

Letters

Species Loss

M. A. Mares (Articles, 15 Aug., p. 734) argues credibly that a stronger database is needed to develop rational conservation strategies for the world's richest biota. Present knowledge of much of the South American biota is simply too rudimentary to substantiate various forecasts of catastrophic species loss in the wake of tropical deforestation. In questioning these predictions, Mares discusses the imprecision of existing quantitative models of species loss. He also advances the analogy that there have been very limited extinctions in the wake of nearly complete deforestation in North America and Europe; virgin forests are practically lacking on both continents today.

Because significant biological differences exist between these regions, this analogy seems biologically improper and imprecise, marring an otherwise insightful article. The analogy is based on comparison of species-rich tropical habitats with those in comparatively impoverished temperate ones; although complex and poorly understood, the overall stability of ecosystems may be related to diversity (1). The analogy also compares the insular Neotropical biota, protected from biotic interchange for most of the Tertiary, with the expansive and confluent Holarctic biota of the northern continents. Insularity may promote biotic instability to perturbation via the absence of stringent selection pressures (for example, Australian ecosystems and introductions of European species). Physiologically and behaviorally, each species in temperate regions must have an ecological amplitude sufficient to cope with radical seasonal changes in weather. While seasonal, most tropical climates fail to reach temperate extremes, and organisms adapted to them are correspondingly stenotopic. Such traits make tropical species more vulnerable to perturbation.

Temperate and tropical areas differ importantly not only in the amount of diversity, including its ecological and physiological aspects, but also in its geographic scale. Alpha diversity, the number of species occurring in a restricted area within a given habitat type, tends to be remarkably constant from region to region. In contrast, beta diversity, measuring species turnover between habitats within a region, shows strong geographical patterns (2). Thus, tropical habitats owe much of their heightened diversity to high species turnover between habitats. This pattern is based on north temperate species having larger ranges than tropical species, and more continuous

(less patchy) distributions (3). Environmental changes that have an impact on a given area will therefore affect a smaller proportion of the range of a temperate species. Higher unit densities and wider distributions make temperate species less susceptible to extinctions from spatial perturbations such as deforestation. Scientists can afford to ignore neither the confidence limits on their quantitative models nor the variables and trends in their qualitative ones.

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REFERENCES

1. R. M. May, *Stability and Complexity in Model Ecosystems* (Monographs in Population Biology, Princeton Univ. Press, Princeton, NJ, 1973); S. L. Pimm, *Oikos* 33, 351 (1979).
2. M. L. Cody, in *Ecology and Evolution of Communities*, M. L. Cody and J. M. Diamond, Eds. (Belknap, Cambridge, MA, 1975), pp. 214-257.
3. E. H. Rapoport, *Areography: Geographical Strategies of Species* (Fundacion Bariloche Series, Pergamon, Oxford, 1982); R. B. Foster, in *Conservation Biology: An Evolutionary-Ecological Perspective*, M. E. Soule and B. A. Wilcox, Eds. (Sinauer, Sunderland, MA, 1980), pp. 75-92.

Response: Patterson makes a number of interesting points. Several, however, merely illustrate the general misunderstanding of South American ecosystems that was pointed out in my article. I will largely limit my remarks to mammals, for the sake of brevity. While South America was an island for much of the last 80 million years, several notable colonizations occurred during that period, each resulting in a pronounced adaptive radiation (1). More important, the Great American Interchange of about 3 million years ago ended the continent's isolation and resulted in numerous colonizations with subsequent radiations of such groups as rodents, deer, and carnivores. The faunal mixing of the Pleistocene did not result directly in massive waves of extinction (hence, one must question whether insularity on this scale in fact leads to instability); rather, extinctions probably resulted from climatic effects and habitat disruptions (2). There is no reason to believe that the South American ecosystems of the pre-Interchange period were unstable; they were both complex and diverse (3). Their species, we must assume, were well-adapted to their particular roles in the ecosystem. That massive extinctions were associated with great climatic fluctuations and geological upheavals [for example, the Andes arose primarily in the Miocene and Pliocene, (4)] is neither surprising nor reflective of their degree of adaptedness to the environments in which they had evolved.

Patterson's comments on the behavior

and physiology of South American species are, again, illustrative of points raised in my article. First, we do not know whether the effects of a dry season on a tropical organism are as pronounced as the effects of winter on a North Temperate species. We do know, however, that periodic droughts can be devastating to small mammals, as was demonstrated by our work in the Brazilian Caa-tinga, a huge tropical scrubland subjected to pronounced droughts (5). Further, much of South America is temperate, with climatic extremes as pronounced as those of North America. Each macrohabitat on the continent has its particular flora and fauna, mostly unstudied. To generalize on stenotopy is presumptuous. One of the first species of mammals we captured while doing research in central Brazil in 1983 was a marsupial, *Monodelphis kunsii*, known from only two specimens in Bolivia, 2000 kilometers distant! Might it have been considered stenotopic before we extended its range?

Finally, a few comments are in order concerning the differences between temperate and tropical patterns of distribution. Temperate areas in North and South America do have lower alpha diversity than do tropical habitats, although I question whether the patterns are "remarkably constant" (6). Species turnover within tropical habitats probably differs from taxon to taxon. Many insect species may well be associated with a plant having a very limited distribution, for example, while tropical mammals frequently have extensive geographic distributions. In many cases, we just do not have enough information to know with certainty what the actual ranges of most organisms are. We frequently do not know if two organisms found in two different parts of South America that appear to be the same species are, in fact, separate species. When the ecological, physiological, or behavioral amplitudes of a species are not known, it is hazardous to predict exactly how it will respond to habitat conversion. Clearly, species having a great population density and a broad geographic range (like the passenger pigeon or the bison, for example) would seem to be insulated from extinction, but "it ain't necessarily so." We must understand how obligately specialized an organism is to particular ecological parameters before we can glibly predict its demise. It is relatively simple to proffer sweeping biogeographic or ecological theories when dealing with a fauna that is very poorly known. We may find, however, that theories generated from studies conducted in one region, and that have a particular philosophical orientation to them, may not be tenable when data on the biology of species in the unstudied area become available. The an-

swers to the South American conservation dilemma are in the field. There is no substitute for data.

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REFERENCES

1. M. A. Mares, in *The Great American Biotic Interchange*, F. G. Stehli and S. D. Webb, Eds. (Plenum, New York, 1985), pp. 489-520.
2. B. Patterson and R. Pascual, in *Evolution, Mammals, and Southern Continents*, A. Keast, F. C. Erk, B. Glass, Eds. (State Univ. of New York Press, Stony Brook, 1972), pp. 247-309; R. L. Cifelli, in (1), pp. 249-266.
3. S. D. Webb, in (1), pp. 357-386.
4. A. Soriano et al., in *Temperate Deserts and Semi-Deserts*, N. E. West, Ed. (Elsevier, New York, 1983), pp. 423-460.
5. M. A. Mares, M. R. Willig, T. E. Lacher, Jr., *J. Biogeogr.* 12, 57 (1985).
6. M. A. Mares, and R. A. Ojeda, in *Mammalian Biology in South America*, M. A. Mares and H. H. Genoways, Eds. (Spec. Publ. 6, Pymatuning Laboratory of Ecology, Linesville, PA, 1982), pp. 393-432.

Peace and Virtue

A few comments are in order concerning Charles C. Price's letter (24 Oct., p. 411), which promoted participation in the "First International Peace Week of Scientists." Im-

plicit in this letter and underlying the staging of this event is the idea that peace, in and of itself, is to be desired, and that militarization, termed the "arms race," is to be deplored. I would like to dispute this.

The dictionary tells us that peace is the state characterized by harmony, freedom from discord, absence of mental conflict, or that condition attained at the conclusion of a war. We might surmise that the peace is far more pleasant for the victor of the war than for the defeated. In this case, peace is a desirable condition for those with the upper hand.

Several specific examples of the undesirability of peace are apparent. For instance, a corpse can be said to be in a state of peace. Also, slaves, be they modern or historical, experience many of the characteristics of a peaceful existence. Perhaps the Union of Concerned Scientists is lobbying for increased numbers of slaves and corpses. In the late 1930's, as Nazi Germany was swallowing up portions of Europe, many Western leaders argued that appeasing Hitler would preserve the peace.

Peace is only one of a gamut of virtues; in many cases, one cannot be favored without adversely affecting the others. There is one

virtue that is cherished by many living in democratic societies but is often ignored by promoters of peace, and that is freedom. In a world in which there are many who would squelch that freedom, it may be necessary to fight to protect it. For a society to abandon the option of war, be it waged with muskets or MIRV's, is to invite attack by evil men, of which, sadly, there is presently no shortage.

Price's letter is, in essence, an advertisement for an event espousing a particular political point of view. Political advertisements should not appear in the Letters section of *Science*.

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Erratum: In the article "R&D budgets: Congress leaves a parting gift" (News & Comment, 31 Oct., p. 536), the 1987 appropriation for the National Aeronautics and Space Administration was incorrect. Total funding for the agency is \$10.4 billion, not \$7.95 billion, as stated. The budget includes money to cover construction of a new space orbiter and shuttle operations. Research and development funding stands at \$3.1 billion, as reported.

Erratum: The listing in the 3 October Books Received (p. 94) for *Reinventing Technology* (p. 97) was incorrectly printed as *Reinvesting Technology*.

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