Vol. 19 no. 5, November 2001
available as pdf-files at
www.wsl.ch/land/iale/bulletin.htm

Bulletin

International Association for Landscape Ecology

ADVANCES IN ECOSYSTEM DEPICTION: FRAMEWORKS FOR SUSTAINABLE ECOSYSTEM MANAGEMENT

by Jacob McC. Overton [1], John R. Leathwick [1], Gary Barker [1], Anthony Lehmann [2]

Ecosystem management at regional and national scales presents many challenges. One of the major challenges is the spatial depiction of the biotic and abiotic components of landscapes and ecosystems in ways that are rigorous and consistent with the properties of these systems. Traditional approaches to ecosystem depiction have severe operational and conceptual difficulties. This can be illustrated by a traditional vegetation map, which can be considered a depiction of ecosystems, based on the patterns of primary producers. Operational difficulties of many traditional vegetation maps include the subjective definition of classes, the inflexibility of the classification, and the lack of an explicit and repeatable process for defining and mapping the types. Conceptual difficulties include the inability of the techniques to depict the fractal nature of the species distribution, and the loss of the independence between the species. Similar problems exist with other forms of ecosystem depiction, including many traditional ecoregion maps, soil maps, and land-cover classifications. The Spatial Ecosystem Research Group at Landcare Research (*http://www.landcare.cri.nz*) in Hamilton, New Zealand, along with Australian and Swiss collaborators, has taken advantage of advances in spatial analysis techniques and computing power to contribute to conceptual and methodological advances in ecosystem depiction. While ecosystems are spatially, structurally and functionally complex, with many properties inadequately understood, we prefer to focus on known and measurable properties, including the biotic and abiotic components, measurable emergent properties, and ecosystem processes. Our aim is to produce biodiversity indicators at the ecosystem and landscape level that can be strictly and explicitly defined from underlying data, with any subjective decisions in the process of mapping from data to depiction identified. Our approach is to couple biotic information with extensive spatial coverages (e.g. climate, landform, remote sensing). Our methods are largely statistical, but the overall approach does not preclude mechanistic or process based models.

Addresses of the authors: [1] Landcare Research, Private Bag 3127, Hamilton, New Zealand, Corresp. to: *OvertonJ@Landcare.cri.nz*; [2] Swiss Center for the Cartography of Fauna, Terreaux 14, CH-2000 Neuchâtel, Switzerland

Environmental Domains

An environmental domains analysis (Mackey et al. 1988; Belbin 1993; Leathwick et al. 2001, Hargrove et al. 2001 *http://www.scientificamerican.com/2001/0801issue/0801hargrove.html*) provides a general ecosystem classification, using environmental characteristics as surrogates for ecosystem character. Environmental variables are chosen that have functional significance in determining physiological performance, and high statistical correlation with species distributions. Domains are defined as areas that

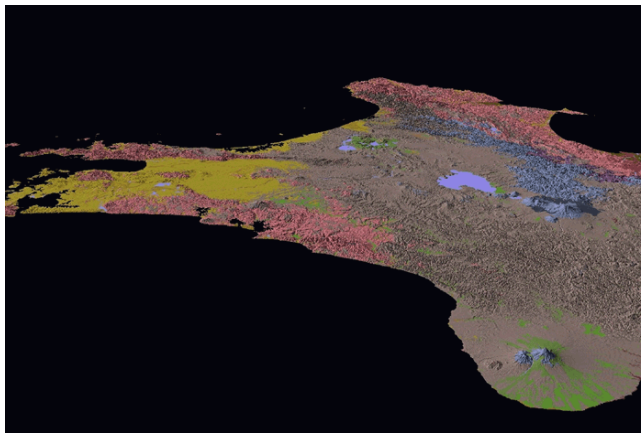

Figure 1. Land Environments New Zealand (LENZ) Level I, with 20 groups for the country. This 3D view is looking northeast across the middle of the North Island, with Mount Taranaki right foreground, Auckland far left, and East Cape background. Courtesy of the New Zealand Ministry for the Environment.

...continued from p. 1 (Ecosystem depiction)

are similar in environmental space, and are then mapped back into geographic space. Environmental domains classifications are hierarchical and scalable, reflecting the properties of ecosystems themselves. A national domains implementation, Land Environments New Zealand (LENZ, Figure 1, *http://www.environment.govt.nz/lenz*), is underway and due for completion by July 2002. Other uses of environmental information provide continuous measures, rather than classifications (Belbin 1993; Faith and Walker 1996; Overton and Leathwick 2001). Rather than impose a discrete classification onto the continuous environmental variation, **environmental distinctiveness** provides a continuous measure of the distance of each part of the landscape from some reference part of the landscape.

Generalized Regression Analysis and Spatial Prediction (GRASP)

GRASP (Lehmann et al. 2000, *http://www.colorado.edu/research/cires/banff/upload/166/* is both a general concept and a specific implementation in S-Plus. As a concept, GRASP is a combination of regression modeling in predictor space and spatial prediction in geographic space. Regression modeling is used to establish relationships between a response variable and a set of predictors with spatial coverages. These relationships are then used to make spatial predictions of the response. Lehmann et al. (2000) have developed an interface and collection of functions in S-Plus designed to facilitate the GRASP process, while standardizing the modeling process and making it more reproducible and less subjective. Figure 2 shows a spatial prediction of vegetation produced by combining plot-based measurements of vegetation condition with environmental and land cover variables in GRASP.

Predict First, Classify Later

The Predict First, Classify Later (PFCL) *http://www.colorado.edu/research/cires/banff/upload/80/* approach to the spatial depiction and generalization of environmental information produces flexible, scalable classifications consistent with many properties that ecosystems display across the landscape. The PFCL approach uses GRASP or other techniques to produce spatial predictions of ecosystem components (such as species distributions). These individual predictions can be used alone, or generalized in various ways, including flexible, scalable classifications. **Biotic domains** follow the PFCL approach to community classification, and avoid many of the problems of traditional ecosystem classifications. Leathwick (2001) provides an example of a biotic domains based on the extensive spatial modeling of canopy tree species distributions (Leathwick 1998, Leathwick and Austin 2001).

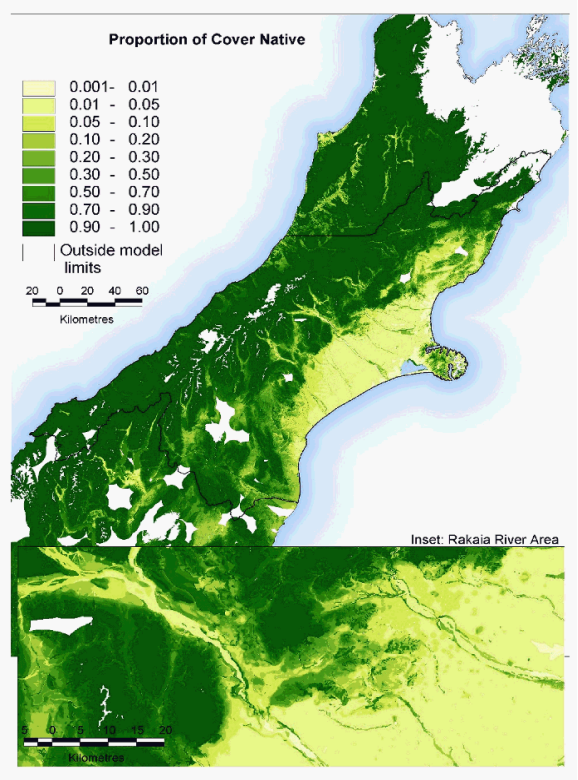

Figure 2. Natural vegetation condition for the central South Island, New Zealand. This shows a spatial prediction of the proportion of the total plant cover comprised by native plant species, produced from GRASP to support the Measuring Conservation Achievement process.

The IALE Bulletin is distributed six times a year to the members of the IALE. The IALE - International Association for LandscapeEcology- was founded in 1982 to promote communication between scientists, planners and interdisciplinary scientific research. IALE Executive Committee: ***President***: Richard J. Hobbs (CSIRO Wildlife and Ecology, Private Bag, P.O., Wembley WA 6014, Australia), tel +61 8 9333 6442 fax +61 8 9333 6444 email *Richard.Hobbs@per.dwe.csiro.au*; ***Past President***: John A. Wiens (USA), email *jaws@lamar.colostate.edu*; ***Vice Presidents***: Duning Xiao (China), email *lndscp@iae.syb.ac.cn*; Kathryn Freemark (Canada), email *kathryn.freemark@ec.gc.ca*; Margareta Ihse (Sweden), email *ihse@natgeo.su.se*; Francoise Burel (France), email *francoise.burel@univ-rennes1.fr*; ***Secretary General***: Michael Moss (Faculty of Environmental Sciences, University of Guelph, Guelph, Ontario, N1G 2W1 Canada), tel +1 519 824-4120 ext.4800 fax +1 519 763-4686 email *mmoss@uoguelph.ca*; ***Bulletin Editor and Deputy Secretary General***: Felix Kienast (Swiss Federal Institute of Forest, Snow and Landscape Research WSL, CH-8903 Birmensdorf, Switzerland), tel +41 1 739 23 66 fax +41 1 737 40 80 email *felix.kienast@wsl.ch*; ***Treasurer***: Rob Jongman (WAU, Department of Physical Planning and Rural Development), Gen. Foulkesweg 13, 6703 BJ Wageningen, The Netherlands, tel +31 317 483 713 fax +31 317 482 166 email *R.H.G.Jongman@Alterra.wag-ur.nl*
.
IALE on the Internet: IALE International: *http://www.crle.uoguelph.ca/iale/*

...continued from p. 2 (Ecosystem depiction)

The resulting classification of natural forest pattern is based on explicit extrapolations from extensive plot measurements. The overall ecosystem depiction consists of both the spatial predictions of the ecosystem components, as well as the generalizations of them.

Phylogenetic diversity

One value of biodiversity lies in its option value – the greater the complement of features conserved in contemporary biodiversity, the greater the options for continued evolution. The 'Phylogenetic Diversity' measure (PD) (Faith, 1992) estimates the relative feature diversity of any nominated set of species from the patristic or path-length distances in a tree depicting evolutionary relationships among those species. Modifications of the PD measure have enabled capture of not only the phylogenetic relatedness of species, but also their abundances in samples (Barker, 2002).

BIOSECURE

BIOSECURE is both a general concept and a specific GIS-based application for biosecurity management. Contrasts in both biotic and abiotic distances are used to define species' native niche species, and both its realized and potential invasion niche space. The model also includes a quantitative framework for assessing potential impacts of alien species, by integrating predictions on establishment likelihood with information on the ecological roles of alien species and the spatial configuration of biodiversity and other values in the landscape.

Applications

Together, these approaches provide the basis for a diverse range of applications requiring spatial depiction of information on the character or components of ecosystems. Current examples include state of the environment reporting, assessment of representativeness, setting of conservation priorities, reserve selection, identification of areas of high biosecurity risk, monitoring response to management, selection of indicator species, and the distributions of threatened species, weeds, and pests. The development of this work is closely linked to and supported by two major government initiatives, the Measuring Conservation Achievement (MCA) process *http://www.doc.govt.nz/cons/scires/MCAbroch.pdf* of the New Zealand Department of Conservation (DOC), and the Environmental Performance Indicators Programme (EPIP) of the New Zealand Ministry for the Environment (MfE). Fundamental science development has been supported by the New Zealand Foundation for Research, Science & Technology *http://www.frst.govt.nz*.

References can be downloaded at *http://www.wsl.ch/land/iale/bulletin.htm* (attachment to the Bulletin No. 19.5, November 2001 or directly via ftp: *ftp://ftp.wsl.ch/pub/kienast/iale/Overton_references.pdf*)

US-IALE: FOREIGN SCHOLAR TRAVEL AWARDS FOR 2002 (DEADLINE: JAN. 15 2002)

Travel awards for the 17th Annual Symposium of Landscape Ecology, University of Nebraska, Lincoln, Nebraska, USA, April 23-27, 2002.
US-IALE has a program to support attendance at the annual meeting by landscape ecologists from foreign countries to foster international exchange about advances in landscape ecology. We anticipate awarding 5 of Foreign Scholar Travel Awards (FSTA). Recipients will receive US$1,000 at the Annual Meeting and a waiver of registration fees. It is the recipient's responsibility to make all transportation arrangements and cover all transportation and lodging costs associated with participating in the meeting.

Award information: *http://www.msu.edu/~riffells/fsta.htm*
Meeting information see page 4 of this Bulletin or *http://www.calmit.unl.edu/usiale2002/*

CONGRATULATIONS! A NEW IALE REGION: SWEDEN

Sweden forms its own region. President is Margareta Ihse, secretary is Helle Skånes, treasurer is Christer Ihse.
Mailing address: Svenska IALE / IALE Sweden, Dept. of Physical Geography and Quaternary Geology, Stockholm University, S-106 91 Stockholm, Sweden
Phone: +46 8 164789/164773, Fax: +46 8 164818, e-mail: *helle.skanes@lm1.natgeo.su.se*

REGIONAL IALE NEWSLETTERS

The Newsletter of IALE-OZ (Australasian IALE) and IALE-CZ (Czech Regional Chapter) was recently brought to the editor's attention. If you have interest in any of these Newsletters please contact Amy Hahs (*a.hahs@pgrad.unimelb.edu.au*) for the IALE-OZ Newsletter or Zdenek Lipsky (*lipsky@kostelec.czu.cz*) for the IALE-CZ Newsletter.

SPECIAL OF THE JOURNAL ISSUE ECOLOGICAL MODELLING

A special issue on "Integration of Ecology with Human Demography, Behavior, and Socioeconomics" has been published in the International Journal "Ecological Modelling" (volume 140, issues 1-2, pages 1-192, 2001).

The ten papers in the special issue cover a wide range of topics, including landscape changes, expansion and management of protected areas, ecosystem management, endangered species conservation, and game species management. The topics cover four continents namely Asia, Europe, North America, and South America and areas with different human population densities (nature reserves, wildlife refuges, rural, suburban, urban areas). Various driving forces and their impacts on land development are treated such as demographic factors (human density, growth, population size, population structure), social factors (attitudes, perceptions, willingness to sell), economic factors (incentives, production, consumption, income, cost, ownership), and behavioral factors (e.g., forest harvesting, deer harvesting, land use, tiger poisoning, land selling and purchasing, use of fertilizer, agriculture, tourism, plantation, raising livestock). The papers deal with different spatial, temporal and organizational scales, i.e. patch, landscape, region; daily, seasonal, annual, decadal; individual household, group, population, species, community. Various sources of information are used (interviews, surveys, remote sensing imagery, aerial photos, government records, and field observations) and a variety of technological tools are presented (GIS, interactive modeling etc.).

MEETINGS

April 23-27, 2002

17th Annual Symposium of the International Association for Landscape Ecology, United States Regional Association (US_IALE): "Landscapes in Transition: Cultural Drivers and Natural Constraints". University of Nebraska, Lincoln, Nebraska, USA (SEE TRAVEL AWARDS PAGE 3!)

Landscapes host intrinsically complex dynamics: biotic and abiotic processes occur within and across the landscape yielding patterns of influence that affect these processes in turn. Ecological patterns and processes weave their mutual causality through space and time. Human actions and decisions in the landscape are an integral aspect of the mode and tempo of how dynamics unfold across the landscape. Thus in this Symposium we challenge the integration of socio-economic and socio-political perspectives into the theory and practics of landscape ecology. We expect contributions in the fields of agroecology, agroforestry, geospatial information systems, historical and contemporary landscape ecology (of the Great Plains), landscape ecology and biodiversity, changing ecology of lakes, rivers and wetlands, landscape ecology and natural disturbances, landscape ecology and natural history museums.

More information on: *http://www.calmit.unl.edu/usiale2002/*

August 25 - September 1, 2002

20th meeting of the Permanent European Conference for the Study of the Rural Landscape (PECSRL): "Rural landscapes: past processes and future strategies". Institute of Geography, University of Tartu, Estonia.

The Permanent European Conference for the Study of the Rural Landscape

- is an international network of researchers whose interest focus on the past, present and future of European landscapes;
- is an international platform for new initiatives, meetings and publications about European landscapes;
- meets every two years in a different European country for discussions, lectures and field excursions;
- has several working groups that focus on actual problems in European landscape management and landscape research.

The 2002 conference will be organized by Hannes Palang, Tiina Peil, Helen Sooväli, Helen Alumä. Any comments on potential symposia themes are welcome. For more details contact the Secretary General at *t.spek@alterra.wag-ur.nl* or visit the Web page *http://www.pecsrl.org*

September 10-13, 2002

11th Annual IALE-UK Conference. Avian Landscape Ecology: "Pure and applied issues in the large-scale ecology of birds". University of East Anglia.

Speakers to include: Dr. Rob Fuller (British Trust for Ornithology), Prof. Kevin Gaston (University of Sheffield), Dr. Shelley Hinsley (Centre for Ecology & Hydrology), Prof. Steve Ormerod (University of Wales, Cardiff), Dr. Rex Sallabanks (Sustainable Ecosystems Institute, Idaho), Prof. William Sutherland (University of East Anglia)

As for previous IALE conferences, talks and poster abstracts will be pre-published as conference proceedings. Further details available on the IALE-UK website: *www.iale.org.uk/avian1.html*

Contact Dan Chamberlain if interested in contributing a talk or poster at: British Trust for Ornithology, The Nunnery, Thetford IP24 2PU, UK; email: *dan.chamberlain@bto.org*

MEMBERSHIP FEES 2002

IALE members that **do not pay the annual fee via their region** are kindly requested to pay the 2002 (and 2001!) fee to Rob Jongman, our treasurer. Payment forms can be downloaded at *http://www.wsl.ch/land/iale/bulletin.htm* (attachment to the Bulletin No. 19.5, November 2001) or directly via ftp: *ftp://ftp.wsl.ch/pub/kienast/iale/fee2001.pdf* or *ftp://ftp.wsl.ch/pub/kienast/iale/fee2002.pdf*)