



Edited by Jennifer Sills

## Brazil's government attacks biodiversity

To address the rapid and massive loss of biodiversity worldwide, scientific research must inform agile decision-making. The political leaders of Brazil, the country with the planet's greatest biological wealth (1), continue to undermine this goal. In 2001, citing the laudable objective of preventing biopiracy, the government created the Genetic Heritage Management Council (CGen) (2), making established biodiversity research activities illegal overnight by imposing severe limitations on access and shipment of specimens and samples. After 5 years of pressure from the academic community, the government finally resolved to exempt several areas of basic research from the restrictive policy (3). Now, after severe budget cuts (4, 5) and legal maneuvers directly affecting biodiversity (6), the Brazilian Federal Government has reversed its position once again with the so-called New Law on Biodiversity (7, 8), striking a potentially fatal blow to biodiversity.

Disguised as a milestone of progress for scientific research and endorsed by some scientific sectors (9), this law constitutes a monumental setback. According to the law, which is retroactive to 2000 or 2015, depending on the area of research (8), and technically applies to researchers at both Brazilian and foreign institutions (10), virtually every research activity on Brazilian biodiversity—even nongenetic studies in taxonomy, ecology, physiology, and behavior—must be registered in the National System of Genetic Resource

Management and Associated Traditional Knowledge (SisGen), which was created to assist the CGen. The deadline for meeting these draconian rules is 5 November 2018 (9, 11). Failure to comply, including the unregistered dissemination of scientific results, even if based only on public databases like GenBank or previously published data or results, will result in heavy fines (7). A lecture given by the coordinator of the Academic Sectoral Board of the CGen, titled “How not to be fined,” highlights the punitive spirit of the law (10). Paradoxically, commercial activities involving Brazilian biota, such as export of ornamental fishes, plants, grains, and other marketable products, remain unaffected by the law (7).

### NEXTGEN VOICES: SUBMIT NOW

## Broad interests: Benefits for science

Add your voice to *Science*! Our new NextGen VOICES survey is now open:

How do broad interests benefit your science? Describe one non-science interest or hobby, and explain how it has made you a better scientist.

To submit, go to [www.sciencemag.org/nextgen-voices](http://www.sciencemag.org/nextgen-voices)

Deadline for submissions is 1 June. A selection of the best responses will be published in the 6 July issue of *Science*. Submissions should be 150 words or less. Anonymous submissions will not be considered.

The pumpkin toadlet is just one example of the diverse fauna endemic to Brazil.

If not repealed or substantially overhauled, this Byzantine labyrinth of unnecessary demands and threats will decimate scientific research on Brazilian biodiversity by requiring scientists to divert an inordinate amount of already limited resources from research to the time-consuming process of registering every specimen, DNA sequence, photograph, and any other observation of Brazilian biodiversity before publication, presentation at scientific meetings, or dissemination to media outlets. Scientists must take back the reins of their own activities by demanding that the Brazilian government implement laws that facilitate international collaboration and encourage biodiversity research instead of stifling it. Otherwise, a substantial part of the world's biodiversity and its benefits may silently vanish behind a wall of bureaucracy.

**Flávio Alicino Bockmann,<sup>1\*</sup> Miguel Trefaut Rodrigues,<sup>2</sup> Tiana Kohlsdorf,<sup>1</sup> Lorian Cobra Straker,<sup>1</sup> Taran Grant,<sup>2</sup> Mário César Cardoso de Pinna,<sup>3</sup> Fernando Luis Medina Mantelatto,<sup>1</sup> Aléssio Datovo,<sup>3</sup> José Perez Pombal Jr.,<sup>4</sup> John Campbell McNamara,<sup>1</sup> Eduardo Andrade Botelho de Almeida,<sup>1</sup> Wilfried Klein,<sup>1</sup> Annie Schmaltz Hsiou,<sup>1</sup> Milton Groppo,<sup>1</sup> Ricardo Macedo Corrêa e Castro,<sup>1</sup> Dalton de Souza Amorim<sup>1</sup>**

<sup>1</sup>Department of Biology, Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto, Universidade de São Paulo, Ribeirão Preto, SP 14040-901, Brazil.

<sup>2</sup>Department of Zoology, Instituto de Biociências, Universidade de São Paulo, São Paulo, SP 05508-090, Brazil. <sup>3</sup>Museu de Zoologia da Universidade de São Paulo, São Paulo, SP 04263-000, Brazil.

<sup>4</sup>Department of Vertebrates, Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro, RJ 20940-040, Brazil.

\*Corresponding author.

Email: fabockmann@ffclrp.usp.br

### REFERENCES

1. R. A. Mittermeier, C. G. Mittermeier, P. R. Gil, E. O. Wilson, *Megadiversity: Earth's Biologically Wealthiest Nations* (CEMEX, 1997).
2. Medida Provisória No 2.186-16, (23 August 2001); [www.planalto.gov.br/ccivil\\_03/mpv/2186-16.htm](http://www.planalto.gov.br/ccivil_03/mpv/2186-16.htm) [in Portuguese].
3. Resolução No 21 (31 August 2006); [www.mma.gov.br/estruturas/sbf\\_dpg/\\_arquivos/res21cons.pdf](http://www.mma.gov.br/estruturas/sbf_dpg/_arquivos/res21cons.pdf) [in Portuguese].
4. H. Escobar, *Science*, 10.1126/science.aal0276 (2016).
5. C. Angelo, *Nature*, 10.1038/nature.2017.21766 (2017).
6. H. T. Pinheiro et al., *Science* **350**, 1043 (2015).
7. Lei No 13.123 (20 May 2015); [www.planalto.gov.br/ccivil\\_03/\\_ato2015-2018/2015/lei/13123.htm](http://www.planalto.gov.br/ccivil_03/_ato2015-2018/2015/lei/13123.htm) [in Portuguese].
8. Decreto No 8.772 (11 May 2016); [www.planalto.gov.br/ccivil\\_03/\\_ato2015-2018/2016/decreto/D8772.htm](http://www.planalto.gov.br/ccivil_03/_ato2015-2018/2016/decreto/D8772.htm) [in Portuguese].
9. M. da Silva, D. R. de Oliveira, *Braz. J. Microbiol.* **49**, 1 (2018).
10. Audiovisual IB-USP, “Lei da Biodiversidade e Plataforma SisGen: Como não ser multado. - Dra. Manuela da Silva” (2018); <https://youtu.be/x6t4rXARkEs> [in Portuguese].
11. D. R. Oliveira, M. da Silva, F. do Carmo, R. Angeli, *J. Ciênc.* **5772**, 1 (2017).

10.1126/science.aat7540

## The road to wild yak protection in China

China is home to about 22,000 wild yaks, which account for 90% of the global wild yak population (1). The International Union for Conservation of Nature (IUCN) categorizes the wild yak, a cold-tolerant herbivore, as a vulnerable species (2), mainly attributable to excessive hunting for food and trade. China's wild yak is also threatened by land-use change, disease, environmental pollution, genetic contamination, climate change, and resource competition (1, 3, 4). In recent decades, infrastructure construction in China has grown increasingly disruptive to remaining wild yak populations.

Most wild yaks live in or near the Tibetan Plateau (1). These regions are located in or adjacent to areas zoned for the Western Development Strategy (5), an ambitious plan proposed in 1999 to increase the economic level and quality of life of China's rural citizens. The plan's implementation has accelerated the construction of railways and roads. Railways in the central western region of China, which account for 76.6% of China's current rail traffic (6), expanded from 70,000 km in 2014 (7) to 95,000 km in 2016 (6). Meanwhile, highway density increased from 7.7 km/100 km<sup>2</sup> in 1999 to 20.6 km/100 km<sup>2</sup> in 2008 (8). The increasing density of railways and roads has fragmented the habitats of wild yaks and forced them to migrate to resource-limited areas to escape from predation and conflict with humans.

China's wild yaks are an important genetic resource for breeding new yak species in an effort to sustainably develop animal husbandry in the Tibetan area and enrich the region's biodiversity (1, 9). Wild yaks are also an important component of biodiversity in nature (9). To protect China's wild yaks, the Chinese government has built several nature reserves (10, 11), but even there, the yaks are threatened by illegal hunting (10). To ensure the safety of China's wild yaks, China must further expand the nature reserves and effectively enforce existing hunting bans. The government should also implement scientific management and protection policies that minimize habitat fragmentation, resource plunder, and predation.

Ming Chen,<sup>1,2\*</sup> Yingzhu Sun,<sup>1,2</sup>  
Chunping Yang,<sup>1,2\*</sup> Guangming Zeng,<sup>1,2</sup>  
Zhongwu Li,<sup>1,2</sup> Jiachao Zhang<sup>3</sup>

<sup>1</sup>College of Environmental Science and Engineering, Hunan University, Changsha 410082, China. <sup>2</sup>Key Laboratory of Environmental Biology and Pollution Control (Hunan University), Ministry of Education, Changsha 410082, China. <sup>3</sup>College of Resources and Environment, Hunan Agricultural University, Changsha 410128, China.

\*Corresponding author. E-mail: mchensn@hnu.edu.cn (M.C.); yangc@hnu.edu.cn (C.Y.)

### REFERENCES

1. Q. Shi *et al.*, *J. Nat. Conserv.* **32**, 35 (2016).
2. IUCN, "Red list of threatened species" (2017); [www.iucnredlist.org/details/2892/2890](http://www.iucnredlist.org/details/2892/2890).
3. X. Liang, A. Kang, N. Pettolelli, *Oryx* **51**, 361 (2017).
4. J. Berger *et al.*, *Sci. Rep.* **5**, 8676 (2015).
5. H. H. Lai, *Modern China* **28**, 432 (2002).
6. Xinhuanet, "Length of railroad lines in service extends to 124,000 km where high-speed railway is 22,000 km long" (2017); [www.xinhuanet.com/politics/2017-01/03/c\\_129430123.htm](http://www.xinhuanet.com/politics/2017-01/03/c_129430123.htm) [in Chinese].
7. Xinhuanet, "Length of railroad lines in service extends to 112,000 km" (2015); [www.xinhuanet.com/politics/2015-01/29/c\\_127436479.htm](http://www.xinhuanet.com/politics/2015-01/29/c_127436479.htm) [in Chinese].
8. "The 10th anniversary of Western Development: The achievement of traffic development" (2009); [www.china-highway.com/news/2009/376530.php](http://www.china-highway.com/news/2009/376530.php) [in Chinese].
9. L. Chunlian *et al.*, *Mitochondrial DNA Part A* **27**, 4266 (2016).
10. P. J. Buzzard *et al.*, *Oryx* **44**, 577 (2010).
11. G. B. Schaller, W. Liu, *Biol. Conserv.* **76**, 1 (1996).

10.1126/science.aat6749

## Trout in hot water: A call for global action

Trout are one of the most culturally, economically, and ecologically important taxonomic groups of freshwater fishes worldwide (1). Native to all continents in the Northern Hemisphere, trout belong to seven genera, which are distributed across 52 countries. These cold-water specialists provide recreation and food to millions of people and play important roles in ecosystem functioning and health (2). They are also extremely sensitive to human disturbances because they require cold, clean, complex, and connected habitats for survival and persistence (3)—all attributes that humans have substantially altered and degraded (4, 5). Despite their importance as societal icons and as indicators of biodiversity, many of the world's trout species and lineages are endangered and some require immediate conservation efforts to reverse their precarious decline.

Of the 124 recognized species of trout (6, 7), only 67 (54%) have been assessed by the International Union for Conservation

of Nature (IUCN) (7). Alarming, 73% of these species are currently threatened with global extinction, and four are now extinct (7). Although some of these species are likely subspecies, lineages, or distinct ecotypes, this level of threat is exceptionally high compared with other vertebrate groups assessed by the IUCN (8). Widespread imperilment of trout reflects numerous human activities identified in the IUCN assessments, including invasive species, overfishing, pollution, dams, deforestation, agriculture, grazing, and mining (7). Climate change is further stressing trout populations by warming water temperatures, shifting streamflow regimes, increasing extreme events (such as floods, drought, and wildfire), and facilitating species invasions (9, 10). Worse, climate change often acts in synergy with other stressors to further endanger trout (11, 12), a pattern that will be intensified in coming decades as global temperatures continue to rise, with important consequences for trout, aquatic ecosystem functioning, and human well-being.

Reversing these declines will require progressive conservation efforts to protect native trout diversity and ameliorate ongoing and future threats at local and global scales. To preserve these unique fishes, we must protect ecological and genetic diversity, which are critical for long-term resiliency, viability, and adaptation in the face of rapid environmental change. Innovative conservation approaches include reconnecting rivers with floodplains, establishing native fish refuges, restoring habitat diversity, and reducing invasive species, including non-native trout stocking programs. Moreover, comprehensive, coordinated, and comparable approaches are needed immediately to assess conservation status and to delineate conservation units across the globe, particularly for data-poor species. Only by



Many trout species, such as these native bull trout, are endangered.



addressing threats at their root causes can we accomplish these conservation goals.

**Clint C. Muhlfeld,<sup>1,2\*</sup> Daniel C. Dauwalter,<sup>3</sup> Ryan P. Kovach,<sup>1</sup> Jeffrey L. Kershner,<sup>4</sup> Jack E. Williams,<sup>5</sup> John Epifanio<sup>6</sup>**

<sup>1</sup>Northern Rocky Mountain Science Center, U.S. Geological Survey, West Glacier, MT 59936, USA.

<sup>2</sup>Flathead Lake Biological Station, Division of Biological Sciences, University of Montana, Polson, MT, 59860 USA. <sup>3</sup>Trout Unlimited, Boise, ID 83702, USA. <sup>4</sup>Northern Rocky Mountain Science Center, U.S. Geological Survey, Bozeman, MT 59936, USA.

<sup>5</sup>Trout Unlimited, Medford, OR 97501, USA. <sup>6</sup>Illinois Natural History Survey, University of Illinois, Urbana, IL 61801, USA.

\*Corresponding author. Email: cmuhlfeld@usgs.gov

## REFERENCES AND NOTES

1. J. Prosek, *Trout of the World* (Stewart, Tabori, & Chang, Revised edition, 2013), pp. 224.
2. C. M. Holmlund, M. Hammer, *Ecol. Econ.* **29**, 253 (1999).
3. R. J. Behnke, *Trout and Salmon of North America* (The Free Press, 2002).
4. F. R. Hauer *et al.*, *Sci. Adv.* **2**, e1600026 (2016).
5. A. L. Haak, J. E. Williams, *J. Conserv. Plan.* **9**, 38 (2013).
6. We searched the FishBase database ([www.fishbase.org](http://www.fishbase.org)) for all described freshwater species of trout belonging to the genera *Oncorhynchus*, *Salvelinus*, *Salmo*, *Hucho*, *Parahucho*, *Brachymystax*, and *Salvethymus*.
7. We searched for each species on The IUCN Red List ([www.iucnredlist.org](http://www.iucnredlist.org)). Of the 124 species, IUCN has assessed 67, and of those, 49 are listed as Vulnerable, Endangered, or Critically Endangered, and 4 are extinct.
8. IUCN Red List, "Table 1: Numbers of threatened species by major groups of organisms (1996–2017)" ([http://cmsdocs.s3.amazonaws.com/summarystats/2017-3\\_Summary\\_Stats\\_Page\\_Documents/2017\\_3\\_RL\\_Stats\\_Table\\_1.pdf](http://cmsdocs.s3.amazonaws.com/summarystats/2017-3_Summary_Stats_Page_Documents/2017_3_RL_Stats_Table_1.pdf)).
9. R. P. Kovach *et al.*, *Rev. Fish Biol. Fish.* **26**, 135 (2016).
10. C. C. Muhlfeld *et al.*, *Nat. Clim. Change* **4**, 620 (2014).
11. R. P. Kovach *et al.*, *J. Appl. Ecol.* **54**, 638 (2017).
12. C. C. Muhlfeld *et al.*, *Glob. Change Biol.* **23**, 4663 (2017).

10.1126/science.aat8455

## TECHNICAL COMMENT ABSTRACTS

**Comment on "Plant diversity increases with the strength of negative density dependence at the global scale"**

**Lisa Hülsmann and Florian Hartig**

LaManna *et al.* (Reports, 30 June 2017, p. 1389) claim that subadult trees are proportionally less common at high conspecific adult density (CNDD), and that this effect increases toward the tropics and for rare species. We show that the CNDD-abundance correlation may have arisen from a methodological artifact and that a range of processes can explain the reported latitudinal patterns.

Full text: [dx.doi.org/10.1126/science.aar2435](http://dx.doi.org/10.1126/science.aar2435)

**Response to Comment on "Plant diversity increases with the strength of negative density dependence at the global scale"**

**Joseph A. LaManna, Scott A. Mangan, Alfonso Alonso, Norman A. Bourg, Warren Y. Brockelman, Sarayudh Bunyavejchewin, Li-Wan Chang, Jyh-Min Chiang, George B. Chuyong, Keith Clay, Susan Cordell, Stuart J. Davies, Tucker J. Furniss, Christian P. Giardina, I. A. U. Nimal Gunatilleke, C. V. Savitri Gunatilleke, Fangliang He, Robert W. Howe, Stephen P. Hubbell, Chang-Fu**

**Hsieh, Faith M. Inman-Narahari, David Janík, Daniel J. Johnson, David Kenfack, Lisa Korte, Kamil Král, Andrew J. Larson, James A. Lutz, Sean M. McMahon, William J. McShea, Hervé R. Memiaghe, Anuttara Nathalang, Vojtech Novotny, Perry S. Ong, David A. Orwig, Rebecca Ostertag, Geoffrey G. Parker, Richard P. Phillips, Lawren Sack, I-Fang Sun, J. Sebastián Tello, Duncan W. Thomas, Benjamin L. Turner, Dilys M. Vela Díaz, Tomáš Vrška, George D. Weiblen, Amy Wolf, Sandra Yap, Jonathan A. Myers**

Hülsmann and Hartig suggest that ecological mechanisms other than specialized natural enemies or intraspecific competition contribute to our estimates of conspecific negative density dependence (CNDD). To address their concern, we show that our results are not the result of a methodological artifact and present a null-model analysis that demonstrates our original findings—(i) stronger CNDD at tropical relative to temperate latitudes, and (ii) a latitudinal shift in the relationship between CNDD and species abundance—persist even after controlling for other processes that might influence spatial relationships between adults and recruits.

Full text: [dx.doi.org/10.1126/science.aar3824](http://dx.doi.org/10.1126/science.aar3824)

**Comment on "Plant diversity increases with the strength of negative density dependence at the global scale"**

**Ryan A. Chisholm and Tak Fung**

LaManna *et al.* (Reports, 30 June 2017, p. 1389) found higher conspecific negative density dependence in tree communities at lower latitudes, yielding a possible mechanistic explanation for the latitudinal diversity gradient. We show that their results are artifacts of a selective data transformation and a forced zero intercept in their fitted model. A corrected analysis shows no latitudinal trend.

Full text: [dx.doi.org/10.1126/science.aar4685](http://dx.doi.org/10.1126/science.aar4685)

**Response to Comment on "Plant diversity increases with the strength of negative density dependence at the global scale"**

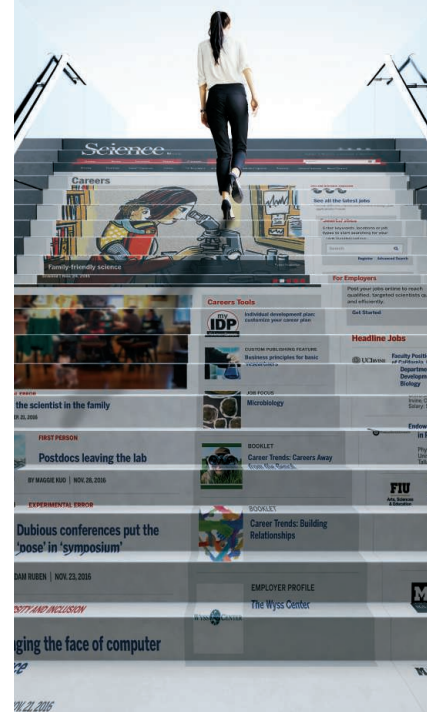
**Joseph A. LaManna *et al.***

Chisholm and Fung claim that our method of estimating conspecific negative density dependence (CNDD) in recruitment is systematically biased, and present an alternative method that shows no latitudinal pattern in CNDD. We demonstrate that their approach produces strongly biased estimates of CNDD, explaining why they do not detect a latitudinal pattern. We also address their methodological concerns using an alternative distance-weighted approach, which supports our original findings of a latitudinal gradient in CNDD and a latitudinal shift in the relationship between CNDD and species abundance.

Full text: [dx.doi.org/10.1126/science.aar5245](http://dx.doi.org/10.1126/science.aar5245)

**ScienceCareers**  
FROM THE JOURNAL SCIENCE AAAS

Step up  
your job  
search with  
**Science  
Careers**



- Access thousands of job postings
- Sign up for job alerts
- Explore career development tools and resources

Search [ScienceCareers.org](http://ScienceCareers.org)

## Brazil's government attacks biodiversity

Flávio Alicino Bockmann, Miguel Trefaut Rodrigues, Tiana Kohlsdorf, Lorian Cobra Straker, Taran Grant, Mário César Cardoso de Pinna, Fernando Luis Medina Mantelatto, Aléssio Datovo, José Perez Pombal Jr., John Campbell McNamara, Eduardo Andrade Botelho de Almeida, Wilfried Klein, Annie Schmaltz Hsiou, Milton Groppo, Ricardo Macedo Corrêa e Castro and Dalton de Souza Amorim

*Science* **360** (6391), 865.  
DOI: 10.1126/science.aat7540

### ARTICLE TOOLS

<http://science.sciencemag.org/content/360/6391/865.1>

### REFERENCES

This article cites 3 articles, 1 of which you can access for free  
<http://science.sciencemag.org/content/360/6391/865.1#BIBL>

### PERMISSIONS

<http://www.sciencemag.org/help/reprints-and-permissions>

Use of this article is subject to the [Terms of Service](#)

---

*Science* (print ISSN 0036-8075; online ISSN 1095-9203) is published by the American Association for the Advancement of Science, 1200 New York Avenue NW, Washington, DC 20005. 2017 © The Authors, some rights reserved; exclusive licensee American Association for the Advancement of Science. No claim to original U.S. Government Works. The title *Science* is a registered trademark of AAAS.