LETTERS

Edited by **Jennifer Sills**

A genomics revolution in amphibian taxonomy

Amphibians feature the highest rates of both new species discoveries and species declines among vertebrates worldwide (*1*). To characterize this diversity faster than it disappears, zoologists have been using molecular data to rapidly describe new frog and salamander lineages, from species to family levels (*2*). About a third of the approximately 8500 known amphibian species (*3*) were first described in 2005 or later (*4*). However, mainstream species description practices relying on one or a few genes are critically flawed.

The majority of taxonomic descriptions rely on a few mitochondrial or nuclear-encoding genes (known as DNA barcodes). Because the variation of a small set of genes is often poorly indicative of the true evolutionary history of populations, overreliance on DNA barcodes distorts our perception of species diversity and distributions (*5*). In addition, a substantial proportion of newly identified amphibians merely consist of populations of the same species separated by geography that differ at the few genes analyzed. The ongoing trend of splitting such genetic lineages into multiple species ("phylogenetic species") artificially increases the total number of species identified on Earth (an issue known as "taxonomic inflation"), a shortcoming that complicates conservation, social, and economic decision-making (*6*).

Emerging genomic data are demonstrating the risks of these practices (*7*). The unreliability of frequently used DNA barcodes appears to be more common than previously assumed. Any new amphibian taxon supported mostly by mitochondrial divergence could be a "ghost lineage" (i.e., not a real extant species). Furthermore, it might be affiliated to the wrong clade, and its rank as a "species" might be inappropriate. Its name might also be mistaken because the type locality (i.e., the reference population where the taxon was first described) was misidentified (*7*).

Because of these ambiguities, the massive number of recent amphibian species descriptions will undoubtedly require time-consuming taxonomic revisions in the near future. To limit the confusion, we call for more cautious interpretations of genetic data in testing new species hypotheses. Given their higher resolution, genomic datasets will ultimately recover any structured population as unique genetic lineages, rendering the idea of "phylogenetic species" obsolete (*8*). The rise of genomics in taxonomy will inevitably require a conceptual revolution.

Christophe Dufresnes[1] and Daniel Jablonski[2]
[1]Laboratory for Amphibian Systematic and Evolutionary Research, College of Biology and the Environment, Nanjing Forestry University, Nanjing, China. [2]Department of Zoology, Comenius University in Bratislava, Bratislava, Slovakia.
*Corresponding author.
Email: christophe.dufresnes@hotmail.fr

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The green toad (*Bufotes sitibundus*) has been misidentified as a result of overreliance on single-gene barcoding.

PHOTO: DANIEL JABLONSKI

Comprehensive support for diversity in STEM

In their Policy Forum "Achieving STEM diversity: Fix the classrooms" (3 June, p. 1057), J. Handelsman *et al.* explain that past interventions have not resulted in equitable representation for students from historically excluded communities in science, technology, engineering, and mathematics (STEM). We agree that implementation of their suggested classroom changes would likely contribute to greater persistence and retention in STEM throughout college. However, fixing the classroom alone will not be sufficient. If we are to achieve a fully inclusive workforce (*1*, *2*), we need a comprehensive approach that simultaneously and collaboratively addresses factors both within and outside the classroom (*3*).

Recruitment into a scientific discipline requires classroom experiences that stimulate curiosity and foster the sense that a career in the field is possible (*4*, *5*). Once student interest is piqued, retention demands financial, mentoring, and advising support (*6*), all of which occur outside the classroom. Achieving positive change in workplace demographics requires increased attention to postgraduation factors. For instance, employers must reconsider where and how they advertise positions to reach diverse populations. They must also recognize that stating preferences for candidates with work or internship experience (*7*) may deter otherwise qualified candidates from historically excluded communities, who have not had access to internships or relevant work experience, from applying. Employers also need to mitigate potential unconscious biases in the interview and hiring processes by using strategies such as standardized interview questions (*8*, *9*).

Institutions and organizations need to dismantle barriers to equity and build a culture of inclusion through career mentoring and sponsorship programs. Equity-focused mechanisms that support vulnerable groups, opportunities that recognize their contributions, and clear paths for professional advancement are critical (*10–12*). An ecosystem approach that includes classroom fixes, individual support, and institutional culture change is essential for achieving enduring diversity in STEM.

Teresa Mourad[1]* and George Middendorf[2]
[1]Ecological Society of America, Washington, DC 20036, USA. [2]Howard University, Washington, DC 20059, USA.
*Corresponding author. Email: teresa@esa.org

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In memoriam

The *Science* family mourns longtime copyeditor Jeffrey Cook, who died unexpectedly last month. Jeff joined AAAS in 1994. He was a true perfectionist and cared deeply about language, editing, and scientific communication. Thousands of *Science* papers published over the past three decades are clearer and more accurate because of Jeff's meticulous dedication to his craft. He deftly transitioned from the hardcopy era to the world of online publication. Beyond being a mainstay of the Editorial team, Jeff was an accomplished musician and multi-instrumentalist. When *Science* launched its weekly podcast in 2007, Jeff composed the theme music, which still welcomes listeners to this day. Jeff was kind, talented, and thorough. He will be missed.

Ecological footprint of Russia's Ukraine invasion

Russia's invasion of Ukraine continues to have a devastating effect on the well-being of Ukrainians and their economy (*1*). The tragic human consequences will be compounded by the long-term ecological implications of the war, such as the contamination of soil and water by the weaponry and other pollutants, wildfires and disruptions to ecosystem structure and services, and the environmental impact of the eventual postwar rebuilding activities (*2*, *3*). Ongoing hostilities in the vicinity of the Zaporizhzhia Nuclear Power Station (the biggest in Europe) highlight the risks of large-scale nuclear disaster (*4*). To prepare for Ukraine's recovery, we need to understand both the current and long-term environmental impacts of the war (*2–5*).

The Ukrainian government has established the Operational Headquarters of the State Environmental Inspectorate to create an inventory of war damages (*6*). The damage is broadly divided into several categories, including infrastructure and ecology. Infrastructure damage evaluation will benefit from on-the-ground observations, remote sensing data, and media reports (*7–9*). In contrast, the long-lasting detrimental effects on the environment and the resulting ecosystem damages are notoriously difficult to quantify, especially during wartime and by a resource-constrained governmental authority (*10–12*).

The international science community can complement the top-down, government-driven, centralized approach by Ukrainian institutions by conducting robust, decentralized, distributed research. Researchers, managers, and funding institutions can help by developing collaborative projects that focus on the ecological impacts of the war, including assessment of the costs of remediation efforts. We hope that the body of knowledge accumulated through such studies would provide a reference point for subsequent remediation plans in Ukraine as well as evidence to support postwar reparation claims to Russia. It could also provide a blueprint for wartime damage and recovery assessments in other parts of the world affected by military conflicts.

Mark Zheleznyak[1]*, Gennadii Donchyts[2], Vladimir Maderich[3], Iryna Dronova[4], Pavel Tkalich[5], Dmytro Trybushnyi[6], Boris Faybishenko[7], Alla Dvorzhak[8]
[1]Institute of Environmental Radioactivity, Fukushima University, Fukushima, Japan. [2]Deltares, Delft, Netherlands. [3]Institute of Mathematical Machine and System Problems, National Academy of Science, Kyiv, Ukraine. [4]Department of Environmental Science, Policy and Management and Department of Landscape Architecture and Environmental Planning, University of California Berkeley, Berkeley, CA 94720, USA. [5]Tropical Marine Science Institute, National University of Singapore, Singapore 119222, Singapore. [6]Institute for Thermal Energy Technology and Safety, Karlsruhe Institute of Technology, Karlsruhe, Germany. [7]Energy Geosciences Division, Earth and Environmental Sciences Area, Lawrence Berkeley National Laboratory, Berkeley, CA 94720, USA. [8]Centre for Energy, Environment and Technology Research, Madrid, Spain.
*Corresponding author.
Email: r702@ipc.fukushima-u.ac.jp

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Teresa MouradGeorge Middendorf

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