Establishing Long-term Biodiversity Assessment and Monitoring in Northwest Yunnan, China: A Growing Need for Baseline Information

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Establishing Long-term Biodiversity Assessment and Monitoring in Northwest Yunnan, China: A Growing Need for Baseline Information

Increasing attention is being paid to land use changes in the mountain environments of southwest China. Yet it is essential to develop a network of relevant sites for long-term analysis and comparison. For this reason an important part of an ongoing ethno-ecological project being undertaken by the Kunming Institute of Botany is the establishment of permanent vegetation plots across key environmental gradients in northwest Yunnan. These sites are envisaged as a model for a network of permanent plots that will provide baseline data to help delineate the potential effects of climatic and land-use changes in this region. Northwest Yunnan is important—not only as a biologically and culturally significant area in its own right, but, since it forms the headwaters of major rivers in Southeast Asia (ie the Mekong, Irrawaddy, Salween, and Yangtze), this region has immense regional significance as an upstream provider of ecosystem services (Figure 1).

FIGURE 1 Map of northwest Yunnan, showing the parallel mountain ranges and the position of the Qianhu–Haba transect. (Map by Andreas Brodbeck)

In response to rapidly increasing environmental pressures, China has introduced large-scale regulatory land use measures (exemplified by logging bans, reforestation projects, and the Sloping Land Conversion Program [SLCP] that aim to replace farms with forests on mountain slopes. The scale of these schemes is mind-boggling—the SLCP is budgeted at over US$ 40 billion, affects more than 15 million farmers across 25 provinces, and plans to convert 14.67 million ha of cropland to forests by 2010. However, these programs have been criticized for their simplistic and monolithic approach, particularly in light of the diversity of landscapes and ecosystems affected (Xu et al 2004; Weyerhaeuser et al 2005).

To some extent, shortfalls in China's land-use policies are inevitable, because relevant research is constrained by a lack of fundamental baseline data. Although great strides are being made in introducing high-tech managements tools (eg GIS and remote sensing), most temporal land use modeling is based on image analysis, which is often superficial. The paucity of long-term ecological records is especially notable in China, because large amounts of

scientific data and experience were lost or purged during the turbulent post-revolution period (Shapiro 2001). It is with a view to filling these gaps—now and for the future—that we are establishing long-term monitoring sites.

A biodiversity and cultural refuge

As an internationally recognized biodiversity hotspot, the mountains of southwest China have been prioritized for conservation and ecological research (Mittermeier et al 2004). In particular, the Critical Ecosystem Partnership Fund (CEPF), which is supporting this project, aims to safeguard Earth's biodiversity hotspots and enhance biodiversity conservation. Our project addresses 2 of the main strategic directions of CEPF:

1. Developing hotspot-wide monitoring and evaluation projects; and,
2. Integrating biodiversity conservation concerns and benefits into the implementation of policies and programs.

The mountains of southwest China have been subject to changing land-use practices. Fast-track modernization has driven the exploitation of natural resources, denuding the once expansive forests and polluting waterways. Currently, the main threats to biodiversity are livelihood activities, including agricultural production, livestock grazing, and the collection of fuelwood, construction timber, and non-timber forest products (NTFPs; Xu and Wilkes 2004). To redress such problems, these rural regions are now subject to drastic resource management and conservation policies. Some of these policies are paradoxical—for example, the government's push to increase livestock, while at the same time hamstringing grazing by discouraging rangeland burning and promoting plantations at the expense of pasture. Similarly, there are concerns that unrealistic forest protection measures could actually result in more intensive and unsustainable wood collection practices.

A number of questions have arisen. Are the current proscriptive policies going to achieve the best balance of resource utilization and conservation? How successful is reforestation, in terms of forest cover and forest quality? How will recent shifts in land use affect habitats critical for local livelihoods? Are there significant changes to biodiversity? How rapid, widespread, and profound are these changes?

Monitoring a continuum of mountain habitats

Northwest Yunnan is dominated by parallel mountain ranges that run north–south and form 3 major river valleys. This altitudinal and latitudinal range gives rise to the wide variety of habitats. In terms of site selection, this diversity is most parsimoniously captured with transects across the mountains. Consequently, we will place monitoring sites in key ethno-botanical zones along these transects. The first permanent monitoring sites were established last year on a transect from the Qianhu to the Haba mountain ranges (Figure 1).

Eleven sites on the Qianhu–Haba transect were selected to be representative of important factors, including: indicators of climate change (alpine wetlands, alpine rangelands); climax reference (mature forests); post-disturbance effects (wildfire, insect-affected); importance to local livelihoods (headwater forest, grazing lands, sources of NTFPs or wood) (Table 1).

Permanent sites have been GPS-located, photo-recorded, and marked with concrete posts. A nested quadrat system is employed to record information appropriate to the major vegetation (forest, shrubland, or grassland). At each site, floristic, structural, and environmental attributes are recorded. These include species richness, biodiversity indices, community structure, landscape, and edaphic conditions. For forest sites, stand basal areas were determined, making possible forest dynamics and biomass calculations. In addition, woody debris is measured (significant as an index of ground habitat diversity and potentially affected by wood collection). The methods minimize subjectivity so that measurements can be repeated by different observers; for example, point quadrats are used in grasslands and photo points are designated.

This information will be stored in a database for comparative studies to help make informed decisions on land use management. Such information may include the ecological tolerances of plant communities to ongoing fuelwood or fodder collection, the long-term implications of grazing or burning, the regeneration of replanted forest, and/or restored rangeland communities.

Working towards a monitoring network

The value of ecological reference sites is unquestionable. Experience around the globe has shown that long-term plots and monitoring are a reliable source of baseline data, which can vastly improve modeling accuracy and resource management (Bakker et al 1996). Moreover, for changes that affect land users, on-the-ground sites are an effective way to communicate and demonstrate changes.

This project dovetails with other conservation research on sustainable management (eg use of forest products and grazing studies) being carried out by a number of other agencies, and hopefully some of this research can be piggybacked with long-term monitoring. Certainly, cooperative research is envisaged, as our partners include the Shangri-La Alpine Botanic Gar-

TABLE 1 Overview of the major vegetation habitats across the Qianhu–Haba mountain transect.

Major aspect	Elevation (m)	Vegetation type	Width of the zone (km)	% of transect	Monitoring plot
East	~4000	Alpine mosaic of lake–grassland–*Rhododendron* shrub–*Abies* forest	1.4	3.25	Yes
East	3800–4000	Mosaic of grassland–*Abies* forest	5.6	4.88	Yes (2)
East	3600–3700	*Abies* forest	1.5	5.69	Yes
East	3400–3600	Forest mosaic of *Abies–Picea–Quercus–Betula*–bamboo	2.0	6.50	Yes
East	3200–3400	*Pinus densata* forest	0.8	2.44	
Flat	~3200	Mosaic of agriculture–grassland	2.0	3.25	
East	3000–3200	*Pinus densata* forest	3.0	7.32	
Flat	~300	Xiaozhongdian River			
West	3000–3300	*Pinus densata* forest	4.0	14.63	Yes (2)
Flat	~3000	Mosaic of agriculture–grassland	2.5	6.50	Yes
Varied	3100–3500	*Pinus densata* forest	4.0	11.38	
West	3500–3600	Forest mosaic of *Pinus densata–Quercus pannosa*	0.4	1.63	
West	3600–3700	Forest mosaic of *Quercus pannosa–Abies*	0.4	1.63	Yes
West	3700–3900	Rangeland–forest mosaic (*Abies–Larix*)	1.0	1.63	Yes
West	3900–4000	Alpine mosaic of *Rhododendron* shrub–grassland	0.4	2.44	Yes
West	>4000	Alpine scree	0.4	1.63	

den, Zhongdian; Zhongdian Tibetan Research Institute; Center for Biodiversity and Indigenous Knowledge (CBIK), Kunming; and World Agroforestry Centre, Kunming. This work will also complement ongoing alpine assessments in this region by the Nature Conservancy, who are establishing permanent plots on mountain summits as part of a coordinated global monitoring effort (Pauli et al 2004).

It is envisaged that a permanent plot program will be expanded to cover other ranges at various latitudes. While far from complete, these sites will form an invaluable resource in coming years to track the effects of climate change and varied land use. In the long term, we want a mechanism in place to monitor the status of key ecosystems in northwest Yunnan, with a view to targeting policy changes in land use practices that reflect local conservation and community development needs.

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