Tyranny of trees in grassy biomes

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LETTERS

Edited by **Jennifer Sills**

Rough waters for native Chinese fish

IN THE POLICY FORUM "China's aquaculture and the world's wild fisheries" (9 January, p. 133), L. Cao *et al.* identify the increasing growth of aquaculture in China as potentially placing considerable pressure on global marine stocks. The impact of aquaculture on wild fisheries will also be felt much closer to home, particularly in China's freshwaters.

Aquaculture in Asia is increasingly reliant on the farming of alien species, whether stocked from other countries or intentionally translocated from remote water basins within the same nation (*1*). Recent estimates suggest that more than 100 alien species of freshwater finfish are farmed in China (*2*). Many of these species have become widely established in the wild either as a result of escape from aquaculture ponds or through deliberate introductions into lakes and freshwaters to enrich wild fisheries. Unfortunately, the consequences have usually been disastrous. Several alien finfish

Bighead carp threaten native species in China.

threaten native species through predation (*3*), competition (*4*), the spread of pathogens (*5*), and hybridization (*6*). The end result is often the decline in native finfish and associated wild fisheries. For example, following the introduction of bighead and silver carp in Lake Xingyun for aquaculture, the proportion of the endemic barbless carp in the total fish yield declined from 50% to less than 1% within a few decades (*7*).

China is recognized as a major center for global freshwater fish diversity with a high level of endemism, attributable to its major river systems that have been isolated for millennia (*8*). Thus, while the economic value of alien aquaculture species provides a strong incentive to their introduction, the loss of wild fisheries and the extinction of endemic species as well as the reduced resilience of freshwater ecosystems should be taken into account in regulations regarding stocking practices (*9*). In the absence of effective regulation of species introductions and translocations to support aquaculture development in China, progressive reductions in the size and sustainability of wild freshwater fisheries are to be expected.

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The value of audiovisual archives

FOR CENTURIES, HUMANS have collected specimens and deposited them in scientific collections housed in zoological or natural history museums. Such documentation is essential for the recognition and classification of our extinct and extant biodiversity. As technology improved, we created DNA databases that have helped us to understand the evolutionary relationships between organisms. Both genetic archives and museum specimens are well recognized as important biodiversity repositories, and scientific literature routinely refers to them.

Equally important, but often overlooked, are audiovisual archives, which allow us to record complementary information that could not be recovered from dead specimens or DNA sequences. Sound archives are particularly interesting, as they capture behavior with great accuracy and are often involved in conspecific recognition. These digital archives are relatively inexpensive to store and curate, and are usually obtained with no harm to the focal species and no need for collection.

Unfortunately, audiovisual archives are being neglected; voucher numbers, which provide access to the files and the possibility of replication, are often not available in articles. Furthermore, the files are not always georeferenced, despite the importance

of verifying the presence of certain taxa in a specific space and time. To raise the standards of documentation, we call for all scientific journals to require authors to deposit their audiovisual recordings in scientific collections or online repositories, just as they do for specimens, DNA sequences, and even raw data.

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Tyranny of trees in grassy biomes

TREE PLANTING, FIRE suppression, and exclusion of megafaunal herbivores (native or domestic) are ecologically reasonable restoration strategies in deforested landscapes, but similar interventions can be catastrophic when applied to grassy biomes such as grasslands, savannas, and open-canopy woodlands (*1*). As hopes grow that carbon payment schemes will finance forest restoration (*2*), we must clearly distinguish between "reforestation"—planting trees on deforested land—and "afforestation"—converting historically nonforest lands to forests or tree plantations (*3*). Afforestation of grassy biomes can severely compromise ecosystem services, including hydrology (*4*) and soil nutrient cycles (*5*), and markedly reduce biodiversity (*6*).

Despite these high environmental costs, grassy biomes, particularly those with seasonally dry tropical climates, are prime targets for carbon sequestration programs that emphasize tree planting (*1*, *7*). Threats of afforestation and agricultural conversion are exacerbated because the grassy biomes are not formally recognized by the United

PHOTO: (LEFT) AP PHOTO/M. SPENCER GREEN, FILE; (TOP RIGHT) G. W. FERNANDES

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Highland grassland in Brazil is considered a forest landscape restoration opportunity

Nations (UN) Framework Convention on Climate Change, the program for Reducing Emissions from Deforestation and Forest Degradation (REDD+), or the UN Food and Agriculture Organization. This lack of recognition reflects fundamental misperceptions about the ecology, conservation values, locations, and antiquity of the grassy biomes.

The World Resources Institute's (WRI's) map of "Forest and Landscape Restoration Opportunities" (*2*) serves as an example of these misperceptions. The map identifies 23 million km^2 of the terrestrial biosphere as highly suitable for tree planting. Yet much of the area targeted for "forest restoration" corresponds to the world's ancient grassy biomes. The WRI erroneously assumes that nonforest areas where climate could theoretically permit forest development are "deforested," an assumption rooted in outdated ideas about potential vegetation and the roles of fire and herbivores in natural systems (*8*). This map is intended as a tool to help meet the Bonn Challenge to "restore 150 million hectares of the world's deforested and degraded lands by 2020." Although many ecosystems within the grassy biomes might benefit from ecological restoration, the restoration strategies proposed by WRI (*2*) are incompatible with grassland biodiversity.

Meanwhile, among the landscapes correctly identified as deforested by the WRI map, extensive areas of agriculture are not considered restoration opportunities (*2*). Clearly, the economic output of agricultural lands makes them expensive to reforest. But attempts to offset agricultural deforestation through afforestation of the grassy biomes will simply worsen biodiversity losses and further compromise ecosystem services.

The "Forest and Landscape Restoration Opportunities" map was produced and presumably vetted by influential scientific and environmental organizations, which lends it legitimacy. WRI (*2*) collaborated with and/or was supported by the International Union for the Conservation of Nature, the Global Partnership on Forest and Landscape Restoration, the Program on Forests, the University of Maryland, South Dakota State University, the German Ministry for the Environment, and the Forestry Commission of Great Britain. The producers of the map also acknowledge receiving review comments from the UN Environment Programme–World Conservation Monitoring Center.

That such a scientifically flawed analysis is poised to promote misinformed tree planting is emblematic of deep misunderstandings about the grassy biomes, as well as their devaluation relative to forests. We worry that so long as tree planting is viewed as innately good and the grassy biomes are assumed to be the result of deforestation, afforestation projects will face limited public resistance and analyses such as this WRI map will escape scientific scrutiny. Deforestation and forest degradation are critical problems that must be addressed, but with due consideration of the value of the many naturally nonforest biomes that also face tremendous pressure from human-caused environmental change.

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