn, pers. Comm.; Ellis 121). One horn can cost more than \$8,000 on the black market, a huge source of income for people who may make less than \$100 in an entire year (Ellis 114). Habitat loss occurs with higher frequency as people cut down trees for farmland and pasture land for their animals. Retaliatory killings of wildlife occur when animals eat crops, kill livestock, or damage property. Human-wildlife conflict is increasing as the population grows (Martin and Vigne, 1996). For rhinos specifically, human-wildlife conflict includes crop damage, injury, and even death (Sitidevi Community Forestry User Group; Gyaneshwor Community Forestry User Group, pers. Comm.).

One USAID project that seeks to mitigate human-wildlife conflict is power fencing. One kilometer of fencing costs 100,000 rupees (US\$1,000), but can save millions in crop damage or livestock loss (Hariyo Ban Annual Report). The fencing is supposedly effective against rhinos, wild boar, and spotted deer, and has led to a significant decrease in human-wildlife conflict and retaliatory killings (Hariyo Ban Annual Report). I had the opportunity to speak with villagers in Sitidevi and Gyaneshwor Community Forests and ask them their opinions on power fencing. The community members in Gyaneshwor said that the fencing is 75% effective in keeping out animals, while the villagers in Sitidevi said that it works well for rhinos but does not always prevent deer and boar from entering the village. One problem is that Nepal does not have enough electricity for the whole country, which means that

the government employs load-shedding. People are without power for up to 18 hours a day. The villagers would like continuous current for the electric fences, as well as compensation for crop and livestock damage.

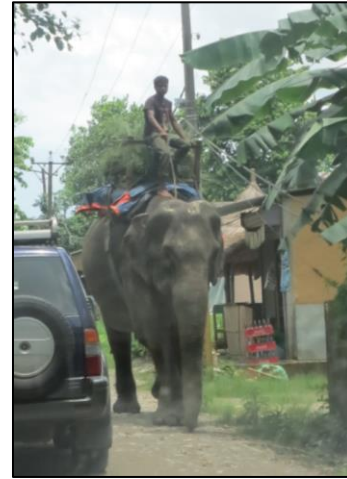


Figure 3. Elephant and driver walking down street. Photo by author.



Figure 4. Mother and young elephant at the breeding center. Photo by author.



Figure 5. Tourists take part in an elephant safari. Photo by author.

Nepal has had a successful history of conservation for several reasons. It's true that in impoverished communities, poaching is a way for people to earn money (Community-Based Anti-Poaching Unit, pers. Comm.). In 1993, a rhino horn cost over US\$11,000 per kilogram, a significant amount of money in a region where the average income per capita is only \$90 a year (Martin and Vigne, 1996). As prices are likely increasing, poaching is a lucrative opportunity for impoverished Nepalis and Indians alike (Bronwyn Llewellyn, pers. Comm.) However, not only is tourism a significant source of income, it also benefits the whole community rather than a select few individuals. There are dozens of hotels around the National Park that employ locals as cooks, waiters, housekeepers, and guides. Tourism in Chitwan focuses on experiencing the wildlife through elephant safaris and canoe rides. I was even able to participate in an elephant bath, riding an adult female bareback down to the river. These wildlife tourism activities employ locals with indigenous knowledge of the region, and provide money to improve infrastructure, education, and nutrition. People living around Chitwan understand that loss of rhinos and tigers means loss of tourism, so they do not support poachers. To quote Abdul Ansari, the director of the World Wildlife Fund's Terai Arc Landscape (WWF-TAL) program, "without conservation, there is no tourism."

In fact, one of WWF's main projects actually focuses on increasing and improving tourism by promoting eco-tourism. Home stays of visitors benefit the community directly, and with regular tourism, the hotels and resorts employ local guides, as well as cooks, and housekeepers. However, more studies should be conducted on the effects of so many people around Chitwan National Park (Abdul Ansari, pers. Comm.). Each area of the forest only has a limited carrying capacity, or the number of species that an environment can sustainably support, but dozens of elephants and hundreds of people may use the forest every day. In the future, a study should be done to see if there is a lack of engagement in normal behavior for rhinos, such as mating (Bronwyn Llewellyn, pers. Comm.). Certain behaviors may be distorted due to the large numbers of people and elephants using the same areas surrounding the national park.

While the effects of tourism on the local environment is still be studied, tourism has had a significant economic benefit for the community. Park entry fees alone bring 220 million rupees, or around \$2 million, a year (Abdul Ansari, pers. Comm.). Approximately 50% of this money returns to local communities (Abdul Ansari, pers. Comm.). Hotels

and businesses also promote community involvement for tourists, and many adopt schools or villages.

Invasive Species

While in Chitwan, I met with the director of the program for WWF-Nepal, Abdul Ansari. He says that the largest threat to the rhino population is not poaching or other forms of human-wildlife conflict. Instead, he said that the largest threat is alien invasive species on grasslands.

Mikania micrantha, a fast-growing plant also known as "mile-a-minute," is becoming a significant threat to the rhino population in Nepal (Abdul Ansari, pers. Comm.). Nepal underwent a civil war from 1998 to 2008, and during this time the army covered their barracks with mile-a-minute to hide them from the Maoist insurgents (Sapana Lodge guide, pers. Comm.). The plant has since spread, and is covering the native grasses that the rhinos usually eat (Figure 6). The rhinos cannot eat the *Mikania* plant, and park officials are unsure of how to destroy it (Abdul Ansari, pers. Comm.).



Figure 6. Invasive species *Mikania micrantha* covering grass, the main food source for rhinos. Photo by author.

Combating Poaching with Community Involvement

Community members in Chitwan have also established Anti-Poaching Groups to prevent poaching of animals such as rhinos and tigers. Their main focus is improving awareness for the poorest communities via songs during festivals, household visits, quiz competitions in schools, and advertisements on local radio. According to the leaders with whom I met, education is the most important aspect of reducing poaching. By teaching children about the importance of wildlife, the anti-poaching members hope that parents and family members will also learn. The anti-poaching groups also have a cadre of informants, make observations while patrolling, and report suspicious behavior to the National Park Authorities.

The Anti-Poaching members are all volunteers. When I asked the five men their motivations, two answered conservation of forests, one said to improve the world for future generations, another responded with protection of animals, and only one person responded that his main motivation was to help the local economy promote tourism. Nepal's success rate cannot just be attributed to the economic benefits of tourism.

Conservationists agree that the best way to promote wildlife protection is to engage and mobilize the community (Wells and Sharma, 1998; Bronwyn Llewellyn, pers. Comm.). When people take ownership of natural resources, they have motives to protect them that go beyond money. The people living around Chitwan National Park have a generally positive attitude towards the animals and see them as a source of pride. All of the villagers that I interviewed said that they liked the rhinos and did not consider them to be a pest. Such positive opinions seem conflicting when looking at the damage that rhinos can cause. In Sitidevi Community Forest, one person was recently killed by a rhino while cutting grass in the forest, and four people were injured since the spring. In Gyaneshwor Community Forest, three people were killed by rhino attacks and two were injured in the past seven years. According to the villagers, rhinos are the most dangerous animals in the jungle, followed by tigers and leopards.

Villagers that live next to the jungle are less accepting of conservation and anti-poaching efforts, due to wild animals eating their crops and livestock. Since the Community-Based Anti-Poaching groups protect these animals, villagers often view them as responsible for their loss of livelihood. People involved in combatting poaching are not always safe. The anti-poaching volunteers said that they feel unsafe during night patrols and told me about a masked man on a motorcycle who would drive behind them and make death threats. And sadly, in October, two National Park employees were shot and one was killed likely by wildlife smugglers (Republica).

When I met with the anti-poaching group, they were all men. While women are involved in planning and organizing events, there are no women patrolling in the field. Anti-poaching leaders say that patrolling is too physically demanding for the women, and claim that women cannot run or climb trees if pursued by an animal. They also worry about women encountering poachers. The main problem, however, is societal and cultural pressure. It would be considered improper to send women into the jungle with men, and there are no patrolling groups that are composed solely of women.

Current Issues and Future Threats

Nepal has some advantages that other countries lack when it comes to promoting conservation efforts and reducing poaching. In part due to its extreme poverty, Nepal often provides soldiers for United Nations Peace-Keeping missions, and these soldiers train by patrolling national parks (Bronwyn Llewellyn, pers. Comm.). There are more than 1,000 soldiers stationed in Chitwan National Park alone, and they have been effective in reducing the amount of poaching (Abdul Ansari, pers. Comm.). When poachers shot and killed a rhino in May, they did so during a change of command in the army (Abdul Ansari, pers. Comm.). The presence of the army is a strong deterrent for poachers.

Chitwan National Park is also a relatively small area at 932km² (Martin and Vigne, 1996) It is surrounded by buffer zones, so poachers must pass through populated areas to get in and out of the park. Between the anti-poaching members, soldiers, and villagers, it can be difficult for poachers to remain unseen. This is not the case in many wildlife reserves and parks in Africa, where the vast areas cannot always be adequately patrolled (Bronwyn Llewellyn, pers. Comm.).

Other countries may not be able to fully replicate Nepal's success in rhino conservation, which benefits from the strength of the army and the small size of the park. However, other programs can learn from Nepal's focus on community engagement and mobilization. The anti-poaching groups and community forest groups take charge when it comes to conservation and natural resource management. Sense of ownership and self-governance encourages local people to not only participate in conservation, but to become leaders. Any and all conservation practices need to have the full support of the local community and a strong understanding of the culture.

The future of rhino conservation in Nepal looks positive. However, certain challenges remain. Potential problems are a planned railroad and postal roads connecting India and Nepal. The current development plan has the railroad and roads cutting directly through Chitwan National Park (Bronwyn Llewellyn, pers. Comm.; Abdul Ansari, pers. Comm.). While the railway and roads would bring economic benefit to the people living in the area, they would likely have a severe and long-lasting effect on wildlife conservation. If the railway or the postal roads are constructed, conservation agencies and government officials will need to work with community members to ensure that rhinos and other species are protected.

Due to the relatively small size of the rhino population, genetic diversity may also become a threat in the future. There are genetic problems in the

tiger population due to its small size of 200 individuals within the park, but no studies have been conducted on the rhinos (Bronwyn Llewellyn, pers. Comm.). A study should be done on genetic diversity, as a bottleneck may have occurred following the reduction in population size during the Maoist insurgency or in years of poaching prior. During the insurgency, at least 29 rhinos were killed in Chitwan as soldiers left their posts at the national Park to fight the Maoists (Ellis 116).

In the future, studies should also be conducted on the carrying capacity of the park and buffer zone area to see the impact of tourism on the environment. Agencies working in Chitwan should promote active involvement and leadership by women, which would not only help with conservation efforts but also in raising the status of women in an area where they have fewer rights and opportunities than men. Since women and men cannot go together into the jungle, all-women anti-poaching teams should be established. The local government should work with the national government and aid agencies to expand solar-powered electric fencing to all communities, to reduce human-wildlife conflict, crop damage, and death. The two biggest challenges for the future will be the effects of the possible roads and railways and the habitat loss caused by *Mikania micrantha*.

While there are several barriers for Nepal to overcome, the future looks promising. Rhino populations continue to rise as poaching decreases, and the open collaboration between the government and conservation agencies continues to create new solutions for environmental sustainability and rhino protection.

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