river that flowed through in the Thar Desert region in the north.

The author makes a brief discussion on the tectonic movements that shook the region west of the Aravalli Mountains possibly during the last 10,000 years. Nonetheless, virtually no attempt was made to relate these movements with the actual process of migration and extinction of the Vedic river. The statement that the shifting of the river course took place over the past 1.5 million years, has no scientific basis. He mentions about the river Lavanavati (Luni), but did not consider the fallacy in the name of the river. No flowing river can have saline water. On the other hand, we might say that it was only because of the withdrawal of the water from the channel, the riverbed turned into pools of saline water. Water flows through the present Luni 'channel' only during heavy rains. The very name of the river, Lavanavati, is indicative of the fact that the transformation must have been witnessed by the civilized man, and therefore it cannot be a part of the proto-history.

Certain statements made by the author in the book may not stand scientific scrutiny. Some of these 'wrong' statements may even send off-beam signals to readers who may be interested in trapping the 'flowing sweet water channel' in solving the acute water crisis in the region. On page 4, the author writes about the 'subterranean flow of freshwater in abundance'. Even the most remote possibility of this may help strengthening the conviction (based only on faith!) of certain people that the Vedic Saraswati had plunged underground and is now having a subterranean flow. Those who may be willing to subscribe to this view with the hope of getting perennial water supply, may take note of the fact that the isotopic study of the groundwater collected from the 'Saraswati palaeo-channels' indicated that the sampled water was only 22,000 to 6,000 years old (referred to in the book being reviewed). These old dates (albeit that these are not very well-constrained dates!) only help to disprove the fact about subterranean flow in replenishing the present day groundwater reserve.

Taken as a whole, the book, in spite of its apparent shortcomings, may make a good reading especially in view of the useful illustrations and the long list of references. It would be considered a highly creditable endeavour if the book helps in instilling keen inquisitiveness in readers' minds to know more about the river, which has evidently migrated from the realm of myth to the field of physical science.

A. B. ROY

9 Mayurvan,
Panerionki-Madri,
Udaipur 313 002, India
e-mail: abroy_g@yahoo.com

Biodiversity and Environment: Remote Sensing and Geographic Information System Perspective. Proceedings of the workshop organized by IIRS, India and ITC, Netherlands. P. S. Roy, Sarnam Singh and A. G. Toxopeus (eds). Indian Institute of Remote Sensing, 4, Kalidas Road, Dehra Dun. 219 pp.

This book under review presents many techniques that are currently being used in different parts of the globe to map and conserve nature. The interdisciplinary approach is essential for implementation of integrated conservation strategies. The approaches/applications presented in this book have great influence on the design, planning and implementation programmes to protect nature. The management of ecosystems requires inventory and monitoring of biodiversity in large areas of natural landscapes at fine scales.

Biodiversity refers to the range of variations among a set of entities and is commonly used to describe variety and variability of living organisms in terms of genetic diversity (heritable variations within populations), species diversity (species richness in a habitat) and ecological diversity (biophysical diversity).

India, because of its unique biogeographic location embraces three major biological realms, viz. Indo-Malayan, Eurasian and Afro-tropical. It is notable in its species-richness and endemism, and is ranked tenth amongst the biodiversity-rich countries. India is one of the world's 12 Vavilovian centres of origin and diversification of cultivated plants (with 167 species of agrihorticultural crops and 320 species of their relatives known to have originated here). Conservative estimates of species-richness show that around 127,000 species (plants, animals and microorganisms) have been so far reported from India and 400,000 species are yet to be explored. Conservation of biodiversity is important to mankind for various reasons. It facilitates ecosystem functions (carbon exchange, watershed flows, soil fertility, climate, etc.), offers aesthetic, scientific, cultural and other values and forms the basis for foodstuff, fibres, pharmaceuticals, chemicals, etc.

Anthropogenic activities coupled with the burgeoning human population, have led to the grim biodiversity scenario; numerous important plant and animal species are on the verge of extinction, while others are threatened or vulnerable. In order to bring about sustainable resource conservation and management, it is essential to adopt several different approaches for managing the ecosystem and biodiversity. To arrest the process of degradation and species-loss requires specialized solutions and an understanding of ecological processes. Protecting biodiversity does not merely involve setting aside chunks of area as reserves. Instead, all the ecological processes that have maintained the area's biodiversity such as predation, pollination, parasitism, seed dispersal and herbivory, involving complex interactions between several species of plants and animals need to be ensured. As of now, there are still major lacunae in information resources pertaining to forests, biodiversity – flora and fauna, causative factors for their degradation, and major threats. The available data are alarmingly inadequate to provide a lucid picture of the current status and ongoing losses/gains. The accelerated rate of extinction of species has prompted a need for a comprehensive assessment of the status, causes and trends of biodiversity at landscape levels and recommend conservation strategies for proper monitoring and management of forests and grassland, along with their inventory at regional, national and global levels.

Today, there is a shift from broad inventory surveys due to costliness and impracticality of such an approach. Instead, there is much interest in techniques that can predict species occurrence, habitat type and genetic impacts with the help of spatial and temporal tools – Geographic Information System (GIS) and Remote Sensing (RS).

Mapping the distribution of habitat types in the region as landscape elements could be done efficiently with the help of remotely sensed data acquired at different time intervals along with field surveys (which is also referred to as ground-truthing or training data collection). This would help in establishing association of groups of species with different landscape elements on the basis of field surveys. Temporal data (i.e. the data acquired at different time periods for the same location) help in assessing rates of transformations of habitat and the threats to different species as a result of ongoing landscape changes. This analysis would help in assigning conservation priorities to species on the basis of threats to their populations, rarity, endemism and taxonomic distinctiveness, and to different types of habitats or landscape elements on the basis of richness and significance of the threatened species that occur.

Utilization of spatial and temporal analyses tools such as GIS and RS could help determine the rates, causes and scale of biodiversity loss. GIS intermingle information obtained from various sources such as Survey of India topographic sheets, vegetation maps, remote sensing imagery, and other archival material to provide a picture of the state and extent of resource loss over time. Information on deforestation and land-use change can be integrated with data on the distribution of biodiversity and existing information on soils, topography, climate, etc. to obtain a comprehensive picture. GIS could be used more extensively as a tool in policy and landscape level planning. Thus, GIS aids in managing and monitoring the spatial relationships of various components making up the stratification (species distribution pattern, plant associations, bio-geo-climatic variables, forest and soil types, etc.).

Remote sensing provides the most efficient tool available for determining landscape-scale elements of biodiversity, such as the relative proportion of matrix and patches and their physical arrangement. At intermediate scales, remote sensing provides an ideal tool for evaluating the presence of corridors and the nature of edges. At the stand scale, remote sensing technologies are likely to deliver an increasing amount of information about the structural attributes of forest stands, such as the nature of the canopy surface, the presence of layering within the canopy and presence of (very) coarse woody debris on the forest floor.

This publication is a conference proceedings with 16 papers presented by lead researchers in the field. It has diverse objectives and methods currently being used to map nature. These case studies serve as prime examples of approaches that employ databases and maps as conservation planning, management and monitoring tools.

Maslekar's paper lucidly explains the biodiversity and conservation status in India, touches upon richness statistics, and various threats to biodiversity loss and conservation strategies. Finally, it highlights the importance of data in evolving conservation strategies and usage of remote sensing in the management of natural resources.

While highlighting the need for assessment of forest cover for rational planning and objective management of forest resources, Pandey prescribes usage of RS (with ground truthing) as a potential tool for mapping, periodic assessment for detecting change, its rate, degradation and denudation of forest resources. This paper also touches upon the Indian policy on forest cover, and provides a detailed account on forest cover in India from 1987 (19.49%) to 1999 (19.39%), which is well below the National Forest Policy fixation of 33.3%.

Roy *et al*. describe in great detail the RS and GIS methodology involved in characterizing landscape for better understanding of the ecosystem. The methodology presented in this paper for understanding biota considers both spatial and non-spatial data. Parameters and analyses of landscape for biodiversity characterization are exhaustive and would be a good reference material for researchers. The biodiversity characterization done for three regions (Northeastern India, Western Ghats and Western Himalaya) are well presented. This paper also discusses 'BioCAP' – software which helps planners and decision makers in prioritizing *in situ* conservation areas. Similar exercise of biodiversity characterization at landscape level for Meghalaya has been reported by Porwal *et al*.

The fuelwood model for Cibodas biosphere reserve, West Java is explained by Toxopeus. This model with the help of spatial and temporal data proposes sustainable use of fuelwood to prevent deforestation. Various parameters considered in this endeavour are fuelwood demand, consumption pattern, resource availability, population growth, etc. This paper also touches on various management options, which could aid as guidelines for decision makers.

Sharma and Singh review an excellent account of the status of plant diversity in India along with the conservation aspects and strategies. Researchers who are looking for data on Indian flora have to read this chapter with enormous input on ecosystems, floral richness and endemic species.

Mathur provides how best RS and GIS may be applied to spatial database development and strengthening management in protected area at Tadoba–Andhari Tiger Reserve in Maharashtra, Bandhavgarh National Park and Great Himalayan National Park. This paper outlines the need for systematic capacity building efforts at the protected area level to meet the growing management needs.

Singh *et al*. report the efforts of the Botanical Survey of India (BSI), a nodal agency of GOI dealing with floral diversity of India in developing query-based databases for biodiversity characterization. This helps in finding the location of all the taxa belonging to a particular conservation category, number of such taxa for a given administrative boundary, or other attribute information related to a particular taxa. The knowledge of occurrence of particular categories is important for inclusion of a particular habitat in conservation prioritization and management strategy.

Rawat reviews the status of patterns of species distribution in alpine vegetation of the western Himalayas and emphasizes the need for application of multi-scale spatial studies for inventorying and long-term monitoring.

Indiscriminate habitat fragmentations due to unplanned developmental activities have led to the elephant habitat erosion at an alarming rate, which has led to human–animal conflict, inbreeding, etc. which question its very survival. Rout *et al*. advocate usage of remote sensing and GIS in wildlife management by presenting an interesting case study dealing with characterization of elephant habitats and corridors in Orissa along with a part of Bihar using digital image processing technique in analysing remote sensing data and GIS and advocate their usage in wildlife management.

Mukherjee reports a preliminary study undertaken at a serpentine ecosystem (vegetation over ultrabasic rocks) of Rutland Island of Andamans using RS.

Kushwaha *et al*. explain how biological richness map for conservation prioritization and management was achieved by using RS, landscape analysis along with field survey, with an illustrative case study undertaken at Subausiri district of Arunachal Pradesh.

Rajendran reports the biodiversity status in Western Ghats of Karnataka with the help of biodiversity sample plots. This paper highlights the need for identifying 'hotspots within hotspots' in the Western Ghats in which there are areas rich in plant and animal diversity and degraded and threatened habitats, where revival of eco-system is a possibility.

A study reported by Sinha *et al*. on traditional homegardens at Parugram, Barak valley reveals that plant diversity richness has been maintained due to sustainable management practices of Bishnupriya Manipuri community, which highlights the role of traditional communities in maintaining biodiversity.

Kumar *et al*. present an analysis of various parameters to assess the forest fragmentation in Garo Hills Conservation Area (GCA) and have identified corridors of old tropical forests. Kumar and Kankane brief the efforts of the Zoological Survey of India (ZSI) as a nodal agency of GOI in disseminating information and biodiversity conservation. This chapter provides an excellent data on the faunal diversity.

The gist of the discussion so far, based on the chapters presented in this book highlights that the management of ecosystems requires inventory and monitoring of large areas of natural landscapes at fine scales. Increasingly, modelling is being used as a research and management tool to examine spatio-temporal processes such as land use conversion, natural disturbance, resource harvesting and species dynamics. In this regard, geographical information systems and remote sensing could help determine the rates, causes and scale of biodiversity loss. Information on deforestation and land-use change can be integrated with data on the distribution of biodiversity and existing information on soils, topography, climate, etc. to obtain a comprehensive picture. Maps can provide us not only important regional information about species and habitat distributions but also indicate precise location information about dynamic distribution patterns in relation to landscape features. Thus, GIS could be a powerful tool in policy and landscape level planning for sustainable management of the natural resources.

This book addresses the exigency of the spatial and temporal analyses skills in addressing the problem of loss of biodiversity, and stimulates discussion on the potential use of GIS and RS for inventorying and mapping for conservation and management of biological diversity. This publication with excellent illustrations will be a useful reference for all researchers in the field of biodiversity and conservation. The problem we have noticed in this publication is the presence of a large number of typographical errors, which might irritate a serious reader!

T. V. RAMACHANDRA
A. V. NAGARATHNA*

Energy & Wetlands Research Group,
Centre for Ecological Sciences,
Indian Institute of Science,
Bangalore 560 012, India
e-mail: cestvr@ces.iisc.ernet.in
**Biodiversity Unit,*
Jawaharlal Nehru Centre for Advanced Scientific Research,
Jakkur, Bangalore 560 064, India
e-mail: avn@jncasr.ac.in

Annual Review of Microbiology 2001. Nicholas Ornston, Albert Balows and Susan Gottesman (eds). Annual Reviews Inc., 4139 El Camino Way, P.O. Box 10139, Palo Alto, California 94303-0139, USA. vol. 55. 817 pp.

Reviewing this volume of *Annual Review* was a daunting task. Twenty-six reviews explore almost all major areas of intensive research. The good side of this volume is the availability of at least four reviews which are of direct interest to me, not counting on the review on 'Biological weapons – A primer for microbiologist'.

The review of Wayne and Sohaskey brings forth the dangers of lurking *M. tuberculosis* in a suspended animation in the human body. They use a new term 'non-replicating persistence' (NRP) to describe this deadly deception. Hypoxic NRP could possibly give a handle to combat this pathogen with novel drugs.

The review on big bacteria is timely. *Thiomargarita* (= sulfur pearl) *namibiensis* could reach a whopping 700 μm length and is clearly visible to the naked eye. Another big bacteria *Epulopiscium fishelsoni* living in a protein soup of fish guts has more amount of DNA than a eukaryotic cell.

Phages of dairy bacteria show that there are still newer concepts in molecular biology to come from phage biology. A combination of *l*-like paradigm, mycobacterial phage resemblance and totally new characteristics makes these phages useful models. The fungus-growing ants were once presumed to be better than microbiologists. They are reported to be growing a monoculture of a fungus. Recent reports showed that another deadly fungal pathogen Escovopsis could create havoc in these ant-fungus gardens. What is extraordinary is the presence of an actinomycetes that grows more abundantly on workers that tend the garden. These bacteria secrete antibiotics that keep the Escovopsis in check.

This tripartite mutualism is the topic reviewed by Currie who has done seminal work as well. What I found astonishing is that Escovopsis could not develop antibiotic resistance against the antibiotics produced by the ant garden actinomycete in spite of their age-old mutualism. However, the reckless use of antibiotics by humans led to the evolution of antibiotic resistance in bacteria in just sixty years. Horizontal gene transfer apparently is a phenomenon having a definitive contribution in the evolution of bacterial species. The review by Koonin *et al*., shows how the microbial comparative genomics will open up new vistas to the initiated.

K. DHARMALINGAM

Department of Genetic Engineering,
School of Biotechnology,
Madurai Kamaraj University,
Madurai 625 021, India
e-mail: kdharmalingam@vsnl.com