



## Taxing Debate for Taxonomists

**AS EDITOR-IN-CHIEF OF *THE AMERICAN Journal of Botany***, which regularly publishes articles dealing with plant molecular and morphological systematics, I found Elizabeth Pennisi's News Focus article "Linnaeus's last stand?" (23 Mar., p. 2304) as cogent and well balanced as the logic of the proposed PhyloCode is ill conceived and worrisome.

The PhyloCode system of taxonomic classification rests on the proposition that cladistically based phylogenetic relationships are sufficiently stable such that formal taxonomic designations can be ascribed to critical cladogram nodes or node clusters. My experience as an editor indicates that nothing could be farther from reality. In the scramble to publish—and publish often—it is not uncommon to find some authors submitting for review new cladograms overturning the systematic relationships they've published in a preceding issue of the same journal. Until the phylogenetic relationships among plant and animal taxa become reasonably well stabilized in the literature, the use of the PhyloCode could thus lead to endless (almost monthly) revision of plant and animal names.

Equally worrisome is that fact that a small, albeit vociferous, group of PhyloCode advocates appear eager to bypass the protocols established internationally by generations of scientists who have been duly appointed by the scientific community to modify as well as codify the Linnaean system. This premature usurpation of well-established and time-tested scientific protocols is probably doomed to failure, but not before it may cause irreparable harm and confusion.

The Linnaean system is anything but antiquated or inadequate. It provides stability, flexibility, and a high degree of structure that facilitates communication, information retrieval, and editorial sanity. In contrast, the precepts of

the PhyloCode appear to rest on the currently unstable bifurcate hierarchies of seemingly endlessly revised cladograms, whose nodes may have nothing to say about the hierarchy of taxonomic ranks or their biology.

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**SOME OF THE COMMENTS MADE IN PENNISI'S** News Focus article by detractors of the PhyloCode, the project to develop a phylogenetic code of biological nomenclature, are misleading.

First, contrary to Kevin Nixon's complaint that PhyloCode proponents "have the ear of the large funding agencies" and

Jerrold Davis's comment that the project is "starting to consume resources," the PhyloCode project has never re-



**The stability of names is of primary concern to taxonomists, a problem illustrated by the name changes of the groups to which these plants belong.\* The Linnaean and PhyloCode systems have different sources of name instability.**

\* See Pennisi's article for details.



ceived support from any source outside the home institutions of the authors and members of the advisory group.

To date, this has been a low-budget operation that has in no way competed for the funds available for systematic biology research.

Second, contrary to Nixon's concern that we "are going to erect a shadow government and [set up] a coup," proponents of the PhyloCode do not wish, nor do we have the power, to force the community of systematic biologists to adopt our propos-

als. As stated in the Preface of the PhyloCode ([www.ohio.edu/phylocode](http://www.ohio.edu/phylocode)), "[t]he PhyloCode is designed so that it can be used concurrently with the preexisting codes or (after rules governing species names are added) as the sole code governing the names of taxa, if the scientific community ultimately decides that it should." If this new code of nomenclature is eventually adopted by a substantial number of systematic biologists, adherence to its rules will only be enforced by the members of the community themselves.

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**PLANTS AND ANIMALS ARE NOT THE ONLY** groups facing renaming problems that would be introduced by the proposed PhyloCode classification scheme. Similar difficulties have afflicted the world of microbes, especially bacteria. Rampant renaming of bacteria, based on an assumed "Rosetta Stone"—namely, a single molecular property (16S RNA sequence)—is causing confusion in literature searches and also has the potential to interfere with prompt identification of bacteria important in medicine and public health.

One such example, the proposed reclassification of *Chlamydia*, has been challenged by Schacter *et al.* (1). They note that creation of an excessive nomen-

### Letters to the Editor

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clature based on a single molecular sequence difference "will only produce chaos and would not result in nomenclature stability" (2). A perceptive article by R. A. Lewin (3) illustrates why there is no benefit from adopting many proposed taxonomic rearrangements or name changes.

Schemes for revision of bacterial taxonomy and name changes based on limited "molecular trees" have become muddled by the discovery of widespread lateral gene transfer among bacterial species. Thus, neat-looking molecular trees have begun to anastomose and now resemble tangled masses of spaghetti. The complexities of bacterial evolution have been greatly underestimated by those who believe we can now trace billions of years of bacterial evolutionary history with a simple "molecular litmus test." We advise a moratorium on useless name changes pending more research on the course of evolution of microbial cells (in contrast to evolution of 16S RNA molecules).

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#### References and Notes

1. J. Schacter *et al.*, *Int. J. Syst. Evol. Microbiol.* **51**, 249 (2001).
2. For a similar view on "taxonomic ambiguities," see H. Gest, J. Favinger, *Int. J. Syst. Evol. Microbiol.* **51**, 707 (2001).
3. R. A. Lewin, *Nature* **410**, 637 (2001).

**THE DEBATE BETWEEN THE SUPPORTERS OF PhyloCode and those of the traditional Linnaean classification system could benefit from the wisdom of Thomas Jefferson. Eighteenth-century scientists proposed a variety of nomenclatures. Jefferson accepted the importance and usefulness of such systems, but believed them to be inherently arbitrary (man's attempt to organize the units of nature) and subject to error. He reviewed the various nomenclatures first proposed by Ray, Klein, Brisson, and, finally, Linnaeus, which competed with the systems of Blumenbach and Cuvier.**

After thoughtful analysis, Jefferson supported the Linnaean system for a number of reasons. More importantly, Jefferson reflected on the validity of nomenclature systems in general: "But to this objection every mode of classification must be liable, because the plan of creation is inscrutable to our limited faculties. Nature has not arranged her productions on a single and direct line. They branch at every step, and in every direction, and he who attempts to reduce them into departments, is left to do it by the lines of his own fancy" (1).

As PhyloCode proponents argue that their system would fix a fundamental flaw in the Linnaean system, they too must be reminded that Jefferson recommended cau-

tion before supporting novel systems, lest competing nomenclatures actually lead to confusion. The scientific community must be cautious in quickly accepting multiple systems, a situation that could lead to more, not less, organizational confusion.

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#### References and Notes

1. Letter to John Manners, 22 February 1814, in M. D. Peterson, Ed., *Thomas Jefferson: Writings* (Literary Classics of the United States, New York, 1984).

## Invasive Carp in the Mississippi River Basin

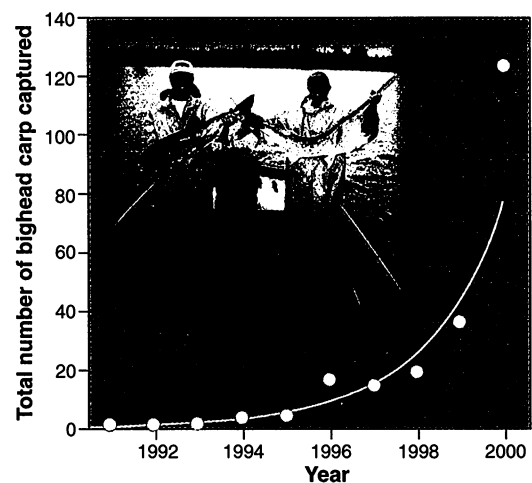
**BLACK CARP POSE A POTENTIAL THREAT TO the ecology of the Mississippi River Basin, as Dan Ferber warns in his News Focus article "Will black carp be the next zebra mussel?" (13 Apr., p. 203). Nevertheless, before black carp ever become a problem, the Mississippi Basin will have been contending with two other invasive Asian carp, bighead and silver carp, for several years. Both species were brought to the United States in the 1970s for use in aquaculture, escaped into the Mississippi River soon thereafter, and subsequently established reproducing populations in the Mississippi, Missouri, Ohio, and Illinois rivers (1). Recently, populations of these two species have increased dramatically in certain areas. For example, the bighead carp population in navigation pool 26 of the Mississippi River (near St. Louis, Missouri) appears to be increasing exponentially (see the figure). An exceptional year class of bighead carp was produced in the La Grange reach of the Illinois River (near Peoria, Illinois) in 2000, with the total number of carp captured increasing by two orders of magnitude compared with previous years (i.e., from less than 10 per year to more than 1100 captured in 2000).**

Catch data from commercial fishers also show dramatic increases in recent years. From 1988 to 1992, the combined annual harvest of bighead and silver carp by Illinois commercial fishers in the Mississippi and Illinois rivers was less than 600 kilograms (2). Total harvest increased to more than 5000 kilograms in 1994 and has been greater than 50,000 kilograms since 1997.

Bighead and silver carp pose a threat to the ecology of the Mississippi River Basin and connecting aquatic ecosystems. Both species are filter feeders, consuming a va-

riety of planktonic organisms, and are capable of significantly reducing zooplankton abundance in ponds and lakes (3). Because all fishes forage on planktonic organisms during their early life history stages, bighead and silver carp have the potential to adversely affect every species of fish in the Mississippi River Basin. Additionally, several fishes native to the Mississippi River Basin are filter feeders as adults, including paddlefish (listed as a species of special concern by the U.S. Fish and Wildlife Service), bigmouth buffalo, and gizzard shad. If nothing is done to halt the upstream spread of bighead and silver carp in the Illinois River, they will soon enter the Great Lakes, ecosystems already stressed by introductions of sea lamprey, zebra mussel, and the round goby.

Once a nonnative species successfully invades an ecosystem, it is often difficult or



**Bighead, big problem.** Researchers in the Long Term Resource Monitoring Program (7) sample fishes each year from June through October. Catch data for navigation pool 26 of the Mississippi River reveal an exponential increase in bighead carp (8). (Inset) A bighead carp (left) and a fellow filter feeder, a paddlefish, were caught in the same net in pool 26.

impossible to eradicate it (4). Extirpating populations of bighead and silver carp from the Mississippi River Basin will require detailed information about the biology of these species specific to this system, including their reproductive behavior and the habitats used by larvae and juveniles. Nevertheless, such information does not guarantee a workable solution will exist. These problems highlight the need to prevent introductions of non-native species through management and laws such as the National Invasive Species Act of 1996, which is up for reauthorization this year (5). Currently, an electric barrier is under construction on the Chicago Waterway to prevent the movement of round goby from Lake Michigan to the Upper Mississippi River System (6). Re-

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