LETTERS

Making a Rebuilt New Orleans Sustainable

THE TRAGIC EVENTS RESULTING FROM Hurricane Katrina have seen a major U.S. city almost totally destroyed, and it is 100 years of human activity that have created the conditions leading to this inevitable tragedy.

The dramatic, human-driven deterioration of 25% of the wetlands of the Mississippi delta has removed an important buffer against storms. The river that built and nourished the delta over thousands of years has been leveed to its mouth, preventing the freshwater, silts, and nutrients that nourished and sustained the delta from flowing over the wetlands. The natural subsidence that delta soils undergo continues, and without river input, most wetlands sink below the water and die. Within the delta plain, there have been enormous changes in the natural hydrology as more than 15,000 km of canals have been dredged through the marshes. Barrier islands that helped protect the wetlands have fragmented and disappeared.

A broken levee on the east side of the London Avenue Canal in the Gentilly neighborhood of New Orleans, 11 September 2005.

One of the most notable of the canals is the Mississippi River Gulf Outlet (MRGO), which runs southeast from New Orleans to the Gulf of Mexico. It was constructed by the Corps of Engineers in the 1950s as a shorter shipping route to the gulf; however, it has never carried more than a small percentage of the shipping that comes to New Orleans. Saltwater intrusion through the MRGO killed extensive freshwater cypress wetlands in St. Bernard Parish just downriver from New Orleans. Thus, MRGO has been an economic and environmental disaster.

The levees of the MRGO, when combined with those along the Gulf Intracoastal Waterway and the Mississippi River, form a funnel drawing the surge into the heart of New Orleans. Paul Kemp and Hassan Mashriqui, researchers with the LSU Hurricane Center, published surge simulation results days before the storm hit that showed the city flooding (www.hurricane.lsu.edu/floodprediction) through the funnel. Early availability of the results is believed to have played an important role in convincing both civic leaders and the citizenry to begin an unprecedented evacuation, estimated at over 85%. As Katrina approached, the storm surge was forced into the funnel and built up to levels that overtopped levees in eastern New Orleans and St. Bernard Parish. This is not the first time that this has happened. In 1965, Hurricane Betsy followed a similar path that led to extensive flooding in the same area of eastern New Orleans.

What should be done now? The City of New Orleans should be rebuilt, but not as it was, or the inevitable will happen again. New Orleans and South Louisiana can be reborn in a way that is sustainable and serves as an example to the rest of the nation. The living spaces of homes need to be above maximum flood level. These buildings need to be strong enough to survive hurricane force winds and should be super-efficient and constructed to use renewable energy such as solar and wind power. As the city rebuilds, efficient mass transit and use of wetlands for assimilation can contribute to sustainability. All of this should be done in a way that engages and enables the poor and marginalized citizens of the city.

New Orleans sits in the middle of the largest and most productive coastal wetland ecosystem in the United States, the Mississippi delta. Louisiana and the federal government have begun a joint effort to restore the delta, and the first significant funding has been approved this year in the Energy Bill. Restoration of the delta is critical for the protection of a rebuilt New Orleans because of the storm buffer that wetlands provide.

New Orleans and the surrounding region must be rebuilt in a way that is sustainable and energy efficient. In this way, out of this tragedy, a new vision for the future can emerge, not only for south Louisiana, but for the nation as a whole.

JOHN W. DAY

Distinguished Professor Emeritus, Louisiana State University, Baton Rouge, LA 70803, USA.

Problems of Studying Extinction Risks

M. CARDILLO *ET AL.*'S ANALYSIS OF MAMmalian extinction biology ("Multiple causes of high extinction risk in large mammal species," Reports, 19 Aug., p. 1239) uses data from the IUCN Red List of Threatened Species (*1*). I believe that conservationists should be much more circumspect than we currently are about conclusions based on such analyses of the Red List.

The Red List is not managed as a database for biological analysis. Many problems are inherent in using threatened species lists for purposes for which they were not designed (*2*). The Red List's categorizations are largely informed guesswork by experts. That guesswork is vital and appropriate, given how little we know of most of the world's species and how little would be done about them if we insisted on full knowledge before action. Nevertheless, what is going to inform guesswork but knowledge of extinction biology?

Consequently, the biology of extinction is being investigated by the use of data that are (properly) fundamentally affected by knowledge of extinction biology. I cannot see that the inevitable circularity is removed by use of, for example, only species categorized on the basis of only population size or rate of decline [(*3*); Cardillo *et al.*]: The expert does not know the rate of decline (*4*) but does know that large-bodied, slow-reproducing species that live in small geographic ranges are more likely to be threatened than are small-bodied, fast species in large ranges—and so suggests a faster decline for the former.

How can use of Red Lists to investigate extinction biology avoid such circularity, especially when the IUCN does not yet have the resources to make available the data on which the categorizations are based?

A. H. HARCOURT

Department of Anthropology, Graduate Group in Ecology, University of California, Davis, CA 95616, USA. E-mail: ahharcourt@ucdavis.edu

References

1. IUCN, *2003 IUCN Red List of Threatened Species* (International Union for Conservation of Nature and

Published by AAAS

Natural Resources, Gland, Switzerland, 2003) (available at www.redlist.org/).
2. H. P. Possingham *et al.*, *Trends Ecol. Evol.* **17**, 503 (2002).
3. A. Purvis, J. L. Gittleman, G. Cowlishaw, G. M. Mace, *Proc. R. Soc. London Ser. B* **267**, 1947 (2000).
4. S. Blake, S. Hedges, *Conserv. Biol.* **18**, 1191 (2004).

M. CARDILLO *ET AL.* APPLY PHYLOGENETICALLY controlled comparative analyses to investigate patterns of extinction risk in large mammals ("Multiple causes of high extinction risk in large mammal species," Reports, 19 Aug., p. 1239). Similar analyses have been reported elsewhere (*1*–*3*). Although it is obviously important to understand the factors affecting extinction risk, these techniques are being applied beyond their intended application and may not be providing meaningful results.

The technique of independent contrasts is designed to control for nonindependence among traits resulting from shared phylogenetic history or common descent (*4*). However, extinction risk is not a phenotypic trait and has no shared phylogenetic history with any trait. For most mammal species, the external threats or processes promoting higher risk of extinction (e.g., habitat loss, alteration or fragmentation, exploitation, etc.) are often very recent in origin and have no phylogenetic history at all, shared or otherwise. In these cases, it is meaningless to infer values for such recent and externally driven factors at deeper (i.e., ancestral) nodes of a phylogeny. As a result, the calculated contrast values of extinction risk are potentially misleading.

Although extinction risk may indeed vary across a phylogeny, this phylogenetic signal is not the same as nonindependence resulting from shared phylogenetic history. A possible association with phylogeny is something for which we should test, not something to assume a priori. We need to develop and employ more appropriate methods for investigating associations between traits that are linked by phylogeny (e.g., life history variables) and other factors that are not (e.g., extinction risk). The big danger for conservation biology is that the continued use of inappropriate techniques may lead to erroneous conclusions and poor decisions.

DAVID PUTLAND
School of Integrative Biology, The University of Queensland, St. Lucia, QLD 4072, Australia.

References
1. M. Cardillo, *Anim. Conserv.* **6**, 63 (2003).
2. D. O. Fisher, S. P. Blomberg, I. P. F. Owens, *Proc. R. Soc. London Ser. B* **270**, 1801 (2003).
3. M. Cardillo *et al.*, *PloS Biol.* **2**, 909 (2004).
4. P. H. Harvey, M. D. Pagel, *The Comparative Method in Evolutionary Biology* (Oxford University Press, Oxford, 1991).

Response

USING THE IUCN RED LIST (*1*) WE HAVE shown that body mass strongly mediates the effects of biological and environmental factors on mammal species extinction risk. Our extinction risk measure was conservative in only including threatened species listed under criterion A of the Red List, which is based on rates of population decline.

Despite Harcourt's concerns about circularity, biological traits do not form part of the process of categorizing species under criterion A. Categorizations of extinction risk are made under explicit, objective, and quantitative criteria (*2*). For example, under criterion A1, a species is listed as Vulnerable, Endangered, or Critically Endangered if the rate of population decline has been 50 to 70%, 70 to 90%, or >90%, respectively, over a period of 10 years or three generations, whichever is longer (*3*). Rates of decline may be assessed from direct observations or inferred from indirect evidence such as catch statistics or habitat loss. If the latter, there are explicit guidelines for inferring population decline rates from indirect evidence (*3*), and assessors must present the evidence they have used to conclude that a population has declined by the amount claimed. Before listing, assessments are

Published by AAAS

reviewed by independent Red List Authorities. Species listings are accompanied by a justification giving support for the listing, together with relevant data and references, thus making the process as repeatable and transparent as possible. Species for which too little data exist to assign to an extinction risk category are listed as Data Deficient.

Our comparative analysis used phylogenetically independent contrasts (PICs) to eliminate the pseudoreplication that would otherwise result from the phylogenetic nonindependence of the observations in our data set (*4*). A phylogenetically nonrandom distribution of extinction risk among mammals and other taxa is well established, has long been recognized as a noteworthy and important phenomenon (*5*, *6*), and appears to be the rule rather than the exception (*7*). Despite the case for using PICs in extinction risk studies having recently been clearly and elegantly made (*6*), Putland is skeptical about the need to employ such methods. However, as we and many others have shown, extinction risk is correlated with many different factors, some of which (e.g., body mass) are strongly heritable and closely associated with phylogeny. Whether or not it is itself heritable, extinction risk shows a phylogenetic signal. Comparative tests that fail to account for this signal suffer from pseudoreplication, with potentially misleading results (*7*, *8*).

MARCEL CARDILLO,[1]
GEORGINA MACE,[2] ANDY PURVIS[1]

[1]Division of Biology, Imperial College London, Silwood Park Campus, Ascot SL5 7PY, UK. [2]Institute of Zoology, Zoological Society of London, Regent's Park, London NW1 4RY, UK.

References

1. IUCN, 2003 *IUCN Red List of Threatened Species* (IUCN, Gland, Switzerland, 2003).
2. A. S. L. Rodrigues, J. D. Pilgrim, J. F. Lamoreaux, M. Hoffmann, T. M. Brooks, *Trends Ecol. Evol.*, in press.
3. IUCN, www.iucn.org/webfiles/doc/SSC/RedList/RedListGuidelines.pdf (2005).
4. P. H. Harvey, M. D. Pagel, *The Comparative Method in Evolutionary Biology* (Oxford Univ. Press, Oxford, 1991).
5. M. L. McKinney, *Annu. Rev. Ecol. Syst.* **28**, 495 (1997).
6. A. Purvis, P.-M. Agapow, J. L. Gittleman, G. M. Mace, *Science* **288**, 328 (2000).
7. D. O. Fisher, I. P. F. Owens, *Trends Ecol. Evol.* **19**, 391 (2004).
8. A. Purvis, M. Cardillo, R. Grenyer, B. Collen, in *Phylogeny and Conservation*, A. Purvis, J. L. Gittleman, T. Brooks, Eds. (Cambridge Univ. Press, Cambridge, 2005), pp. 295–316.

Benefits of a Regional Climate Model

THE EDITORIAL BY C. HUNTINGFORD AND J. Gash encouraging regional climate modeling studies in developing countries ("Climate equity for all," 16 Sept., p. 1789) perfectly captures the objectives of the Regional Climate Network (RegCNET) (see www.ictp.trieste.it/RegCNET/). Based

at the International Centre for Theoretical Physics (ICTP) in Trieste, Italy, F. Giorgi, J. Pal, X. Bi, and others have developed and supported the use of the regional climate model RegCM via a listserv, workshops around the world, time on ICTP computers, and personal correspondence with users. At last count, RegCM is used by scientists in over 40 mostly developing countries or countries with economies in transition, including Egypt, Iran, Pakistan, India, Nigeria, Cameroon, Ghana, Bangladesh, China, Vietnam, the Philippines, Estonia, Peru, and Brazil. The benefits of support to these climate scientists cannot be overstated, as many of the smaller countries would not even show up in the geography of a global climate model, yet they are at considerable risk from climate change. Furthermore, the model itself benefits as developers strive to make it perform in regions influenced by monsoons, tropical convection, dramatic topography, and large lakes. Funding the efforts of climate scientists already working at the regional level and encouraging them to collaborate with those assessing impacts would be an expedient way to achieve more local capacity for climate prediction and adaptation.

LARA M. KUEPPERS
Department of Earth Sciences, University of California, Santa Cruz, 1156 High Street, Santa Cruz, CA 95064, USA.

Proposed Changes to Biomedical Funding

THE EDITORIAL "NIH FUNDING REFORM" (J. F. Strauss III, 5 Aug., p. 851) correctly identifies many of the problems facing the biomedical research community. To the proposed solutions, I would add two more. First, institutional indirect costs should be capped at a reasonable level for all institutions. As institutions can collect up to 100% in indirect costs, a limit of 25% would free many billions of dollars to fund additional investigators. Indeed, the rush to generate more indirect costs has been a driving force behind expansion at many medical schools. Second, universities should provide a larger fraction of salary support for their faculty. The Principal Investigator's salary and benefits eat up another large portion of the research budget. At a time when NIH paylines are nearing 10%, from 25 to 30% just a few years ago, we need to ask why our most prestigious universities are sitting on billion-dollar endowments while the taxpayers, through the NIH, support the salaries of their faculty and the expansion of their research enterprises.

GREGORY R. DRESSLER
University of Michigan, Ann Arbor, MI 48109, USA.

The Paradox of Radiation's Effects

PARADOXES ARE VERY OFTEN INDICATIVE OF our inadequate insight into natural phenomena rather than being features of the phenomena themselves. C. Dissanayake's description of the intimate entanglement of human health with mankind's local material basis ("Of stones and health: medical geology in Sri Lanka," Essays, 5 Aug., p. 883) provides another example of this rule. His "radiation paradox" (that people living in certain areas with high levels of background radiation do not seem to suffer adverse effects from exposure to radiation) resides entirely in the minds of those who are convinced that any small amount of chronic exposure to ionizing radiation constitutes a health risk, a notion devoid of any empirical corroboration. Most fittingly, Dissanayake's Essay actually already spells out the solution to this putative "paradox" by quoting Paracelsus's nearly 500-year-old dictum "The right dosage differentiates a poison and a remedy." This dictum seems to apply to ionizing radiation, one of the most persistent and ubiquitous environmental toxins of the biosphere, much as it applies to virtually any other substance that pharmacology or toxicology has studied so far.

RAINER FACIUS
Institute of Aerospace Medicine, DLR, German Aerospace Center, Linder Hoehe, Cologne 51147, Germany.

CORRECTIONS AND CLARIFICATIONS

Reports: "Inner core differential motion confirmed by earthquake waveform doublets" by J. Zhang *et al.* (26 Aug., p. 1357). In Fig. 1B, Mw = 5.5 and Mw = 5.6 should be m_b = 5.5 and m_b = 5.6, respectively. In reference (*30*) on page 1360, Air Force Tactical Applications Center was incorrect. It should be Air Force Technical Applications Center.

News of the Week: "Earth's inner core is running a tad faster than the rest of the planet" by R. A. Kerr (26 Aug., p. 1313). The figure caption should read "Seismic waves from a later quake follow the same path but arrive earlier because the inner core has rotated more than the rest of the planet."

Letters to the Editor

Letters (~300 words) discuss material published in *Science* in the previous 6 months or issues of general interest. They can be submitted through the Web (www.submit2science.org) or by regular mail (1200 New York Ave., NW, Washington, DC 20005, USA). Letters are not acknowledged upon receipt, nor are authors generally consulted before publication. Whether published in full or in part, letters are subject to editing for clarity and space.