Shifting Cultivation and Biodiversity Conservation in Bhutan

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Shifting cultivation and other utilitarian activities are widely believed to be incompatible with conservation of biological diversity and management of national parks (Kramer et al. 1997; Struhsaker 1998; Terborgh 1999). In the country of Bhutan, a biodiversity hotspot in the eastern Himalayas, over 38% of the land area is protected (Wang 2008). Bhutan began to curtail shifting cultivation throughout the country in 1969 (Bhutan Forestry Act), adopted a total ban in 1995 at the 70th Session of the National Assembly, and had effectively eliminated the practice in protected areas by the late 1990s (Giri 2004). Nevertheless, shifting cultivation was practiced throughout much of Bhutan for centuries, including areas now in national parks (Wangchuk 2005; Kerkhoff & Sharma 2006). We considered relationships between historical anthropogenic disturbances, specifically shifting cultivation, and biological diversity in Jigme Singye Wangchuck National Park (JSWNP), Bhutan.

Shifting cultivation, commonly known by its derogatory name "slash and burn agriculture," has been deemed destructive, wasteful, and wild since the colonial era (Dove 1983). Colonial regimes and modern, independent nation-states have long sought its elimination and replacement with sedentary agriculture and large-scale plantations (Dove 1983). But shifting cultivation is not a single, monolithic practice. Over half a century ago, Conklin (1957) distinguished integral shifting cultivation systems, which are well adapted to social and ecological conditions, from destructive and unsustainable incipient or pioneer practices. Integral shifting cultivation developed over millennia to site-specific environmental and social conditions and reflects a rich and nuanced understanding of local vegetation, soils, and climate (Conklin 1957; Kunstadter et al. 1978). Integral shifting cultivators regulate their practices, including the location and size of parcels as well as the length and species composition of fallows, through customary norms and religious beliefs (Conklin 1957; Schmidt-Vogt 2007). In other words, ecological disturbances created by integral shifting cultivators are controlled, managed, and an ancient practice.

The productivity and sustainability of integral, long-fallow shifting cultivation is well documented (Conklin 1957; Nye & Greenland 1960; Spencer 1966; Kunstadter et al. 1978; Cairn 2007). Researchers studying mountain agriculture in the Eastern Himalayas, including Bhutan, concluded that shifting cultivation is an adaptive forest management practice predicated on sound scientific principles that productively uses hill and mountain lands, conserves forest, soil, and water resources, and is ecologically preferable to alternative agricultural and forestry activities (Kerkhoff & Sharma 2006).

The effect of integral shifting cultivation on biological diversity depends on specific attributes of the disturbance created and the niche, dietary, habitat, and other requirements of individual species. More specifically, the type, size, intensity, duration, frequency, and return interval of shifting cultivation affects and in turn are affected by flora and fauna. Until its prohibition, shifting cultivation was the second-most extensive agricultural practice in Bhutan in terms of land area and the dominant land use in much of the subtropical central and eastern part of the country (Wangchuk 2005; Kerkhoff & Sharma 2006). Shifting cultivation and associated livestock grazing and collecting of forest products were widely practiced and managed throughout much of the area now set aside for the conservation of biological diversity. This prompts the question: how significant were historical anthropogenic disturbances to the development and maintenance of contemporary biological diversity in Bhutan? Or to put it another way, could biological diversity be

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Paper submitted January 29, 2008; revised manuscript accepted March 26, 2008.

Conservation Biology, Volume 22, No. 5, 1349–1351

DOI: 10.1111/j.1523-1739.2008.01019.x

compatible with and possibly even depend on shifting cultivation?

Jigme Singye Wangchuck is a 1723-km^2 national park in south-central Bhutan that ranges from 150 to 5000 m asl and contains a wide diversity of habitats, from subtropical forest to alpine meadows (Wang et al. 2006*a*). The park is of particular conservation interest due to substantial populations of ungulates, such as muntjac (*Muntiacus muntjak*) and sambar (*Cervus unicolor*), and large carnivores, including tigers (*Panthera tigris*) and leopards (*P. pardus*). The park's broadleaved forests are believed to support 10–15% of Bhutan's tiger population (Wang & Macdonald 2006). Broadleaved forests also support indigenous integral shifting cultivators and collectors of forest products, such as the Monpas, who for centuries have lived in, utilized, and managed what is now the Nabji–Korphu core area of the park (Giri 2004). Satellite imagery indicates that over 28% of JSWNP was in shifting cultivation or fallow vegetation in 1989 (Ministry of Agriculture 2002). In 2005 shifting cultivation was estimated to have declined to approximately 6% of the park (Ministry of Agriculture, unpublished) as cultivators abandoned distant fields, intensified cultivation near settlements (i.e., eliminated fallow fields), increased their harvest of wild bamboo and rattan for cash income, and benefited from the development of village-based ecotourism (U.N., personal observation). Farmers in JSWNP report that crop damage (Wang et al. 2006*b*) and livestock predation (Wang & Macdonald 2006) by wildlife pose serious threats to their livelihoods. Twenty-one percent of surveyed households reported losing domestic animals to predators in the previous year (the number of households potentially affected by wildlife total 596 inside the park and 265 in an adjacent park buffer zone; Wang & Macdonald 2006).

Surveys of ungulate and carnivore scat, tracks, observations, and other signs conducted in the Nabji–Korphu core area of JSWNP found evidence of muntjac, sambar, tigers, and leopards in fallowed shifting cultivation fields and communally grazed woodlands and that these species may be more common in disturbed sites than in adjacent closed forest (Namgyel 2007; Wang 2008). This raises an intriguing question. Why would shifting cultivation be compatible with rare ungulates and carnivores?

Shifting cultivation by the Monpas historically involved clearing and burning of secondary vegetation (i.e., fallows), cultivation of maize, rice, millet, wheat, barley, buckwheat, and mustard for 1 or 2 years, followed by a 5- to 6-year fallow period (Giri 2004). These practices create complex vegetation mosaics and maintain more early successional vegetation and edge habitat than occurs in "natural," undisturbed forests. This early-successional vegetation (i.e., annuals and young perennial shoots) may in turn provide more forage for herbivores and thus prey for carnivores than is available in adjacent closed forest. Conversely, the elimination of Monpas shifting cultivation and early-successional vegetation could reduce the availability of forage and result in lower populations of ungulates and carnivores. The situation in JSWNP is unique. The Monpas population is small and their population density is very low (Giri 2004), they are Buddhists who do not hunt carnivores, and there is no bushmeat trade in Bhutan. In addition, Bhutan's Forest and Nature Conservation Act of 1995 prohibits hunting or killing wildlife except in self-defense or to protect livestock or crops.

Although the social, economic, and environmental conditions considered here are unique, there is growing evidence documenting the role and importance of shifting cultivation and other historical anthropogenic disturbances to the development and maintenance of biological diversity and "pristine" forests throughout the tropics (Willis et al. 2004). This includes the Amazon Basin (Denevan 2001; Woods & Glaser 2004; Mann 2005; Bush & Silman 2007), Mexico (Gomez-Pompa & Kaus 1999), Central Africa (Weber et al. 2001), Thailand (Kealhofer 2003), New Guinea (Denham et al. 2003; Haberle 2007), and the Solomon Islands (Bayliss-Smith et al. 2003). We suggest that relationships between biological diversity and historical anthropogenic disturbances, particularly shifting cultivation, collection of forest products, and extensive livestock grazing, warrant empirical investigation and that one should not simply assume a negative relationship a priori. Understanding site- and species-specific ecological effects associated with historic land-use practices are likely to be of significant biodiversity conservation value.

Acknowledgments

We appreciate the comments and suggestions provided by J. Belsky in the development and preparation of this manuscript. We thank the editor and two anonymous reviewers for valuable assistance and the Royal Government of Bhutan (Nature Conservation Division), the U.S. Department of Agriculture Forest Service International Program Office, and the University of Montana for supporting the work.

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