

## 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*

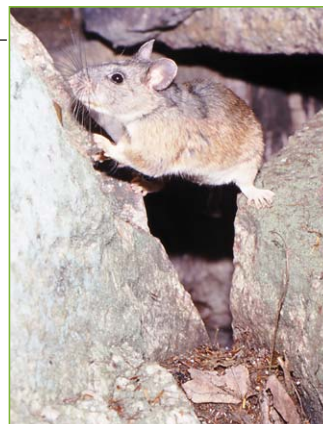
- 661 A Thirty-Year Study of Phenotypic and Genetic Variation of Blue Tits in Mediterranean Habitat Mosaics**  
*Jacques Blondel, Donald W. Thomas, Anne Charmantier, Philippe Perret, Patrice Bourgault, and Marcel M. Lambrechts*

- 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*

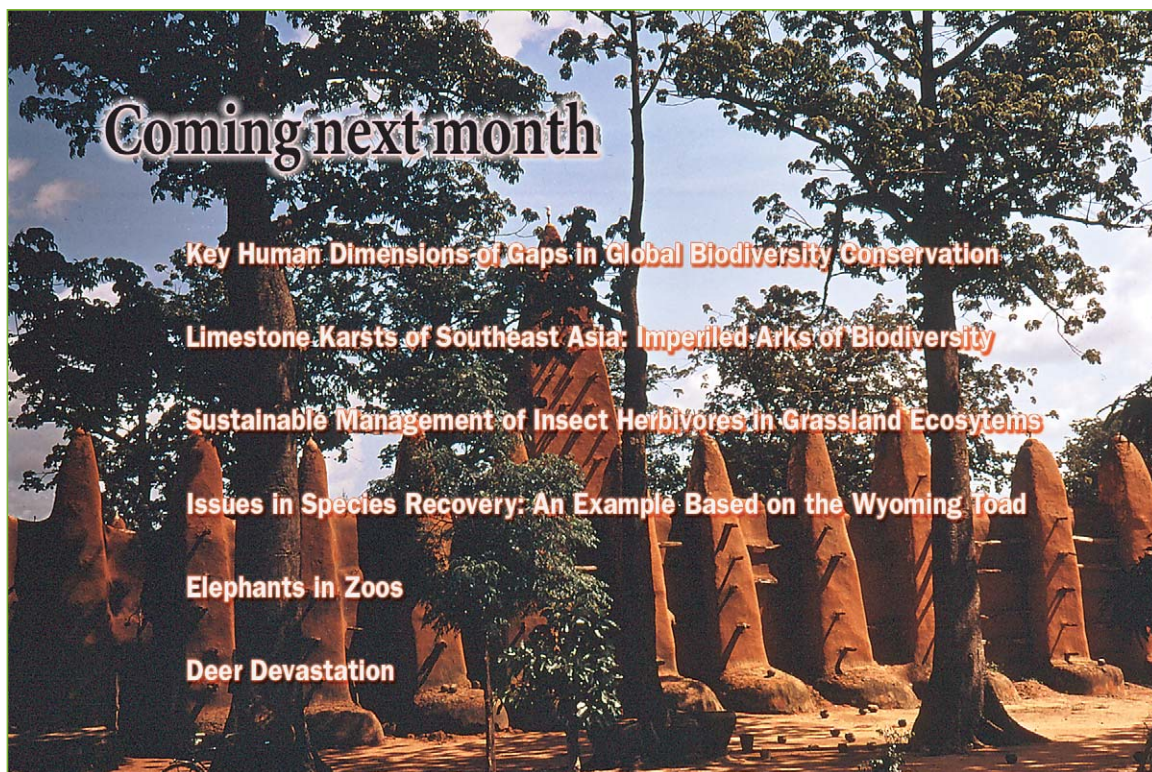


## DEPARTMENTS *(continued)*

|                                     |            |
|-------------------------------------|------------|
| <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  |
| <b>694</b> | <b>Species Invasions: Insights into Ecology, Evolution, and Biogeography</b><br><i>Dov F. Sax, John J. Stachowicz, and Steven D. Gaines, eds.</i><br>Reviewed by James T. Carlton |
| <b>695</b> | <b>Robustness and Evolvability in Living Systems</b><br><i>Andreas Wagner.</i> Reviewed by Claus O. Wilke   |
| <b>696</b> | <b>Holistic Darwinism: Synergy, Cybernetics, and the Bioeconomics of Evolution</b><br><i>Peter A. Corning.</i> 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 Mabey; 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



# American Institute of Biological Sciences

*Dedicated to advancing biological research and education for the welfare of society.*

## 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

Marvaalee 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

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

## Member Societies and Organizations

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