

## Organisms from Molecules to the Environment

Author: Beardsley, Timothy M.

Source: BioScience, 56(8) : 635

Published By: American Institute of Biological Sciences

URL: [https://doi.org/10.1641/0006-3568\(2006\)56\[635:OFMTTE\]2.0.CO;2](https://doi.org/10.1641/0006-3568(2006)56[635:OFMTTE]2.0.CO;2)

---

BioOne Complete ([complete.BioOne.org](https://complete.BioOne.org)) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at [www.bioone.org/terms-of-use](https://www.bioone.org/terms-of-use).

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

---

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

## NEWS & OPINION

---

- EDITORIAL  
**635 Perennials Forever**  
*Timothy M. Beardsley*
- VIEWPOINT  
**638 Faith-based Evolution Education?**  
*Ross H. Nehm*
- VIEWPOINT  
**640 Who Is Science Writing For?**  
*Margaret Wertheim*
- FEATURE  
**642 On a Collision Course: Ocean Plankton and Climate Change**  
*Cheryl Lyn Dybas*
- WASHINGTON WATCH  
**648 Senators Propose Fundamental Change to Scholarly Publishing**  
*Robert E. Gropp*
- AIBSNEWS  
**698** AIBS Executive Director's Blog Now Online • Photos from the 2006 AIBS Annual Meeting Now Available Online; Lectures to Follow • Recent Articles Online at [www.actionbioscience.org](http://www.actionbioscience.org) • Recent AIBS Public Policy Reports Online at [www.aibs.org](http://www.aibs.org)
- BIOBRIEFS  
**704 Chase Lake Pelicans Make a Comeback**  
*Jeffrey P. Cohn*



## OVERVIEW ARTICLES

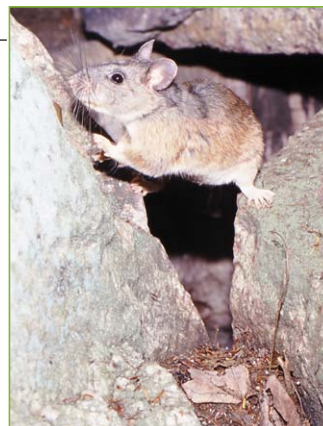
---

- 649 Prospects for Developing Perennial Grain Crops**  
*Thomas S. Cox, Jerry D. Glover, David L. Van Tassel, Cindy M. Cox, and Lee R. DeHaan*
- 661 A Thirty-Year Study of Phenotypic and Genetic Variation of Blue Tits in Mediterranean Habitat Mosaics**  
*Jacques Blondel, Donald W. Thomas, Anne Charmantier, Philippe Perret, Patrice Bourgault, and Marcel M. Lambrechts*
- 675 Tidal Marshes: A Global Perspective on the Evolution and Conservation of Their Terrestrial Vertebrates**  
*Russell Greenberg, Jesus E. Maldonado, Sam Droege, and M. V. McDonald*

## DEPARTMENTS

---

- FORUM  
**687 Toward a Synthetic View of Extinction: A History Lesson from a North American Rodent**  
*Kathleen LoGiudice*



**DEPARTMENTS** (continued)

<b>Officers</b>	<b>636</b>
<b>Letters</b>	<b>637</b>
<b>New Titles</b>	<b>697</b>
<b>Calendar</b>	<b>700</b>
<b>Classifieds</b>	<b>701</b>
<b>Information for Contributors</b>	<b>702</b>

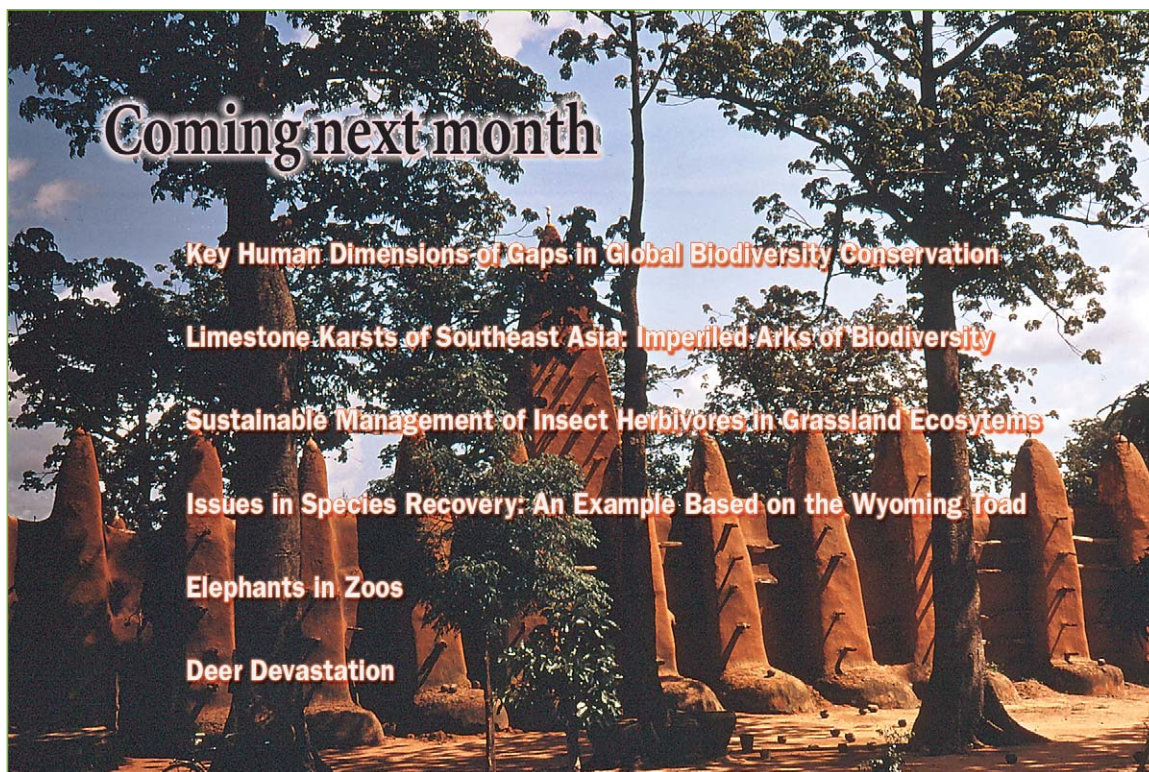
BOOK REVIEWS

**694** **Species Invasions: Insights into Ecology, Evolution, and Biogeography**  
*Dov F. Sax, John J. Stachowicz, and Steven D. Gaines, eds. Reviewed by James T. Carlton*

**695** **Robustness and Evolvability in Living Systems**  
*Andreas Wagner. Reviewed by Claus O. Wilke*

**696** **Holistic Darwinism: Synergy, Cybernetics, and the Bioeconomics of Evolution**  
*Peter A. Corning. Reviewed by Brian Charlesworth*

Cover: The Allegheny woodrat (*Neotoma magister*), shown in the large photograph wearing a radio collar, is native to the Appalachians. The species has undergone a pronounced decline in much of its range over the past 30 years, and possibly longer. No single cause seems to explain the species' near disappearance, but in the article that begins on p. 687, Kathleen LoGiudice provides a historical–ecological analysis pointing to several pressures that may have contributed. They include the declining dominance of oak (*Quercus*) species, which supply acorns the woodrats eat; fragmentation of talus habitat used for den sites; loss of the American chestnut (*Castanea dentata*) as a winter food source; and increased exposure to the parasitic raccoon roundworm (*Baylisascaris procyonis*). She considers these factors in the context of the changing Appalachian wildlife community of the 19th and 20th centuries. Photographs: Kathleen LoGiudice.



PUBLISHER  
Richard T. O'Grady

EDITOR IN CHIEF  
Timothy M. Beardsley

SENIOR EDITOR  
Donna Daniels Verdier

PRODUCTION MANAGER / ART DIRECTOR  
Herman Marshall

PUBLICATIONS ASSISTANT  
Jennifer A. Williams

**Editors:** Eye on Education: Susan Musante (educationoffice@aibs.org); Feature articles: Cathy Lundmark (features@aibs.org); Washington Watch: Robert E. Gropp (publicpolicy@aibs.org).

**Editorial Associate:** Barbara J. Orton.

**Editorial Board:** Agriculture: Sonny Ramaswamy; Animal Behavior: Janice Moore; Animal Development: Paula Mabee; Botany: Gregory J. Anderson; Cell Biology: Randy Wayne; Ecology: Scott Collins, Daniel Simberloff; Ecotoxicology: Judith S. Weis; Education: Gordon E. Uno; Environmental Policy: Gordon Brown, J. Michael Scott; Evolutionary Biology: James Mallet; Genetics and Evolution: Martin Tracey; History and Philosophy: Richard M. Burian; Invertebrate Biology: Kirk Fitzhugh; Landscape Ecology: Monica Turner; Microbiology: Edna S. Kaneshiro; Molecular Biology: David Hillis; Molecular Evolution and Genomics: David Rand; Neurobiology: Cole Gilbert; Plant Development: Cynthia S. Jones; Policy Forum: Eric A. Fischer; Population Biology: Ben Pierce; Professional Biologist: Jean Wyld; Sensing and Computation: Geoffrey M. Henebry; Statistics: E. Barry Moser; Vertebrate Biology: Harvey B. Lillywhite.

**Editorial Correspondence:** 1444 I Street, NW, Suite 200, Washington, DC 20005; telephone: 202-628-1500; fax: 202-628-1509; e-mail: bioscience@aibs.org. Instructions for preparing a manuscript for *BioScience* can be found at [www.aibs.org/bioscience/resources/Info\\_for\\_contribs.pdf](http://www.aibs.org/bioscience/resources/Info_for_contribs.pdf).

**Advertising:** For information on both display and line classified advertisements and deadlines, contact John Rasanen, American Geological Institute; telephone: 703-379-2480, ext. 224; fax: 703-379-7563; e-mail: jrasanen@aibs.org.

**BioScience** (ISSN 0006-3568) is published monthly by the American Institute of Biological Sciences. To subscribe, call 1-800-992-2427, ext. 29. Individual membership: sustaining, \$90/yr; individual, \$70/yr; family, \$90/yr (includes \$36 for *BioScience*); emeritus, \$50/yr; K-12 teacher/administrator, \$45/yr (includes \$22 for *BioScience*); graduate and postdoctoral students, \$40/yr (includes \$21 for *BioScience*); undergraduate and K-12 students, \$20/yr (includes \$15 for *BioScience*); lifetime, \$1400 (one-time fee). Institutional subscriptions: domestic, \$280/yr; foreign, \$336/yr. Single copies: \$14 plus shipping and handling for up to 20 copies; volume discounts available for more than 20 (call 1-800-992-2427, ext. 29). Subscription renewal month is shown in the four-digit year-month code in the upper right corner of the mailing label.

© 2006 American Institute of Biological Sciences. All rights reserved. Periodical postage paid at Washington, DC, and additional mailing offices.

**POSTMASTER:** Send address changes to *BioScience* Circulation, AIBS, 1313 Dolley Madison Blvd., Suite 402, McLean, VA 22101. Printed in USA. AIBS authorizes photocopying for internal or personal use, provided the appropriate fee is paid directly to the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923; telephone: 978-750-8400; fax: 978-750-4744; Web site: [www.copyright.com](http://www.copyright.com). To photocopy articles for classroom use, request authorization, subject to conditions thereof, from the Academic Permissions Service at CCC. Each copy must say "© [year] by the American Institute of Biological Sciences." Statements and opinions expressed in *BioScience* are those of the author(s) and do not necessarily reflect the official positions of the American Institute of Biological Sciences, the editors, the publisher, or the institutions with which the authors are affiliated. The editors, publisher, and AIBS disclaim any responsibility or liability for such material.

# BioScience

## Organisms from Molecules to the Environment

American Institute of Biological Sciences

### Perennials Forever

Humanity has achieved its present world-dominating status fueled largely by annual crops, principally maize, rice, wheat, and other grains, as well as legumes. Perennial crops supply most forage (and fruits and nuts), but have not thus far hit the big time as suppliers of calories to humans.

There are powerful reasons, however, for supporting the development of new perennial grain crops, despite abundant difficulties. As Thomas S. Cox of the Land Institute and his coauthors explain in the article that starts on p. 649, perennials thrive on land that is marginal for annual cropping; in comparison with annuals, perennials use nutrients more efficiently, produce more biomass, and can photosynthesize over a longer part of the year. They can also tolerate increasing temperatures and curb soil erosion better than annual crops.

Set against those advantages are their smaller seed yields and size, asynchronous ripening, and a tendency to spontaneously shed seed before harvest. Nonetheless, there are good reasons to believe that artificial selection—augmented by new technologies and genetic analysis—will make it possible to develop perennial grain crops with acceptable yields. The Land Institute is working on several possibilities, notably intermediate wheatgrass, wheat, sorghum, and sunflower. But as Cox and his coauthors make clear, the biological obstacles to rapid progress remain formidable.

The millions who die from malnutrition worldwide—together with the still rapidly growing world population and mounting pressure on ecosystems of all types—are a quite sufficient argument for stepped-up efforts to develop improved perennial crops, both for forage and for human food. Nitrogen fertilizers and the Green Revolution have allowed annuals to supply most of the food needs of 6.5 billion *Homo sapiens*, but, as *BioScience* readers are well aware, the growth has come at a high price, and some different options may become very compelling in decades to come.

Growing alarm about rising oil prices provides another argument. Biofuels, including ethanol and biodiesel, have enormous promise for bolstering energy supplies, because liquid fuels are civilization's most pressing vulnerability. Corn-based ethanol, which is now in vogue, is not a long-term solution: The environmental costs of producing it seem certain to prevent its filling more than a small fraction of gasoline demand, however much US farmers may wish otherwise. Some perennial grains now being developed as food oil sources, such as sunflower and flax, could also prove valuable in biofuels of the future. They too will have environmental costs and, doubtless, competitors. But at this early stage of biofuel development, the more choices, the better. Let a thousand (perennial) flowers bloom.

TIMOTHY M. BEARDSLEY  
Editor in Chief



**2006 Officers and Board of Directors**

**President**

Kent E. Holsinger  
University of Connecticut

**President-Elect**

Douglas J. Futuyma  
State University of New York

**Immediate Past-President**

Marvalee H. Wake  
University of California–Berkeley

**Secretary**

Dan L. Johnson  
(2005–2007)  
University of Lethbridge  
and Research Centre

**Treasurer**

Richard B. Norgaard  
(2004–2006)  
University of California–Berkeley

**Board Members**

Charles Berry  
(2005–2007)  
South Dakota State University

Arturo Gómez-Pompa  
(2004–2006)  
University of California–Riverside

Eric S. Nagy  
(2006–2008)  
University of Virginia

Barbara Schaal  
(2005–2007)  
Washington University

J. Michael Scott  
(2004–2006)  
University of Idaho

Geraldine W. Twitty  
(2005–2007)  
Howard University

Gordon Uno  
(2005–2007)  
University of Oklahoma

Terry Yates  
(2006–2008)  
University of New Mexico

Richard T. O'Grady  
(ex-officio)  
AIBS Executive Director

**Member Societies and Organizations**

- Academy of Natural Sciences
- American Arachnological Society
- American Association of Botanical Gardens and Arboreta
- American Bryological and Lichenological Society
- American Fern Society
- American Fisheries Society
- American Malacological Society
- American Mosquito Control Association
- American Museum of Natural History
- American Ornithologists' Union
- American Phytopathological Society
- American Society for Gravitational and Space Biology
- American Society for Photobiology
- American Society of Agronomy
- American Society of Ichthyologists and Herpetologists
- American Society of Limnology and Oceanography
- American Society of Mammalogists
- American Society of Naturalists
- American Society of Parasitologists
- American Society of Plant Biologists
- American Society of Plant Taxonomists
- American Type Culture Collection
- Animal Behavior Society
- Arkansas State University Department of Biological Sciences
- Association for Politics and the Life Sciences
- Association for Tropical Biology and Conservation
- Association of College and University Biology Educators
- Association of Ecosystem Research Centers
- Association of Southeastern Biologists
- Bailey-Matthews Shell Museum
- Bell Museum of Natural History
- Berkeley Natural History Museums
- Biological Sciences Curriculum Study
- BioQUEST Curriculum Consortium
- Bishop Museum
- Botanical Research Institute of Texas
- Botanical Society of America
- Brooklyn Botanic Garden
- Burke Museum of Natural History
- Cactus and Succulent Society of America
- California Academy of Sciences
- Carnegie Museum of Natural History
- Cell Stress Society International
- The Centennial Museum
- Charles R. Connor Natural History Museum
- Chicago Botanic Garden
- Cleveland Museum of Natural History
- Coastal Education and Research Foundation
- Cooper Ornithological Society
- Cornell Center for the Environment
- Cornell University Department of Plant Biology
- Council of Science Editors
- Crop Science Society of America
- Dallas Museum of Natural History
- Delaware Museum of Natural History
- Denver Museum of Nature and Science
- Ecological Society of America
- Entomological Society of America
- Entomological Society of Canada
- Estuarine Research Federation
- Field Museum
- Florida Division of Plant Industry
- Florida Marine Research Institute
- Florida Museum of Natural History
- Freshwater Mollusk Conservation Society
- Georgia Museum of Natural History
- Gulf Coast Research Laboratory
- Harvard Museum of Comparative Zoology
- The Helminthological Society of Washington
- Herpetologists' League
- Human Anatomy and Physiology Society
- Hunt Institute for Botanical Documentation
- Illinois Natural History Survey
- Illinois State Museum
- Instituto de Geología, UNAM
- International Association for Bear Research and Management
- International Association for Landscape Ecology, US Region
- International Society for Ecological Modelling
- International Society of Protistologists
- Kansas (Central States) Entomological Society
- Kansas University Natural History Museum and Biodiversity Institute
- Long Term Ecological Research Network
- Louisiana Museum of Natural Science
- Miami University, W. S. Turrell Herbarium
- Michigan State University Museum
- Milwaukee Public Museum
- Mississippi Museum of Natural Science
- Missouri Botanic Garden
- Monte L. Bean Museum of Life Sciences
- Moore Laboratory of Zoology
- Morton Arboretum
- Museum of Southwestern Biology
- Mycological Society of America
- National Association of Biology Teachers
- National Association of Marine Laboratories
- National Evolutionary Synthesis Center
- National Museum of Natural History
- National Shellfisheries Association
- National Tropical Botanical Garden
- Natural Areas Association
- Natural History Museum of Los Angeles County
- Natural Science Collections Alliance
- NatureServe
- New Mexico Museum of Natural History and Science
- New Mexico State University Department of Entomology, Plant Pathology, and Weed Science
- New York Botanic Garden
- New York State Museum
- North American Benthological Society
- North American Lake Management Society
- North Carolina Botanical Garden
- North Carolina Museum of Natural Science
- North Carolina State University Insect Collection
- Ohio State University Museum of Biological Diversity
- Ohio University Department of Environmental and Plant Biology
- Oklahoma State University, Office of the President
- Organization for Tropical Studies
- Organization of Biological Field Stations
- The Orthopterists' Society
- Paleontological Research Institution
- Peabody Museum of Natural History
- Phi Sigma Biological Sciences Honor Society
- Phycological Society of America
- Poultry Science Association
- Purdue University Entomology Environmental Lab
- R. M. Bohart Museum of Entomology
- Radiation Research Society
- Sam Noble Oklahoma Museum of Natural History
- San Bernardino County Museum
- San Diego Natural History Museum
- Santa Barbara Museum of Natural History
- Sarah P. Duke Gardens
- Science Museum of Minnesota
- Scripps Institution of Oceanography
- Slater Museum of Natural History
- Society for Conservation Biology
- Society for Economic Botany
- Society for In Vitro Biology
- Society for Industrial Microbiology
- Society for Integrative and Comparative Biology
- Society for Mathematical Biology
- Society for Northwestern Vertebrate Biology
- Society for Range Management
- Society for Sedimentary Geology
- Society for the Study of Amphibians and Reptiles
- Society for the Study of Evolution
- Society of Environmental Toxicology and Chemistry
- Society of Nematologists
- Society of Systematic Biologists
- Society of Wetland Scientists
- Soil Science Society of America
- Southern Appalachian Botanical Society
- Southwestern Association of Naturalists
- Sternberg Museum of Natural History
- Texas A&M University Department of Entomology
- Texas Memorial Museum
- Texas Tech University Department of Biological Sciences
- Torrey Botanical Society
- University of Alaska Museum of the North
- University of California–Santa Barbara Center for Biodiversity and Ecological Restoration
- University of Connecticut Department of Ecology and Evolutionary Biology
- University of Iowa Department of Geoscience
- University of Michigan Genomic Diversity Laboratory
- University of Nebraska State Museum
- University of Wisconsin Zoology Museum
- US Federation for Culture Collections
- US Society for Ecological Economics
- Utah Museum of Natural History
- Virginia Institute of Marine Science
- Virginia Museum of Natural History
- Weed Science Society of America
- Western Society of Naturalists
- The Wildlife Society

To find out more about AIBS and its member societies and organizations, go to [www.aibs.org](http://www.aibs.org).