BioOne COMPLETE

Historical Landscape Change in Northwestern Yunnan, China

Author: Moseley, Robert K.

Source: Mountain Research and Development, 26(3) : 214-219

Published By: International Mountain Society

URL: https://doi.org/10.1659/0276-4741(2006)26[214:HLCINY]2.0.CO;2

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

Downloaded From: https://complete.bioone.org/journals/Mountain-Research-and-Development on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

Mountain Research and Development Vol 26 No 3 August 2006: 214–219

Robert K. Moseley

Historical Landscape Change in Northwestern Yunnan, China

Using Repeat Photography to Assess the Perceptions and Realities of Biodiversity Loss



Biodiversity conservation programs rely on accurate knowledge about past rates of ecological change and patterns of human use. In remote areas of the world, empirical data on historical trends rarely exist to inform conservation planning. Such is the case in the mountains of Yunnan, where there are many perceptions about historical drivers of environmental change, but little direct evidence. Since 2001, The Nature Conservancy has employed repeat photography to develop a historical profile for northwestern Yunnan. This 100-year profile allows us to assess the true magnitude of threats to biodiversity and the long-term contributions made by indigenous cultures to biodiversity maintenance. We found that many assumptions, often stated as fact, are wrong or do not apply universally. The magnitude and drivers of forest cover loss, arid shrubland dynamics, crop field expansion, and glacier retreat fall into this group. We also found that some threats have been ignored, such as a rapidly warming climate. The direct evidence of landscape change provided by repeat photographs has a range of conservation policy, investment, and management implications.

Repeat photography in northwestern Yunnan

Northwestern Yunnan (28° N latitude; 99° E longitude) lies in the Hengduan Mountains, a physiographical and biological transition between the Tibetan Plateau on the north and Indo-Malayan lowlands on the south. The 15 counties comprising northwestern Yunnan cover 69,000 km^2 and are dominated by 11 ethnic minority cultures, including Naxi, Tibetan, Bai, Lisu, and Nu. Basic knowledge about the rates and patterns of ecological and land use change is lacking in this remote area. Until empirical studies are conducted, historical landscape photographs provide a readily accessible baseline of visual indicators from which to assess past change. Repeating this photography—capturing a modern image that recreates as nearly as possible conditions of the original scene—can provide a direct assessment of ecological and land use trends during the last century.

We started by collecting as many old landscape photographs as possible. Sources include published books and magazine articles, as well as many unpublished photographs in the archives of the National Geographic Society (US), Royal Geographical Society (UK), Harvard University, and other institutions in the US and Europe. Of the total set of photographs available, we chose only landscape photographs with enough features to aid in the exact relocation of the original photopoint. Excluded were portraits of people and close-ups of villages and vegetation, because the photopoint could not be relocated exactly. So far, we have compiled a collection of about 1000 historical landscape photographs. These baseline or "original" photos were taken by Western explorers traveling through the area between 1899 and 1949, including botanists, zoologists, geologists, diplomats, geographers, ethnographers, foreign aid workers, religious missionaries, and tourists.

Between April 2001 and June 2005, we relocated 413 of these historical photopoints that were originally occupied by 16 different photographers. These repeated photographs sample every major ecosystem type, 11 counties, and 7 ethnic groups (Figure 1). Although the data set is rather large, areal coverage is still only a small fraction of northwestern Yunnan. The Nature Conservancy maintains an electronic database with the old image and new images that capture the original scene, as well as related text information on the original photograph, photopoint location, dominant ethnic groups, and a description of changes in the visual indicators of environmental change.

Conservation implications of the photo record

The database continues to grow, but from a preliminary interpretation of the photo record 6 results emerge as noteworthy in terms of biodiversity conservation.

Forest cover

Overall, forest cover has changed little in northwestern Yunnan during the last

Downloaded From: https://complete.bioone.org/journals/Mountain-Research-and-Development on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

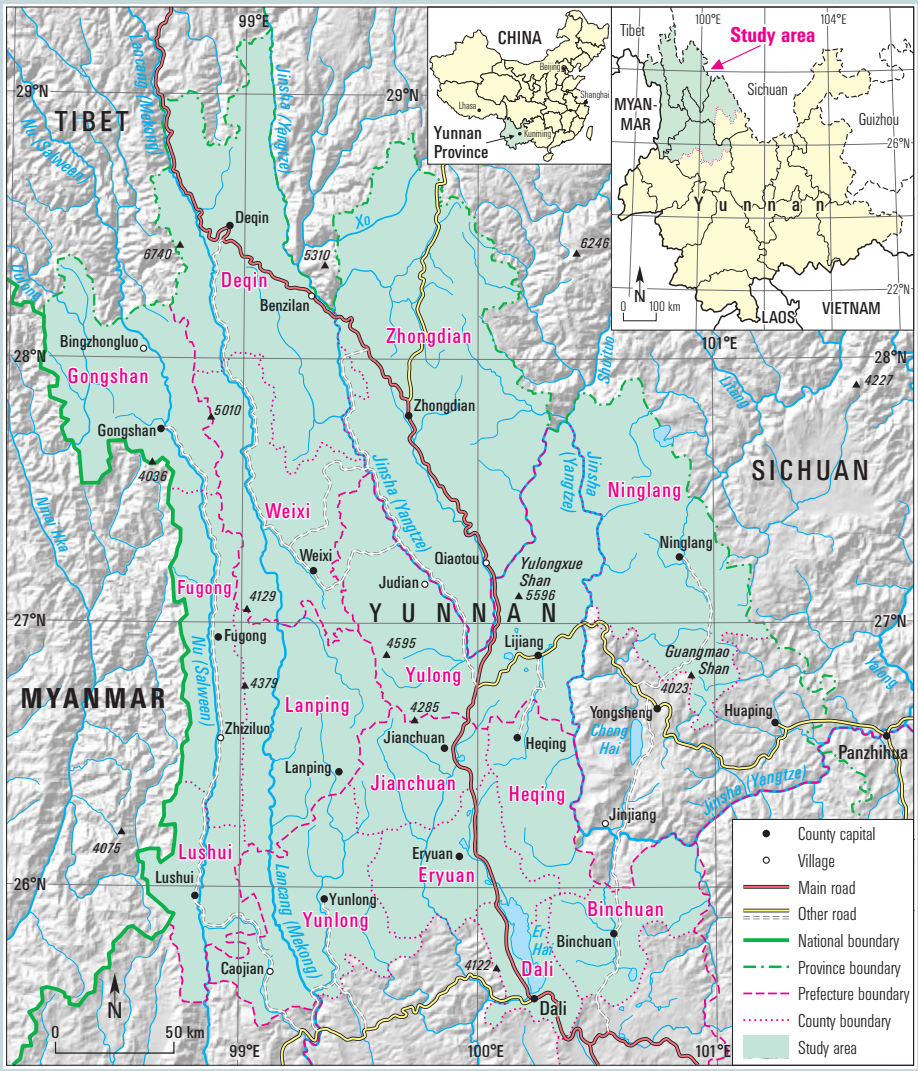


FIGURE 1 Northwestern Yunnan. (Map by Andreas Brodbeck)

century. In nearly all scenes of landscapes managed by local communities, forest area and tree density within existing stands have remained stable or increased. The few exceptions to this trend include areas dominated by the Yi ethnic group and stands clear-cut by commercial logging between the 1970s and 1990s. These findings contradict most other accounts of forest cover dynamics in China and Yunnan. Further research on the causes of this relative stability is needed, but preliminarily there appear to be 3 main causes in northwestern Yunnan:

1. Wildfire appears to have been widespread during the first half of the 20th century, most likely originating from intentional or accidental human sources. Vigorous fire suppression during the last 50 years has allowed some grasslands to reforest naturally and for savannahs and woodlands to increase tree cover, in some cases becoming closed-canopy forests.
2. There has been greater crop field abandonment in forests than clearing of new areas during the last 100 years (see below, "Agriculture").
3. The photos clearly show that some forests have been continuously used by villagers for fuel and construction material during the last century, yet forest area and tree density have

Downloaded From: https://complete.bioone.org/journals/Mountain-Research-and-Development on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

FIGURES 2A AND 2B Mountainside above Chalitong village, Deqin County. Vertical streaks on the left side of the images, faint in 1923 and obvious in 2003, are trails used to slide logs down to the village. Their presence in both images indicates that forests have been under continuous use for 80 years, yet cover has remained stable. (Original photograph by Joseph Rock/National Geographic Image Collection, 19 November 1923; modern photograph by Robert Moseley/The Nature Conservancy, 24 October 2003)





remained stable or increased in these stands (Figures 2A and 2B).

A note of caution is called for here. Repeat photography can easily detect changes in forest cover and density, but trends in other attributes of forest health are more difficult to observe. For example, low-magnitude, selective tree felling for local use as fuel and construction material can cause compositional and structural changes inside a forest stand that alter biodiversity. This activity is widespread across northwestern Yunnan, but is very hard to detect with repeated landscape photography. A more intensive sampling method will be needed to measure its conservation impact.

Arid shrublands

Photo comparisons along the Lancang (upper Mekong) and Jinsha (upper Yangtze) rivers illustrate that arid shrublands have dominated the landscape for at least a century. These dry environments, characterized by less than 300 mm of annual precipitation, are caused by localized climatic effects, whereby tall mountains to the west stop the rain from reaching the valley bottoms on the east. However, many people in southwestern China, including policy makers and government officials, believe that this non-forest zone has been caused by recent deforestation. Recent popular writing has even blamed the lack of forestland in the arid canyon bottoms on government logging and local villagers. These misperceptions have led to government reforestation programs for land that cannot support trees. The repeat photos provide direct evidence that this is a misguided investment.

Agriculture

Even though village populations have noticeably increased, clearing of native vegetation for crop fields has not increased dramatically during the 20th century. Most increases have been small in area and located adjacent to settlements. In many places, crop fields have been abandoned and subsequently reverted to shrubland and forest vegetation. It is commonly stated that there has been considerable forest clearing during the last 50 years because of agricultural expansion. Our research supports the view that, for most areas of northwestern Yunnan, this threat to biodiversity has been overstated and that deforestation due to agricultural

Downloaded From: https://complete.bioone.org/journals/Mountain-Research-and-Development on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

conversion is not just a new phenomenon in the region. It dates back several centuries.

Climate change and glaciers

The photos show that all glaciers in northwestern Yunnan are shrinking, like nearly all glaciers in the world. The loss of snow and ice cover worldwide is considered to be the classic indicator of a warming climate. In northwestern Yunnan, however, there are misperceptions as to the cause of rapid glacial retreat. A surprisingly widespread misperception places the blame on tourism development. After a development company built a tram to the edge of an alpine glacier in Yulong Snow Mountain Nature Reserve in 1997, they were widely criticized for causing the noticeable retreat of this small glacier. Due to this criticism, they contracted the Chinese Academy of Sciences to study the situation. Many glaciers in our repeat photographs have never experienced any tourism development, yet all have been declining throughout the last century.

A more local misperception involves the retreat of Mingyong Glacier, which descends from Khawa Karpo Peak on the Yunnan–Tibet border in Deqin County (Figures 3A and 3B). Khawa Karpo is in the top tier of mountains sacred to all Tibetan Buddhists. Mingyong Glacier is an important part of the sacred landscape around Khawa Karpo and 2 temples are located along its lower edge. Having repeatedly observed the terminus on the way to the temples, long-time residents and pilgrims know that this glacier is in rapid retreat. Indeed, a local Buddhist monk once reflected on this retreat and was concerned that it may be due to lack of devotion by himself and fellow Buddhists.

Climate change and alpine meadows

While the physical manifestation of a warming climate is easily observed in shrinking glaciers, indicators of ecological impacts are subtler. One of the most thermally sensitive and visibly distinct indicators is the boundary between woody and herbaceous vegetation in high mountains.



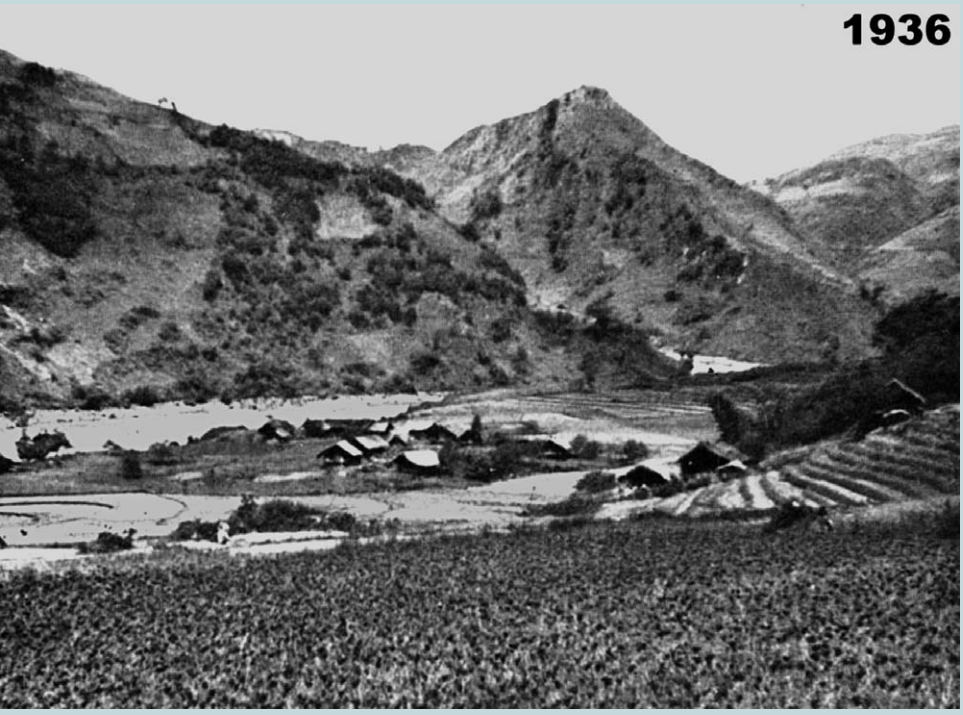
FIGURES 3A AND 3B The sacred Mingyong Glacier adjacent to Taizi Temple, Deqin County. There has been a decrease in ice volume over the 91 years and bedrock has become exposed in the icefall. (Original photograph by Frank Kingdon Ward/Royal Geographical Society, June 1913; modern photograph by Robert Moseley/The Nature Conservancy, 19 October 2004)

Research has shown that alpine timberline increases in elevation and alpine shrublands increase in cover as the result of a warming climate.

These vegetation dynamics are readily observed in repeat photographs. In northwestern Yunnan, several sets of photos show that these phenomena are in progress. Shrubs are encroaching into alpine meadows and timberline is increasing in elevation, measured at one site at a rate of about 8.5 m per decade. We know that increasing woody vegeta-

Downloaded From: https://complete.bioone.org/journals/Mountain-Research-and-Development on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

FIGURES 4A AND 4B Hillsides near Lazhidi village, Fugong County. Many crop fields and pastures in 1936 are now forested. (Original photograph by André Guibaut/Annales de Géographie, summer/autumn 1936; modern photograph by Robert Moseley/The Nature Conservancy, 4 November 2003)





tion in alpine regions of Yunnan will reduce both the high biodiversity naturally found in meadows and the livelihoods of Tibetans who rely on herbaceous vegetation for yak butter production and medicinal plants. This situation may now be exacerbated by a government ban on all use of fire as a management tool. Although this ban was established to protect forests, it is applied to all ecosystems and now prevents Tibetan herders from using this traditional method to reduce shrubs in alpine meadows. Government policy needs to recognize variation in ecosystems. A single, universally applied policy can conserve some ecosystems, but cause the loss of biodiversity and livelihoods in others.

Invasive plant species

Exotic species invading native habitats is a global threat to biodiversity and a major conservation issue in China. One exception to this appears to be northwestern Yunnan. The photo comparisons, as well as field observations and expert opinion, all suggest that invasive plant species are not a major threat to terrestrial biodiversity here, unlike virtually every other temperate region of the world. One hypothesis put forward to explain this phenomenon is that the high species, community, and landscape diversity of the area has limited the ability of non-native species to become established and spread.

Conclusions

Repeat photography of northwestern Yunnan delivers some clear signals for conservationists. In particular, comparisons of photographs taken between 1899 and 2005 do not support many common assumptions made regarding Yunnan's environmental degradation. Causes of glacier retreat on the peaks and the presence of arid shrublands in the canyons have been blamed on the wrong sources. Likewise, we need to reevaluate the relative threats of climate change, agricultural expansion and local wood collection to biodiversity (Figures 4A and 4B). Notably, the repeat photos show that there has been no simple unidirectional loss of forest cover associated with human activity during recent decades. Forest cover change has been driven by a complex of biological, physical, and anthropogenic factors that had their origins long before 1950. More generally, our repeat photography points out that there needs to be a much better linkage between conservation

Downloaded From: https://complete.bioone.org/journals/Mountain-Research-and-Development on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

decision making and the scientific understanding of biodiversity loss. The risk of making bad conservation investments is too high to ignore this.

Considerations for conservation policy, management, and investment

- Historical profiles promote realistic goal-setting for conservation and development programs.
- Conservation managers should be thoughtfully skeptical of prevailing assumptions and require data-driven threat assessments before making investment decisions.
- Historical landscape photography can provide an inexpensive and readily accessible source of baseline data on historic conditions for the last century.
- Traditional resource management in northwestern Yunnan appears to be more sustainable than previously thought. Managers need to document indigenous ecological knowledge and incorporate it into conservation programs as a complement to modern scientific knowledge.
- There is a considerable lack of understanding in Yunnan about the effects of global warming on natural and social systems, causing both inappropriate investment and spiritual angst. Photo comparisons help demonstrate that glacial retreat is a global climate change phenomenon, not a local conservation or faith issue.
- Conservation managers must recognize that rapid warming is occurring and is affecting the land and species under their jurisdiction. They must adapt their practices and policies to anticipate and be resilient to this inevitable change.
- Observing the past through repeat photography helps establish reliable indicators for measuring future conservation impact.

AUTHOR

Robert K. Moseley
The Nature Conservancy, 77 Xi Chang Road, Kunming, Yunnan, China 650034 (Current address: 1902 North 11th Street, Boise, Idaho 83702, USA).
bobmoseley@hotmail.com

Robert Moseley was Director of Conservation Science for The Nature Conservancy's China Program from 2000 to 2005. For the 25 years prior to that he worked on biodiversity conservation in the mountains of Idaho. Although trained in alpine ecology, he has spent his career as an applied conservation biologist involved in a wide range of interdisciplinary collaborations, including protected area design and management, rare plant conservation, high-mountain floristics, primate conservation planning, wetland and riparian ecology, broad-scale conservation assessments, and, more recently, the implications of climate change and Tibetan sacred landscapes for biodiversity conservation.

FURTHER READING

Baker BB, Moseley RK. In press. Advancing treeline and retreating glaciers: Implications for conservation in Yunnan, China. *Arctic, Antarctic, and Alpine Research.* Available from Robert K. Moseley.

Byers A. 2005. Contemporary human impacts on alpine ecosystems in the Sagarmatha (Mt Everest) National Park, Khumbu, Nepal. *Annals of the Association of American Geographers* 95:112–140.

Ives JD. 2004. *Himalayan Perceptions: Environmental Change and the Well-being of Mountain Peoples.* New York: Routledge.

Lassoie JP, Moseley RK, Goldman KE. 2005. Ground-based photomonitoring of ecoregional ecological changes in northwestern Yunnan, China. *In:* Aguirre-Bravo C et al editors. *Monitoring Science and Technology Symposium: Unifying Knowledge for Sustainability in the Western Hemisphere. 2004 September 20–24; Denver, CO.* Proceedings RMRS-P-37CD. Fort Collins, CO: US Department of Agriculture, Forest Service, Rocky Mountain Research Station. CD-ROM. See http://www.fs.fed.us/rm/pubs/rmrs_p037.html for details.

Moseley RK, Tang Y. 2006. Vegetation dynamics in the dry valleys of northwestern Yunnan, China, during the last 150 years: Implications for ecological restoration. *Journal of Plant Ecology* 30(5):713–722.

Downloaded From: https://complete.bioone.org/journals/Mountain-Research-and-Development on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use