



China's karst cave ecosystems, home to myriad unique species, remain inadequately protected.

Edited by Jennifer Sills

## Protect China's karst cave habitats

China's 1.9 million-km<sup>2</sup> karst area is one of the most threatened biodiversity hotspots in the world (1). Karst caves have unique habitats with dim light, limited nutrient supply, high humidity, and relatively low temperature fluctuation (2), and most of the organisms that live in the caves have very narrow distributions and small populations. Although small parts of the karst cave region in South China were designated a United Nations Educational, Scientific, and Cultural Organization (UNESCO) World Heritage Site in 2007 (3) and 2014 (4), most karst caves in China do not fall within the current system of national natural reserves. Without effective protection, starting with the designation of the caves as national reserves and classification of species as endangered, the many species that live only in karst caves may not survive.

The karst caves are home to entire genera of some organisms, as well as recently discovered species and likely countless species yet to be discovered. Almost all of the 49 known species of the golden-line barbel genus (*Simocyclocheilus*) in the cyprinid fish family (Cyprinidae) live in or around one or a few caves (5). More than 100 newly described plant species are endemic to karst caves, including *Chiritopsis* spp. and *Petrocosmea* spp. in Gesneriaceae and *Polystichum* spp. in Dryopteridaceae (6–8). Despite their small populations and limited habitats, many of these species have not been listed by the International Union for

Conservation of Nature (IUCN) as Critically Endangered because assessments are outdated or have not been done at all.

Karst cave organisms are highly adapted to the environments and restricted in their ranges. Increased human exploitation of natural resources for herbal remedies, mining activities (8), tourism (9), fishing, and agricultural activities has led to habitat and vegetation degradation in karst caves, putting endemic and rare species at risk of extinction. With no charismatic flagship species, karst cave ecosystems receive little governmental support. No governmental agency or nongovernmental organization focuses on these ecosystems (10).

Protecting karst cave species requires urgent and coordinated action from the government and the public. China should pass legislation to protect the region and make a government body, such as the National Forestry and Grassland Administration, accountable for success. The legislation should include the designation of a karst national reserve that includes both caves in the UNESCO world heritage sites and those outside their borders. A national reserve would draw funding to manage and restore habitats and place limits on nearby human activities. In addition, the IUCN should assess or update previous assessments of karst cave species. China should raise public awareness to ensure that biological species in the karst region are added to the latest list of national key protected wild organisms (11). We must take action to protect the karst cave ecosystems if we want a chance to mitigate biodiversity loss.

Yi-Fan Duan<sup>1</sup>, Meng Li<sup>1</sup>, Ke-Wang Xu<sup>1</sup>, Liang Zhang<sup>2</sup>, Li-Bing Zhang<sup>3,4\*</sup>

<sup>1</sup>Co-Innovation Center for Sustainable Forestry

in Southern China & Key Laboratory of National Forestry and Grassland Administration on Subtropical Forest Biodiversity Conservation, College of Biology and the Environment, Nanjing Forestry University, Nanjing 210037, China. <sup>2</sup>Key Laboratory for Plant Diversity and Biogeography of East Asia, Kunming Institute of Botany, Chinese Academy of Sciences, Kunming 650201, China. <sup>3</sup>Missouri Botanical Garden, St. Louis, MO 63110, USA. <sup>4</sup>Chengdu Institute of Biology, Chinese Academy of Sciences, Chengdu 610041, China. \*Corresponding author. Email: libing.zhang@mobot.org

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## Biodiversity loss due to more than climate change

With the UN Climate Change Conference (COP26) taking place this week, climate change is on everyone's radar. Unfortunately, the myopic lens of climate change has both diminished and distorted our understanding of the biodiversity crisis (1). The conservation

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of biodiversity should be approached as a solution to the climate crisis, rather than an ancillary victim. Losses of biodiversity are increasingly corrosive, and they are driven by traditional threats that dwarf the potential impacts of climate change (2).

The principal drivers of species extinctions vary by taxonomic group and location (3, 4), but evidence shows that conventional anthropogenic factors (habitat loss, land-use change, and deforestation) are consistently more important than the contemporary effects of climate change (3–5). Land use–driven loss of biodiversity will have the most pronounced impact in the Tropics and Temperate Zones, where biodiversity is greatest and land-use change most rapid. In marked contrast, the impacts of climate change will initially be felt most sharply in polar regions, where biodiversity is unique but much less abundant (5). At current rates of land-use change, it is unlikely that much biodiversity will be left by the time climate change severely affects the Tropics (5).

Paradoxically, tropical forests and savannahs are the only economically viable buffer against climate change (6, 7). To save biodiversity and reverse climate change, we must tackle habitat destruction and exploitation of species rather than believing that reducing fossil fuel use will solve both problems.

Andrew Dobson<sup>1,2\*</sup>, Zeke Rowe<sup>3</sup>, Joel Berger<sup>4,5</sup>, Philippa Wholey<sup>3</sup>, Tim Caro<sup>3,6</sup>

<sup>1</sup>Department of Ecology and Evolutionary Biology, Princeton University, Princeton, NJ 08544, USA.

<sup>2</sup>Santa Fe Institute, Santa Fe, NM 87501, USA.

<sup>3</sup>School of Biological Sciences, University of Bristol, Bristol BS8 1TQ, UK. <sup>4</sup>Department of Fish, Wildlife, and Conservation Biology, Colorado State University, Fort Collins, CO 80523, USA.

<sup>5</sup>Wildlife Conservation Society, Bronx, NY 10460, USA. <sup>6</sup>Center for Population Biology, University of California, Davis, CA 95616, USA.

\*Corresponding author.

Email: dobber@princeton.edu

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## Science-informed salmon conservation strategies

Human population growth and activities over the past century have broadly affected marine fish biodiversity, with several species declining or near extinction (1). Many of the world's salmon species are particularly vulnerable because they rely on a diverse array of habitats for survival and reproduction (2), which compromises their ability

to adapt to environmental changes (3). Salmon populations throughout the world face unprecedented threats to their survival and viability, including habitat degradation, climate change, pathogens, illegal trade, and overfishing (4–9). Protecting these fish and their ecosystems will require scientific strategies and technology on both land and sea.

Global assessments can help to map the intact Northern Hemisphere rivers that serve as stronghold habitats for salmon, better informing where whole watershed-scale conservation investments should be made. Aquatic telemetry acoustic tags and environmental sensors can also improve our understanding of salmon migration patterns and habitat use (10). Better information about the habitats on which salmon depend throughout their life cycle and changes to their distribution resulting from drought, food web fluctuations, and river fragmentation will enable more effective and comprehensive conservation efforts (2, 4). Targeted high-throughput molecular screening of infective agents may aid in addressing potential fish health problems arising from existing and unknown pathogens (6, 11). Genotype technology can help enforce legal trade by identifying fish that are being sold illegally, which in turn could mitigate overexploitation of sensitive fisheries (2, 4, 9).

Together, conducting global research and applying technology to monitoring (6, 9, 10) and enforcement could help identify and address local combinations of threats. If successful, the protection of vulnerable salmon species would serve as a model for similarly complex species that require specialized conservation efforts (12).

Michael S. Bank<sup>1,2\*</sup>, Christian Sonne<sup>3</sup>, Sophia V. Hansson<sup>3,4</sup>, Matthias C. Rillig<sup>5,6</sup>

<sup>1</sup>Institute of Marine Research, Bergen, Norway.

<sup>2</sup>University of Massachusetts Amherst, Amherst, MA, USA. <sup>3</sup>Aarhus University, Roskilde, Denmark. <sup>4</sup>Laboratoire Ecologie Fonctionnelle et Environnement, Centre National de la Recherche Scientifique, Toulouse, France. <sup>5</sup>Institute of Biology, Freie Universität Berlin, 14195 Berlin, Germany.

<sup>6</sup>Berlin-Brandenburg Institute of Advanced Biodiversity Research, 14195 Berlin, Germany.

\*Corresponding author. Email: michael.bank@hi.no

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