Organisms from Molecules to the Environment

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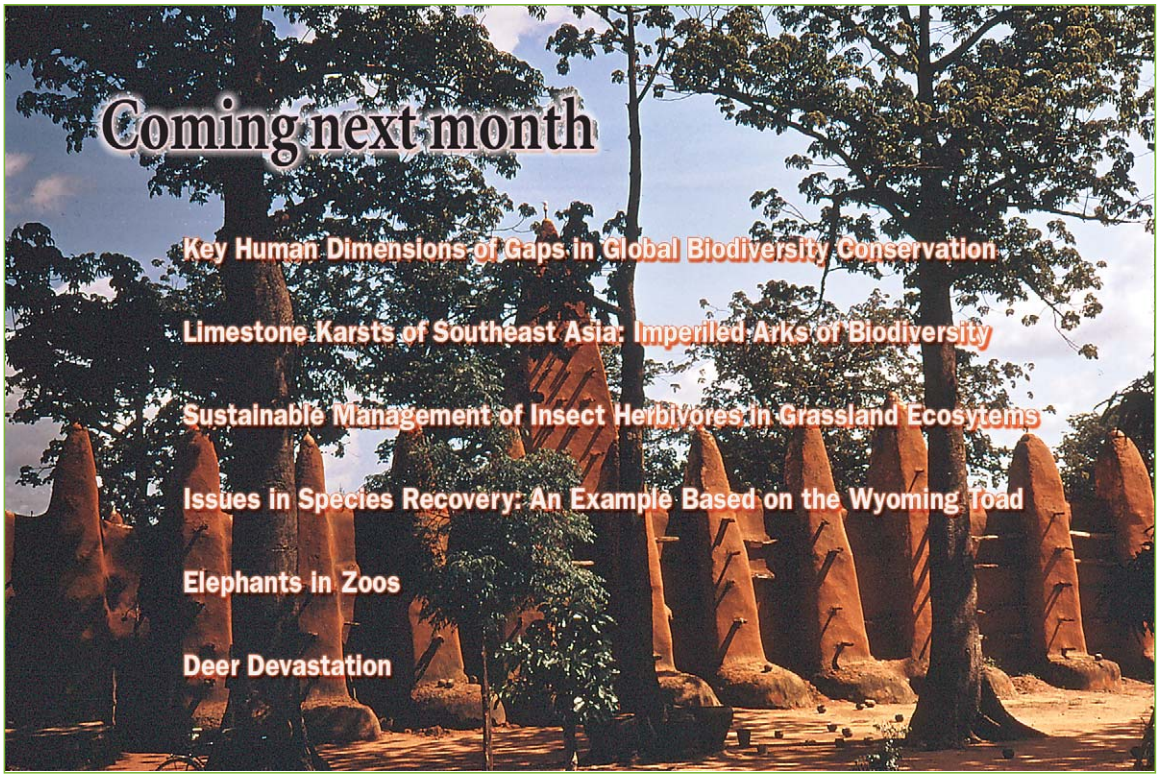
*Cover: The Allegheny woodrat (*Neotoma magister*), shown in the large photograph wearing a radio collar, is native to the Appalachians. The species has undergone a pronounced decline in much of its range over the past 30 years, and possibly longer. No single cause seems to explain the species' near 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.*



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BioScience

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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

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