



Farmward bound. Livestock that have grazed on these high grasslands are being moved into fenced areas, and nomadic herders are being settled in villages.

A Green Fervor Sweeps the Qinghai-Tibetan Plateau

In a controversial venture, officials plan to halt open grazing, eradicate rodents, restore “degraded” grasslands, improve wetlands, and plant many trees and shrubs

XINING, CHINA—No detail seems too small these days for officials working on environmental issues in western China’s Qinghai Province. The chief of tree planting in the forestry bureau can attest to this. Leaving the telephone, he told a recent visitor that he had just had a surprising call: Qinghai’s governor had noticed some unhealthy trees on her way to the airport. Her office wanted him to investigate.

Tending to sick trees is at one end of an array of government-led initiatives here that include some monumental undertakings as well. All have been deployed in the past decade in pursuit of a single goal. Government officials say that over several decades, human activities have left the grasslands of Qinghai in a “degraded” condition. Rivers and lakes are declining as well, according to this view, and environmental restoration is needed across the plateau, a fragile area that is the source of several major Asian rivers and is considered an ecological resource for eastern China. The central government has offered to share the costs, which helps to explain the enthusiasm for environmental reclamation in this province.

In May, Qinghai’s governor announced the launch of the latest initiative, a 10-year plan to

restore the region’s crown jewel—Lake Qinghai, or Qinghai Hu—and surrounding lands. Embracing 30,000 square kilometers, the project includes a slew of tasks: to curtail grazing on grasslands, control rodents and insect pests that damage alpine meadows, protect wetlands, curb desertification, plant trees and shrubs, protect biodiversity, and construct small towns in which nomadic herders and

their livestock would be settled in accord with “ecological migration.”

This sweeping program has been promised \$227 million from the central government—about half the amount initially sought. It comes on the heels of a larger conservation effort begun in 2005 in the plateau’s Sanjiangyuan region, the headwaters of the Yellow, Yangtze, and Lancang (Mekong) rivers. This plan covers 320,000 square kilometers and has been promised \$1 billion in central government funds over 6 years.

Many welcome the government’s green initiatives. Some also have reservations. Julia Klein, a global change researcher from Colorado State University in Fort Collins who is collaborating with Chinese researchers, gives a mixed review: “The protection of Lake Qinghai is an important endeavor,” she says. “Some of the proposed actions, such as wetlands protection, are useful and practical objectives.” However, she notes that other proposals, such as halting grazing, “may be ineffective or potentially harmful.”

“Sanjiangyuan and Qinghai Hu are very good projects with huge investments,” says Zhao Xinquan, director of the Northwest Institute of Plateau Biology of the Chinese Academy of Sciences (CAS) in Xining, “but they should be guided by science.” A proposed scientific component of the Qinghai Hu project was dropped, and scientists say that so far they have had little input.



Jewel in the crown. Lake Qinghai, affected by large agricultural projects in the past, is the focus of an environmental remediation program.

Better benchmarks

Both Chinese and U.S. scientists say more research is needed to understand the funda-



Unlikely villains. Experts disagree on whether pikas (*inset*) deserve the blame for creating “black sands” areas within grasslands.



mental changes taking place in the area known as the Qinghai-Tibetan Plateau, sometimes called the “water tower of Asia.” To begin with, there are no agreed-upon standards to measure environmental degradation, says Andrew Smith, a conservation biologist at Arizona State University in Tempe, who first visited Qinghai Hu in 1984. “Chinese officials characterize the plateau in broad terms,” he says, “but it is huge—constituting 25% of the land area of China—and very diverse. One cannot say the entire plateau is degraded.”

Cai Yanjun, a researcher at the CAS Institute of Earth Environment in Xi’an, agrees that clearer benchmarks are needed. But some exist: Grasslands are degraded, he notes, “if ground vegetative cover, biomass production, and quality of forage have decreased.” A key issue, says Cai, is to determine if alterations are the result of global climate change or are caused by local human activities, such as overgrazing, that could be better regulated.

There’s wide agreement that human activities over half a century can be blamed for some of the environmental damage around Qinghai Hu. Under Mao Zedong, grasslands along the shores of Lake Qinghai were plowed for crops. Mao’s government also sited dozens of labor camps in Qinghai, to which a quarter of a million criminals and political prisoners were banished. Later, as commerce boomed in the 1980s, mineral prospectors and medicinal plant hunters gouged the area.

The pattern changed in 1999, when the Beijing government pushed for environmental improvement after a 1998 Yangtze River flood killed thousands of people. Many thought deforestation upstream in Sichuan and Qinghai contributed to the severity of the flood. The government launched the “grain to green” program to return farmlands not suitable for agri-

culture to forests or grasslands. In 2001, 12 military-owned farms around Qinghai Hu were returned to local civilian governments, and about 80% of tillage on shores developed in the 1950s has been returned to grass.

But critics worry that simple engineering solutions aren’t adequate; they could lead to the same kind of brute-force, monolithic strategies that caused trouble in the first place. Many officials who advocate ecological improvement, Smith asserts, “do no science, utter proclamations, and spend ferociously to engage in activities that are totally unproven.”

Fencing the plateau

Provincial officials often cite overgrazing as a major cause of land degradation on the Qinghai-Tibetan Plateau. According to the province’s forestry bureau, grasslands around Qinghai Hu can support a maximum livestock equivalent of 3.65 million sheep, but the equivalent of 6 million sheep now graze there. The Qinghai Hu and Sanjiangyuan conservation plans calls for sealing off from grazing 854,700 hectares of grassland, resettling 881 households (4157 persons) away from the lake, and reducing livestock by the equivalent of 1 million sheep.

Resettlement has already been carried out in the Sanjiangyuan region on a larger scale, depopulating part of the plateau. Although the government provided \$7000 to \$12,000 per household to build houses and fences, herders have found it hard to live on this level of support, says Zhao. Smith is concerned about the social consequences; he claims that the low-status jobs and crime in resettlement villages have caused resentment.

The consequences of long-term over-

grazing on the plateau are not clear, but removal of grazing entirely, as the Qinghai Hu conservation plan calls for, may be harmful, argues Klein. Since 1997, Klein has been simulating warming and grazing to observe the effects on grasslands in field experiments in Haibei county north of Qinghai Hu. She and her colleagues found that warming reduces plant biodiversity and alpine meadow biomass, but grazing helps to slow down the loss of species. When livestock are completely removed from rangeland, dried grass left over from the previous year stunts new growth,

keeping grass yellow even at the height of the growing season. The Tibetan Plateau “is a system that has evolved with grazing; the removal of grazing from the system could have profound ecological consequences,” says Klein.

Fencing off grasslands also may pose a threat to the critically endangered Przewalski’s gazelle (*Procapra przewalskii*). This species, which is endemic to China, used to roam the dry western grasslands but is now found in small populations only in the vicinity of Lake Qinghai, according to the International Union for the Conservation of Nature, which in 1996 put Przewalski’s gazelle on its Red List of Endangered Species. The last population survey conducted in 2003 counted about 600 gazelles, less than half the number of wild pandas.

Wang Dajun, a conservationist, and his grad students at Peking (Beijing) University have been conducting a new population survey since January 2008. Grad student Zhang Lu says that even though gazelles can jump over fences separating pastures, the barriers are dangerous to young or pregnant animals. Every year, there is news of a gazelle dying on a fence, says Zhang, and fences make it more difficult for gazelles to escape predators such as wolves.

Taking out a keystone

The Qinghai wolves’ major food source—small native mammals including plateau pikas (*Ochotona curzoniae*), voles (*Microtus brandti*), and zokors (*Myospalax baileyi*)—have been blamed for causing grassland degradation as well and are targeted for eradication under the conservation plans. They are thought to compete for forage with livestock, and their burrows damage plant roots. Agriculture and animal husbandry

agencies lump them together as rodents.

For more than 4 decades, local government agencies have been trying to control plateau pika populations using various rodenticides, including Compound 1080 and Fussol; both have since been discontinued because of environmental contamination and collateral damage to predators. Now the primary chemicals are Gophacide and Zinophos and anticoagulants, according to Smith and J. Marc Foggin, founding director of Plateau Perspectives, an organization in the provincial capital Xining that supports conservation and sustainable development. (Foggin did research on mammals and birds in Qinghai as a grad student at Arizona State University in the 1990s.)

The pika eradication effort could have unintended consequences for other species, Foggin and Smith wrote in what is considered the definitive study in *Animal Conservation* in 1999. Pikas are a keystone species, providing many ecosystem functions to the Tibetan Plateau, they wrote. The animals are a major food source not just for wolves but for brown bears and most of the large predatory birds of the plateau, and many nesting bird species use pika burrows as shelters for breeding. Where pikas have been poisoned, bird populations are also low, they found. But Smith claims that “for all the money spent, there is little evidence to show [that poisoning is] effective.” Adds Wang: “The main causes for grassland degradation are overgrazing and climate change; killing native wild animals will not solve the problem.”

Water level rebounds

A fundamental—and critically important—rationale for remediation efforts in Qinghai is to protect the wetlands and prevent lakes from declining. A growing body of evidence, however, suggests that climate change is more important than human activity in changing water levels in Qinghai—and that water levels may be rebounding.

The earliest measurement of Lake Qinghai's water level was taken in 1908 by a Russian explorer. Since then and for almost the entire century afterward, the lake has been dropping. But that could be changing.

Using data from 1959 to 2000, Li Xiaoyan and his colleagues at Beijing Normal University have studied water balances of Qinghai Hu. They found that the lake water level dropped at an average rate of 8 cm per year during this period, primarily from evaporation losses and reduced precipitation. They estimated that crop irrigation and livestock watering were less significant factors,

amounting to only 1% of evaporation.

Li Shijie, a researcher at the CAS Nanjing Institute of Geography and Limnology, had observed high-altitude lakes decline for more than 2 decades. But in 2006, when he went back to Zigetang Co, a small saline lake fed primarily by surface discharges in northern Tibet, he “was very surprised” to find that its level had increased by 1.8 meters since 2002. Meteorological and hydrological data indicated that annual precipitation had increased since 2000 compared with the 1980s, at least over the southern part of the Qinghai-Tibetan Plateau. Some Chinese scientists had argued that climate warming would first make the plateau drier as land temperatures rose, but that later, as ocean temperatures

feeding runoffs into the lake.

Although some say it's too early to tell whether this fluctuation is temporary or a turning point for lake water level, one thing is clear: The ecological issues affecting the Qinghai Hu basin are complex. “We are just beginning to understand how different drivers—such as climate change, large herbivore grazing, and small mammals—interact to affect the Tibetan Plateau grasslands and the water balance in this system,” says Klein.

“The situation in the Qinghai Lake region illustrates how climate change can have some of its greatest impacts on subsistence-oriented communities who are tightly coupled to their natural resource base,” says Klein. Although many problems require



Rare sight. Critics say that a plan to fence in some wild areas could make life more difficult for the endangered Przewalski's gazelle.

caught up, heavier summer monsoons from the Indian Ocean would bring more rainfall to the plateau.

Li obtained data for four catchments near Qinghai Hu and applied the Soil and Water Assessment Tool developed by the U.S. Department of Agriculture to model the lake's water balances. Fitting past meteorology and hydrology to the model, he and his colleagues predicted that water levels in Qinghai Hu likely will fluctuate from 2006 to about 2010 and then rebound.

Remote sensing and weather data so far seem to bear out Li Shijie's modeling. According to Li Fengxia, director of the Qinghai Institute of Meteorological Science, the lake's surface area has fluctuated since 2005 and was 9.75 square kilometers larger in July 2005 than it was in July 2004. Several monitoring dates in July 2006 showed lake area increase as well. She attributes the trend to two factors: increased precipitation and increased snow melting

mitigation at a global scale, “local policies should enhance the herders' and the ecosystem's resilience and adaptation to these and future ecosystem changes. Herder relocation and its associated consequences will likely be counter to these goals.”

Both Chinese and American scientists are planning more research in the area. The U.S. National Science Foundation recently approved a \$1 million, 5-year project to study the social and ecological dimensions of pastoralism in Qinghai, says Smith, who is a co-principal investigator of the study, which involves researchers from several U.S. institutions.

The Chinese Ministry of Science and Technology wants to pick up the tab to support the scientific research left out of the Qinghai Hu conservation plan to help guide the engineering endeavor; the project's budget of \$4.4 million is awaiting final approval by the finance ministry.

—HAO XIN