

Introduction

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ABSTRACT

Change in land-use and hence biodiversity result from decisions at local level, which are restrained only in part by formal environmental assessments. However, local knowledge and adaptive management for small de-intensification measures could be mediated by the internet to restore biodiversity and ecosystem services at low cost, by providing decision support to local managers of land and species while also collating their knowledge to guide policy-making. We introduce four questions that challenge the development of suitable internet systems and which this project seeks to answer.

BACKGROUND

For 50 years, subsidies at continental and state level have successfully driven the production of a few crop species in Europe. Commercially driven homogenisation of diverse local land-use continues to degrade ecosystem services that sustained Europeans for centuries (Pretty 2002). Species whose dynamics and colonisation operates at small scale have disappeared through habitat loss and fragmentation, so that biodiversity has declined drastically at local level (e.g. Paine & Pienkowski 1997; Thomas *et al.* 2004).

Over the same 50 years, human ability to predict the outcome of manipulations has increased through the use of computers. Forecasts from associative models, which neglect causation, are being replaced by more accurate prediction from individual-based models that incorporate behavioural mechanisms (Goss-Custard 1996, Sutherland 1996). Models can be spatially specific through linkage to habitat and socio-economic data as cells in geographic information systems (GIS). Adverse development can be constrained (under 85/337/EEC) after environmental impact assessment (EIA) at local level (e.g. Treweek 1999) and more recently (under 2001/42/EC) following strategic environmental assessment (SEA) on a broader scale (Wood & Jeddow 1992). However, these high-level directives, and protection of areas (e.g. Habitats Directive, 92/43/EEC), have not had the desired effect of halting the loss of biodiversity by 2010 (Dimas 2009).

USE OF LAND, ECOSYSTEM SERVICES AND BIODIVERSITY

Irrespective of the formal processes for planning strategic programmes (SEA) and large development projects (EIA), the myriad local “me-too” decisions tend to make use of land intensive and monotonous outside protected areas. This creates the risk that the 17% of land which is targeted for protection (CBD 2010) tends either to be remote or “small islands of biodiversity in a sea of agriculture” (Hutton & Leader-Williams 2003). However, recent thinking goes beyond a hands-off approach to conserving the riches of nature.

After the Ecosystem Approach of CBD (2002) stressed that humans too are a part of natural systems, the Millennium Ecosystem Assessment (2005) recognised benefits for humans from ecosystem services, for *regulating* climate, floods and disease, for *provisioning* with food and materials, for *cultural* recreation and aesthetics and for *supporting* those three service categories with soil and clean air and water. Recent interest in valuing those services (e.g. in *The Economics of Ecosystems and Biodiversity* 2010) has tended to focus on the importance of *provisioning* services, and the need for public spending to conserve *regulating* and *supporting* services from ecosystems as public or common goods. Unfortunately, *provisioning* services tend to become private crops grown intensively at the expense of biodiversity; moreover, high biodiversity is not always essential for *supporting* and *regulating* services, partly because humans can fill the consumptive role of other species (e.g. predators).

However, some *cultural* services that depend on biodiversity generate resources, in terms of finance and voluntarism, which are only just being recognised in Europe. Resources from private recreational use of biodiversity (e.g. hunting, fishing and watching wildlife) could provide de-intensification measures at local level (Kenward & Garcia Ciudad 2005). The importance of de-intensifying was illustrated by Newton (2004), who identified the main factors associated with decline of 30 bird species as: (i) weed control, (ii) early ploughing, (iii) grassland management, (iv) increased livestock levels, (v) hedgerow loss and predation. All can be addressed in ways that produce small reductions in crop yields. Thus, reduced cereal yield when field-edges are left unsprayed, which increases the abundance of game birds and other wild fauna and flora (Boatman & Sotherton 1988), could be offset by income from hunting and watching wildlife.

THE PROBLEM OF COMPLEXITY

Unfortunately, the current system of formal environmental assessment is bottlenecked by a dependence on experts, which limits its application to large or severe cases and can also prejudice repeatability in conflictive ways (Therivel 2004). When socio-economic sustainability factors are included as well as environmental, as recommended at the World Summit on Sustainable Development (WSSD 2002), the complexity of assessment becomes daunting (Jacobs & Sadler 1989; Therivel & Minas 2002): application of assessment to 70 ecosystem services in 34 contexts was listed in the Convention on Biological Diversity (CBD 2002). Moreover, the challenge far beyond the current assessment system is how to influence the daily small-scale decisions made for farming, forestry, gardening and council management of parks and road verges.

Thus, although we now know that annual spending in Europe on biodiversity-dependent recreational activities exceeds €40 billion (Kenward et al. 2009), and have accumulated much information about re-diversifying land and restoring ecosystem services (Rey-Benayas et al. 2010, Bullock et al. 2011), we also know that to re-diversify much land outside protected areas is very complex, both in terms of ecological research and also in terms of economic support for applying that research. So we are still as constrained as when Pimm et al. (2001) noted “Paradoxically we are not limited by lack of knowledge but failure to synthesis and distribute what we know.”

TOWARDS A TRANSACTIONAL SYSTEM

To address these issues, the TESS project maintained the view proposed to Council of Europe (Kenward & Garcia Ciudad 2005) that the internet offers the best way to implement CBD commitments on local knowledge, monitoring and governance for adaptive management of biodiversity resources. Web services could collate the extensive bio-socio-economic environmental knowledge that is currently fragmented across Europe, to provide background for SEA and EIA. Furthermore, an internet system could also supplement these formal assessments, based on a few individuals, by context-adapted support for the myriad small-scale decisions taken by local stakeholders. Information could be provided to encourage projects at local level (e.g. farm shops) to neutralise wider commercial pressures, and for skilful tuning of small de-intensification measures (e.g. headlands), public works (e.g. road verges) and gardens which

could benefit biodiversity at minimal cost. It is challenging to bring together all the information needed for use of land and its wild resources in ways that are environmentally, socially and economically sustainable. However, to give all land-managers across Europe comparable expertise without such a system is impossible.

Environmental knowledge for assessment is a commodity, of value for government decisions but also to individuals constrained by government regulations and motivated by an array of public and private incentives. Potentially, the market for such knowledge is huge. This provides scope for a transaction between governments and local communities. In order for governments to conduct complex SEA and SIA assessments for developing policy and high-level plans, they need a summation of the results of local decisions. In order for individuals to make small-scale assessments and decisions, they need complex knowledge that government can provide automatically to local communities and individuals via the internet, in exchange for the summation of local knowledge and monitoring. In brief:

- Central government can derive complex knowledge by collating local knowledge.
- For sustainability, central government needs to guide local actions and monitor results.
- Communities and individuals have local knowledge & capabilities (skill, cash, time).
- They need complex knowledge to guide their actions for long-term sustainability.

Thus, TESS aimed “to design a decision support system related to environment and land use that will enable policy makers to integrate knowledge from the regional and local level into the decision making process, while also encouraging local people to maintain and restore biodiversity ecosystem services”.

STRUCTURE OF THE WORK

Stages in TESS were planned as Work-Packages (Figure 1). The preparatory stages examined information requirements, processes and other governance used in formal environmental assessments and other decisions that affect biodiversity. This was done for governments at national (WP2) and local levels (WP3), and also for individual stakeholders (farmers, foresters and managers of land for angling, hunting and watching wildlife, first in TESS partners countries, and then through systematic pan-European survey (WP5). Capabilities of local communities to supply information were examined, as was the availability of models to offer decision support from that information (WP4). Analysis of gaps in demand and supply of knowledge, and of best practice in governance, then informed the synthesis of a system design (WP6).

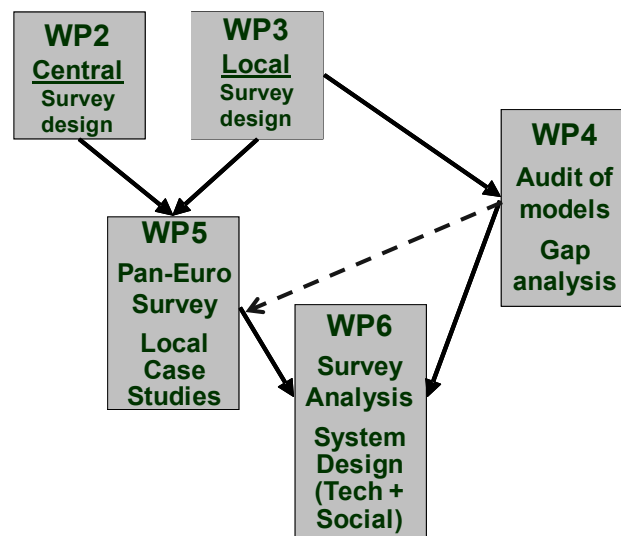


Figure 1. The temporal sequence (from the top) and connections (arrows) between work packages that represent stages in the TESS project and chapters in this book.

In this book, Chapter 2 is about the pilot survey of government officers at national level, to identify information demand and supply (WP2), which was completed in countries with TESS partners (Table 1). Chapter 3 (based on WP3) addresses the equivalent pilot surveys at local level, of stakeholders who make decisions directly affecting use of land and species, including administrators in the two lowest tiers of government, farmers and foresters, and managers of land for fishing, hunting, gathering and watching wildlife, and for countryside exercise activities. Chapter 4 shows how the information flows from sources to stakeholders can be synthesised.

Table 1. The 14 Partners in 10 countries who started the TESS project in 2008.

Aristotle University of Thessaloniki	Greece
Tero Ltd	Greece
Bournemouth University	United Kingdom
Natural Environment Research Council Centre for Ecology and Hydrology	United Kingdom
Anatrack Ltd	United Kingdom
European Sustainable Use Specialist Group	Belgium
Federation of Associations for Hunting and Conservation of the EU	Belgium
Tallinn University of Technology	Estonia
Szent István University	Hungary
Pro-Biodiversity Service	Poland
Ordenamento e Gestão de Recursos Naturais Ltd	Portugal
Danube Delta National Institute for Research and Development	Romania
Centre for Cartography of Fauna and Flora	Slovenia
WWF Turkey	Turkey

Chapter 5 (based on WP4) presents a survey of models suitable for predictions and decision support when managing land and species at local level, and takes a first look at how well these meet demands for data identified in earlier chapters. Chapters 6 to 8 describe the Pan-European survey (WP5) that was conducted across all EU member states except Cyprus, together with Norway, Switzerland, Turkey and Ukraine. The survey used questions refined from Chapters 2 and 3 to record information demand systematically, for analysis of institutional capacity, other governance factors and environment indicators to suggest best practice that should be built into a decision-support system.

The capacity and willingness of local communities to supply knowledge was then a special feature of Case Studies, involving socio-economic projects and mapping, that are summarised in Chapter 9 and then detailed briefly in Chapters 10-19. Chapter 20 then brings together data on governance and demand for information from the Pan-European survey (from WP5), with findings of excellent local ability to collect data in Case Studies, and with further evidence of gaps in supply of predictive models (WP4), to inform the technical and socio-economic design for a Transactional Environmental Support System.

The process of designing TESS revealed many interesting findings, on central governance relationships and local data demand and supply, which form the basis for broad recommendations and guidelines in Chapter 21. This leads in Chapter 22 to recommendations for European Commission and similar future projects, after which the editors provide a concise summary of the project in Chapter 23.

CONCLUSIONS

TESS produced regular reports for European Commission to demonstrate the successful progress of the project. Those of most interest have been simplified to produce the chapters that follow, which include many interesting research findings. However, the most important questions to be answered if the TESS project is to be implemented, and which are considered again in the concluding chapter, are the following:

- Do local people require information that a transactional system can deliver?
- Can local people contribute enough data of use at higher levels?
- Can current technology build such a system?
- Can the building and long-term operation of such a system be supported?

REFERENCES

- Boatman, N.D., & Sotherton, N.W. (1988). Agronomic consequences and costs of managing field margins for game and wildlife conservation, *Annals of Applied Biology*, 17, 47-56.
- Bullock, J.M., Aronson, J., Newton, A.C., Pywell, R.F., & Rey-Benayas, J.M. (2011). Restoration of ecosystem services and biodiversity. *Trends in Ecology and Evolution*, 26, 541-549.
- Convention on Biological Diversity (2002). Report of 6th meeting, in The Hague, Netherlands. Retrieved June 21, 2012, from www.cbd.int/doc/meetings/cop/cop-06/official/cop-06-20-en.pdf
- Convention on Biological Diversity (2004). Decision 12 at the 7th meeting, in Kuala Lumpur, Malaysia. Retrieved June 21, 2012, from <http://www.cbd.int/doc/decisions/cop-07/cop-07-dec-12-en.pdf>
- Convention on Biological Diversity (2010). 2011-20 targets from 10th meeting, in Nagoya-Aichi, Japan. Retrieved June 21, 2012, from <http://www.cbd.int/doc/strategic-plan/2011-2020/Aichi-Targets-EN.pdf>
- Dimas, S. (2009). *Speech to European Biodiversity Action Plan Conference, European Parliament*. Retrieved June 21, 2012, from <http://europa.eu/rapid/pressReleasesAction.do?reference=SPEECH/09/54>
- Goss-Custard, J.D. (1996). *The Oystercatcher: from individuals to populations*. Oxford: University Press.
- Hutton, J.M., & N. Leader-Williams. (2003). Sustainable use and incentive-driven conservation: realigning human and conservation interests. *Oryx*, 37, 215-226.
- Jacobs, P., & Sadler, B. (Eds.) (1989). *Sustainable development and environmental assessment: perspectives on planning for a common future*. Quebec: Canadian Environment Assessment Research Council.
- Kenward, R.E., & Garcia Ciudad, V. (2005). Innovative approaches to sustainable use of biodiversity and landscape in the farmed countryside. In *UNEP High-Level Pan-European Conference on Agriculture and Biodiversity* (pp 565-589). Strasbourg: Council of Europe.
- Kenward, R. Manos, B., Arampatzis, S., & Papathanasiou, J. (2009). A transactional environmental support system for Europe. In Hřebíček, J., Hradec, J., Pelikán, E., Mírovský, O., Pilmann, W., Holoubek, I., & Legat, R. (Eds.) *Towards eEnvironment (Challenges of SEIS and SISE: Integrating Environmental Knowledge in Europe)* (pp. 58-65). Brno, Czech Republic: Masaryk University Press.
- Millennium Ecosystem Assessment (2005). *Ecosystems and Human Well-being: Synthesis*. Washington, DC: Island Press.
- Newton, I. (2004). The recent declines of farmland bird populations in Britain: an appraisal of causal factors and conservation actions. *Ibis*, 146, 579-600.
- Pimm, S.L., Ayres, M., Balmford, A., Branch, G., Brandon, K., Brooks, T. Bustamante, R., Costanza, R., Cowling, R., Curran, L.M., Dobson, A., Farber, S., da Fonseca, G.A.B., Gascon, C., Kitching, R., McNeely, J., Lovejoy, T., Mittermeier, R.A., Myers, N., Patz, J.A., Raffle, B., Rapport, D., Raven, P.,

- Roberts, C., Rodríguez, J.P., Rylands, A.B., Tucker, C., Safina, C., Samper, C., Stiassny, M.L.J., Supriatna, J., Wall, D.H., & D. Wilcove. (2001). Can we defy nature's end? *Science*, 293, 2207-8.
- Pain, D.J., & Pienkowski, M.W. (Eds.) (1997). *Farming and birds in Europe*. London: Academic Press.
- Pretty, J. (2002). *Agri-culture- reconnecting people, land and nature*. Cambridge: Earthscan.
- Rey-Benayas, J.M., Newton, A.C., Diaz, A., & Bullock, J.M. (2009). Enhancement of biodiversity and ecosystem services by ecological restoration: a meta-analysis. *Science*, 325, 1121-1123.
- Sutherland, W.J. (1996). *From individual behaviour to population ecology*. Oxford: University Press.
- The Economics of Ecosystems and Biodiversity (2010). *The Economics of Ecosystems and Biodiversity: Ecological and Economic Foundations*. London: Earthscan.
- Therivel, R. (2004). *Strategic Environmental Assessment in Action*. London: Earthscan.
- Therivel, R., & Minas, P. (2002). Ensuring effective sustainability appraisal. *Impact Assessment and Project Appraisal*, 20, 81-91.
- Thomas, J.A., Telfer, M.G., Roy, D.B., Preston, C.D., Greenwood, J.J.D., Asher J., Fox, R., Clarke, R.T., & Lawton, J.H. (2004). Comparative Losses of British Butterflies, Birds, and Plants and the Global Extinction Crisis. *Science*, 303, 1879-1881.
- Treweek, J. (1999). *Ecological Impact Assessment*. Oxford: Blackwell.
- Wood, C., & Jeddow, M. (1992). Strategic Environmental Assessment: EA of Policies, Plans and Programmes. *Impact Assessment Bulletin*, 10, 3-21.
- World Summit on Sustainable Development (2002). Retrieved June 21, 2012, from http://www.unmillenniumproject.org/documents/131302_wssd_report_reissued.pdf

KEY TERMS

Keywords

Adaptive Management, Decision Support, De-intensification, Ecosystem Approach, Ecosystem Services, Environmental Governance, Pan-European, Sustainable Development, Sustainable Use