Natural Resource perspectives

Number 32, July 1998

The material that follows has been provided by Overseas Development Institute

BIODIVERSITY CONSERVATION AND ITS OPPONENTS

Roger Blench

"What good heed Nature forms in us! She pardons no mistakes. Her yea is yea, her nay, nay." Emerson (1836)

Arguments over biodiversity conservation continue to generate more heat than light. This paper reviews pro-conservation arguments, concluding that the main policy requirements are to improve the scientific basis of our understanding, and to popularise up-to-date knowledge among a wide audience. This is essential if the debate is to be placed on a more factual, and less emotional footing.

Policy conclusions

- Although there is a worldwide surge of interest in conservation, many justifications rest on shaky or ephemeral grounds.
- Arguments for conservation of biodiversity often include strong ethical or aesthetic components which are superficially attractive but depend on potentially changeable social circumstances.
- Economic justifications based on undiscovered potential are susceptible to changing external conditions and so are highly uncertain.
- Biodiversity can erect a barrier against super-pathogens and so prevent catastrophic collapses in food security.
- Recent developments in extinction theory are being appropriated to underpin spurious justifications for environmental destruction.
- The assumption that indigenous peoples will tend to conserve their environment holds true only in specific cases.
- Any effective policy response must be on scientific and educational levels. Continued support to hard science, notably taxonomy, remains a priority, as many questions of direct relevance to policy remain unresolved. Without a more informed public, shriller voices will continue to dominate the debate, making it difficult to institutionalise effective conservation.

Biodiversity conservation: an ethical swamp?

The recent (May 1998) Conference of the Parties on Biodiversity in Bratislava has drawn attention to the need for a uniform code in developing approaches towards conservation of global biodiversity. As international and bilateral development agencies increasingly accept its importance and protocols are signed, scientists everywhere can be heard exhaling a quiet sigh of relief. Although the vast majority of professional scientists favour the conservation of biodiversity those who have seriously explored the ecological or economic justification for it have found themselves on the edge of an ethical swamp. If, as the signatures suggest, the non-scientists can be persuaded without a real argument (and a hundred thousand rainforest T-shirts say they can) then maybe there will be time to classify another million or so arthropods out there still lying anonymous.

This is a caricature, of course, like all polemics, but it highlights a real paradox. Scientists professionally interested in biodiversity have seen a huge surge of interest in conservation during the last decade. Governments and ordinary individuals appear to be concerned about the fate of environments and animals, the existence of which would have been unknown to a previous generation. The majority of this concern is directed to ‘natural’ environments, notably forests, with much less attention paid to crops and livestock. This is partly because these are less photogenic and because as human constructs they are somehow less ‘natural’.

At the same time, all across the planet, people who will never read any articles in professional journals are voting against biodiversity conservation with their feet. Forests continue to be chopped down, rivers, oceans and the atmosphere polluted and rare species hunted out. At a more sophisticated level, businessmen and industrialists are appropriating the language of extinction theory to justify destruction of individual habitats. The conservation lobby must attract at least some global institutions to their side to be in a better position to influence political action at the local level.

To make sense of this paradox it may be time to at least dabble our toes in this ethical swamp. This involves a much more cogent understanding of extinction theory, an approach to understanding both the factors responsible for low-level extinction (e.g. Lawton and May, 1995) and the broader historical pattern of the mass extinctions that have occurred in geological time. Advocates of biodiversity conservation have sometimes allowed their advocacy to skim over the difficulties in the argument.

Arguments for biodiversity conservation

There are five types of argument for biodiversity conservation: economic, indirect economic (protection against epidemic pathogens), ecological and aesthetic/ethical (Ehrenfeld, 1988; Ehrlich and Ehrlich, 1992).

Box 1. Summary of arguments for biodiversity conservation	
Economic	1. The output from land is greater when biodiversity is conserved. 2. Unknown biochemical and genetic resources of potentially considerable value.
Protection	Genetic uniformity may allow super-pathogens to evolve and

against evolving pathogens	cause sudden, catastrophic deficits in food, fuel etc.
Ecosystem services	Biodiversity essential to ecological functioning of planetary system
Aesthetic	Diversity has a value in itself.
Ethical	Present society is a 'steward' of earth's biological resources and we have no right to destroy them.

Economic arguments

The arguments from economics are most commonly heard in the discourse of development. Broadly speaking, they have two elements; 'unmined riches' (i.e. undiscovered genetic resources of use to society) and relative outputs from land use systems. In the case of undiscovered potential, it is pointed out that 25 to 50 per cent of the drugs in our pharmacopoeia were originally extracted from plants and thus we have the potential to discover new drugs to cure a disease such as AIDS in the unprospected rainforest. This is a very emotionally attractive, but dangerous argument, since it depends both on the probability of discoveries which cannot be transparently estimated and on a technology of screening naturally-occurring compounds whereas many drugs can be built 'molecule-upwards'. However, with rapid technological development, pharmaceutical companies will increasingly switch from the rainforest to the electron microscope, especially as the legal entanglements and moral nexus now surrounding the genetic resources of developing countries are discouraging many companies from embarking on intensive programmes of bioprospecting (Groombridge, 1992).

More attractive is the relative output argument. Either a piece of land can be exploited by managing its existing resources sustainably (harvesting and then consuming and selling its products) or it can be ecologically transformed, for example, by turning rainforest into grassland grazed by domestic stock. In almost all tropical environments, the first option is more productive over the longer-term as cultivation has a very short-term future without further inputs. However, exploiting wild or semi-cultivated resources demands a very specific lifestyle, a taste for unusual, more toxic plants and animals and a willingness to accept dependence on patchy resources. This diversity and unpredictably is often unacceptable especially to migrant populations for whom such environments are unfamiliar. This argument thus depends on consumer preferences and their expression through markets. If people refuse to eat turtles, iguanas or palm-grubs, their overall biomass becomes largely irrelevant. The calculations of exploitable biomass can be made to work more convincingly in some environments than others; equatorial forest will always have an advantage over drylands.

The ecological argument is that biodiversity is essential to the normal functioning of the planet (Ehrlich and Ehrlich, 1992). The evapotranspiration of tropical forests, the maintenance of the chemical balance in the atmosphere, the phyoplankton layer in the oceans, the fertility of soils are related to current levels of diversity. In one sense this is tautologically true, the status quo will depend on biodiversity being maintained at current levels. However, if we reduce biodiversity and the balance of the planet changes (warmer climates, rising sea levels, catastrophic soil erosion) then the response will be technological solutions. Sustainable or not, the evidence suggests that in a choice between air-conditioning and conserving the 600,000 beetle species, air-conditioning will win every time.

Box 2. Outputs over time

Non-diverse farming systems succeed because revenues are sufficient to cover the cost of the special attention needed to preserve a uniform and non-climax vegetation. Where such effort relies heavily on seed, chemicals or mechanical power, it may also benefit from economies of scale. Outputs from such systems are usually higher when measured over short periods of time against ‘complex’, diversified production systems such as those involving an elaborate interface with the tropical forest. Turning rainforest to degraded grassland can support a household for several years, but then the household still has the option to burn other pieces of forest. The greater the simplification of the genetic base, the greater the risk from pathogens. The likelihood of a pathogen eliminating the resource base and thereby causing major food insecurity is hard to quantify, although it demonstrably occurs, for example in the case of potato blight. The political pressure for food in the present is likely to outweigh the potential for famine in the future.

Species richness may also develop to survive extreme shocks, especially climatic. Studies of grasslands have shown that where greater levels of diversity have been conserved, recovery subsequent to a drought is much more rapid (Tilman and Downing, 1994). This argument may not immediately seem to be applicable to equatorial forests where the climate would seem to be more stable, but this is only a matter of time-scale. For example, at certain periods during the last 12,000 years, the West African rainforest has been reduced to a tiny fraction of its present size and it is likely that this type of expansion and contraction has occurred regularly in prehistory. For a forest environment to be reconstituted effectively it must carry large amounts of apparent redundancy. It must also be located in areas where human population density is low enough to permit regeneration.

Indirect economic benefits: evolving pathogens

One of the more difficult questions for this type of biology is understanding why biodiversity occurs, in other words why organisms and genes appear to speciate at such frantic rates in certain circumstances and why habitats evolve to support this diversity. One significant underlying cause may be the defence against pathogens; the more genetically uniform a population is, the more vulnerable it is to pandemic diseases. Pathogens evolve rapidly and plants and animals must adapt constantly to their attacks. Speciation is one obvious result; the more biodiverse a population is the less likely it is to be eliminated when a powerful pathogen evolves. Analogous arguments have been developed in relation to predation; the more effective the predator the greater the tempo of speciation.

In the case of domesticated plants and animals, the object of food production is to select cultivars and races that have desirable qualities and which retain those qualities by being reproduced in as genetically uniform a manner as possible. Modern techniques of propagation and selective breeding make possible a degree of homogeneity impossible until recently. As a result, extremely similar animals, trees and crops are found across much of the world. This is generally seen as a contribution to food security; over recent decades high-yielding varieties with accompanying changes in agronomy have significantly reduced the risk of famine, especially in Asia.

This strategy is not without risks, as has long been evident from basic evolutionary theory. In their home areas, organisms have co-evolved with pathogens and have more or less developed defences. However, when transplanted, the plants and animals face an alien array of pathogens they have not encountered before. Many of these will be harmless, but it is possible for a 'super-pathogen' to evolve that will be extremely damaging to the imported plant. If such a pathogen is then carried back to the 'home' area of the organism (i.e. its centre of evolutionary diversity) it can have enormous destructive potential.

In case this should seem to be just a hypothetical argument, an some examples: European domestic animals were carried to the New World where they were parasitised by the screw-worm. Screw-worm infestation initially had near 100 per cent mortality although the impact of co-evolution over the last few centuries has made it less dangerous in the neotropics. However, in the Old World it is transmitted rapidly between animals which have no resistance and is almost always fatal. Screw-worm was carried to North Africa in the 1980s and was only eliminated after a costly and lengthy campaign (FAO, 1992). Further outbreaks must remain a distinct possibility. The rinderpest pandemics of the late nineteenth century entered Africa as livestock pathogens, but were also responsible for massive mortality among indigenous wild bovids such the buffalo which had no natural resistance.

Historically, it has been much easier to protect livestock since they can be moved around and separated from sources of infection by physical barriers. Trees are relatively inflexible organisms and preventing infected plant material from circulating around the world is all but impossible. In addition, it is now common in forestry to produce trees by vegetative propagation, thereby eliminating variation and allowing diseases or infestations to be 100 per cent effective. The spread of needle blight (*Dothistroma septospora*) on pines and the Cryphonectria canker on eucalypt plantations represent examples of existing pathogens causing major losses after spreading from their source area.

Beyond this, there is a potential for catastrophic effects on source-populations from super-pathogens. All the eucalypt plantations in the world derive from a relatively small genetic base, originating in Australia. Guava rust (*Puccina psidii*), a pathogen of the native Myrtaceae in the New World has jumped to eucalypt plantations there. Since the original Australian eucalypts have not co-evolved with the rust, should it spread back to Australia its impact on the wide range of native eucalypts could be devastating. In a similar vein, the psyllids that have damaged the Leucaena hedges planted in so many hopeful agro-forestry projects in the 1970s and 1980s suggest the error of basing agricultural strategies on a narrow genetic base.

Similar patterns can show up in major cultivated plants, for example the potato. The potato blight, *Phytophora infestans*, was responsible for the Irish ‘great hunger’ in the 1840s, but has never disappeared. A more virulent stain of the blight (genotype A2) was identified in Switzerland in 1981. A series of smaller outbreaks were reported through to the early 1990s, when it was realised that the fungus has switched to sexual reproduction, thereby dramatically increasing its mutation rate and becoming polymorphous and thus less susceptible to individual fungicides. It appears that some forms had ‘swapped crops’ and were now infesting tomatoes. By 1992, the International Potato Centre estimated that yields in the developing world were down 30 per cent as a result of infestation and, moreover, threatening to spread back to the high Andes, the original centre of domestication and still the major diversity reserve (Fry *et al*, 1993). Potatoes are now among the most chemical intensive crops in the world (Mooney, 1996).

Aesthetic
The third type of argument suggests that diversity has a value in itself, that it is aesthetically desirable. Strangely enough, there is little or no resistance to this type of argument when presented in terms of the diversity of human culture. It is generally accepted that a diversity of language and culture is worth preserving, that the globalisation of American English would not necessarily be a desirable goal. Suggesting to governments that it would be convenient to eliminate indigenous languages would now generally meet with intellectual resistance. The argument for biodiversity is analogous; we should not impoverish the biological environment any more than the cultural one.

However much this view has to recommend it to the Western middle-classes, it simply does not seem to be widely upheld. In many places in the world, biodiversity is being destroyed either through habitat destruction or intentional pinpointing of resources such as large mammals by individuals too absorbed by financial gain to notice or households too poor to care. Demographic pressure will ensure that this process continues largely unabated; relentless burning of the Amazonian rainforest sometimes drops slightly when political pressure is applied and rises again when it is relaxed.

Ethical
Ethical approaches to nature and the environment have a long history in human society: animals and plants must not be destroyed because they are part of a larger spiritual web. This has a strong historical association with food taboos, making vegetarianism a prestigious behaviour in south Asian society, for example. More general, however, has been the extension of ethical precepts developed to apply human culture to non-human entities. Just as human rights have been extended over time to slaves and to children, the argument is that they should extended to animals and even the environment as a whole. From this perspective, we are ‘stewards’ of earth’s biological resources and we have no right to destroy them and deny future generations the opportunity to experience and interact with them. Ethical arguments have a strong emotional appeal but remain extremely culture-bound: presenting such a case to someone who does not accept their cultural presuppositions will only be rewarded with more burning forests.

Are indigenous peoples natural conservationists?

A key element in the psychology underlying attempts to conserve biodiversity is the notion that although we are destroying the environment in the present, in the past indigenous peoples lived in harmony with it. Hence the world was full of ‘pristine’ environments until the expansion of the West. Whether we like it or not, thinking in this area is powerfully influenced by those sepia posters quoting the supposed statements of American Indians on our relation with the earth and our duty to conserve it. Whether these are fakes or not is often difficult to know, but their message is clear: indigenous peoples naturally tend to conserve their environment. A more sophisticated version is often cited from anthropological texts concerning Amazonia: the shaman asks permission from the animal’s spirit before killing it. The shaman becomes proto-conservationist, checking that hunters are only harvesting a sustainable yield from the forest. This idea lurks beneath the surface of all too many community conservation projects, especially in Africa: wildlands are rich sources of essential products valued by the community and only exceptional pressure causes their destruction. Hence, bolstering income from these areas will persuade individuals it is in their interest to conserve them.

This would be delightful if it were so: but since the 1980s evidence has mounted from many regions that Quaternary extinctions (the disappearance of megafauna in recent prehistory) in many parts of the world were in fact directly the result of human irruption. This was first proposed long ago for the New World by Darwin’s rival, Alfred Russell Wallace (1911) and reprised again the 1980s (Martin, 1984; Diamond, 1989). It now seems likely that the Australian megafauna also disappeared coincidentally with primary human colonisation. In more recent times, the destruction of much of the fauna and flora of Madagascar and New Zealand followed the coming of the Malagasy and the Maori. Fossil evidence suggests that the Polynesians left a trail of destruction across the Pacific as they expanded (Pimm, Moulton and Justice, 1995).

There is no reason why conservation should be a natural process: ethical arguments are plucked from scientists’ wish lists rather than based in empirical reality. Indeed the pressure for protected areas and environmental conservation usually follows panoramas of destruction and tends to be driven essentially by nostalgia and, more recently, recreational use. A considerable amount of evidence from Africa in the wake of community wildlife projects suggests that underlying attitudes are no different today. Especially where modern rifles have spread, game parks are more notable for their vegetation than their large mammals, except where policing has remained effective.

Extinction theory

The disappearance of the dinosaurs has always been the subject of half-humorous debate, but recent surveys of the fossil record have begun to provide evidence for mass extinctions on a much grander scale. It has been argued that large-scale extinctions are one of the major motors of evolution, as the totality of living things pass through genetic bottlenecks and rediversify. Five major extinctions have been recorded, but the most spectacular of these was the Permian, some 250 million years ago, when 95 per cent of the species on the planet died out. Although the causes of these extinctions remain disputed, almost all appear to be due to geological processes or possibly the impact of asteroids. The Permian in particular, which has been linked to rising levels of carbon dioxide in the oceans, may have been the result of global warming, which has a resonance for our present predicament.

The fossil record suggests a ‘background extinction rate’ of approximately one species per million per year. Anthropic extinctions in tropical regions are presently running at least a thousand times this rate (Wilson, 1992). The reduction in biodiversity during the last ten thousand years has been on a scale that suggests human activity is precipitating a ‘sixth extinction’. The relevance of this is that extinction theory is being adapted to suggest that biodiversity loss ‘does not matter’. In other words if there have been massive extinctions in the past, with no consequent loss of global biodiversity, why should this not apply to the future? On a smaller scale, the scarred biotic history of the Polynesian islands has recently been uncovered, but their inhabitants were managing quite satisfactorily, in subsistence terms, at the time of first European contact.

These arguments have excited a robust rebuttal from what might be called the radical humanist lobby. Simon and Wildavsky (1995) suggest that not only have the numbers been exaggerated by the unconvincing piling-up of anecdotal examples, but that even if the numbers were true there is no evidence that it matters. A more subtle adaptation of extinction theory appeared in the Wall Street Journal, arguing not only that the loss of a squirrel subspecies (the Mount Graham squirrel) is relatively unimportant compared with local development interests but that it is part of the evolutionary process, as mass extinctions have historically allowed a re-radiation of species (Copeland, 1990). Copeland articulates the feelings of many non-scientists that such extinctions have no immediate impact either on the human future or on ‘nature as a whole’. Gould (1993) rebuts this at the scientific level, pointing out that such processes occur only on geological time scales. But the general theme, technological triumphalism—the idea that whatever the biological backlash, human ingenuity can overcome it and lead us to ever greater material progress—is as much an obstacle to biodiversity conservation as migrant farming in the Amazon basin.

Conclusions

Of the arguments for conserving biodiversity, only those relating to protection against pathogens and the relative output of systems over time have any real validity. No amount of undiscovered nostrums or rococo aesthetic justifications will have an impact on real-world outcomes on anything greater than a 'conservation area' scale. Society would rather use technology to adapt to the changes wrought by its impact on the planetary system than reduce its consumptive behaviour. Whether techno-fixes can ever outpace the threat from super-pathogens must be debatable; the threat accelerates as genetically uniform species continually replace diverse production systems. Only when the humanitarian crises and economic losses from this reach unacceptable levels will there be a response from governments and research establishments. In the same vein, it may be that all the forests have to burn down once before farmers and policy-makers can be convinced that using trees sustainably is ultimately more effective than destroying them. Species do not reconstitute themselves; extinction is a one-way process. Even if we attempt rebuild the original biota—and human population pressures will not permit this—without all the species present, an environment becomes merely a theme-park version of itself. In the concrete jungle there are only mechanical cockroaches.

Any effective response must be on two levels: the scientific and the educational. The speed at which the argument has taken off and spread beyond the pages of *Nature* or *Science* has meant that many crucial technical questions are far from being resolved. Complex arguments with numerous uncertainties become simplified for absorption into policy documents. Continued support of hard science, such as taxonomy, remains a priority, as many questions of direct relevance to policy remain unresolved. However, without an informed public, shriller voices will dominate the debate making the slow processes of effective biodiversity conservation still more difficult to institutionalise. At the same time, the process of diffusing the factual data and the arguments to the public may need to be more sophisticated than animatronic cafés and gurgling World Music CDs if policy-makers are to be given the political support they will ultimately need.

References

Copeland, M.D. (1990) 'No red squirrels? Mother Nature may be better off'. *Wall Street Journal*, 7th June 1990.

Diamond, J.M. (1989) 'Quaternary megafaunal extinctions: variations on a theme by Paganini'. *Journal of Archaeological Science* 16:167-175.

Ehrenfeld, D. (1988) 'Why put value on diversity?' in E.O. Wilson and F.M. Peter (eds) *Biodiversity*, 212-16. Washington, DC: National Academy Press.

Ehrlich, P.R. and A.H. Ehrlich (1992) 'The value of diversity'. *Ambio* 21:219-226.

FAO (1992) *The New World Screw Worm Eradication Programme*. Rome: FAO.

Fry, W.E. *et al.* (1993) 'Historical and recent migrations of Phytophora infestans: chronology, pathways and implications'. *Plant Disease* 77(7):653-661.

Groombridge, B. (ed.) (1992) *Global Diversity: Status of the Earth’s Living Resources*. London: Chapman and Hall.

Gould, S.J. (1993) *Eight Little Piggies*. London: Jonathan Cape.

Lawton, J. and R. May (eds) (1995) *Extinction Rates*. Oxford: OUP.

Martin, P.S. (1984) 'Prehistoric overkill: the global model', in P.S. Martin and R.G. Klein (eds) *Quaternary Extinctions: A Prehistoric Revolution*. Tucson: University of Arizona Press.

Mooney, P.R. (1996) *The parts of life: agricultural biodiversity, indigenous knowledge and the role of the third system*. Special issue of *Development Dialogue*. Uppsala: Dag Hammarskjöld Foundation.

Pimm, S., M. Moulton and L. Justice (1995) 'Bird extinctions in the Central Pacific', in J. Lawton and R. May (eds) *Extinction Rates*, 75-87. Oxford: OUP.

Simon, J.L. and A. Wildavsky (eds) (1995) 'Species loss revisited', in J.L. Simon (ed.) *The State of Humanity*, 346-361. Oxford: Blackwell.

Tilman, D. and J.A. Downing (1994) 'Biodiversity and stability in grasslands'. *Nature* 367:363-5.

Wilson, E.O. (1992) *The Diversity of Life*. New York: Norton.

Roger Blench is a Research Fellow at ODI.
Email: r.blench@odi.org.uk
The author would like to thank Prof. Stephen Hall of De Montfort University for his valuable comments on the first draft of this paper.

ISSN: 1356-9228

Administrative Editor: Helen Suich
Series Editor: John Farrington

ISSN: 1356-9228
© Copyright: Overseas Development Institute 1998

Overseas Development Institute
Portland House
Stag Place
London SW1E 5DP, UK

Telephone +44 (0)171 393 1600
Fax +44 (0)171 393 1699
Email: nrp@odi.org.uk
