

The entangled bank unravels

This third special issue in *Nature's* year-long celebration of Charles Darwin focuses on the dire challenges to Earth's biodiversity — and finds some reason for hope.

“It is interesting to contemplate an entangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth.” So Charles Darwin begins the concluding paragraph of *On the Origin of Species*, published 150 years ago next week. By invoking this gentle image, Darwin sought to emphasize how “endless forms most beautiful and most wonderful” have all evolved through the process of natural selection.

Were he alive today, Darwin would have cause to be less rhapsodic. The modern version of his bank might well be dominated by invasive shrubs, having been denuded of most native plants by deforestation, and nearby streams would probably be polluted and filled with sediment from excess run-off.

It is hardly news that the rich pageant of life, which inspired Darwin and his work, is now suffering. According to data released this month by the International Union for Conservation of Nature in its Red List of Threatened Species, one-fifth of mammals and nearly one-third of amphibians are threatened with extinction, and the situation is no better among plants: almost one-third of known gymnosperms, the group that includes conifers, are threatened. Yet despite all the warnings from scientists and environmentalists, nations have done little more than fret over the problem. Although almost 200 countries have pledged through the Convention on Biological Diversity to significantly reduce the rate of biodiversity loss by next year, leaders of that effort acknowledge not only that the world will come up short of this target, but also that it was basically unachievable from the start and that it represented more of a political statement (see page 263).

This week, *Nature* ends its year-long celebration of Darwin (www.nature.com/darwin) by examining some of the most pressing issues concerning the loss of biodiversity, as well as ways to address the problem. The fact that upper levels of government are beginning to focus their attention on the biodiversity crisis gives

some cause for optimism. For example, the United Nations General Assembly has named 2010 as the International Year of Biodiversity, with a meeting scheduled in New York next September at which heads of state will take up the issue. The following month, parties to the biodiversity convention will gather in Nagoya, Japan, to develop specific and verifiable biodiversity targets for nations over the coming decades. These meetings give countries an incentive to start protecting vital ecosystems during the next 11 months so that they can head to the Nagoya summit boasting of success.

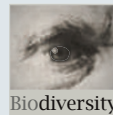
There is growing recognition that diverse ecosystems can provide substantial economic benefits — a concept known as ecosystem services — which has strengthened support for conservation in the business and political communities. The News Feature on page 270 profiles ecologist Gretchen Daily of Stanford University in Palo Alto, California, an advocate of this concept who helped it to emerge as a major idea in conservation. Another article (page 266) shows this concept in action in Brazil, where it has helped to preserve the remaining patches of the species-rich Atlantic forest. And in an Opinion piece (page 277), the leader of an international study, known as the Economics of Ecosystems and Biodiversity (TEEB) project, argues that governments must put taxes and benefits in place to protect nature's ‘public goods.’ Just last week, the TEEB project announced initial results suggesting that investments in conservation can reap economic benefits that far exceed the initial outlay.

The situation in Brazil is a good example. Preserving patches of forest has not only helped the golden lion tamarin to survive, but has also helped to provide clean water, flood control and other economic benefits to nearby communities. These ‘win-win’ situations are natural starting points for conservation efforts because they are easily sold to politicians and other stakeholders.

Climate change will place new stresses on already weakened ecosystems but it can also present political and economic

EDITORIAL

- 251 **The entangled bank unravels**



NEWS

- 263 **Efforts to sustain biodiversity fall short**
Natasha Gilbert

NEWS FEATURES

- 266 **Biodiversity's bright spot**
Gene Russo
- 270 **Putting a price on nature**
Emma Marris
- 272 **On the origin of bar codes**
Nick Lane

OPINION

- 277 **Costing the Earth**
Pavan Sukhdev
- 278 **A force to fight global warming**
Will R. Turner, Michael Oppenheimer & David S. Wilcove
- 280 **Let the locals lead**
Robert J. Smith
- 282 **A call to the custodians of deep time**
Douglas Erwin

BOOKS & ARTS

- 287 **Log of life beneath the waves**
Mark Schrope



For podcast and more online extras see www.nature.com/darwin

opportunities. One example is a strategy known as reducing emissions from deforestation and forest degradation (REDD). According to estimates by the Intergovernmental Panel on Climate Change, the clearing of forests accounts for approximately one-fifth of greenhouse-gas emissions by humans. Thus, stopping deforestation could be a relatively cheap and effective way to reduce emissions and slow the rate of global warming. At the same time, argue Will Turner and his colleagues in an Opinion piece on page 278, efforts to preserve natural ecosystems can help to ameliorate some of the effects of climate change. The international climate treaty currently under negotiation is likely to include a REDD mechanism that would provide funds to tropical countries to save their forests, a move that would help to mitigate climate change and sustain biodiversity.

Although ecosystem degradation looks set to increase in the future

as a result of climate change, the biggest threat to biodiversity today is the rapid disappearance of habitats. At present, only around 14% of land surface and less than 6% of territorial seas are protected worldwide. Yet such areas help to support nearly one-sixth of the world's population, according to the TEEB study. As nations look beyond the likely failure of the 2010 biodiversity target, they should commit to placing more areas under protection. It will be crucial to select valuable sites that harbour the species that are most threatened. The wealthiest sectors of society tend to be the most removed from nature, whereas the world's poorest people rely heavily on the fruits of diverse ecosystems. As a result, care must be taken to ensure that conservation initiatives do not come at the expense of people, particularly indigenous communities that can be indirectly harmed when land is suddenly set aside. ■

Access denied?

Information-sharing resources are essential to biologists and deserve international support.

Every weekday, thousands of researchers around the world access the Arabidopsis Information Resource (TAIR), which contains the most reliable and up-to-date genomic information available on the most widely used model organism in the plant kingdom. But now, to those users' horror, TAIR faces collapse: the US National Science Foundation (NSF) is phasing out funding after 10 years as the data resource's sole supporter (see page 258).

TAIR's plight is emblematic of a broader crisis facing many of the world's biological databases and repositories. Research funding agencies recognize that such infrastructures are crucial to the ongoing conduct of science, yet few are willing to finance them indefinitely. Such agencies tend to support these resources during the development phase, but then expect them to find sustainable funding elsewhere.

Unfortunately, that is not easy. Other funding agencies are no more likely to provide long-term support than the agency that launched the resource in the first place. Moreover, any government agency's long-term plans are vulnerable to short-term political expediency. Witness, for example, Japan, where the new government has slashed the budget of the RIKEN BioResource Centre by one-third (see page 258).

Private firms are equally poor bets. Advertising and sponsorship are unlikely to bring in enough money to pay the experts needed to maintain such resources. And the superficially plausible idea of charging subscription fees is effectively unworkable for facilities such as TAIR, because the producers and consumers of data are essentially the same community. Scientists provide data and resources for free, because sharing benefits everyone. However, they would be considerably less likely to deposit the fruits of their labour if this synergy was removed from the equation. Subscription-based databases and resources would then enter a downward spiral, becoming less and less complete and so less and less valuable.

The problem is acute even for modest resources. Two examples are the kidney database EuReGene and the mouse-embryo database

EURExpress, both of which were launched with funds from the European Commission that have run out in recent months. The databases are currently being maintained on a hand-to-mouth basis, and the scientists who built them don't know where to turn for maintenance money. Yet the European Commission's investment will have been wasted if the databases disappear.

It is time for a whole new approach. Front-line biology cannot function without these resources, so solutions must be found at both national and international levels.

Governments must ensure that at least one of their national funding agencies has money specifically set aside for the long-term support of bioresource infrastructures. A good model to emulate would be the United Kingdom's Biotechnology and Biological Sciences Research Council, which allows databases and other such resources to apply for ring-fenced funding, saving them from having to compete with hypothesis-driven grants, which are the agencies' mainstay.

But action is also needed on the international front. The sharing of bioresources does not and should not stop at national borders. For example, only about a quarter of TAIR users are based in the United States. China is the second biggest user at around 12%, followed by Japan at around 10%. This is not atypical. Yet it is difficult for a single national agency to justify maintaining a resource for the rest of the world. What is required is an international cost-sharing organization that could fund competitively selected infrastructures, large and small.

The European Commission has made a good start with projects such as ELIXIR (European Life Sciences Infrastructure for Biological Information), which is studying ways of steering national agencies towards the joint funding of bioresources. A global, ELIXIR-like initiative is urgently needed, run perhaps by an international, relatively unbureaucratic organization such as the Human Frontier Science Program.

But an international solution may be a long time coming. In the meantime, bioresource infrastructures might be wise to invest some time in public relations, giving paymasters a greater understanding of the consequences of their decisions. ■

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