Meeting Report

A 'north–south' discussion of biodiversity at Gobabeb

W. Roy Siegfried

Scientists sometimes have delusions of adequacy. They frequently overestimate their importance to society. This is common among natural scientists who are involved as advisers to those private- and public-sector bodies which are responsible for the management of the utilization of renewable natural resources. Biological diversity (biodiversity) is one such resource. Biodiversity is a collective term for the variety of life, ranging from genes through species to ecosystems and landscapes. Its actual and potential usefulness is being eroded at an accelerating rate through the extinction of plants and animals. There is a growing frustration among the scientists concerned over their apparent inability to influence the rate of loss.

Such a group of scientists gathered during a three-day workshop in April, at Gobabeb in the Namib Desert. Gobabeb is a research facility operated in partnership by the Namibian Ministry of Wildlife, Conservation and Tourism, and the Desert Ecological Research Unit of Namibia (an NGO). The scientists concerned were drawn from western Europe (mainly Germany) and southern Africa, and the programme was arranged to draw out socio-economically developing (southern African) and developed (European) regional perspectives in relation to such common problems as: how should biodiversity be measured? where should protected areas be located? how should viable and surplus populations be assessed? how much redundancy in biodiversity is possible? how should biodiversity be monitored? how does global change affect biodiversity? how can museums, zoological and botanical gardens assist in the protection of biodiversity? and, how does one justify the continued existence of protected areas?

These topics were chosen because they are important in the development of strategies aimed at protecting biodiversity. The nations of southern Africa and western Europe are committed, at least in principle, to ratifying the international Convention on Biological Diversity, following the United Nations Conference on Environment and Development (UNCED) held at Rio de Janeiro in June 1992. One of the Convention's more important obligations requires signatory countries to develop national strategies, plans or programmes for the conservation and sustainable use of biodiversity. Moreover, the World Conservation Union's (IUCN) complementary Global Biodiversity Strategy calls for the establishment of strategies in all countries by the year 2000, and a comprehensive world *ex situ* and *in situ* genetic conservation system to be in operation by 2010.

Clearly, the theme and the proceedings of the workshop focused on the role of the natural sciences and scientists in management aimed at enhancing the survival of as much biodiversity as possible, mainly in protected areas: however, biodiversity is not, of course, evenly distributed over the earth, and the nations with the greatest responsibility for protecting biodiversity are, in the main, the ones least equipped to do so. Moreover, since protected areas represent only a relatively small proportion of the earth's surface, the survival of much biodiversity depends on the need for sustained exploitative utilization in conjunction with protection outside the borders of nature reserves. In this context, the limitations of the natural sciences and the frustrations of the scientists soon emerged and continued to surface repeatedly in the face of the stark realities pressuring protected areas in both the developed and developing regions, despite the pressures being different between the two areas.

Scientists are good at recognizing problems but less so at remedying them, because the judgement of scientists is often heavily influenced by their training in their respective disciplines, which tend to be too sectorial for the most important issues involving resources and the environment. An adequate understanding of these issues must include many disciplines.[1] To address these problems with any chance of success, it was agreed that the natural scientists will have to reach out and collaborate with economists, sociologists and others in the socio-economic sphere, rather than rely on the reverse happening. This, however, is not likely to happen to any large extent until the present funding dispensation for such inter-institutional and interdisciplinary collaboration is reformed, and a change occurs in the attitude of natural scientists towards the traditional 'soft' sciences.

Traditionally, much biodiversity has been protected in national parks, nature reserves and other protected areas, encompassing representative samples of relatively untransformed ecosystems. These areas are under threat currently, and none more so than in Africa where mounting pressures from human activities are operating on the boundaries of, and sometimes inside, protected areas. Recently, this problem has been addressed by way of projects that attempt to link and integrate the protection of biodiversity inside protected areas with the social and economic development of neighbouring communities. Judging from what was reported at Gobabeb, the measurable success of these ventures in both Europe and Africa has been small. This conclusion has also been reached in a recently published review of 23 case studies in Africa, Asia and Latin America.[2] The authors of the review stress that there is a difference between beneficiary participation in which local communities are restricted to receiving goods and services, and the participatory approach whereby the arrangement between the two parties (neighbours and park authorities) empowers the people to influence change. The beneficiary approach lacks sustainability and the participatory approach involves a long period of implementation. A balance between the two is desirable in a partnership arrangement. Since such protected areas as national parks 'belong' to all citizens of a country, it could, and perhaps should, be argued that communities neighbouring protected areas should not have special rights or privileges affecting management of these areas. Of course, the case is different when it has involved moving people forcibly from areas later changed into nature reserves.

Several sets of opinions, agreements and conclusions emerged from the Gobabeb meeting. Most of these were specifically technical in nature, but five overarching propositions were of special importance. First, and in spite of past and present efforts involving the use of species as a universal unit for assessing biodiversity, it was concluded that a combined ecophysiographic and species regional approach would be more robust and parsimonious (efficient) than the conventional species richness/endemism basis for selecting protected areas. Secondly, the marine environment differs sufficiently from the terrestrial one to merit separate treatment. Thirdly, although seemingly obvious, European models and experience are of limited use generally. Indeed, universal problems and solutions are few and far between, and most cases demand different treatments according to individual circumstances. Fourthly, the

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potential importance of captive breeding programmes in protecting biodiversity has been (and is) exaggerated. Finally, there was general agreement that natural scientists have relatively small but very important, indeed crucial, roles to play in protecting biodiversity. Reforms are, however, required in the ways in which such scientists are trained and operate professionally, if the role of natural science is to realize its full potential in this field. Time is not on the side of science.

The participants in the workshop were: Dr H. Berry, Dr C. Berry, Dr E. Bezzel, R. Braby, Dr M. Cherry, Dr S.J. Milton, W.R.J. Dean, Prof. C. Dickmann, N. Dorndorf, A. Ferrar, Dr P. Hockey, W. Killian, Dr A. Lombard, Dr J. Midgley, Y. Narain, Dr H. Remmert, Dr R. Scholes, Dr M. Seely, Dr W. Scherzinger, Prof. W.R. Siegfried, P. Tarr, Dr M. Vogel and Dr C. Wissel.

1. Ludwig D., Hilborn R. and Walters C. (1993). Uncertainty, resource exploitation, and conservation: lessons from history. *Science* **260**, 17 and 36.
2. Wells M., Brandon K. and Hannah L. (1992). *People and Parks: Linking Protected Area Management with Local Communities.* World Bank Publications, Washington, D.C.

Meeting report

Multi-species conservation, advanced computer architecture and GIS: where are we today?

A.T. Lombard

Can the technology of the 1990s aid us in understanding and modelling the spatial nature of communities, their population dynamics and their interactions with one another, so we can plan effectively for their futures?

In January, a workshop, entitled 'Planning for the conservation of multi-species biodiversity', was held at the San Diego Supercomputer Center. The meeting attempted to integrate multi-species conservation with geographic information systems and advanced computer architecture. This report summarizes the issues raised and the main conclusions reached in each of the sessions.*

Space, communities and complexity

Many metapopulation models have been developed to help us understand spatial extensions and patchiness within populations and communities, but can these models be linked to reserve design? Can we successfully incorporate information at the life history, population or community level with spatial information at the landscape level in order to predict future species distributions? It appears that our advancement in the computing world has not been matched by an ability to integrate these differing levels of information, and the single-species model is still the norm. In addition, the problem of data at different spatial scales continues to plague us. There are two major problems associated with data which are at a high resolution (fine scale). Firstly, these data may be lost when habitats are mapped at a broader scale (this is a serious problem with remotely sensed information). Secondly, inter- and intra-specific interactions may well affect species' distributions at fine scales, whereas habitat attributes may more obviously affect species' distributions at broader scales. These, and other scaling effects, must be taken into account when designing multi-species reserves.[1,2]

The prevalent use of grid cells (of any defined size) in representing environmental information must also be carefully evaluated. Grid cells are frequently too large to represent fine-scale data. Square cells are not as effective as hexagonal cells in quantifying neighbourhood relationships among cell attributes.[3] There is also the problem of false negatives. Most spatial data layers are infected with 'holes'. These holes can either be areas for which data have not been collected, or they may be areas where a species or phenomenon is absent. Are we able to deal with these differences in our reserve design models? At present, not really. At best our models can extrapolate species distributions to unknown areas using some form of habitat association index.

In the face of these problems, how best do we use the computing power available to us to design effective nature reserve systems? We have been able to harness the powers of computing in single-species models,[4–7] but what is the future of these models? Perhaps they should be replaced by a generalized 'metamodel', into which single-species models can be 'plugged'. The metamodel could represent any generalities that may exist in community ecology (such as the nestedness of species sets across space).[8,9] The present indications are, however, that it will be very difficult to generalize across vastly different taxa.[8,10,11] The main problem with the metamodel is the same as that for a single-species model: it is very difficult to test its predictions. It is often impossible to conduct experiments at the landscape level, although examples of successful landscape experiments do exist.[12]

To return to the focal question of this session, it does seem possible that the application of advanced supercomputing will help conservation biology move from description to prediction. The tools and the single-species approaches are well advanced, but it is their application to efficient landscape management that requires our attention.

The spatial landscape

How can the spatial distribution of species across a landscape influence conservation planning? The fundamental processes that affect landscapes significantly include movement and exchange of species, energy, or materials across edges, down corridors, and through the matrix of habitat. These key landscape processes occur at all scales. Practically speaking, most treatments of landscape ecology occur at regional scales, and it is the regional scale that has been identified as the most appropriate one for conservation planning and reserve design.

Current approaches to landscape ecology have expanded in both space and time. Patch dynamics are now investigated at a broad scale (large area), and population viability analysis (PVA) models operate over time scales ranging from 100–500 years. Many landscape-related processes affect patch dynamics and population models. These include fragmentation, dispersal/colonization, connectivity (corridors) and habitat suitability within sub-populations.

Experimental work on fragmentation has confirmed that source–sink dynamics and inter- and intra-specific density-dependent interactions may often explain population responses within patches.[12] This emphasizes the need for extensive basic field ecology prior to model formulation. In addition, fragmentation within

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*The workshop was divided into four working groups: Space, Communities and Complexity; The Spatial Landscape; GIS and Conservation; and Real World Solutions. The meeting was organized by Michael Gilpin and the four sessions were chaired by Ted Case, Reed Noss, Frank Davis and Peter Brussard, respectively. Dr A.T. Lombard is at the FitzPatrick Institute, University of Cape Town, Rondebosch, 7700 South Africa.