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Incorporating local knowledge into population and habitat viability assessments: Landowners and tree kangaroos in Papua New Guinea

Philip J. Nyhus
Colby College, pjnyhus@colby.edu

J Williams

J Borovansky

O Byers

P Miller

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Chapter 9

Incorporating Local Knowledge: Landowners and Tree Kangaroos in Papua New Guinea

PHILIP J. NYHUS, JOHN S. WILLIAMS, JENNA S. BOROVANSKY, ONNIE BYERS, AND PHILIP S. MILLER

New Guinea is one of the largest, most rugged, and most biologically diverse islands on the planet. Its mountainous topography, limited infrastructure, and remoteness have restricted the study of the island's flora and fauna. Among the least studied of the island's marsupials are the elusive tree kangaroos (figure 9-1) and little is known of the abundance, distribution, or the threats facing these animals. One, the Scott's tree kangaroo is thought to inhabit no more than 40 square kilometers; another, the Matschie's tree kangaroo, is found only on the Huon Peninsula of northern Papua New Guinea (PNG), where much of its potential habitat has already been degraded (figure 9-2). Given the limited information available about wild tree kangaroos and the very real risk of extinction facing several species, the need to summarize existing information and to develop a concerted research and conservation plan is urgent (Kennedy 1992; Flannery, Martin, and Szalay 1996).

It was in this context that we began one of the most logistically ambitious experiments of the Network's efforts to incorporate greater stakeholder involvement in the Population and Habitat Viability Assessment (PHVA) workshops. To assess the current state of knowledge about the abundance, distribution, and threats to the eight species of tree kangaroos currently thought to occur in PNG, a workshop was held August 31–September 4, 1998, in Lae, PNG, with an emphasis on assessing the status of the Matschie's tree kangaroo (Bonaccorso et al. 1999).

The Conservation Breeding Specialist Group (CBSG) was invited to hold the workshop by the PNG National Museum, Rainforest Habitat, and the PNG Department of Environment and Conservation (DEC). The workshop was intended to be a forum to enable collaboration among

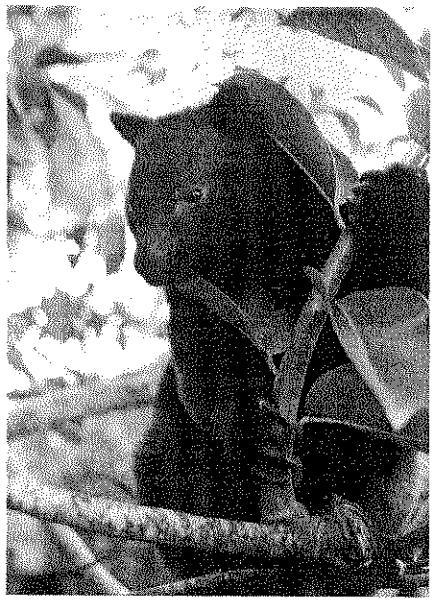

Figure 9-1.
The tenkile, or Scott's tree kangaroo *(Dendrolagus scottae)*.
(Photo courtesy M. Vincent.)

local agencies, stakeholders, and international scientists. Several international and local groups and individuals suggested the workshop process as essential to ensuring the survival of tree kangaroos in PNG. Dr. Timothy Flannery of the Australian Museum, researcher of tree kangaroos and co-author of *Tree Kangaroos: A Curious Natural History*, was the first to call attention to the need for such a workshop and the strategic planning that would follow (Flannery, Martin, and Szalay 1996). The Marsupial and Monotreme Taxon Advisory Group of the Australian Zoo Association and the PNG National Museum endorsed the need for a workshop to be organized and held in PNG.

The Network chose the tree kangaroo workshop in PNG as an ideal case study; because relatively little published biological information was available on tree kangaroos, information from local people would take on added significance. In addition, PNG represented an example of a developing country with low human population densities. The decision to include an interdisciplinary Network field team in this workshop was made approximately three months before the workshop. This evolved out of concerns about how to incorporate local community hunters and landowners in a meeting that was organized and designed by scientists and resource managers. Many of the world's most endangered species are located in areas that are remote and where scientists know little about their basic biology or threats. We hypothesized that Indigenous knowledge

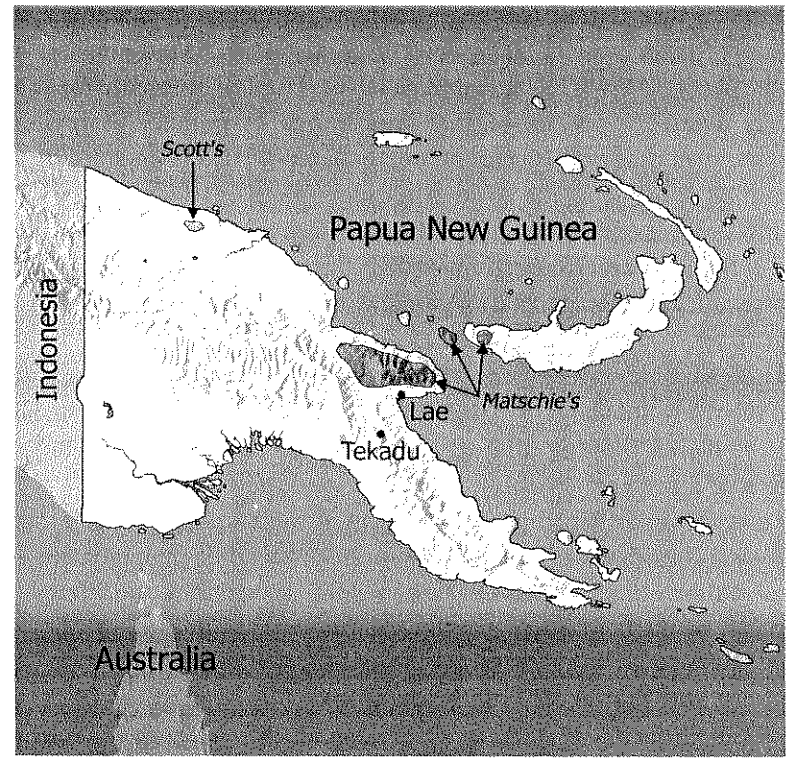

Figure 9-2. Map of Papua New Guinea showing (major provinces) the location of the workshop in Lae, the location of the preworkshop field research in Tekadu, and distributions of Matschie's and Scott's tree kangaroos.

could augment and guide the collection and use of data in the workshop, and broader stakeholder involvement could help to drive recommendations and actions that would be locally relevant and politically and culturally feasible.

This chapter explores the context and process of the tree kangaroo workshop, describes the Network's involvement before and during the workshop, and explores the lessons we learned about incorporating local knowledge and broader stakeholder participation into the wildlife assessment process.

The Context of Tree Kangaroo Conservation

Papua New Guinea, covering the eastern half of the island of New Guinea (the western half is Indonesia's Irian Jaya Province), encompasses almost half a million square kilometers (figure 9-2). The main island and

its satellite islands are home to more than 200 species of mammals, 700 species of birds, and 25,000 species of plants, many found nowhere else on the planet (Alcorn 1993; Paijmans 1976). Tropical evergreen forest still covers nearly 70 percent of the island's area. A number of mammal species, including one species of tree kangaroo, have been scientifically identified only during the last two decades (Flannery 1995).

PNG also is one of the most culturally diverse countries on the planet and is home to an estimated one-third of the living languages on earth. The country is unique in that an estimated 97 percent of its land area is still held under customary tenure (Lynch and Marat 1993). As a result, the central government exerts relatively little control over how resources are used and relatively little land (3–4 percent) is designated as formally controlled protected area. Shifting cultivation still predominates, creating a complex matrix of forest and agricultural lands (Gagné and Gressitt 1982).

Grassroots participation and approval of methods and plans by landowners is considered essential to the success of wildlife management and conservation efforts in PNG because wildlife is generally considered the property of the landowner, not the government.

Biology and Status of Tree Kangaroos

Tree kangaroos (*Dendrolagus* spp.), are found only in Australia and the island of New Guinea. The first tree kangaroo was made known to science in 1836 (Groves 1982); the most recent was made known in the 1990s. Tree kangaroos are members of the family Macropodidae, which is represented in New Guinea by eighteen living species. Tree kangaroos are the only member of this family adapted to an arboreal existence. Six species and ten taxa (species and subspecies) of tree kangaroo are known to inhabit PNG (Flannery, Martin, and Szalay 1996). All six species are endemic to the island—that is, they are found there and nowhere else. Relatively little is known about the ecology of these elusive animals because of their arboreal lifestyles and the inaccessibility of their rugged habitat (Hutchins et al. 1991). They range in size from 6.5 to 17 kilograms, have long, coarse fur; short, broad feet; a tail densely covered with long hairs that often form a brush at the tip; and are found in both lowland and mountainous habitats (Flannery 1995). Three species occur in very small geographic ranges totally within PNG: Matschie's *(D. matschie)*, lowlands *(D. spadix)*, and Scott's *(D. scottae)*. Three other species, Doria's *(D. dorianus dorianus)*, grizzled *(D. inustus inustus)*, and Goodfellow's *(D. goodfellowi goodfellowi)*, have somewhat larger distributions that include

Table 9-1.
Status of tree kangaroos (after Bonaccorso et al. 1999).

Taxon	IUCN Status
Doria's *(D. dorianus dorianus)*	Lower Risk
Finsch's *(D. inustus finschi)*	Vulnerable
Golden-mantled *(D. goodfellowi pulcherrimus)*	Critically Endangered
Goodfellow's *(D. goodfellowi goodfellowi)*	Vulnerable
Grizzled *(D. inustus inustus)*	Vulnerable
Ifola *(D. dorianus notatus)*	Vulnerable
Lowlands *(D. spadix)*	Lower Risk: Near Threatened
Matschie's *(D. matschie)*	Vulnerable
Scott's *(D. scottae)*	Critically Endangered
Seri's *(D. dorianus stellarum)*	Lower Risk
Timboyok *(D. goodfellowi buergersi)*	Vulnerable

Irian Jaya Province, Indonesia. Table 9-1 outlines the conservation status of tree kangaroo populations.

In the last few decades, logging, mining, agriculture, and the development of infrastructure to meet the needs of the country's growing and economically developing population have put tremendous stresses on the country's ecosystems. International logging companies in particular have managed to obtain government sanctioned concessions for large areas, even when the concessions violated existing forestry legislative provisions and landowner rights. The threats of large-scale deforestation are particularly significant for tree kangaroos. Because of their slow reproduction and vulnerability to hunting, even moderate habitat disturbance and hunting pressures can have significant impacts on their populations (Flannery, Martin, and Szalay 1996).

Preworkshop Activities

The Network team members arrived in PNG one week before the workshop. The team was organized to use rapid participatory appraisal tools to carry out a village-level assessment of community knowledge about the tree kangaroo and to evaluate how local communities affect tree kangaroos and their habitat. The team had prior experience with human demography, wildlife management, community conservation, and rapid Participatory Rural Appraisal (PRA). The group was assisted by a representative of a local nongovernmental organization (NGO), the Foundation for People and Community. This person had worked in the

community since 1994 in a conservation and development project and served as a guide and interpreter. The team hoped to develop a better understanding of local-level issues affecting tree kangaroos and to gather village-level data on human population growth, resource use, and habitat change and hunting of tree kangaroos that could be incorporated into the modeling process at the workshop. Plans were also made to work with the village representatives that were to attend the workshop to enable more effective participation in the workshop process.

The team's research objectives were to gather qualitative and quantitative data on human impacts affecting tree kangaroos and tree kangaroo habitat, including habitat quality, such as food, predators, water, and pollution; size of protected tree kangaroo habitat; habitat fragmentation (e.g., the number of habitat areas and barriers that might prevent tree kangaroo dispersal); and species exploitation, such as subsistence hunting and trade for profit.

The field site was the remote village of Tekadu and the surrounding settlements in the Lakekamu Basin of Morobe Province (figure 9-2). This area was selected because it was logistically accessible on short notice, we had access to a guide and interpreter, and two villagers from this area were scheduled to take part in the workshop. This area was inhabited by at least two species of tree kangaroos, but not by Matschie's tree kangaroos.

The team members first met with their guide the night before the trip to the village. There was an extended discussion of the purpose of the visit and the logistics and methods to be used. There was spirited discussion among the team about the workshop methods to be used and the role of the team members as researchers versus a more activist role (e.g., making suggestions regarding ecotourism or family planning). The member of the team with the greatest experience with PRA techniques supported a more activist approach, while other team members supported a more passive, participant-observer approach. By the time the team reached the village, it was agreed that the team would use participatory methods but focus on the biology of the tree kangaroo, its habitat, and human threats. Box 9-1 outlines the tools used for rapid participatory appraisal while in the village.

Arriving at the village's small grass landing field by small aircraft, the team's plane was immediately surrounded by a large group of people; these people were in the village to meet judges who were making their first visit to the community in order to try a number of court cases in Tekadu. The judges' visit in some ways made the arrival of the research team less

Box 9-1.

Tools for rapid participatory research used in preparation for the workshop.

The Network team used the following tools during the pre-workshop visit to Tekadu and the Lakekamu Basin. These methods were used to gather information about tree kangaroos, basic village demography and land- and resource-use patterns, and other information affecting tree kangaroos and their habitat.

Village mapping: For each of four small communities in the area, knowledgeable individuals were asked to identify each household; the number, age, and sex of individuals in each household; and the major livelihood strategies associated with each household (fishing, hunting, and gold panning).

Interviews: Interviews were held with representatives of the local health clinic, the local school, the regional court, and with the community "councilor." Additional interviews were carried out with village elders and a number of "average" villagers.

Village transect: Several villagers walked the team from one end of the village to another, and pointed out major geographic and cultural features (rivers, gardens, hills, forests, houses, government buildings) in and around the village.

History: A village history was completed with the help of several village elders from approximately World War II to the present. Questions were asked about major natural and cultural events that have helped shape the village.

Landscape-level map: A map of the surrounding villages, landscape features (rivers, mountains, valleys), and major cultural features (airplane runway, trails) was made with the assistance of several local community members.

Wildlife resource use: A group of hunters was asked to identify all the different species of mammals commonly hunted in the area. These animals were identified in the local language, and a description of each animal was written as well. These hunters were then asked to rank these animals by their relative abundance. The list was narrowed by asking them to first rank each animal as 3 (very abundant), 2 (abundant), or 1 (not abundant). The animals identified as 2 or 3 were then ranked using a "paired ranking" technique by comparing each animal to every other animal. The most common (or at least most commonly hunted) animals then received the largest total score.

Tree kangaroo knowledge and hunting: To examine current knowledge about tree kangaroos and hunting practices, interviews were held with hunters and other villagers in which they were shown pictures of tree kangaroos and asked to identify the common species. Landowners were also asked to recall how many tree kangaroos they had killed, where they had killed them, and the type of animals they killed.

Seasonal calendar: A one-year calendar was made that identified major rainfall patterns, agricultural patterns, and specific hunting practices, generally and with regard to tree kangaroos.

Miscellaneous activities: Interviews were held wherever possible, such as during the local market and with individuals who came to talk with us. Several group exercises, such as a map showing the altitudinal distribution of tree kangaroos, were also carried out.

intrusive. The court proceedings taking place during the next few days proved an unexpected backdrop to our work, making it more difficult to spend time with some villagers, but enabling the team to more easily pursue its activities unobtrusively and to gain access to people from surrounding villages.

The team began with a village transect walk to better understand the underlying economy of the valley and its geography. This served as a base for later mapping, interviews, and group interviews with hunters and other community members (figure 9-3). The team was hampered by not having any accurate maps of the area. In hindsight, the team could have included additional areas in the transect walk.

In order to obtain information on the distribution, movement, and size of the local human population, the team interviewed a number of individuals, including the school master and the health worker. In addition, a local artist was introduced to us and we were able to persuade him to draw maps of both the communities and the surrounding landscapes. These maps became an important tool to encourage the active participation of other villagers, who provided information to place on the maps.

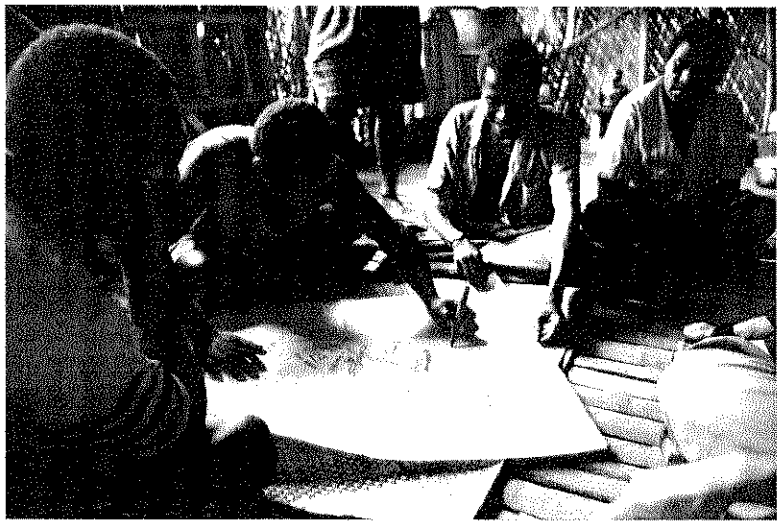

Figure 9-3. Villagers in the Tekadu area of eastern Papua New Guinea work on activities during the PRA conducted by Network members before the PHVA workshop. (Photo courtesy Jenna Borovansky.)

With the aid of these maps, we were able to complete a detailed census of the local population of about 80 households by sex and age. This information became the starting point for the analysis of hunting, population pressure, and human population change. The maps were helpful in defining the areas of hunting; the maps also provided a backdrop to the stories that were later told about hunting in general and the characteristics of the tree kangaroo population in particular. However, the maps were less helpful for determining the size of the area being hunted. If these locally drawn maps had been linked to aerial photographs or other existing maps, we may have been able to determine more accurately the nature of hunting pressure, the abundance of animals, the presence of mining or logging in adjacent areas, and to better estimate the population of tree kangaroos.

The discussions around hunting started with the maps. A "paired ranking" technique was used to determined the names and relative abundance of the mammals in the hunting area. After the completion of this task, the group relaxed and entered a storytelling mode. But it was mostly in the storytelling mode that we found out about how the hunting took place and that only a very few hunters in the village, those with skilled hunting dogs, ever saw or killed tree kangaroos. These discussions proved useful at the workshop in helping guide our estimates and analysis of hunting pressure on tree kangaroos.

We came out of the village with some general information about the population of tree kangaroos in the Lakekamu Basin area. We had no evidence that there had been a significant decline in the tree kangaroo population during the previous two decades. We learned that the village's population had increased slowly over the decades, but guessed that hunting pressure on the tree kangaroos may not have risen because a smaller proportion of men in the village were now hunting. Fifty years ago, all the men of the village reportedly hunted, now fewer than half did. Firearms were not widely used and it seemed likely that the traditional hunting (with bows and arrows) still in use in Tekadu did not yet pose an immediate threat to the future of the tree kangaroos in that area. On the other hand, it was clear from discussions with some villagers that if roads opened up and large-scale logging occurred, or if human population growth continued, a situation common in areas closer to the coast, the impact of these activities could have a disastrous effect on local populations of tree kangaroos.

Workshop Dynamics: Content and Process

The workshop itself was held at the University of Technology (Unitech), Lae. Forty-five people attended the workshop. Participants from PNG, Australia, and the United States, including specialists in population biology, captive management, reproduction, veterinary medicine, and human demographics, compiled and analyzed both published and unpublished information on all six tree kangaroo species of PNG. Thirteen local landowners, representing several regions of PNG where tree kangaroos are found, participated in the workshop. While the PHVA focused largely on the Matschie's tree kangaroo, this workshop was unique among the Network cases in that a general conservation assessment was done concurrently for all of PNG's tree kangaroo species.

The workshop began with formal introductions and background presentations about the modeling process and tree kangaroo biology. In the afternoon, the floor was given to a hunter from the Huon Peninsula, who brought out a plastic sack containing samples of food plants that provided the preferred diet for the tree kangaroo. This presentation immediately sparked a discussion among the landowners about the similarities and differences between plants in their areas, and also sparked a barrage of photo-taking by the foreign participants (figure 9-4). This watershed event appeared to "break the ice" and changed the tone to a more accessible discussion of issues surrounding the tree kangaroo. It appeared that having "one of their own" take center stage helped to empower the landowners and to encourage them to participate more actively in the workshop process.

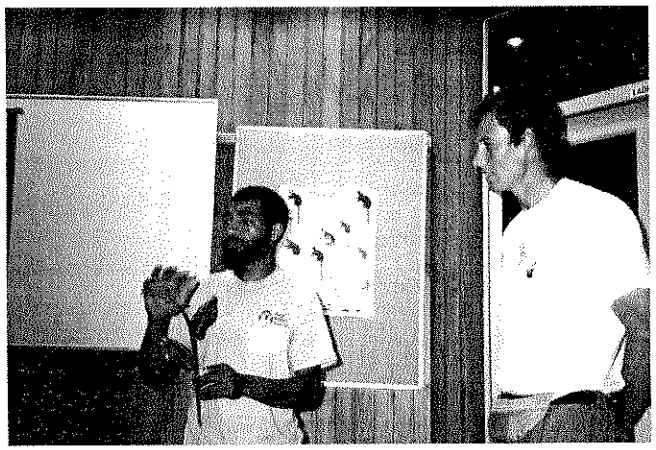

Figure 9-4. A landowner (left) and American field researcher (right) present information on tree kangaroo ecology to workshop participants, tree kangaroo PHVA workshop, PNG. (Photo courtesy P. Miller.)

Following the introductory presentations came an issue-generation session that set the stage for collaboration on all issues raised by stakeholder groups. This straightforward, grounding exercise identified the interests of each stakeholder group. The groups were self-identified as landowners, captive managers, and biological and social scientists. The issues highlighted during this exercise served as a reference point to ensure consideration of all stakeholder groups' concerns throughout the workshop. After this initial issue-generation session, participants self-selected into mixed-stakeholder, topic-based working groups, including life history and modeling, government and legislation, and socioeconomic issues. Plenary consensus sessions each day served two critical purposes: to help keep all issues at an equal level and to assure that responsibility for management and policy recommendations was taken by all participants.

Landowner Participation

Thirteen landowners came from communities located across the country and spoke different languages, so they communicated with each other and with other workshop participants using Pidgin. Three workshop participants who could speak Pidgin and English served as translators.

The landowners provided a significant amount of information that became a valuable part of the workshop process. For example, considerable information about the distribution and life history of tree kangaroos was obtained from those with hunting experience. Without the landowners present, much of the information available during the workshop would have been limited to a relative handful of publications and one researcher's preliminary field information. The landowners also expressed a number of unique concerns and issues that may have not otherwise arisen (see box 9-2). For example, they expressed concern that many of their fellow villagers were not following existing wildlife regulations.

Throughout the meeting, landowners also helped to suggest specific methods for carrying out recommendations at the village level. By actively taking part in the workshop, the landowners could return to their villages and share information and recommendations with a wider audience, expanding the benefits of their participation during the actual workshop. Formally, the landowners only represented themselves as individuals, but indirectly they represented the concerns and issues of their communities.

On the final day, the landowner stakeholder group reconvened to evaluate the progress of each working group in relation to the needs their

Box 9-2.

Landowner stakeholder group issues generated at the workshop. (Source: Bonaccorso et al. 1999.)

The goal of this issue-generation exercise was to define the concerns and needs of each group member. All group recording and discussion was done in Pidgin; what follows is an English translation.

- Many habitats of the tree kangaroo are vanishing (due to mining, logging, oil palm).
- People go against the Wildlife Management Area regulations for the tree kangaroo and other animals; they want to hunt as much as possible; landowners don't have enforcement power.
- There is not enough information and experience for experts to teach locals and those responsible for looking after tree kangaroos in the wild and in zoos.
- The population of tree kangaroos is going down.
- There is additional hunting pressure from immigrants and increasing human populations (e.g., from Wau—people coming in to mine).
- New technology is being used to hunt (e.g., guns).
- (As a landowner who hunts tree kangaroos, he has hunted with dogs now and in the past,) he doesn't know how many tree kangaroos are in his bush.
- Landowners have information about the tree kangaroo (e.g., what tree kangaroos eat, where they are, when they breed) to share and haven't been given the opportunity to share.
- There is little time to think about conservation because of other social needs (health, transportation, education).

stakeholder group had expressed on Day 1. The group met for nearly an hour and then a plenary session was held during which all groups presented their conclusions. It was a tense moment. The landowners were asked if they were pleased with the progress of the workshop. There was silence. They were asked again and still silence. It was made clear to us that we could not end the workshop unless the landowners expressed their opinion to us all. Finally, one landowner stood up and spoke passionately for quite a long time. The non-Pidgin speakers held our breath wondering what was being said. In the end, it was translated that the landowners were very pleased with the workshop results and by the attention being paid to their wildlife. All the landowners began clapping and the Network team almost passed out from the relief!

There was one other tense moment in this plenary session when one of the landowners said that they were wasting their time talking to DEC because the government would not help them. The DEC representative responded saying that he knew that everyone was angry but that landowners do not understand that DEC wants to help but cannot due to lack of funds. Participants were reminded that on the first day of this workshop they had all agreed to a set of guidelines including that they assume good intent on the part of all participants. Everyone confirmed that they had made that agreement and then each stakeholder group was asked directly, beginning with DEC, if they were willing to work in good faith to realize the implementation of the workshop recommendations. They publicly agreed to do so and, from that moment on, DEC representatives were much more engaged and animated. It was a shame that this conflict was not aired on the first rather than the last day, but it was a significant incident and another turning point that was extremely rewarding.

The workshop highlight was the input and level of participation of the local landowners. We were told repeatedly that the local landowners had never before had the opportunity to voice their concerns and have them addressed in this type of forum. (In fact, the PNG Conservation Needs Assessment conducted in 1993 was reportedly picketed by landowners who were angry at being excluded from the process.) We learned an incredible amount from the landowners and they told us that the level of commitment and assistance shown by the international conservation community during the workshop pleased them.

Workshop Recommendations and Conclusions

The inclusion of both the landowners and a Network team specifically contributing data on the human dimension of species conservation had several impacts on the workshop process. The field research team had gained a basic understanding of how a village worked, the institutions present, general household livelihood strategies, and how resources were used in one area. In particular, the team was able to determine the proportion of households that hunt, when they hunt, and what they hunt, estimating how many tree kangaroos households hunt and the relative importance of these animals to the hunters.

Several tools were used during the workshop to better incorporate information from the landowners, the team's field activities, and additional threat information that surfaced during the workshop. Box 9-3 outlines these tools, which included several mapping exercises, the population projection program DemProj (Stover and Kirmeyer 1997), and discussions with Geographic Information Systems (GIS) specialists at Unitech in Lae to gather habitat and other spatial data about Matschie's tree kangaroo habitat.

Box 9-3.
Interdisciplinary tools used at the workshop to incorporate local knowledge into the population model.

Human population projections: Data from the 1980 PNG census were collected from the Unitech library to augment data collected during our village trip. These data were analyzed with the computer program DEMPROJ (Stover and Kirmeyer 1997) to develop a thirty-year projection of the population in that area. A second set of projections was made using data from the Huon Peninsula, home of the Matschie's tree kangaroo. These data were obtained indirectly from a GIS database at Unitech.

Tree kangaroo extraction rate estimates: Based on interviews with two landowners and a field biologist from the Huon Peninsula, and on additional information from our field activities, crude estimates were made of tree kangaroo hunting rates for the Huon Peninsula.

Habitat quality and area estimates: Information about land use and hunting pressure from interviews, published data, and Unitech's GIS database were used to estimate total habitat area for the Matschie's tree kangaroo.

Catastrophe estimates: Interviews with landowners and government officials at the workshop were conducted to estimate potential natural and human-made catastrophic events that could significantly affect the Matschie's tree kangaroo. These included the prevalence of major drought and flood events and the likelihood of major deforestation by logging.

VORTEX modeling: Relevant data gathered before and during the workshop were shared with the population biology modeling group and integrated into the VORTEX modeling activities.

Several constraints limited the team's ability to incorporate some of this information into the larger workshop process generally and into the VORTEX simulation models specifically. The field data were not from the Huon Peninsula, the home of the Matschie's tree kangaroo. The team had some qualitative information but limited numerical data due to a lack of access to maps and quality population data; and we were concerned about applying information from Tekadu to the Huon Peninsula. Finally, the ability to share information among groups during the workshop did not work as well as was expected because there was limited communication among working groups.

Nevertheless, several specific benefits came out of the Network team's participation and suggest how the pre-workshop activities were able to provide unique data for the actual workshop. The following examples

describe how we were able to ask qualitative questions in the field and translate them into quantitative applications within the workshop. These in turn resulted in specific and significant conservation recommendations.

How Important Is Hunting to Livelihood Strategies?

To answer this question, a map of the villages was drawn and knowledgeable villagers were asked to identify houses and the primary livelihood strategy of people living in those houses. We found that most villagers in this area have a garden where they plant a range of annual and perennial crops. Fishing is the most important activity, but hunting is a principal household strategy for almost one-third of the houses in four villages (table 9-2).

Table 9-2.
Principal household livelihood strategies in PNG by village.

	Number of Households				
Village	Hunt	Fish	Goldpan	Other	Total
One Mile	4	6	6	0	16
Yenuwe	4	9	8	1	22
Korama	8	11	4	3	26
Piarogamango	3	4	3	0	10
Total	19	30	21	4	74

What Is the Estimated Human Population Size and Expected Population Growth Rate?

To answer this question, we summarized the number of people per household, their approximate age, sex, and marital status. Population projections were made based on past census data, estimates and projections of mortality and fertility, and anecdotal evidence with regard to patterns of migration. Using the demographic software package DEMPROJ, the population of the Tekadu area was projected over the next two decades. The projection showed that the population was expected to increase approximately 100 percent, from 320 to 614 people. Over recent years, the proportion of villagers who actively hunt has declined.

The population projections for the Huon Peninsula showed that the population was growing faster, that the area was less sparsely populated, and that there could be significant increases in human pressure on the Matschie's tree kangaroo over a twenty-year time horizon.

What Do Villagers Hunt?

During the field research, village elders and other recognized "expert hunters" were asked to summarize the principal mammal species they hunted. This list of animals was then ordered using a paired ranking technique whereby each species was compared to every other species and the more commonly hunted was given a mark. In total, villagers identified more than forty different mammal species that they commonly hunted, from those living in the treetops to ground-dwelling animals. Information regarding the relative number hunted and locations of species by altitude was described. (Had the team been more familiar with PNG species, the descriptions of where tree kangaroos were found and their numbers relative to other mammals could have been used to determine population information and habitat ranges.) Little information was available to the team to cross-reference the villagers' knowledge. Additional information was collected to summarize the total number and species of tree kangaroos that selected hunters had killed over the years.

How Much Do Villagers Hunt and What Is the Impact on Tree Kangaroos?

To derive the estimated number of tree kangaroos killed by hunters throughout the Huon Peninsula, the team began by talking to one of the landowners from that area over several hours one evening at the PHVA to determine how many tree kangaroos he had killed or captured, the size of the area from which these were obtained, and the time it took him to kill them.

First, we found that he had killed a total of seventeen tree kangaroos (ten males and seven females) in a six- to seven-year period. Two were juveniles (one male, one female). Nine of these were taken from his land and the remaining eight were taken from other people's land in the immediate area. These data are summarized in box 9-4.

Second, to derive an estimate of the number of households in his area that hunt, the team asked him to describe all the households in his village (a total of forty-one) and then the number that hunt (eleven). He described four hunters as "serious hunters" and seven as not serious hunters. He described himself as a serious hunter and, in fact, probably one of the best. This information was used to estimate that approximately 25 percent of the village population hunts. This was a similar estimate derived from detailed household data from four different villages in the Tekadu area, gathered by the same team. Moreover, based on this study of four villages

Box 9-4.

Example of translation of local information from landowner interviews into VORTEX input data for the hunting of Matschie's tree kangaroos around villages in the Huon Peninsula.

Expert Hunter's Tree Kangaroo Harvest

Extraction Type	Male	Female	TOTAL
Killed on his land	5	1	6
Killed on other's land	4	2	6
Captured on his land	1	2	3
Captured on other's land	0	2	2
TOTAL	10	7	17

Village Hunting Information

Total households	41
Serious hunters (estimated 2 tree kangaroos/year)	4
Less-serious hunters (estimated 0.5 tree kangaroos/year)	7
Proportion of hunters	11

Data Summary

N	= Total population size living at > 1,800 m
Villages near suitable habitat	= 0.5 (estimated that ½ villages suitable)
Households per person	= 0.2 (estimated 5 people/household)
Hunters per household	= 0.25 (proportion that are hunters)
Hunting rate high	= 1 tree kangaroo/hunter/year
Hunting rate low	= 0.5 tree kangaroo/hunter/year

Formula for VORTEX Input

High extraction rate	= [N] x [Suitable Villages] x [Households] x [Hunters] x [Rate]
	= [N] x [0.5] x [0.2] x [0.25] x [1]
	= [N] x 0.025
Low extraction rate	= [N] x [0.5] x [0.2] x [0.25] x [0.5]
	= [N] x 0.0125

in the Tekadu area, the team concluded that the average household size was about five people. This estimate was applied to the Huon area.

Third, assuming that the four serious hunters mentioned above killed tree kangaroos at a similar rate as the landowner being interviewed (2 per year), and the less-serious hunters killed only a quarter as many (0.5 per year), we estimated an average of 1 tree kangaroo killed per hunter per year (box 9-4).

Fourth, the team obtained from both landowners and a researcher with considerable field experience an estimate of how many villages in their area had forest cover that was suitable for tree kangaroos. Out of the seven villages listed, three probably had no tree kangaroos in the forests surrounding them, three had adequate forest, and one had excellent habitat.

When similar questions were posed to a second landowner, he estimated that eight of twenty-one villages in his area were "close to bush." The team used these figures to estimate that roughly half of the villages in the peninsula could be expected to have tree kangaroos in the surrounding forest habitat.

With the above information and estimates in hand, the team began deriving a way to estimate the rate of extraction of tree kangaroos from a particular habitat segment. For the Matschie's tree kangaroo, we assumed that only those villages situated above about 1,800 meters would be in or near suitable hunting habitat. Therefore, if the total human population in such an area is known, the total number of hunters within that population can be calculated and, assuming a particular annual rate of tree kangaroo extraction per hunter, the total number of animals removed can be estimated. For example, if the total human population in the region of interest is 10,000, the annual number of tree kangaroos extracted from a particular population would be between 125 and 250 per year.

Obviously, a critical piece of information required for this analysis is the total human population size in the region of interest (N). Unfortunately, we were unable to gather this information during the workshop. As a result, we were forced to make a more simple set of assumptions concerning the total rate of extraction of tree kangaroos from a given area. However, the discussion presented above provides a set of guidelines that can serve as a starting point for extended analyses on the severity of hunting pressures on wild tree kangaroo populations throughout New Guinea.

To evaluate the effect of hunting on tree kangaroo populations, we assumed that adult females were preferentially removed from the population, primarily because they are slower when they are with joeys (offspring) and therefore easier to catch. In addition, when a female is caught the joey that is with her is also removed from the population (i.e., either eaten or kept or sold as a pet). We assumed that the joeys were male or female with equal probability. Finally, we assumed that hunting resulted in an additional 2 percent mortality among adult females. Therefore, if the baseline adult female mortality rate is 8 percent in a nonhunting scenario, this rate becomes 10 percent when hunting is added to the model. Once again, this estimate of additional hunting-based mortality is largely based on educated guesswork; the primary piece of data required for a more precise estimate of hunting mortality—total tree kangaroo population size within a given forest patch—was not available. Given the total land area available within individual patches and very crude preliminary estimates of tree

kangaroo population densities, we surmised that a hunting rate of 2 percent among local villagers was a reasonable estimate. We realized, however, that this estimate could easily be in error by a factor of two to five times.

The models developed from this information demonstrated that current hunting rates could indeed be a major force influencing the future viability of tree kangaroo populations in PNG, particularly when those populations are quite small (figure 9-5). In addition, workshop participants were able to observe the serious demographic consequences of preferential hunting of adult females over males in this polygynous species, an unexpected result for those engaged in hunting throughout the country. Despite our interest in developing increasingly insightful models of wildlife population viability, it is important to remember that neither sophisticated demographic models nor comprehensive field data are always necessary to generate insights vital to the conservation decision-making process.

Other Conservation Recommendations

Additional focus was directed towards the country's most critically endangered population: the tenkile, or Scott's tree kangaroo. This species is reduced to as few as 50–100 individuals in a single locale within the Torricelli Mountains in the Lumi District of northwestern PNG. The precipitous rate of recent population decline and, more importantly, the serious risk of imminent extinction, as revealed by the data collection and population modeling efforts, were instrumental in the immediate formation of a multidisciplinary "rapid-response team" at the workshop. This new team (Team Tenkile) was composed of representatives from zoo and wildlife management organizations in PNG and Australia and was tasked with traveling to the Torricellis in order to update the conservation status of this rare taxon (see Aftermath of the Workshop, below).

Network Learnings

In our postworkshop assessment, several key process elements were apparent. A significant challenge faced by the Network team was the relatively limited time available to prepare for the trip, the limited amount of data available before and during the trip, and the limited knowledge the team had of PNG and tree kangaroo biology. Team members cumulatively had experiences carrying out similar activities in several countries, but were hampered somewhat by the lack of experience in this very unique country. On the positive side, the different backgrounds and

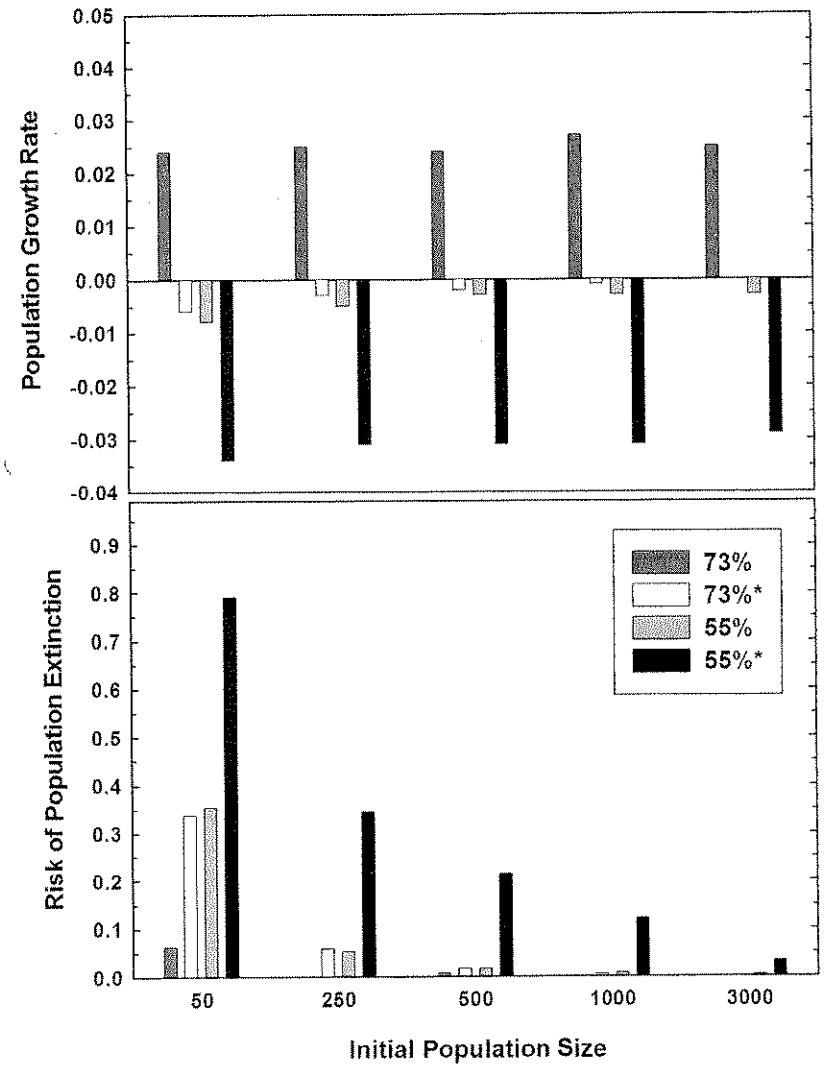

Figure 9-5. Results from simulation modeling conducted at the tree kangaroo PHVA workshop. Stochastic population growth rate (top) and probability of extinction (bottom) for simulated PNG tree kangaroo populations under alternative levels of female breeding success (73% or 55% adults breeding in a given year) and additional mortality of adult females and juveniles of both sexes resulting from hunting by local human populations (designated by * in the legend).
(Source: Bonaccorso et al. 1999.)

perspectives of the team members strengthened the overall effectiveness of the team.

The most significant constraints were the difficulty of coordinating and planning our activities with counterparts in PNG, our limited access to data and maps, and our reliance on external factors (e.g., availability of a guide and transportation) that drove our choice of location.

In comparing the PNG experience with the earlier mountain gorilla and muriqui workshop experiments (chapters 6 and 7), several common comments and suggestions were identified (table 9-3): a need for more lead time and preparation; a need for more nonbiologists with a stake in the animal to be present at the meeting; discussions about the need for and utility of having separate human impact groups, modelers, or facilitators; and the difficulty of translating human impact information into VORTEX.

In any endeavor such as this, two overriding concerns are whether the cost and time necessary to carry out field research prior to a workshop are balanced by the value added to the workshop process. On one hand, this exercise provides the opportunity to better understand the situation at the village level and to gather information and insight that might otherwise be unavailable, especially if villagers are not present at the workshop. On the other hand, the activity takes time and money and there is a risk in placing significant weight on data gathered rapidly by people with limited experience in the host country.

The inclusion of social issues into the workshops requires a considerable degree of planning and preparation, which requires time and commitment from both CBSG and from the workshop organizers. This planning should begin at the outset and take into consideration the following questions:

1. Which are the communities that have the greatest impact on the species?
2. How may stakeholders living in these communities should be represented at the workshop?
3. Should field work be done in these villages prior to the workshop, and how should that be supported?
4. Who will gather analysis of human population, hunting and other local practices, GIS information, and bring that to the workshop? (These data could include census data, health and mortality data, GIS maps, and information on extraction activities such as mining, timber, and hunting.)

Table 9-3.
Comparison of the workshop process experience with Network involvement in Uganda, Brazil, and PNG.

	Workshop Location and Species		
Network Experience	Uganda (Mountain Gorilla)	Brazil (Muriqui)	PNG (Tree Kangaroo)
Human demographic data	Available, difficult to translate into impacts or to integrate with VORTEX	Available, but numbers alone not a major impact on muriqui	Country-level and some local data available, projections made
Expanded stakeholder groups	Few nonbiologist experts, lack of understanding about role of nonbiologists	Lack of experienced nonbiologists and few social scientists	Excellent local landowner participation, little additional nonbiological participation
Role of Network	Difficulty in facilitating due to lack of expertise, need for dedicated human process modeler	Limited value of Network participation due to language differences and small groups, need for dedicated project leader?	Little information shared with population biology group, some value to landowner participation, need for dedicated project leader
Preparation	Lack of lead time to prepare and include human dimension focus	Lack of lead time, need for planning checklist	Lack of lead time, better development and incorporation of planning checklist
Problems	Lack of exchange of information with biology group, disaffection of human impact group members	People and data available, but need longer lead time and broader stakeholder involvement	Field visit to "wrong" location, lack of maps or good biological information
Human dimension information for VORTEX	Limited quantitative human dimension information	Some habitat and species-specific quantitative data	Limited quantitative human dimension data, some hunting data

5. What social scientists might be brought to the workshop: anthropologists, demographers, economists, community development specialists?

While PNG is unique in having most of its land area owned by the people (family groups and clans) and not the government, the successful inclusion of local stakeholders at this workshop seems to lend support for efforts to include similar people at future workshops, especially when little research has been previously completed on the target species. Further expanding the number and experience of participants would probably have enabled us to gather more threat information. For example, we had little expertise regarding logging and mining, two serious threats to tree kangaroo habitat in PNG.

Aftermath of the Workshop

One criticism of the PHVA workshop process, and others like it, is that these meetings often have little tangible, lasting, and measurable impact. In PNG, however, several important products came directly from the workshop. Several recommendations were implemented during the workshop itself, including the development and translation into Pidgin of educational materials specifically requested by the landowners. In addition, a rapid-response team was formed at the request of landowners to address the urgent need for conservation action directed toward the critically endangered Scott's tree kangaroo. This team committed to visit Lumi District, Sandaun Province within thirty days following the workshop.

As a result, Team Tenkile was formed (an interdisciplinary, multinational recovery team initiated at the workshop that has since evolved into an incorporated NGO called the Tenkile Conservation Alliance) and traveled to the Torricelli Mountains in Lumi. This initial visit resulted in a two-year moratorium on hunting tenkiles that was signed by thirteen villages. Plans were also developed to establish a Tenkile Field Station and project based at Lumi Station; the captive breeding and rerelease of tenkile, provided specimens are not removed from the Lumi area; and a community-formed management committee. The Tenkile Conservation Alliance logo will be used on letterhead, T-shirts, and promotional materials, which will help communities identify with the conservation work they are doing in partnership with the Alliance.

In addition, a draft species recovery plan was published in March 2000 (Vincent, Slater, and Clark 2000), and efforts are underway to accomplish some of the tasks identified in the recovery plan. Work is beginning on the

production of a community education booklet, funds are being generated, and Taronga Zoo in Australia is working with a major supplier of rice to PNG on a set of collectable tree kangaroo information cards that will go in the bags of rice.

Conclusions

The tree kangaroo workshop in PNG was the third workshop to explicitly address the Network's efforts to incorporate the human dimension into the PHVA workshop process. This workshop was unique because a team of three Network representatives traveled to a village area before the workshop and a significant number of workshop participants were local landowners.

Meetings were held in Minneapolis and Montreal before the trip to discuss goals, objectives, and integration of human dimension data with VORTEX. In PNG, the team gathered qualitative and quantitative information about village demography, institutions, healthcare, agriculture, tenure, household strategies, specific information about the hunting of tree kangaroos, and other biological and nonbiological information from the Tekadu area in southern Morobe Province.

At the workshop, some information from the field was shared with the population biology modeling working group and other information was used in the social issues and education working group. Constraints faced by the Network team included limited information from the Huon Peninsula, home of the Matschie's tree kangaroo; limited quantitative nonbiological data that could be translated into VORTEX; and limited communication among different working groups. Landowner participation was strong at the meeting and the inclusion of local knowledge and concerns were an integral part of the workshop.

The value of involving local landowners included but was not limited to their significant knowledge about tree kangaroos and their ability to raise unique concerns, questions, and recommendations. This experience contradicts the assumption by workshop participants at the Uganda mountain gorilla workshop that the "sophistication" does not exist at the local level to participate in a science-based workshop (see chapter 6). The tree kangaroo PHVA workshop highlighted the robustness of the PHVA process in its ability to absorb and incorporate local knowledge. This exercise illustrated the value of including local representatives who are knowledgeable, understand the goals and objectives of the exercise, and can communicate their perceptions and those of their constituents.

Chapter 10

Uneasy Guests: The Grizzly Bear PHVA in the Central Canadian Rockies[1]

EMMANUEL RAUFFLET, HARRIE VREDENBURG, AND PHILIP S. MILLER

The Network viewed the grizzly bear Population and Habitat Viability Assessment (PHVA) workshop as an excellent possibility to examine the conditions for involving larger stakeholder groups, particularly industry, and for integrating human-related and biological data. Favorable conditions for larger stakeholder participation included the involvement of two Network members and existing links with a local organization already working on grizzly bear conservation in the Canadian Rocky Mountains: the Eastern Slopes Grizzly Bear Project (ESGBP). Headed by bear biologist Steve Herrero of the University of Calgary, the ESGBP had already created an arena around grizzly bear conservation in the Central Rockies Ecosystem. In addition, scientific studies indicated a strong correlation between human access to range territory and grizzly bear mortality. The intent of this workshop was therefore to focus on the VORTEX model in order to integrate habitat and bear biology data with regional human socioeconomic activities.

In this chapter, we reflect on preparations for and events during the workshop, the lessons we learned, and the aftermath of grizzly conservation eighteen months after the workshop. The chapter is organized into six main sections: the regional context and main challenges for grizzly conservation; the preparation for the workshop, including the Network's expectations; what actually happened at the workshop; workshop recommendations; our learnings; and the aftermath of the workshop.

Context of Grizzly Bear Conservation

Alberta, Canada, is thought to have hosted about 6,000 grizzly bears *(Ursus arctos)* nearly three centuries ago; the current census estimates