

LETTERS



Z. LESZCZYŃSKI/ANIMALS

Location, location

A flood of letters places exotic crabs (above) in their home phylum. Buying tritium from the Russians (instead of producing it in the United States) is said (again) to be an advantageous suggestion. Ernest Rutherford is placed at Cambridge University, discovering the nucleus of the atom. And the "biogeography and politics" of endangered species are discussed.

Misplaced Crabs

Concerning the Random Samples item "Green crabs advance north" (11 Apr., p. 203), how the crabs got from California to Oregon is less problematic than how they got from Arthropoda to Mollusca.

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David M. Hillis's comments about the renaissance of phylogenetic approaches in biology (Perspectives, 11 Apr., p. 218) are most interesting. Has *Science* taken the lead, identifying European green crabs as mollusks instead of arthropods?

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No wonder those crabs are green. Someone has turned them into mollusks! Next we will learn that Lassie is a goldfish and Flipper is an eggplant.

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Tritium Supply

With respect to Andrew Lawler's article "Test reactor touted for bomb fuel" (News & Comment, 4 Apr., p. 28), if anyone is concerned about any level of the environmental impact of any reactor or accelerator, they would support the suggestion in my editorial "The nuclear fleecing of America" (13 Sept. 1996, p. 1475). If we simply arrange, on an annual basis, to buy tritium from the Russians, we would not only save money (a factor of 10 over the accelerator and a factor of 5 over the reactor), but there would be essentially no environmental impact in the United States—none in the construction, operation, or disposal of the facility years from now.

The Russians have a surplus of tritium, and their reactors that produce the material must keep running because of their need for power production. It's too bad the U.S. Department of Energy can't understand the advantages to such a suggestion.

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Rutherford's Contribution

In the 14 March article "The weighty matter of names" by Erik Stokstad (News & Comment, p. 1570), the discovery of the atom is attributed to physicist Ernest Rutherford. The discovery of the atomic nature of matter was not a single event, but rather the result of years of accumulated evidence. Rutherford's contribution was the discovery that atoms contain a positively charged nucleus much smaller than the actual atom. Rutherford was not an Oxford physicist, as stated in the article. He worked in the Cavendish Laboratory at Cambridge University.

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Endangered Species "Hot Spots"

The biogeography and politics of species protection are inexorably linked, as evidenced by the report "Geographic distribution of endangered species in the United

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States" by A. P. Dobson *et al.* (24 Jan., p. 550). Dobson *et al.* demonstrate that species listed by the federal government as threatened or endangered are distributed in regional "hot spots," a pattern that has been described before (1) and one that reflects endemism even more than species richness of an area. Dobson *et al.*, however, assess only one component of biodiversity, thereby missing several major issues in species protection and giving land developers and others reason to hope that development in regions supporting fewer endangered species can proceed without conflict.

The dangers of relying on endangered species "hot spots" on a national scale for determining conservation priorities are well illustrated in Illinois, which has only nine endangered and threatened species according to the federal government, but more than 500 state-listed endangered species (2). Before settlement, about 9 million hectares (ha) of tallgrass prairie existed in the state. Now, about 950 ha remain in pristine condition, but only 17% of this total is in units larger than 4 ha (3). In these remaining small patches, the richness and density of plant species rival those recorded anywhere (4), and of the 862 species of plants identified throughout the geographic extent of the tallgrass prairie, 851 are still present in Illi-

nois, although none is endemic. The distribution of individual species, however, is uneven across the state, species rich as each site might be (about 100 plant species per site) (3, 5). Because of this rarity of many species and the small sizes of the remaining habitat patches, there is a high risk of local extinctions. Seventeen species of mammals, birds, insects, and plants, including the endemic grass *Thismia americana*, are known to have been lost from Illinois prairies. Another 117 species are now listed by the state as threatened or endangered, including 95 plant species (3, 6).

Another reason for the distribution of the few key areas observed by Dobson *et al.* may be the very fact that the federal government has extensive land holdings in the western states. Thirty percent of the United States is owned by the federal government, with 95% of this ownership occurring in the west and Alaska (7). Huge areas are thus somewhat protected from major development, and some semblance of habitat diversity exists. In the Midwest and Northeast, private ownership prevails, with fewer restrictions on adverse impacts to habitat or species. For example, destruction of a privately owned prairie in Kansas resulted in the local loss of two plant species (8). Mapping of state-listed endangered species,

many of which are not endemic but are still endangered by human activities, would present a different picture to policy-makers.

The linkage of habitat protection to species endangerment is further illustrated in the same issue by Ellen McGarahan's description of the demise of a population of the bay checkerspot butterfly ("Much-studied butterfly winks out on Stanford preserve," Research News, 24 Jan., p. 479). The loss of this butterfly population could put the habitat at risk to development, demonstrating the weakness of determining policy by species protection rather than habitat protection. If entire ecological systems can be conserved, species diversity (and other components of biological diversity, such as genetic diversity) would also be conserved.

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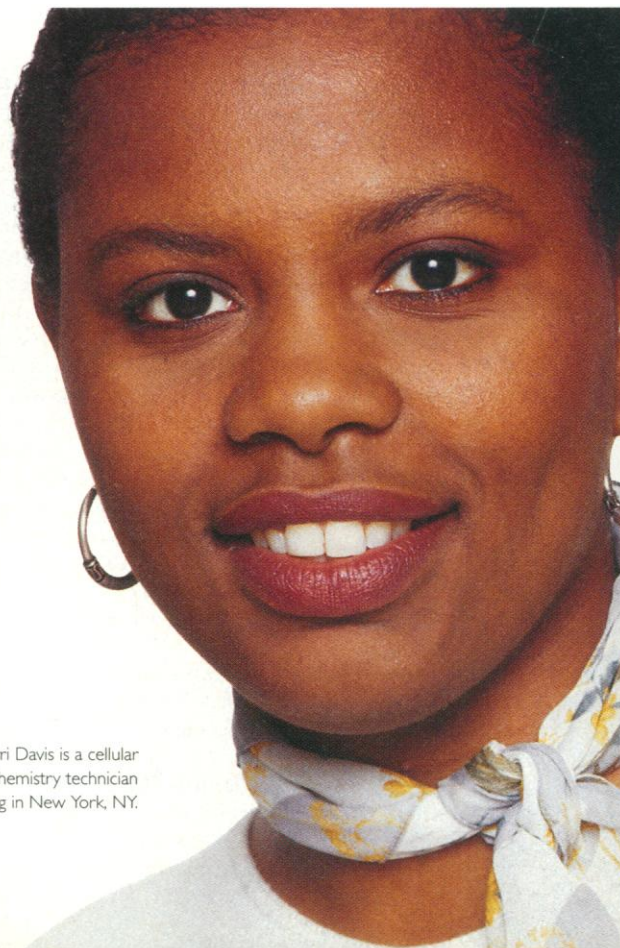
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2. J. R. Herkert, *Endangered and Threatened Species of Illinois: Status and Distribution* (Illinois Endangered Species Protection Board, Springfield, 1994), vol. 3.
3. K. R. Robertson and M. W. Schwartz, in *Ecological Resources* (Illinois Department of Natural Resources, Springfield, 1994), vol. 3, pp. 1–35.
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6. J. R. Herkert, *Endangered and Threatened Species of Illinois: Status and Distribution* (Illinois Endangered Species Protection Board Springfield, 1991), vol. 1.
7. G. T. Miller, *Environmental Science: Sustaining the Earth* (Wadsworth, Belmont, CA, 1991).
8. U.S. Department of the Interior, Fish and Wildlife Service, *Endangered Species Tech. Bull.* **16** (no. 1), 11 (1991).

Dobson *et al.* make a useful, if limited, point about the overlapping distributions of many endangered species. The significance and practical applicability of these findings, however, are exaggerated, mak-

ing it more likely that their data will be misused by others to justify reduced expenditures for environmental protection (especially the conservation of critical habitats) and allow uncontrolled development in some areas.

The database used by Dobson *et al.*—county-level occurrences of the 924 species listed under the Endangered Species Act (ESA) as of August 1995—is biased and incomplete. Many imperiled species are absent from the list for political reasons or because of lack of funding to evaluate their status. In July 1995, the U.S. Fish and Wildlife Service removed nearly 4000 species from consideration (“category 2 candidates,” those species for which sufficient information to decide whether listing is warranted is not available). This decision was based not on scientific information but apparently on the perceived political liability and costs of having so many candidate species. A more accurate reflection of species at risk of extinction in the United States is the Nature Conservancy’s natural heritage database, which as of January 1996 listed 1339 U.S. species as critically imperiled, 1831 as imperiled, and 3076 as vulnerable on a global scale. The distribution of these 6246 species is unlikely to be represented by the limited pattern of “hot

spots” shown by Dobson *et al.*

The conclusion of Dobson *et al.* that “[t]he amount of land that needs to be managed to protect currently endangered and threatened species in the United States is a relatively small proportion of the land mass,” appears simplistic, ecologically unrealistic, and does not heed two of their own caveats: (i) “our analysis underestimates the amount of land necessary to preserve species with large area requirements (such as grizzly bears . . .)” (p. 551) and (ii) “our analysis should not be taken as a measurement of how much land must be protected to conserve endangered species but rather as an approximate indication of the extent to which endangered species are concentrated geographically” (p. 551). The idea that little land is necessary to protect species is highlighted in the accompanying Perspective “Science and the protection of endangered species” by H. Ronald Pulliam and Bruce Babbitt (24 Jan., p. 499), and it meshes well with the Clinton Administration’s and Congress’s current environmental theme that we can have our cake and eat it too. The incorrect message that emerges is that most of the country need not worry about protecting endangered species.

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icies for conservation and environmental protection, the distribution of endangered species is only one element among many that should be considered. Others include the distribution of endangered habitat types, the need for accessible natural areas and wilderness in all parts of the country, and the ecological services provided by natural habitats. Also, in recent years there has been a major shift in environmental thinking to include ecosystem-based information as a critical element in strategic planning. Although this concept is not yet fully codified into law, there is general recognition that endangered species occur in a much larger ecological context than their county-level distributions would indicate. The analysis of Dobson *et al.* does not take these factors into account.

The analysis by Dobson *et al.* underscores the plight of certain parts of the country that have an especially high number of species at risk; the results say little about the conservation status and needs of the rest of the country. Nor do the results inform us about the pressing need for proactive conservation policies to help keep new "hot spots" from developing and to preserve and enhance the wilderness and important natural and seminatural areas that remain elsewhere in the United

States. Wood turtles in the northeast, granite outcrop wildflowers in Arkansas, grizzly bears and wolves in the Rocky Mountains, and Michigan peat bogs would be further endangered were conservation laws to be based on a simplistic reading of this report.

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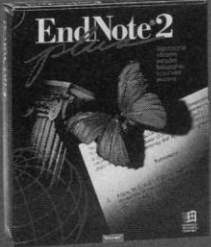
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Response: We did not argue in our report that analyses of "hot spots" on a national scale should be the only criteria in determining conservation priorities. Nevertheless, identifying national "hot spots" and protecting them strikes us as an essential step, which does not preclude state, county, and community initiatives, nor those undertaken by private individuals and organizations. Dunn *et al.* regret the loss of biodiversity on private lands, as do we.

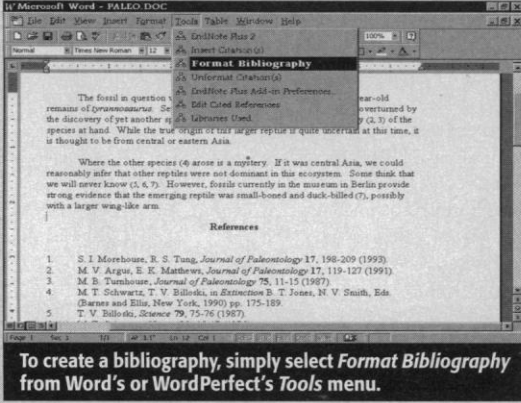
Recent studies indicate that over half of the species on the federal endangered species list have more than 80% of their habitat on nonfederal land (1). Modifying the ESA to reward private landowners whose land harbors such species (for example, with tax incentives, including estate tax breaks) would promote good stewardship and thus advance the recovery of imperiled species. Most of the endangered species that inhabit federal lands in the wilder regions of the West require protection through careful habitat management that is less exploitative than that currently practiced. In many cases, such protection could become self-financing if the present subsidies for extractive industries and recreational activities were replaced by realistic pricing mechanisms that acknowledged both the value of the resources extracted and the species placed in jeopardy through these activities (2).

We agree with Ehrenfeld *et al.* that the protection of natural communities and locally uncommon (but nationally unendangered) species should be a crucial component of the nation's biodiversity policy. But that was not the point of our report, which was to gain a better understanding of the distribution of nationally endangered species in the hope that this might




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lead to a more effective and less contentious program to protect imperiled species under the ESA. We are confident that the areas we identified using the federal database (Hawaii, southern California, southeastern coastal states, and southern Appalachians) will be confirmed by other analyses. We do not believe—and did not state—that most of the country need not worry about endangered species, but we do think that most parts of the country are unlikely to harbor great numbers of endangered species in the foreseeable future. This observation stems from the fact that centers of endemism are rather local and tend to be clustered in the species-rich southern parts of the country. Knowledge of these “hot spots” should be useful in building a comprehensive, national portfolio of protected areas.

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Corrections and Clarifications

The News & Comment article describing graduate student traineeship programs sponsored by the National Science Foundation by Jeffrey Mervis (14 Feb., p. 918) incorrectly identified John Lundberg, the director of one of the programs. He is an evolutionary biologist at the University of Arizona in Tucson.

Letters to the Editor

Letters may be submitted by e-mail (at science_letters@aaas.org), fax (202-789-4669), or regular mail (*Science*, 1200 New York Avenue, NW, Washington, DC 20005, USA). Letters are not routinely acknowledged. Full addresses, signatures, and daytime phone numbers should be included. Letters should be brief (300 words or less) and may be edited for reasons of clarity or space. They may appear in print and/or on the World Wide Web. Letter writers are not consulted before publication.

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