Environmental variations can play an important role in population ecology, not only in generating cyclic patterns of fluctuation[14,15], but also in causing synchrony. Although the Moran effect is the main factor synchronizing the St Kilda sheep populations, it is too early to say that it is the dominant factor in most synchronized populations. Nevertheless, these findings, together with the work by Esa Ranta and colleagues[4,5,11], lead us to suspect that it could be very important in several systems. Ecologists are now coming to grips with spatial population dynamics and have recognized that incorporating simple stochastic variations in models can generate interesting dynamics; further integration will lead to progress in the discipline[3].

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References

1 Elton, C. (1924) **Fluctuations in the numbers of animals: their causes and effects,** *Br. J. Exp. Biol.* 2, 119–163
2 Grenfell, B.T. *et al.* (1998) **Noise and determinism in synchronised sheep dynamics,** *Nature* 394, 674–677
3 Leirs, H. *et al.* (1997) **Stochastic seasonality and nonlinear density-dependent factors regulate population size in an African rodent,** *Nature* 389, 176–180
4 Ranta, E. *et al.* (1995) **Synchrony in population dynamics,** *Proc. R. Soc. London Ser. B* 262, 113–118
5 Ranta, E. *et al.* (1997) **The Moran effect and synchrony in population dynamics,** *Oikos* 78, 136–142
6 Hanski, I. and Woiwod, I.P. (1993) **Spatial synchrony in the dynamics of moth and aphid populations,** *J. Anim. Ecol.* 62, 656–668
7 Sutcliffe, O.L., Thomas, C.D. and Moss, D. (1996) **Spatial synchrony and asynchrony in butterfly population dynamics,** *J. Anim. Ecol.* 65, 85–95
8 Cattadori, I.M. *et al.* **Temporal and spatial dynamics of rock partridge (*Alectoris graeca saxatalis*) in the Italian Dolomites,** *J. Anim. Ecol.* (in press)
9 Royama, T. (1992) *Analytical Population Dynamics*, Chapman & Hall
10 Moran, P.A.P. (1953) **The statistical analysis of the Canadian lynx cycle. II Synchronization and meteorology,** *Aust. J. Zool.* 1, 291–298
11 Heino, M. *et al.* (1997) **Synchronous dynamics and rates of extinction in spatially structured populations,** *Proc. R. Soc. London Ser. B* 264, 481–486
12 Earn, D.J.D., Rohani, P. and Grenfell, B.T. (1998) **Persistence, chaos and synchrony in ecology and epidemiology,** *Proc. R. Soc. London Ser. B* 265, 7–10
13 Clutton-Brock, T.H. *et al.* (1997) **Stability and instability in ungulate populations: an empirical analysis,** *Am. Nat.* 149, 195–219
14 Potts, G.R., Tapper, S.C. and Hudson, P.J. (1984) **Population fluctuations in red grouse: analysis of bag records and a simulation model,** *J. Anim. Ecol.* 53, 21–36
15 Kaitala, V., Ranta, E. and Lindström, J. (1996) **Cyclic population dynamics and random perturbations,** *J. Anim. Ecol.* 65, 249–251

Diversitas: an international programme of biodiversity science

Biologists and ecologists tend to have less experience in gathering their forces together for common goals than do scientists in other fields, such as physics. Yet, cooperation in research is critical if global problems, such as the accelerating loss of biodiversity, are to be faced. *Diversitas* was launched in 1991 to meet this need. *Diversitas* is an international programme established to promote and catalyse the science of biodiversity on a worldwide scale. In 1996, it entered a new phase of organization and activity, with new sponsoring organizations, a new Scientific Steering Committee and a new operational plan[1]. The convenors of the various research components within *Diversitas* met recently in Mexico to review the development and perspectives of the programme. Because most publications describing *Diversitas* have appeared in the 'grey' literature, many scientists who might benefit from joining the programme are simply unaware of its existence. Therefore, we felt it useful to make *Diversitas* better known through this report of the recent project convenors' meeting. Hosted by the Universidad Nacional Autonoma de Mexico, the meeting was preceded by a meeting of experts, held at the request of the Secretariat of the Convention on Biological Diversity (CBD). The aim of this initial meeting was to identify the science that would be appropriate for selected articles of the CBD, for subsequent submission to the CBD Conference of Parties at Bratislava (Slovakia) in May 1998.

Diversitas currently has ten programme elements, each focused on a fundamental scientific question about life's diversity. Five core programme elements (CPEs) represent the central research effort of *Diversitas*, and five special target areas of research (STARs), concerning areas that are related to all the CPEs, focus on problems of special concern in biodiversity science that have received only limited attention. The strength and potential of the *Diversitas* research agenda lie in the inter-relationships among its programme elements.

The CPEs

(1) The effect of biodiversity on ecosystem functioning

This CPE addresses the fundamental issue of how biodiversity contributes services for humanity through the maintenance of ecosystem processes and stability. Several large-scale programmes or projects are part of this element. Harold Mooney (Stanford University, CA, USA) presented the new Global Invasive Species programme, which aims to synthesize and develop knowledge about biological invasions and their socioeconomic consequences. Michel Loreau (Ecole Normale Supérieure, France) reported on BIODEPTH (Biodiversity and Ecosystem Processes in Terrestrial Herbaceous Ecosystems). This is a pan-European experiment replicated across a network of sites. It is designed to test the importance of biodiversity for the functioning of grassland ecosystems, and is linked with theoretical and modelling work that could serve as a basis for a global activity. Osvaldo Sala (University of Buenos Aires, Argentina) explained how the programme on Global Change and Ecological Complexity, which is part of the International Geosphere–Biosphere Programme core project on Global Change and Terrestrial Ecosystems (IGBP-GCTE), contributes to *Diversitas*.

(2) Origins, maintenance and change of biodiversity

Isabelle Olivieri (Montpellier University, France) outlined the goals of the second CPE: to understand the genetic, population and community processes leading to biotic diversification and loss, with a view to developing effective strategies for maintaining biodiversity. To date, it has been mainly coordinated in France (which was the first country to establish a national *Diversitas* programme) through

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several workshops and research networks, and is aimed, in particular, at the national and European levels.

(3) Systematics: inventorying and classification

The main objectives of this element were presented by Pieter Baas (Leiden University, The Netherlands), Lily Rodriguez (Asociacion Peruana para la Conservacion de la Naturaleza, Peru) and Joel Cracraft (American Museum of Natural History, New York, USA). These are to develop an international consensus on the methods and priorities for a systematic inventory of the world's species and a phylogenetic classification of life, and to foster the organization of systematic databases that will be accessible to all countries.

The task is immense and complex; we are seeing only the early stages of a coordinated effort in this area. An interesting initiative, presented by Frank Bisby (University of Southampton, UK), is Species 2000, which aims to provide an electronically accessible index of the world's known species.

(4) Monitoring of biodiversity

The fourth CPE aims to provide standardized methods for sampling, assessing and monitoring biodiversity. Marvalee Wake (University of California, Berkeley, USA) argued that, given the plethora of existing protocols (more than 3000 for freshwater fishes alone), a useful first step (in progress) is a collection and evaluation of these protocols. Long-term monitoring requires international networks that often involve both professional and amateur ecologists. An example was provided by Tim Halliday (Open University, Milton Keynes, UK) with the Declining Amphibian Populations Task Force, which comprises 120 regional groups belonging to 100 countries working to determine the nature, extent and causes of declines in amphibians throughout the world. Pierre Lasserre (UNESCO, Paris, France) emphasized the potential of the Man and the Biosphere reserves in this respect.

(5) Conservation, restoration and sustainable use of biodiversity

Some of the major questions concerning this CPE are:

- How do the dynamics of biodiversity affect conservation policy (Peter Bridgewater, Environment Australia, Kingston, Tasmania)?
- How could different land-use and management practices maximize sustainability and production, while conserving ecosystem services and biodiversity (Peter Bridgewater)?
- What are the rationale and technologies for the restoration of habitats in a landscape complex (Ed Maltby, Royal Holloway Institute for Environmental Research, Huntersdale, UK)?
- How can the genetic diversity of wild species be conserved, especially those used in human activities (Vernon Heywood, University of Reading, UK)?

The STARs

The biota of soils and sediments are still poorly known but play a central role in major ecosystem processes. Diana Wall (College of Natural Resources, Fort Collins, CO, USA) and Isabelle Barois (Tropical Soil and Biology Programme, Xalapa, Mexico) showed the need to coordinate research in this area and reported on recent workshops and other activities within the STAR on 'Soil and sediment biodiversity'.

Marine and freshwater biodiversities also pose special scientific and conservation challenges because of the great size of, and poor access to, marine ecosystems and the variety and isolation of freshwater ecosystems, with their rich but threatened fauna and flora. Several meetings and projects have been organized concerning the maintenance of diversity, systematics and monitoring within the STAR on 'Marine biodiversity' (Carlo Heip, Netherlands Institute of Ecology, Yerseke, and Frederick Grassle, Rutgers University, NJ, USA), as well as the coordination of established marine networks throughout the world. John Ogden (Florida Institute of Oceanography, USA) presented a new project, BIOCORE (Biological Diversity and Ecosystem Function in Coral Reefs), which aims to describe the global diversity of coral reefs and understand their ecosystem impacts. Christian Lévêque (ORSTOM, Paris, France) and Hiroya Kawanabe (Lake Biwa Museum, Kusatsu, Japan) also presented an action plan – the result of several recent meetings – which establishes the priorities to be considered in the new STAR on 'Freshwater biodiversity'.

Another STAR concerns 'Microbial biodiversity'. Microorganisms seem to form a different world from the one most ecologists are used to, and yet are very much the basis of the environment in which we live. Erko Stackebrandt (German Collection of Microorganisms and Cell Cultures, Braunschweig) and James Staley (University of Washington, USA) gave fascinating accounts of the challenges of microbial inventorying and classification (which require new species concepts) and the multiple roles of microorganisms in ecosystems. Lindsay Sly (University of Queensland, Brisbane, Australia) and David Hawksworth (London, UK) also emphasized the need to expand and coordinate their culture collections.

The final STAR is 'Human dimensions'. Setijati Sastrapradja (Indonesian Biodiversity Foundation, Jakarta) convincingly argued that conservation and sustainable use of biodiversity are impossible in a world of poverty: research is necessary to study the extensive interactions between biodiversity and social, economic and cultural dimensions. Peter Schei (Directorate for Nature Management, Trondheim, Norway) further stressed the need for ecosystem-level and multidisciplinary approaches, and Brian Huntley (National Botanical Institute, Claremont, South Africa) provided an example of a capacity building network through training programmes in southern African countries.

Prospects

Diversitas is about life's diversity. A major challenge of the programme is to forge the necessary unity within the scientific community beyond its own diversity. Another is to educate the policy-makers, managers and general public about biodiversity. An important initiative that we hope will contribute to reaching these goals was discussed at the meeting in Mexico: *Diversitas* has designated the year 2001 the International Biodiversity Observation Year (IBOY). Through the establishment of a global observation programme, IBOY will assess the status of biodiversity in the different regions at the beginning of the 21st century. IBOY will thus provide an opportunity to explore important and exciting new dimensions for biodiversity research, while building on existing research and bringing biodiversity to the fore.

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References*

1 Diversitas (1996) *Diversitas: An International Programme of Biodiversity Science* (Operational plan), Diversitas, Paris

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