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COMMUNITY-BASED MONITORING OF TIGERS IN NEPAL

Local citizens recruited and trained as *bagh heralu* (“tiger watchers”) helped us to collect information on the distribution of tiger throughout the Tarai of Nepal. While the ultimate goal of the *bagh heralu* program was to map the current metapopulation of tigers in Nepal and to determine extent of breeding outside protected areas, the *bagh heralu* approach was useful not only because it facilitated data collection but also because it enhanced conservation efforts in multiple ways. Over the five years of the program, *bagh heralu* became knowledgeable about basic tiger biology and they became recognized in their communities as local tiger experts. Their knowledge of the ecological needs of tigers and strong local interest in the project increased discussions of tiger conservation in local communities throughout the lowlands. This case study indicates that the citizen monitoring programs has the potential to shift some of the responsibility for and economic benefits from biodiversity conservation from government agencies and non-governmental organizations to local communities, thus enhancing efforts to manage resources sustainably across entire landscapes. This case study serves as an example of a citizen monitoring project in a developing country and raises questions relevant to its possible expansion and to broader questions of citizen science in a developing country context.

INTRODUCTION

The first response to the tiger (*Panthera tigris*) extinction crisis in the late 1960s was the legal protection of the species. Tiger was categorized as an endangered species in 1969 by the World Conservation Union (IUCN) and in 1975 listed on the Convention on International Trade in Endangered Species (CITES) Appendix I, which restricts trade (CITES 2005). Consequently, throughout the 1970s, a number of protected areas were established in most tiger range countries. However, no clear biological criteria were used in determining the appropriate size of the parks. Furthermore, biological information such as tiger population size was not rigorously estimated (Karanth et al. 2003) and mapping of tiger distribution proceeded slowly (Smith et al. 1987; Ahearn et al. 1990). In the mid-1990s, Dinerstein et al. (1997) mapped tiger distribution across the entire species range. This effort was useful for setting priorities, but was not based on field studies. Because of inadequate counting and incomplete mapping efforts, sizes of discrete tiger populations and their geographic extent are still unknown. Furthermore, it remains difficult to answer the questions: “are protected areas large enough to conserve tigers?” and “how critical is connectivity among populations for

long-term population or species survival?”

Despite inadequate information and uncertainties, Nepal’s 1999 Tiger Conservation Action Plan (TCAP) suggested that protected areas may not be large enough to maintain a viable tiger population (DNPWC 1999). TCAP proposed to determine tiger habitats outside of protected areas and explore connectivity among Nepal’s tiger populations. To address this, the barriers to dispersal among tiger populations in four protected areas in the sub-Himalayan lowlands or Tarai of Nepal and breeding areas occurring outside of these protected areas were investigated by Gurung et al. (2006). The determination of dispersal corridors is a difficult task because dispersal can be a very rare event. Our approach was to determine if any sites along potential dispersal corridors in Nepal are unoccupied for long enough to conclude that there are barriers to dispersal. To do this, we used local citizens recruited as *bagh heralu* (lit. “tiger watchers”) to help collect information on distribution of livestock kills and other tiger sign. The *bagh heralu*, who lived in the area year-round and who were familiar with the forest near their village, were chosen at key sites along potential dispersal corridors. They were trained to search for tiger sign at these sites and to ask local villagers to report any tiger sign or livestock kills.

Livestock kills are a good indicator of tiger presence because there is a very low density of wild prey throughout potential corridors and thus tigers rely on domestic livestock for food (Gurung et al. 2006).

From a tiger conservation point of view, the project was successful at its goal of mapping the current metapopulation (spatially separated populations of the same species which interact at some level) of tigers in Nepal and determining the extent of breeding outside protected areas (Gurung et al. 2006). Tigers were recorded near 24 of 30 *bagh heralu* villages between October 1999 and March 2003 in a total of 511 observations of livestock depredation or tiger sign. Gurung et al. (2006) found four gaps in tiger distribution and hypothesized that four discrete tiger populations occur in Nepal and adjacent habitat in India. At three survey sites outside protected areas, *bagh heralu* found evidence that tigers were breeding.

The *bagh heralu* approach was also helpful in conceptualizing the entire area in Nepal where tigers can be found as a single conservation landscape to manage tigers, rather than focusing only on protected areas (Joshi et al., 2002). The data collected was used in designing and implementing the Tarai Arc Landscape (TAL) concept (Wikramanayake et al. 2004). In 2001, Government of Nepal endorsed the TAL project to manage tiger on a landscape scale to maintain genetic, demographic and ecological integrity

for its population viability and also to provide economic and ecological benefit to the local people (WWF 2001). The TAL is attempting to re-establish connectivity between reserves by restoring degraded habitats in the identified dispersal corridors through local community forestry user groups. This has important global significance because a great deal of uncertainty remains about how much conservation efforts should go to securing existing protected areas versus expanding effort to also include the human dominated landscapes that occur between clusters of regional reserves.

This success could not have been realized without the *bagh heralu*. We chose a citizen monitoring approach primarily because it allowed the monitoring of tiger distribution and breeding with much greater intensity than periodic field surveys conducted by trained biologists. However, we also were aware that a citizen monitoring approach, in addition to being efficient at collecting data, could raise awareness about tigers in local communities and strengthen support for tiger conservation (Danielson 2005, Getz et al. 1999). As the *bagh heralu* program progressed, we realized that it would be useful for future endeavors to capture the social dimensions of the program. Who are the *bagh heralu* and why did they participate in the program? How did their feelings about their participation change over time? Did the program raise awareness about tigers in local communities and strengthen support for tiger conservation? This case study serves as an

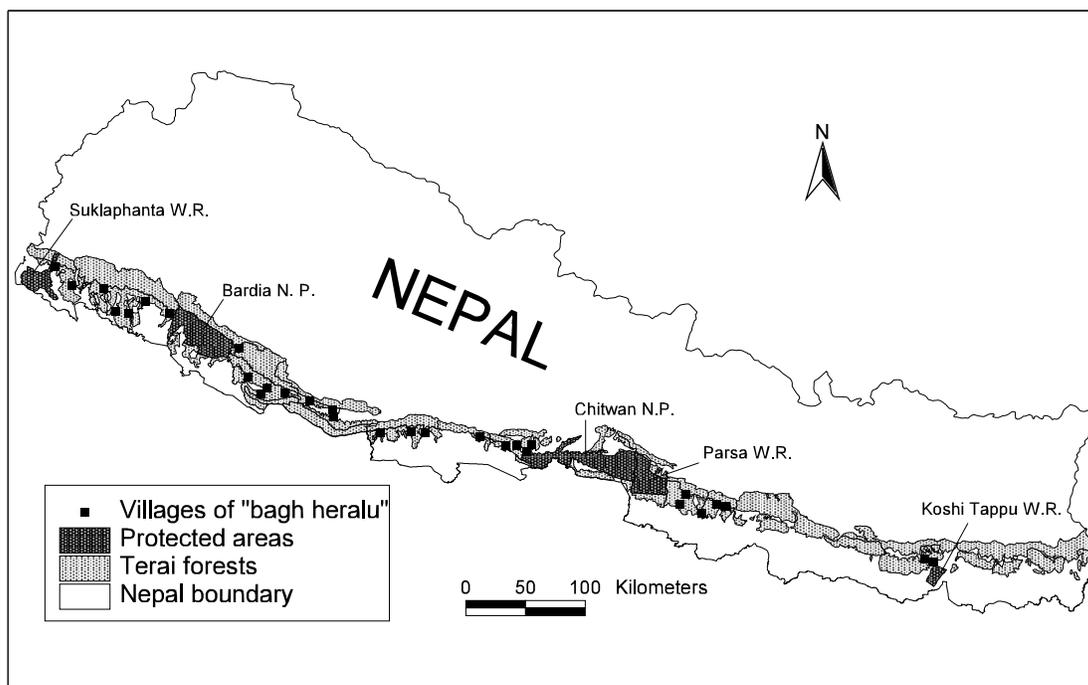


FIGURE 1: LOCATION OF BAGH HERALU VILLAGES.

example of a citizen monitoring project in a developing country and raises questions relevant to its possible expansion and to broader questions of citizen science in a developing country context.

METHODS

A network of thirty *bagh heralu* was established in 1999 to map locations of tiger livestock kills and other sign (Figure 1). The study area included eleven Tarai districts in seven administrative zones that extend from the Koshi River in the east 722 km to the Mahakali River in the west. The Tarai range from 90 to 1000 m in elevation and encompasses the most fertile land in the country.

Bagh heralu were selected when one of the authors (Gurung) went to each of 30 villages spread throughout the Tarai. Upon entering the village, Gurung would talk with the first person, usually male, that he met. He would introduce himself and explain that he was looking for someone in the village who might be interested in helping to monitor tigers. At times, the first person he met would express interest in participating. If he was not, then he might suggest someone else, such as an ex-hunter, or take Gurung to the head of the village or ward representative, who would then suggest someone. They would often suggest someone who knew the forest well and did not have much other work. At times, a group would gather informally and give Gurung advice on who might be a good person or someone would volunteer himself. Once one person indicated that they were interested, no one else would speak up, so Gurung was never forced to choose among people.

While the choosing of *bagh heralu* was opportunistic, it was also purposeful. Different types of *bagh heralu* were selected that we thought would prove most beneficial for gathering tiger data: herders, ex-hunters, Community Forestry User Group (CFUG) members, local leaders, and owners of tea shops. Herders regularly visit the forest with their livestock making them most likely to see tiger sign on a regular basis and able to gather information from other herders. Ex-hunters are familiar with the forest and wildlife behavior. CFUG members are interested in the health of the forest and visit frequently. Local leaders know everyone in the community and can both give and receive information from the entire community. Owners of tea shops are well-situated to hear of illegal poaching activities from members of the local community who gather at their establishment. The owners of tea shops were chosen in villages where it was believed illegal poaching activities were taking place.

Bagh heralu were paid Rs 500/month for the first two years and Rs 700/month for the next 3 years of the program. They were asked to make a minimum of one trip to the forest per week. *Bagh heralu* who were herders went every day as they took their livestock to graze. To put this salary in perspective, at that time, people made approximately Rs 2500/month in full-time salary (based on a rate Rs 80/day that was being paid for manual labor at the time).

During the existence of the program, six *bagh heralu* were let go after 3.5 years because there were no tiger sign in their areas. However, two *bagh heralu* was added in a new area where it was more likely there were tigers. In three other cases, the son of the selected *bagh heralu* took over the monitoring. In two cases, this happened because the father was elderly. In another, the father was busy with legal land issues and was often at court.

Over the span of the program, the *bagh heralu* participated in six training and evaluation workshops. Four workshops were held during the course of the project (December 1999, March 2000, June 2002, March 2003) and two workshops were held after the completion of the project (January 2005 and November 2005). The main objective of the first two workshops was to train *bagh heralu* to record data on livestock depredation and tiger sign. Expert tiger field technicians from the International Trust for Nature Conservation (ITNC), the National Trust for Nature Conservation (NTNC) and the Department of National Parks and Wildlife Conservation (DNPWC) trained the *bagh heralu* and then reviewed and evaluated their skills. Beginning with the second workshop and continuing through the fourth, the focus was to build the capacity of the *bagh heralu* and share research results by facilitating an ongoing dialogue among the *bagh heralu* and wildlife technical staff. Finally, the fifth and sixth workshops introduced the *bagh heralu* biodiversity monitoring system to the Department of Forestry (DoF), where *bagh heralu* and DoF's rangers and forest guards participated in the workshops together (Gurung & Smith, 2007).

Gurung conducted interviews with the 21 *bagh heralu* who attended the last two trainings in 2005. Only 21 attended the training because not all *bagh heralu* were able to safely travel due to the political circumstances in Nepal. We collected information on their motivations to become a *bagh heralu* and the current benefits they perceived of being a *bagh heralu*. Interview questions covered the *bagh heralu* socioeconomic status, length of residency, and the extent of their community involvement. They were then asked their reasons for volunteering to become a *bagh heralu*. After recording their open-ended answers, Gurung listed a series of predetermined reasons and asked if they played a role in their becoming *bagh heralu*. They were then asked open-endedly what they felt the current benefits of being a *bagh heralu* were. After they responded, they were provided with a predetermined list of possible benefits and asked whether they felt each was a benefit. Although having Gurung as interviewer may have biased *bagh heralu* responses because he is the primary coordinator of the *bagh heralu* project, in some ways they might have been more truthful with him because he had been working with them for a long period of time and had established a certain amount of trust.

It would have been ideal to conduct interviews with *bagh heralu* at the beginning of the project concerning their motivations as responses about their motivations six years later are not entirely reliable. However, as with many conservation

projects, the social dimensions are not always fully considered in the initial stages. The first author was brought on in the middle of the study when it was recognized that the social dimensions of the *bagh heralu* had interesting implications for future conservation programs and were important to capture.

In addition to the post-hoc evaluation limitations of the study, we had also planned to conduct in-depth interviews with the *bagh heralu* in their villages as well as with other members of the *bagh heralu* communities and neighboring communities. These interviews would have given us much more insight into the questions we pose here and allowed us to understand the community dimensions of the *bagh heralu* to a much greater extent. However, again due to the political situation in Nepal, traveling to each village was dangerous and not feasible during the time period of the program.

RESULTS

Socio-economic description of *bagh heralu*

Of the twenty-one *bagh heralu* interviewed, seventeen were farmers, three were shop owners, and one was a fisherman. Five of the seventeen farmers were also livestock herders and three of the seventeen were ex-hunters. At the time of the interviews, six of the twenty-one *bagh heralu* interviewed held leadership positions within the communities, such as ward representative, and five belonged to a CFUG.

The average age of the *bagh heralu* was 39.5 years, ranging from 20-62 years. Five were Tharu, five were from Magar or Tamang hill tribes, eight were Chhetri, and three were low-caste. The *bagh heralu* had on average five years of education, ranging from 0-11 years. Landholdings averaged 0.66 hectares with a range of 0.1-3 hectares. (Table 1)

Bagh heralu motivations and benefits

The most common reason given by *bagh heralu* for their volunteering was to gain economic benefits, followed by to gain experience or knowledge and to conserve tiger. A few people mentioned the opportunity to travel. One person each mentioned gaining social status, to conserve the forest, to protect their livestock, and the opportunity to do something for the country. Responses to the predetermined list of reasons generally matched these responses (Table 2). The agreement of so many to the list of predetermined reasons did not surprise us, and it demonstrates why we first asked the open-ended questions. The open-ended questions allowed us to determine the benefits that were most salient to the rangers while the close-ended demonstrated that all *bagh heralu* gained diverse benefits from the program.

For many of them, the *bagh heralu* project was an opportunity with multiple potential benefits. For example, one 35-year-old Chhetri farmer said, “Tiger is living here historically and tiger conservation is necessary so I was interested. I had the impression that working at this job would provide opportunity to learn the work for future promotion and some economic benefit.” A 45-year-old Magar/Tamang political leader at the ward level said, “Livestock and forest could be saved. From this Nepal’s forest could be saved, therefore I was interested. Also, work and respect could be gained.” A 28-year-old Tharu said, “I became a *bagh heralu* to learn a kind of work, to travel to parks such as Bardia National Park, and to get some monetary benefit.”

For some, the novelty of working with tiger was a benefit. A low-caste 29-year-old farmer said: “I was interested because while other people or common people are afraid of tigers because of getting killed but this work was to take measurements of tiger tracks.”

TABLE 1. SOCIO-ECONOMIC DESCRIPTION OF *BAGH HERALU*.

Ethnicity	#	Occupation	Age (years)	Education (years)	Land (hectares)	Length of residency (years)	Community involvement (# and type)
Magar/Tamang	5	5 farmers 1 ex-hunter 2 herders 2 community leaders	42.2 (20-58)	2.6 (0-6)	0.98 (0.3-2)	23 (19-35)	4 (CFUG)
Tharu	5	5 farmers 1 exhunter 1 herder	36.4 (20-54)	7.2 (3-10)	1.75 (0.24-3)	Since birth	4 (family planning, ward representative, VDC, primary school)
Chhetri	8	5 farmers 1 exhunter 2 herders 3 shopowners	36.88 (24-62)	4.5 (0-11)	0.80 (0.1-2.5)	23.6 (10-40)	4 (2 CFUG, 1 ward representative, 1 youth club leader)
Low-caste	3	2 farmers 1 community leader 1 fisher	23.67 (29-42)	3.0 (0-5)	0.51 (.05-1)	18.5 (4-33)	1 (CFUG president)

TABLE 2. INTERVIEW RESPONSES OF BAGH HERALU.

Open-ended responses	Economic	Gain experience/knowledge generally	Learn	Conservation	Travel	Social standing	Meet others	Other
Reasons for becoming a ranger	11 (5, 4, 2)	7 (5, 2)	0	6 (6)	3 (1, 2)	1 (0, 0, 1)	0	3
Current benefits	6 (0, 3, 2, 1)	0	10 (6, 3, 1)	4 (4)	7 (4, 2, 1)	2 (1, 0, 0, 0, 1)	3 (0, 2, 0, 1)	2
Close-ended responses	Pocket money	Interesting activity	Learn	Interest in conservation	Travel	Social standing		
Reasons for becoming a ranger	17	18	19	14	15	11		
Current benefits	19	21	21	21	21	20		

NOTE: THE FIRST NUMBER IS THE TOTAL NUMBER OF BAGH HERALU WHO MENTIONED THIS REASON OR BENEFIT. LISTED IN THE PARENTHESES IS THE NUMBER, IN ORDER, WHO GAVE THIS AS THE FIRST REASON/BENEFIT, SECOND REASON/BENEFIT, OR THIRD REASON/BENEFIT).

The primary current benefits given by *bagh heralu* was the opportunity to learn, followed by the opportunity to travel and economic benefits, with a few people mentioning the conservation of tiger, the opportunity to meet others (such as the other *bagh heralu* and government officials) and social standing, i.e. increased recognition and respect in their communities. Nearly every *bagh heralu* agreed that each of the predetermined benefits was indeed a benefit.

A 24-year-old Chhetri teashop owner said, “I learnt more about the forest near us, learnt about tiger and leopard.” As a 58-year-old Chhetri herder said, “I got the opportunity to travel and saw other wild animals like rhino and elephant. I received economic benefit while staying at home as this job does not require leaving home.”

A 25-year-old Chhetri shop owner said, “Working as *bagh heralu* I am contributing something to the country. Also, experience in this job may help to get a job in the future.” A 40-year-old low-caste fisherman said, “I enjoy seeing tiger tracks in the forest. Let’s hope the wildlife is saved for the future generation.”

In comparing the close-ended list of benefits that they thought they might gain from becoming a *bagh heralu* to the actual benefits they experienced, most of the benefits were recognized before and after by the majority. However, only about half mentioned interest in conservation and an increase in social standing as a possible benefit, but all agreed that it is a current benefit. The only current benefits not recognized by everyone were pocket money and social standing.

DISCUSSION

The *bagh heralu* responses indicate that the *bagh heralu* perceived that their awareness and knowledge of tiger conservation improved over the span of the program. Economic

benefits appear to become less important in relation to other benefits, or other benefits gained in importance, as *bagh heralu* experienced the opportunities to learn and travel. The increased importance of non-economic benefits is indicated not only by the larger number of *bagh heralu* that mentioned learning and travel as current benefits, but also by the fact that economic benefits were never mentioned first as a current benefit.

It is interesting to note the difference between gaining experience and knowledge as a reason they became *bagh heralu* compared to the idea of learning mentioned as a current benefit. While they seem like very similar reasons, experience and knowledge seem to refer to something very general, more of an opportunity whose outcome is unknown. As a current benefit, they talk about learning in a very specific way, as the knowledge they have learned from the training, such as tiger ecology, biodiversity conservation, the identification and measurement of tiger tracks, and how to recognize the difference between leopard and tiger. It is possible that to learn and to travel are specific benefits equivalent to the initial reason of wanting to gain experience and knowledge. They wanted to gain experience and knowledge, and once they had done so, they realized they had the opportunity to learn about tiger and conservation and to travel to see new places and meet new people.

The program, however, did not only increase the awareness and knowledge of the *bagh heralu*. The number of reports that *bagh heralu* collected from residents of other villages, not just from within their own villages, indicates that they were effective in reaching a wide audience. Of the 253 livestock reported killed by tiger, 35 percent of the reports came from other villages (compared to 54 percent that came from the *bagh heralu*’s own village; 11 percent were unknown). The

main reason why there was a high percentage of kill reports from villages outside of *bagh heralu* villages is because herders from several neighboring villages usually graze livestock together in communal forest areas. When a kill occurs in the forest, news travels from these herders to their respective villages and to the *bagh heralu*. Also, as most of the neighboring villagers are related by family ties and most people know each other, people would report missing livestock and kills to the *bagh heralu*. In one case, a *bagh heralu* even traveled 24 miles by bus because a relative had informed him of a kill in their village. Herders, unless there are many of them together, will not always immediately visit the kill sites because it is risky. Also, herders do not necessarily know an animal has been killed. Often, when a herder sees that livestock is missing at the end of the day, the herders will search together for the lost animal(s). During our project, when there was a *bagh heralu* monitoring the area, the owner would report the missing livestock to the *bagh heralu*. Because the *bagh heralu*'s job was to look for tiger kill, he would join the search operation. If it was found that a kill occurred, the *bagh heralu* recorded the data. However, if the *bagh heralu* missed the search operation, he provided Rs. 50 as an incentive to the owner to take the *bagh heralu* to the kill site.

Another indication that the *bagh heralu* raised the awareness of residents is that during the duration of the *bagh heralu* program, there were three to four known cases where people did not poison tiger if there was a *bagh heralu* living in their village. People often put poison into livestock that has been killed by tiger. They leave the carcass with the poison where it was killed because they know the tiger will come to eat the carcass. Some residents, when reporting livestock that had been killed by a tiger, also told the *bagh heralu* that they normally would have poisoned the carcass but did not do so because of the *bagh heralu*. Thus, *bagh heralu* served multiple purposes: they collected data on tiger for the researchers, they provided assistance to livestock owner in the communal activity to search for lost livestock, and they helped to decrease the number of tiger poisoned.

At the second evaluation workshops the *bagh heralu* realized that their group was beginning to function as a conservation education network. During the workshop they interacted with one another and shared the tiger status of their areas. Realizing that the tiger distribution and status were different at different *bagh heralu* villages, they came up with an idea of sharing and distributing the tiger information in one package. They requested that we develop brochures on the basic natural history of tigers, the purpose of their monitoring activities, and maps showing where tigers occurred, which they then distributed. They also requested that the next training workshop be held in Chitwan National Park so they could gain more understanding of tiger management in different parks in the country.

An additional, long-term impact of the *bagh heralu* is that although we are no longer supporting them, researchers and university students continue to use their expertise while

conducting research. For example, two *bagh heralu* assisted a graduate student from the Tribhuvan University who was conducting his MS research work in Dang district (Pokhrel 2007). Similarly, three other *bagh heralu* have assisted researchers and also university students.

While the results presented here are not as complete or thorough as we would have wished due to circumstances in Nepal at the time, we are encouraged to share them because they demonstrate the potential of a citizen monitoring approach for the conservation of biodiversity.

IMPLICATIONS FOR FUTURE PROGRAMS

As we assumed when Bhim Gurung initially chose them, different types of *bagh heralu* were better at fulfilling the different goals of citizen monitoring. In terms of collecting data on tigers, herders made the best *bagh heralu*. Because they went out daily into the forest to graze their own and /or others livestock (i.e. goats, cattle, water buffalo, or sheep) they were most likely to see tiger sign on a regular basis. They also often met with other herders from their village and other villages while grazing. These informal meetings gave them the opportunity to hear from other herders if they had seen tiger sign or suffered any livestock depredation.

Ex-hunters were probably the second best *bagh heralu* because, although their knowledge was high, they did not go to the forest as regularly as herders. They knew about tiger behavior from their hunting experience, they knew how and where to look for tiger track, and they were familiar with the forest. However, their daily routine did not require them to go into the forest, so their success in collecting tiger reports depended to a great extent on their own personal initiative. Some of the ex-hunters made regular trips to the forest looking for tiger sign while others relied more on reports from other residents.

One of the ex-hunters was a famous hunter guide in Dang, now turned conservationist, who was very interested in monitoring tiger and learning more about conservation. In the past his livelihood depended on guiding hunting groups that came from Kathmandu. He was an excellent marksman and had killed many different types of wild animals, including seven leopards. Due to his successful hunting he was well known in the area. His livelihood ended when hunting was banned, wildlife declined, and habitats were fragmented and degraded. However, after working as a *bagh heralu*, he realized the importance of conservation. It was interesting to him that in the past hunting those animals provided his livelihood and now conserving the same animals was providing him economic benefits. Comparing his experiences as a hunter and a conservationist, he said he preferred to be a conservationist because he is supporting activities that can be more sustainable for a long time.

Bagh heralu who were farmers and not also herders or ex-hunters were not particularly good at being *bagh heralu*. They made trips into the forest to graze their livestock or to collect fuel-wood or fodder. However, their trips into the for-

est were irregular because other members of the household were often responsible for grazing the livestock and collecting resources from the forest.

Community leaders, such as ward representatives, frequently talked with villagers and participated in ward and community meetings. This made them ideal for informing residents about the tiger monitoring and disseminating information. We hoped that, because they had the potential for the largest network of informants, this would make it easy for them to collect reports of tigers from residents. This, however, did not happen as much as we hoped because they had many community responsibilities, including frequent travel to government offices, which made it difficult for them to commit much time to being a *bagh heralu*.

At the time the project started, two members of the Community Forestry Users Group (CFUG) were selected because they regularly entered the community forests located close to villages and showed an interest in monitoring the health of their forest and the wildlife that might be using it (at the time of the interviews seven *bagh heralu* were CFUG members). One of the members was located in the buffer zone next to Chitwan National Park and had participated in many trainings. They were neither particularly good nor bad at collecting tiger information.

The informants were selected in villages where poaching was suspected to be occurring. One of the informants was a tea stall owner. It was hoped that he would hear all the local news and might be able to pick up information about poaching activities. The other informant was a young man in the village who knew a great deal about community activities. Although the informants were good at picking up rumors, they were not as good at collecting reports of tiger because they were unlikely to leave their business to go into the forest to check out reports of tiger.

In summary, three types of *bagh heralu* were useful in different ways: community leaders to communicate and raise the profile of the project within the community, herders and ex-hunters to do the actual monitoring, and informants to listen for illegal activity. We conclude that citizen monitoring programs should carefully consider the characteristics of the monitors. For example, if our program were to be expanded to include other types of biodiversity monitoring, then other types of individuals might be more appropriate (e.g. people with more experience with plants, such as women or traditional healers). Or, if the role of a *bagh heralu* had explicit community education components, then different individuals might be more appropriate (teachers, community leaders). Or, if long-term sustainability was important, young, educated people might be most appropriate (as would providing them with an appropriate wage to encourage them to stay in their villages over the long-term).

CONCLUSION

The ultimate goal of the *bagh heralu* program was to map the current metapopulation of tigers in Nepal and to

determine the extent of breeding outside protected areas. However, the *bagh heralu* approach was useful not only because it facilitated data collection but also because it enhanced conservation efforts in multiple ways. Over the five years of the program, *bagh heralu* became knowledgeable about basic tiger biology and they became recognized in their communities as local tiger experts. Their knowledge of the ecological needs of tigers and strong local interest in the project increased discussions of tiger conservation in local communities throughout the lowlands.

We are confident that the use of local citizens to collect data on a landscape scale has wide application in developing countries, especially when resource managers attempt to implement community participation in resource management. Our experience indicates the concept of *bagh heralu*, and similar efforts, have significant potential to shift some of the responsibility for and economic benefits from biodiversity conservation from government agencies and non-governmental organizations to local communities, thus enhancing efforts to manage resources sustainably across entire landscapes.

REFERENCES

- Ahearn, S. C., Smith, J. D. and Wee, C. 1990. "Framework for a geographically referenced tabular/visual conservation database: case study Nepal." *Photogrammetric Engineering and Remote Sensing* 56: 1477-1481.
- CITES, 2005. *CITES Handbook Manual Guide*. Geneva, Switzerland: CITES Secretariat.
- DNPWC, 1999. *Tiger Conservation Action Plan for the Kingdom of Nepal*. Kathmandu, Nepal: Government of Nepal, Ministry of Forest and Soil Conservation, Department of National Parks and Wildlife Conservation.
- Danielson, F., Burgess, N., and Balmford, A. 2005. "Monitoring matters: examining the potential of locally-based approaches." *Biodiversity and Conservation* 14:2507-2542
- Dinerstein, E., Wikramanayake, E., Robinson, J., Karanth, U., Rabinowitz, A., Olson, D., Mathew, T., Hedao, P., Connor, M., Hemley, G. and Bolze, D. 1997. *A framework for identifying high priority areas and actions for the conservation of tigers in the wild*. Part 1. Washington DC: World Wildlife Fund-US and Wildlife Conservation Society.
- Getz, W.M., et al. 1999. "Sustaining natural and human capital: villages and scientists." *Science* 283:1855-6.
- Gurung, B., Smith, J.D., and Shrestha, M. 2006. "Using "Bagh Heralu" network to map the metapopulation structure of tigers in Nepal." In McNeely, J., T. McCarthy, A. Smith, L. Whittaker, and E. Wikramanayake, eds., *Conservation Biology in Asia*. Kathmandu: Society for Conservation Biology Asia Section.
- Gurung, B. and Smith, J. D. 2007. "A monitoring system to evaluate the ecological outcome of the Terai Arc Landscape Project. A final report submitted to The Rhinoceros and Tiger Conservation Fund." USFWS, Washington DC.

Joshi, A., E. Dinerstein, and D. Smith. 2002. "The Terai Arc: Managing Tigers and Other Wildlife as Metapopulations." In E. Wikramanayake et al., eds., *Terrestrial Ecoregions of the Indo-Pacific: A conservation assessment*. Washington, D.C.: Island Press.

Karanth, U. K., et al. 2003. "Science deficiency in conservation practice: the monitoring of tiger populations in India." *Animal Conservation* 6: 141-146.

Pokhrel, G. K. 2007. "Role of community forests in faunal diversity conservation: A case study of the community forests within Satbariya Range Post of Dang District, Nepal." M. S. thesis, Tribhuvan University, Nepal.

Smith, J. L. D. , Wemmer, C. and Mishra, H. R. 1987. "A tiger geographic information system: the first step in a global conservation

strategy." In R. L. Tilson and U. S. Seal, eds., *Tigers of the World: The Biology, Biopolitics, Management and Conservation of an Endangered Species*. Park Ridge, New Jersey: Noyes Publication.

Wikramanayake, E., et al. 2004. "Designing a conservation landscape for tigers in human-dominated environments." *Conservation Biology* 18: 839-844.

WWF 2001. "Terai Arc Landscape, Nepal." Kathmandu, Nepal: WWF Nepal Program.

USAID, 2002. *Biodiversity conservation program design and management: A guide for USAID staff*. Washington, DC: USAID.



TIGER IN CHITWAN NATIONAL PARK.

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