CASE STUDY 17.2

Elephant Conservation in Sri Lanka

Integrating Scientific Information to Guide Policy

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On the island of Sri Lanka scientists are trying to make information from their studies of elephant biology available to policymakers, managers, and the community. Changing existing policies to make use of new science is always challenging, and the conservation scientists must be both advocates for science and messengers to the larger community. In many cases, creating productive partnerships with community groups most affected by any conservation plan is critical. In the case of Asian elephants (Figure A), no meaningful conservation can take place unless surrounding human communities are supportive.

The Asian elephant's (*Elephas maximus*) range has decreased to approximately 15% of its extent of 2–3 millennia ago (Olivier 1978; Sukumar 1989), and it is listed as endangered on the IUCN Red List (IUCN 2004). Habitat loss from conversion of natural landscapes to human-dominated ones that exclude elephants is the underlying cause. But proximal threats include capture for domestication, hunting for ivory, and conflict with people.

Elephants are "edge species" preferring the ecotone between forest and disturbed habitat, as long as there is sufficient freshwater. Asian elephants prefer to feed on pioneer species that colonize gaps in the vegetation and are common in secondary forests. Sri Lanka has no perennial, natural, lentic systems. Consequently, during prehistoric times, water resources available for elephants were limited to the rivers that radiate out from the central highlands. Prior to the fifth century B.C., the total elephant population in Sri Lanka was likely less than 5000 individuals, as Australoid hunter-gatherers did not disturb primary forests (Fernando 2000). However, Sri Lanka was colonized by people of Indian origin in the fifth century B.C., and the subsequent rise of their culture had a huge impact on land use patterns and elephants. Countless numbers of freshwater reservoirs were constructed by damming and diverting rivers, and primary forest in the dry zone was converted to irrigated agriculture. Elephants were used extensively in cultural events, wars, and as work animals (Jayewardene 1994). Thus, agricultural land use excluded elephants from the centers of civilization, and large-scale domestication depleted elephant populations in surrounding areas. Consequently, this ancient civilization drastically reduced the numbers of free-ranging elephants to about 2000 animals, mostly restricted to refugia (Fernando 2000).

After the decline of this civilization in the fifteenth century A.D., secondary forests regrew and thousands of freshwater bodies dotted the landscape. Sri Lanka's dry zone was transformed into enriched elephant habitat, which set the stage for a massive resurgence of elephant populations. Elephant numbers in the dry zone shot up to about 8000 animals (Fernando 2000). Concurrently, the country came under colonial rule, and the wet zone was intensively settled and cleared for cash crops. Elephants were hunted and practically eliminated from this area. During the colonial era, the dry zone was thinly populated by people practicing shifting cultivation. Slash-and-burn agriculture creates and maintains secondary growth, and together with the innumerable fresh water bodies, the dry zone of the country thus remained optimal elephant habitat for over 500 years.

Figure A An Asian elephant (*Elephas maximus*). (Photograph by P. Fernando.)

Sri Lanka's post-colonial drive to develop the dry zone led to large areas of elephant habitat being destroyed for development by irrigated agriculture. However, in contrast to the ancient civilization and colonial era, the present-day approach toward elephants is more conservation minded. The environmental atti-

tudes of the twentieth century, as well as awareness of the threatened status of Asian elephants, led to a national desire to conserve the elephants that inhabited rapidly expanding agriculture areas. Because agricultural development and elephant presence are mutually incompatible (Figure B), mitigating the ensuing human–elephant conflict became the main focus of elephant conservation and management.

Challenges Arising from Early Conservation Efforts

Conservation policy focused on using and expanding existing protected areas to prevent total elimination of elephant habitat, and to reduce conflict with farmers. Elephants were translocated from areas slated for agriculture into protected areas. Further, an attempt was made to confine elephants to protected areas by constructing electric fences on the boundaries. But translocation did not eliminate elephants from human habitats, and electric fencing did not restrict them to protected areas, and so this strategy failed to eliminate human–elephant conflict (Fernando 1993; Rudran et al. 1993; Jayewardene 1994, 1996). Worse, the translocation effort, while well intentioned, did not consider one key point: Translocation of elephants into protected areas endangers those already there (Fernando 1997). Elephant populations had inhabited these "protected areas" for centuries prior to their designation, and these populations were already at well-established carrying capacity. Introducing new animals creates competition for resources, which can destabilize elephant population structure.

Elephants in Sri Lanka do not migrate and have well-defined home ranges that are around 100 km^2 in extent (Fernando 1998; Weerakoon 1999; Fernando and Lande 2000). Genetic studies have shown that these patterns are not of recent origin, but have been preserved for thousands of years (Fernando et al. 2000). Elephants that range entirely inside protected areas have an excellent conservation future as they do not come into conflict with humans, and hence should be considered key populations for conservation of the species in Sri Lanka. However, translocating large numbers of elephants into protected areas, where resources are limited, endangers these key populations that otherwise had good conservation prospects (Fernando 1997).

Compounding the detriment of translocations into protection areas, management of these sites was decreasing the effectiveness of elephant conservation. Most areas designated as protected areas within elephant range were part of the slash-and-burn agricultural cycle. Slash-and-burn agriculture is generally viewed as a destructive method at odds with conservation (Abeywickrama et al. 1991). However, in the lowland dry zone of Sri Lanka, traditional slash-and-burn agriculture is an intermediate disturbance regime. In its traditional practice, a plot is cultivated for two to three successive years, and then left fallow for five to ten years. Studies of elephant habitat use have shown that traditional slash-and-burn cultivation leads to a mosaic of successional stages that is ideal for elephants,

Figure B In an effort to keep elephants out of crop fields, farmers use tactics such as this nail trap, which is intended for the elephant to step on and become lame. (Photograph © Vivek Menon/naturepl.com.)

supporting high elephant densities. However, agricultural methods such as irrigation, mechanized plowing, and use of fertilizer and herbicides enables permanent intensive cultivation of these areas. This manner of land use creates bare land that elephants cannot use. Unfortunately, as modern agriculture made large areas entirely unsuitable for elephants, the protected areas meant to support them declined in quality because people practicing slash-and-burn agriculture were excluded from newly designated protected areas. The "hands off" management regime resulted in a secondary climax of mature scrub habitat where elephants can find little fodder (Mueller-Dombois 1971). Thus, the protected areas meant to support and protect additional elephants displaced by agricultural development began changing into suboptimal elephant habitat.

Currently, more than two-thirds of elephant habitat in Sri Lanka is outside protected areas. With a human population growth rate of over 750 people per day in Sri Lanka, there can be little doubt that more and more elephant range will be developed for human use. Given the need to accommodate elephants displaced by development and the importance of not jeopardizing existing elephant populations, or other species in protected areas, an alternative approach to conservation and management is essential for the long-term survival of elephants in Sri Lanka.

Directions for the Future

The conservation and management of elephants face challenges that are scientific, practical, and cultural. All of these will need to be integrated into an overall strategy. From a purely management point of view, the ideal approach would be to eliminate elephants that are in areas developed for human use by culling or capture for domestication, and to manage the habitat in selected areas to increase their carrying capacities, so as to maintain a viable population size. Even though the con-

tinued killing of elephants by farmers in poorly planned development and settlement projects in elephant habitat amounts to culling, for socio-cultural and political reasons, officially culling elephants as a management policy is unacceptable in Sri Lanka. Similarly, given the environmental attitudes and the endangered status of Asian elephants, large-scale capture for domestication is also unacceptable. Therefore, a way of accommodating elephants displaced by development has to be devised.

Because the elephant is an edge species, habitat management for them is not difficult. Elephants can survive and be managed at high densities provided there is sufficient availability of fodder and water. Based on their research on elephant habits and needs, conservation scientists have suggested that traditional slash-and-burn agriculture be used to create better elephant habitat, and be incorporated into a holistic management approach. This approach envisions management of some present day elephant habitat outside protected areas as "elephant ranges," by regulating the practice of slash-and-burn agriculture. But because of elephant feeding preferences and the need for pioneer species, regulation needs to ensure that a suitable cycling regime for the creation of an optimal combination of successional stages of vegetation is adhered to, and inappropriate methods of cultivation are prevented. This form of management is more likely to be suitable for habitat contiguous with protected areas and large areas of land outside protected areas. Such a management regime is more in line with current approaches to conservation, as it takes into account human requirements and is conducted with the participation of local communities.

Thus, a successful elephant management strategy for the future should consist of land-use planning that recognizes and delineates the landscape into three zones: "human habitat," from which elephants are excluded; "managed elephant range," where habitat management is conducted through appropriate land-use management practices, enabling high elephant densities; and "protected areas," where no specific habitat management for elephants is conducted, but where elephants would exist at lower densities. Managed elephant range and protected areas would be contiguous and elephant barriers would be constructed on the ecological boundaries between "human habitat" and "elephant ranges" would help keep elephants out of high production agricultural areas.

Translocation of elephants from areas opened up for development into areas managed for them would enable the mitigation of human–elephant conflict, and would not jeopardize the future of elephants in protected areas; hence it would address the main shortcomings of the current strategy. In contrast to the present practice of translocation into protected areas, translocation into areas managed for elephants would be effective, as the managed habitat would support a larger number of elephants than were present prior to the translocation. However, the conservation scientists recommend that such management interventions be carried out with pre- and post-translocation monitoring of translocated animals as well as those already in the managed areas. This will enable detection of any unforseen detrimental effects and their appropriate management.

Supporting activities will also need to play an important role in such a management strategy. Managing "elephant ranges" by allowing regulated slash-and-burn agriculture will cause some level of crop depredation by elephants. Even if barriers are sited solely on ecological boundaries occasional breaches will still occur. Therefore activities such as compensation or insurance schemes may need to be streamlined to make them more efficient and acceptable to farmers. Community organization for crop protection can be developed and instituted. Although rural residents are conservation-minded generally, and over 78% support elephant conservation, many express their concern about the costs they bear from elephant damage to their crops (Bandara and Tisdell 2003). Economic compensation would improve local support for elephant conservation measures. A contingent valuation analysis showed that over 93% of urban residents surveyed in Colombo, Sri Lanka's capital, are willing to contribute to elephant conservation efforts, suggesting that a broad national strategy could be successful (Bandara and Tisdell 2004).

Additional forms of income-generating activity related to elephants such as community-based ecotourism can provide local communities with economic incentives that can offset losses from elephants. Elephant populations not subject to off-take by poaching or human–elephant conflict can increase at rates up to 4%–5% annually and can soon exceed what restricted areas can support (Fayrer-Hosken et al. 1997). Therefore, concurrent with habitat management, close monitoring of the health and demography of elephants as well as the effects of elephants on the environment needs to be carried out. To be successful, new efforts must convince local residents that elephant populations can coexist without significant costs to their households.

Making the Science Count in the Adoption of New Strategies

Conservation scientists have been active in bringing their research forward and proposing science-based strategies for elephant conservation. But as with many policymakers, the response to new ideas has been slow and the scientists continually confront the same challenges that all conservation scientists face the world over—integrating scientific information to a system where the decisions are based on social, personal, economic, and cultural factors. It takes time to get the information out to all the players; and it takes effort to present it in useful ways and to get science adopted into policies and on-the-ground action. Elephant management in Sri Lanka continues to be focused mainly on limiting elephants to protected areas by translocation from outside areas. Currently, the conservation scientists are continuing their dialogue with the authorities. But now they are beginning a program to provide wider exposure of the new science and conservation proposals

through the popular press and the media. In addition to working with the Department of Wildlife Conservation, they are also working with different ministries and departments that have an impact on land use management, such as the Forest Department and the irrigation and development authorities. Through working together with the authorities and the people residing in areas with elephants, they hope to develop a management and conservation plan for nonconservation area elephant range that is practical and will benefit both people and elephants.

CASE STUDY 17.3

Management of Spotted Owls

The Interaction of Science, Policy, Politics, and Litigation

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Application of the theoretical and applied principles of population and community ecology in conservation planning is an important step in realizing species protection on the ground. But, political pressures, legal proceedings, and policy decisions can dictate the success or failure of a species management plan. The challenge of conserving the Spotted Owl (*Strix occidentalis)* has epitomized the high-visibility struggle that can ensue when protective legislation restricts uses of natural resources.

The process of developing a scientifically sound conservation strategy that is defensible to political attacks, and is likely to be adopted and implemented, can be the most difficult and least discussed aspect of conservation biology. Many strategies, even those built on a firm foundation of defensible science, will fail if the biologists involved are inept at defending their plan against inevitable criticisms, or are unable to convince decision-makers of the true costs to society of failing to implement conservation actions.

The Northern Spotted Owl

Perhaps more than any other threatened or endangered species, the Northern Spotted Owl (Figure A) has epitomized the struggle between groups representing disparate value systems in a land of limited resources and unlimited demands. The debate has been oversimplified as a choice between employment and economic vitality on the one hand, and the survival of species and ecosystems on the other. This dichotomy provoked lawsuits and intense public and scientific disagreement; and, with rapidly diminishing options in the 1990s, it led the United States Congress and then President Clinton to judge the Spotted Owl–timber harvest situation a conflict requiring resolution at the highest political levels.

A 1989 directive by Congress to four U.S. federal agencies (Fish and Wildlife Service, Forest Service, National Park Service, and Bureau of Land Management) convened the Interagency Spotted Owl Scientific Committee (ISC) to "develop a scientifically credible conservation strategy for the Northern Spotted Owl." As members of the ISC, we struggled to develop a scientific protocol using the rigor of strong inference (that is, hypothesis testing, discussed later), which would allow consideration of both biological and nonbiological factors in the development of a Habitat Conservation Plan. The strategy developed by the ISC and presented to Congress (Thomas et al. 1990) was foundational to the development of the Northwest Forest Plan (FEMAT 1993) and the process, logic, and rationale employed was the basis for all subsequent conservation planning proposals for the subspecies.

Figure A The Northern Spotted Owl (*Strix occidentalis caurina*) is a focal point of conflicts between endangered species preservation and short-term economic interests. (Photograph by D. Johnson.)

Conservation planning for the Northern Spotted Owl has had a long and complex history that reads like the plot of a po-

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