ENVIRONMENTAL AND RESOURCE GOVERNANCE UNDER THE INFLUENCE

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Abstract

Innovative, radical approaches are needed if humanity is to find realistic solutions to social and environmental sustainability. Workable solutions to the sustainable use of natural resources are constrained by institutional barriers, narrowly focused scientific research and compartmentalised systems of natural resource management. Consequently, future sustainability will depend on the system of resource governance that mediates the influences of society (and economy) on one hand, and continuance of ecosystem functional processes on the other. A new research paradigm with novel trans-disciplinary methods is required to understand the spatial relationships of the influences that interconnected social and ecosystem functional elements have on one another. We demonstrate how ecosystem functional capacity might guide social change and adaptation towards more reflexively competent, sustainable natural resource management.

Introduction

As nature retreats from human pressure and the earth's resources diminish, the divergence of human social systems and ecological systems grows. In less than a century, human population and its requirements for space, materials, goods, and amenities have increased by more than five-fold. Arguably more serious are the growing signs of functional problems in the operation of many ecological systems. Declining productivity, land salinisation, blue-green bacterial blooms in rivers and dams are symptoms of breakdown of ecosystem processes and function. Less obvious, but possibly more disturbing because they are mysterious to the general public, are the expanding hole in the ozone layer, global warming and acid rain.

The continuance of ecological processes and functions across multiple spatio-temporal scales provides the foundation for a sustainable future (Noss 1983; Norton & Ulanowicz 1992; di Castri 1995; Forman 1995). Species alone cannot maintain ecosystem function (Naeem *et al*. 1994; Walker 1995; De Leo & Levin 1997). It is also becoming evident that actions to sustain ecological systems, flows and functions must be integrated across regional landscapes. Such regions encompass natural areas, human living places (that include rural or oceanic production), and a mosaic of other land uses (Leopold 1949; Hobbs 1993; Slocombe 1993; Brunckhorst & Bridgewater 1994; 1995; Noss & Cooperrider 1996). Consequently, there is increasing interest in broader ecosystem concepts - 'greater-ecosystems', landscape ecology, eco-regions, and bioregional planning and management concepts (Forman & Godron 1986; Slocombe 1993; Noss 1983; 1993; Kim & Weaver 1994; Forman 1995; Brunckhorst 1995; Brunckhorst *et al*. 1997).

Current institutions seem to be a long way from dealing with these extremely difficult issues but, while scientific knowledge is inadequate, urgency is growing (Brussard 1995; Lovejoy 1995). Our understanding of political economies and economic 'growth' appear to undermine moves towards an economically and ecologically sustainable society. The model most frequently used in decision making gives predominance to economic rationale, arguing that the environment can be 'looked-after' when the economy is good.

We affirm that the economy driven model is fundamentally flawed and the inverse is required (see discussions by Harpham & Boateng 1997; Brunckhorst 1998). The required model for decision making must view economics as a subset of society, which in turn is a part of the biosphere. The foundation of such a model is that environmental productivity, in the form of sustainable ecological function, is the determinant of social values and economic aspirations. Without environmental health there can be no economic or social sustainability.

Securing the quality of life for future generations is one of the key goals of ecologically sustainable development (di Castri 1995). Securing the ongoing functional processes of ecosystems and landscapes is a necessary condition for maintaining biodiversity, sustainable resource use, economies and human quality of life values. Changing technology or amounting masses of biological data will be ineffective in halting destruction of natural capital if the expectations of society are inconsistent with the relationship that people have with their environment. However, not only must environmental degradation be minimised or stopped, considerable ecological restoration is likely to be needed. This might require social transformations towards a restorative economy where investment in biodiversity protection and environmental restoration provides, amongst other benefits, the natural 'growth capital' for future sustainable and restorative industries (Hawken 1993; Brunckhorst *et al*. 1997). Little research effort has focused on understanding of the relationship between society (or local communities) and ecosystems at the scale of regional landscapes (eg, bioregions).

Sustainability at a temporal scale that includes future generations requires long-term vision and social flexibility (Courrier 1992; Smil 1993; Norton & Dovers 1996). It also requires strategic integrated planning, policy development and implementation across jurisdictional boundaries and traditionally, narrowly focused programs. Policy and management responses will need a systems approach that reflects the complexity of the natural world and the cultural values associated with it. There is little likelihood of coherent policies emerging from the usual compartmentalised approach in which different departments or different levels of government each handle different, small parts of a problem. Yet ongoing institutional flexibility and adaptation is possible because systems of rules and institutional operation are cognitive constructions not limited by physical reality as are ecosystems. It remains to be seen if the social transformations towards a sustainable future are of the order that can shift governments and all sectoral interests to such a long term commitment. The future role of policy and administration at all levels of government (as well as the private sector) will be critically important to how sustainable our future might turn out to be.

What ever it may be, future sustainability will depend on a system of land management that mediates the relationship between society (including the economy), and endurance of ecosystem function across human dominated landscapes (Harpham & Boateng 1997; Brunckhorst,1998). Innovative approaches are required for humanity to find practical solutions to social and environmental sustainability issues that institutions and citizens can adopt, and adapt with matching civic skills and knowledge.

We discuss the conceptual and theoretical framework behind a novel trans-disciplinary research paradigm. In doing so we emphasise the role of social and institutional systems because it is human management that will determine sustainability of land use. The research paradigm focuses on the need to develop new methods that recognise and account for the spatial influence that interconnected social and ecosystem functional elements have on one another. In this way we may demonstrate how ecosystem functional capacity might dictate land management. Related data on community and civic elements will guide analysis of social change and adaptation towards more reflexively competent, sustainable land management. Through a simplified hypothetical example we demonstrate the potential of such research and discuss its application.

Social and ecological influences

Many authors now consider that sustainability objectives need to be planned and at the scale of landscapes and regions (see Forman & Godron 1986; Noss 1983; 1990; 1993; Norton & Ulanowicz 1992; Courrier 1992; Noss & Cooperrider 1994; Kim & Weaver 1994; Forman 1995; DeLeo & Levin 1997).

To be effective in achieving sustainable resource use, resource governance systems have to be compatible with the character and dynamics of the ecosystems involved, and with the social, cultural and institutional norms of the society to which resource users belong.

Multi-scale and cross-scale spatial and temporal elements of ecological and social functions and their influence on the landscape need to be mapped and analysed together. Where resources are a part of broader scale systems, the above features and activities might be organised in an operational hierarchy where the scale of governance is matched to the scale of the resource, ecosystem function and associated externalities - the essence of adaptive management (eg, Walters 1986; Walters & Holling 1990).

The landscape-regional scale draws together the variety of attributes that individually occupy a confined space in nature or society, but which have wider influences, so that human needs and activities are reconciled and integrated with ecological processes. We refer to this scale of management as a 'bioregion' (but not bioregionalism). It is a large area exhibiting "soft perimeters" characterised by its drainage, flora and fauna, climate, geology, human culture and land use. Hence, a practical and operational bioregion, or 'biocultural landscape' integrates human governance within ecological law.

Institutional Barriers

Practical solutions to the sustainable use of natural resources are constrained by institutional impediments, narrowly focused scientific research and entrenched or compartmentalised government systems, and other institutionalised constraints such as the market, property rights and, land ownership and use (Caldwell 1970; Ostrom 1990; Slocombe 1993; Kim & Weaver 1994; Holling & Meffe 1996). Implementing ecosystem management approaches are not simply impeded by a lack of knowledge of ecosystems and their function at various scales, but a lack of research and development to applications of existing data (Brunckhorst *et al*. 1994; Brunckhorst 1995). Barriers to integration and communication or extension across institutions, to the rural community and other land managers, and the general public often stem from inflexible or narrowly focused management cultures and jurisdictional barriers (Caldwell 1970; Hobbs & Humphries 1995; Brunckhorst 1995). Enormous benefits and efficiency gains will accrue through better communication and information transfer, a freeing up of institutionalised domains and programs and, improved cross-jurisdictional responsibility for land use management (Caldwell 1970; Saunders 1990; Brown & MacLeod 1996).

Institutional inadequacy stems from relying on entrenched, institutional forms to solve new classes of problems. For example, in Australia and the USA, inherited European styles of agriculture and institutions, such as property rights, do not match the biophysical and climatic nature of these lands. This remains an exceedingly hard lesson to learn. Property rights and ownership issues in industrial nations are also major barriers to the pursuit of sustainability at the necessary, cross-jurisdictional, landscape scale (Bird 1987; Ostrom 1990). For example, the dualism of rural areas, which are agricultural land with freehold title, a commodity on one hand and, a set of interconnected ecosystem functions across a landscape with no regard to ownership boundaries on the other hand (Reeve 1992; Reeve 1997).

Society and Civic Influence

Social systems are not only complex but also convoluted in terms of scale issues (Hagget et al. 1977). The fundamental building block in society is generally considered to be the family (comprising individuals), social norms are then built around the home environment and then a widening circle of interactions with friends/neighbours, education/communication, citizenry/government and work/land use. These are often influenced by a set of spiritual beliefs. Multiple layers of administrative arrangements and infrastructure (e.g., roads, urban services) are probably the main cause of convolutions and overlapping (or competing) institutional requirements (Caldwell 1970; Bromerly 1991; Ostrom 1990; Brunckhorst 1995; 1998). This leads to many important structural and functional elements with a spatial hierarchy. A simple example of a few of these and their spatial hierarchy is given in Figure 1.

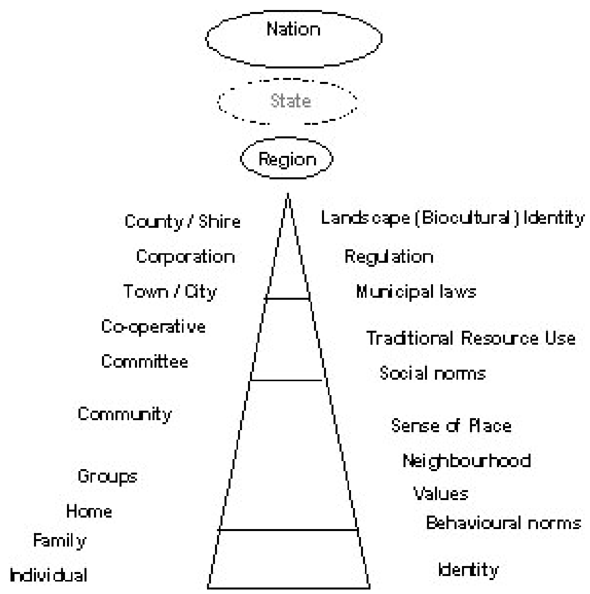

Figure 1. Generalised hierarchy of structural and functional components of social institutions. (Note: States are government structures found only in federated nations; spiritual beliefs may affect both structural and functional elements, and how humans perceive the environment and resources).

The structure and function of spiritual beliefs (Figure 1) may be difficult to represent spatially because of their cognitive and interpretive nature, but they do affect human value systems and how we identify with and interpret our surroundings (Berkes and Folke 1998). Most if not all such features have a spatial context in which they sit and often a wider area of influence (Slocombe 1993). These can be mapped in multiple layers together with the known or assumed sphere of influence across a landscape or urban setting. Similarly, the zone or extent of regulatory mechanisms and administrative arrangements can also be spatially represented. It is at the scale of landscapes that humans and society have the greatest interaction and influence. This understanding can provide an integrated (cultural) bioregional context to plan and manage for integrated conservation and sustainable resource use (Brunckhorst 1995; Brunckhorst & Bridgewater 1994; 1995; Brunckhorst et al. 1997). Policies and institutions for natural resource management might then be planned and integrated for appropriate configurations (Armitage 1995; Norton and Dovers 1996; Holling and Meffe 1996).

Spatial and institutional Requirements for Land Resource Management

Sustainability of resource use ultimately depends on the system of resource governance that mediates the relationship between the citizenry and the economy on one hand and continuance of ecological functional processes on the other. Advances have been made in sociology (e.g., Lawrence 1987; Hannigan 1995), geography (Powell 1976; 1993), resource economics (Young 1992), institutional economics (e.g, Bromley 1991; 1992) and latterly, regional approaches to resource planning and management (Noss 1983; 1993; Slocombe 1993; Noss & Cooperrider 1994; Forman 1995; Brunckhorst 1995; 1998; Brunckhorst & Bridgewater 1994; 1995). However, consideration of the critical interplay between ecosystem function, institutional forms and functions, culturally defined land tenure, land use, and resource governance has been lacking in theoretical and applied research.

Community, civic and institutional adaptation to a system of ecologically sustainable land management will determine whether the functioning of the economy and actions of people erode the natural processes on which society relies, or remain within the limits necessary to sustain the functional integrity of ecosystems and ecological processes (see Ostrom 1990; Young 1992; Bromley 1991; 1992; De Leo & Levin 1997; Reeve 1997). It is apparent from this developing body of work that, to ensure resources are used sustainably, land management systems must have a number of key capacities (adapted after Ostrom 1990 and Reeve 1997):

1. Spatial Information - the ability to spatially define ecosystem structure and the way in which ecosystem processes provide resource-capability function across landscape regions.

2. Functional Influences - the ability to identify and monitor, in a spatial context, the interaction between resource use, the social system and ecosystem functional processes in terms of their extent, magnitude and direction.

3. Coordinated Land management Policy - the ability of the local community or citizenry to arrive at rules for resource use through some form of collective action, which is based on a spatial understanding of landscape ecological functioning across their bioregion.

4. Flexible Adaptation - the ability to adapt these rules in response to new knowledge about the ecosystems, to changing demand for resources originating from exogenous economic forces, and to climatic and other biophysical sources of stress.

5. Enforcement by Community Established Governance - the ability to ensure that the rules for sustainability within the functional capacity of bioregions are adhered to by resource users.

The above attributes are manifested differently according to the social, cultural, institutional and historical differences in the societies to which resource users belong. In industrialised, capitalist societies the resource governance system provides access to resources by individuals and corporations through the institutions of property rights and ownership. Enforcement is provided by contract and statute law, adaptability is mainly achieved through the functioning of markets (science and technology to a lesser extent), coordination is achieved through democratic processes, monitoring is undertaken by the state, and information is constrained within scientific institutions. In traditional societies, the system of land management usually occurs within social, cultural and behavioural norms. Adherence to rules may be self-enforcing through individuals' fear of censure by elders or peers, coordination may be achieved through the processes of small group dynamics, monitoring may be by the resources users themselves, and understanding rests with traditional and/or religious beliefs (Reeve 1997).

While some institutional adaptation has occurred towards improved land management (e.g., development of leasehold tenure; participatory catchment management, and concepts of native title), the pace of institutional adaptation falls far short of what is needed to deal with the forms of land degradation that have emerged in the last few decades. There is an urgent need, particularly in rural areas, to increase the pace of institutional adaptation to encourage the development of sustainable systems of resource governance (see Lawrence 1987; Martin 1991; Reeve 1992; Hobbs 1993; Holmes 1994; Fitzhardinge 1994).

There appear to be two fundamental obstacles to achieving this. Firstly, little recognition is given to the need for resource governance systems to be crafted to fit both the biophysical and socio-economic contexts within which they must function. This is perpetuated by the current system of governance where political expedience and bureaucratic inertia favour the modification of existing institutional forms rather than developing new ones (see Caldwell 1970; Norton & Dovers 1996).

The second obstacle is our inability, or failure to recognise the need to combine three types of spatially distributed information that are essential building blocks for the design of resource governance systems (Brunckhorst 1998). These are: influence of institutional structures; the distribution of social, environmental and political values held by those with interest in particular resources; and functional, ecological-connectivity between landscape components.

Spatial information is required to examine the influence that institutional structures have on the landscape. Geographic information systems that map biophysical characteristics are increasingly common (Thackway & Cresswell 1993; Brunckhorst *et al*. 1994) but, the use of such systems for institutional mapping has yet to be realised. This is due, in part, to the natural evolution of spatial information systems. Over the past 10 years, institutions have been involved in massive data collection projects. Only now, when the databases are coming on-line, have we realised that little attention has been paid to database use and user access (Rollings 1996). Details such as constraints, opportunities and responsibilities that pertain to land uses on each component, as a consequence of the bodies of common law, statute law and associated scheduled regulations administered by State agencies, will be useful in defining new institutional systems. This is necessary if duplication of existing functions is to be avoided and, if appropriate, when new land management models are built on, or replace existing institutions.

Spatial information is required on the distribution, magnitude and direction of social, environmental and political values held by those parties with interest in particular resources. Knowledge of these values, together with various ways of framing resource issues, are essential in determining to what extent land management can depend on social and cultural norms to provide monitoring and enforcement capabilities, and to what extent these capabilities may have to be established by the state or other institutional entities at the regional level (Reeve 1992; 1997).

Spatial information is also required on the extent of functional, ecological-connectivity between landscape components (or surrogates of such, see Forman & Godron 1986; Forman 1995; Brunckhorst 1995; 1998). In the case of dryland salinity, for example, a landscape component in a discharge area would carry information on which land elements in recharge areas had the potential to affect the level of the water table below that land element. This type of information, which essentially maps the extent of the externalities of land use or sphere of functional-influence, is essential to determining which landholders should participate as stakeholders in particular land management systems. We refer to spatial extent of functional influence that might be mapped for both ecological functions and social functions. The total influence will provide, a spatial context for sustainable resource management (constrained by ecosystem function) and, principles and options for resource governance (in that cultural-biophysical context).

This final requirement leads us to the design of land management systems that support the requirements of society but also match and sustain the functioning of ecological processes and services at the scale of regional landscapes (Figure 2).

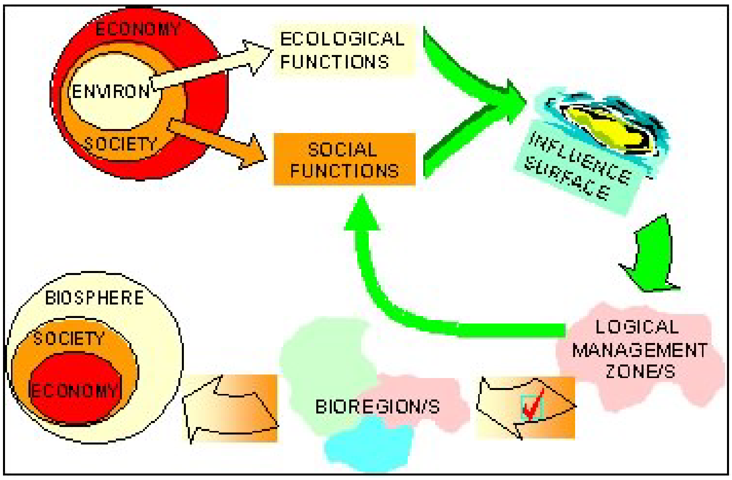

Figure 2. A logical analysis of both biophysical constraints and opportunities, balanced with the needs of society could provide an operational framework for future sustainability.

The Influence Function Model

Our goal is to maintain ecological and social systems across regional landscapes recognising that social systems are the more flexible, and that functional requirements of ecological systems should dictate the design of systems for land management. Our objective, for bioregional planning and management is to facilitate the development of culturally appropriate local and regional systems of resource governance that match resource exploitation to the bioregional capacity to provide resources and ecosystem services.

The question is therefore, can an understanding of how landscape ecological processes transmit costs and benefits between resource users, and an understanding of social functions, catalyse the socio-political processes for resource governance that are needed to establish and adapt to new institutions? We therefore need a rationale to identify socio-ecological management zones that make sense in terms of sustaining ecosystem function across landscapes, with which local citizens feel they can identify (or, with which they hold a bio-cultural identity, see Brunckhorst 1995; Brunckhorst & Bridgewater 1995; Walton and Bridgewater 1996).

Ecological Systems and Landscapes

Previous attempts to understand landscapes have taken either a structural approach or a functional approach (Forman 1995; De Leo & Levin 1997). Structural approaches are concerned with biophysical inventories of populations, species and communities. Under these circumstances the loss of a structural component to the landscape will cause a loss of integrity of that landscape. Functional approaches seek to study production and consumption within landscapes. Under these circumstances the loss of a functional component of the landscape will cause a loss of integrity of that landscape.

Maintenance of ecological function across regional landscapes has been identified as a key requirement if we are to achieve sustainability. Ecosystem function itself stems from the interaction within and between structural components of the landscape that is driven by inputs. An integration between these components will provide flexibility with regard to structural and functional redundancy and landscape integrity (see de Leo & Levin 1997). When combined with social functions across the landscape, such a method may be employed to identify landscape associations that will form the basis for restructuring land management in that region.

If we consider a landscape in terms of its structural and functional components, a hierarchy of landscape components or members can be defined (Figure 3). From a structural perspective we can define a fundamental building block for landscapes termed a structural unit, which is an area of uniform physical characteristics such as slope, aspect and parent material. Correspondingly, each structural unit will have a series of processes attached to it, which may operate within the unit itself, or influence other units. By combining structural units together, based on uniform land cover, we can derive structural elements. The influences emanating from the structural element will be the sum of the influences of the constituent units. We can then define a (multi-scale) hierarchy of structure and function shown in Figure 3. Elements combine into associations, the functional equivalents of which are ecosystems. Associations can be integrated into landscapes, which correspond in scale to functional landscapes (Forman 1995). At the scale of functional landscapes, functioning refers to gross indicators such as productivity. This is the critical level at which to reconcile ecological functioning with social institutions if we are to approach sustainability (see Brunckhorst 1995; Forman 1995; Kim & Weaver 1995). The hierarchy continues through Functional Regions, Continental Ecoregions, Biomes and ultimately, the entire Biosphere.

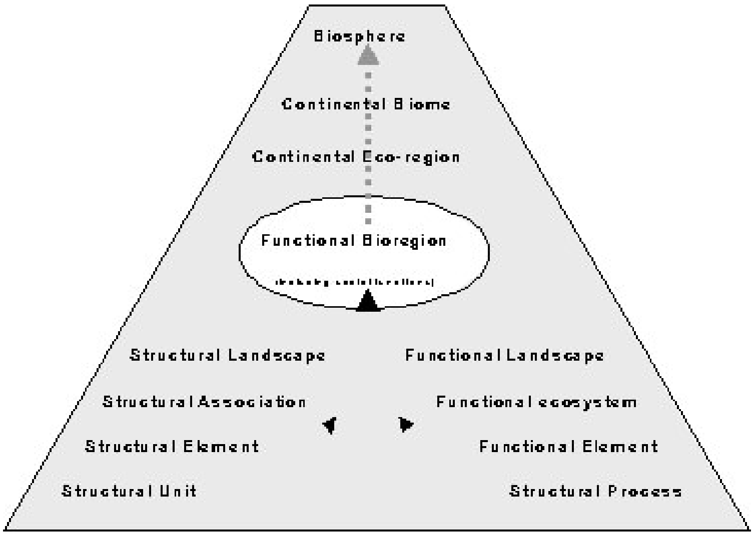

Figure 3. Hierarchy of Structural and Functional Components.

In essence, this model follows previous classifications that are based on spatial hierarchies (eg, Miller 1978; Forman & Godron 1986; Forman 1995). At each level of the hierarchy we can define the spatial-extent, magnitude and direction of the relationship that exists within, and between structural components. This then provides a vehicle to integrate structure and function at fine scales into landscape scale processes that reflect its gross capability which may then be reconciled with new governance models which the citizenry is capable of, and willing to, adopt. This is the scale of the bioregion. Thus we potentially have the ability to move between spatial scales ranging from global issues down to management at the paddock level. Any phenomenon identifiable at one scale must necessarily find expression at other levels.

Influence Functions: Spatial Dimensions

Influence functions describe the relationship within and between structural elements of the landscape. Influence functions are spatio-temporally-variant surfaces that describe the spatial extent, magnitude and direction of influence one landscape component has over another. By integrating these influence functions through the various scales of the hierarchy we can derive the sphere of influence attributed to functional ecosystem processes. From an analytical viewpoint, influence functions are ideally suited to raster data models in geographic information systems and can be visualised as a three dimensional surface, its spatial characteristics defined by strength (height) and the extent and direction of the influence surface (Figure 4).

The role of influence functions is in linking structure and function at all levels by establishing the spatial relationship between structure and function. Concomitant to the influence function is the receptor function. The receptor function governs how a landscape component will react when under the influence of one or more influence functions. Receptor functions are used to modify the shape of the influence function so it more closely represents reality. For example, if we were operating at local scales and generating an influence function for a structural element to represent the influence of water run-off, we would use terrain shape as a major input to the receptor function. This function would then describe how other structural elements would behave under the influence of our target element. In this way we can modify the influence function according to spatial extent, magnitude and direction. Further, we may wish to define an additional role to a landscape component as either a barrier or a conduit; barriers being an element that restricts an influence while a conduit is a landscape component that transmits an influence. By summing all influence functions and their corresponding receptor functions we can build a model of total influence on any landscape element. The same approach may be used to map institutional and social influences on landscape components.

The influence function does not describe ecosystem function. It is a model that describes the influence one component (at any scale) will have on another, be it ecological, social or institutional (Figure 4). By modelling influence functions our aim is to identify regions that share similar ecosystem and social influences across landscapes.

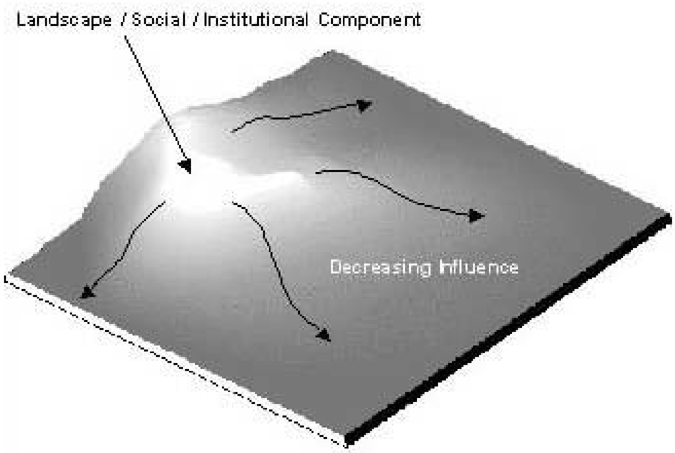

Figure 4. Three Dimensional Surface Representing a Hypothetical Influence Function (after Rollings and Brunckhorst 1999)

Application of Influence Function Surfaces: An Example

Influence functions provide a method to visualise the influence that social, ecological and institutional processes have on components across landscapes. An example is given here to illustrate how this technique may be employed to delineate logical management areas.

The New England Tablelands (NET) is located in north east New South Wales, midway between Sydney and Brisbane. The region is characterised by a major north-south trending escarpment that separates the higher elevations of the NET from the lower coastal plains to the east.

For each landscape component (both ecological and social) a standard influence function can be assigned, in this case a simple distance squared function was used.. In the first instance, ecological processes and social processes are mapped. When all influence functions are assigned they are combined using a simple additive or multiplicative model to generate an influence surface.

The following (Figures 5) consists of both social and ecological influence surfaces. For illustrative purposes the social influence is represented by social surface contours. The social influence decreases with distance from each social centre where the surface is at a maximum. The ecological influence surface was derived from broad scale vegetation communities. The ecological surface represents high functional capacity (influence strength) in the darker areas and decreases with distance to the highly modified systems represented by the lighter areas.

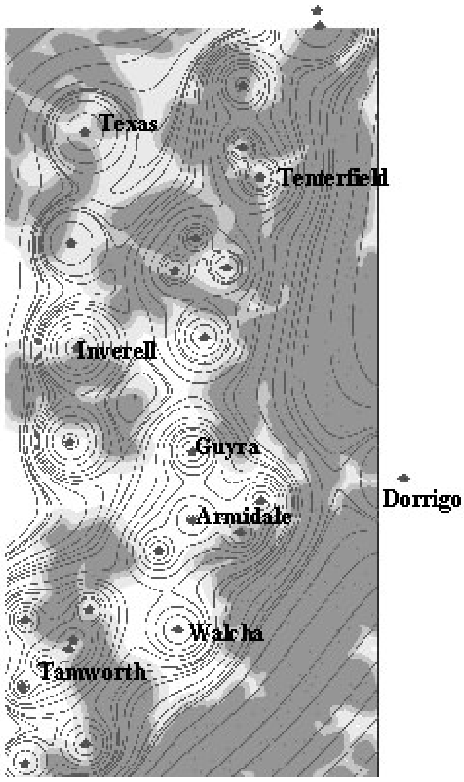

Figure 5. Social Surface (represented as contours) and Ecological Influence Surface

These surfaces represent the total influence exerted by all component influences. At any stage however, it is possible to refer back to an individual component's influence function if necessary. The method is very flexible and standard influence functions can be assigned at any scale in the hierarchy, or they can be generated from influence functions assigned at lower levels in the hierarchy. Social influence functions operate in a similar fashion to ecological influence functions except they depict zones that reflect the spatial-extent and magnitude of bio-cultural identity with a landscape/region; and, social institutions, jurisdictions and their spatial influence.

When the surfaces for social and ecological functions have been generated they are coupled to generate a combined surface that links ecologically functional regions with identifiable socially functioning, human communities.

The social influence surface may also represent the degree to which communities associate with their surroundings. This type of information provides an opportunity to spatially define management areas based on the collective views expressed by participating communities.

Figure 6 depicts the social and ecological influence surfaces and includes management areas that were delineated according to socially defined variables. In this example management area boundaries are defined according to bio-cultural identity. These boundaries follow lines of low bio-cultural identity. An approach such as this maintains the social integrity of the region and assigns resource management responsibility to the communities that express a high social affinity with the area.

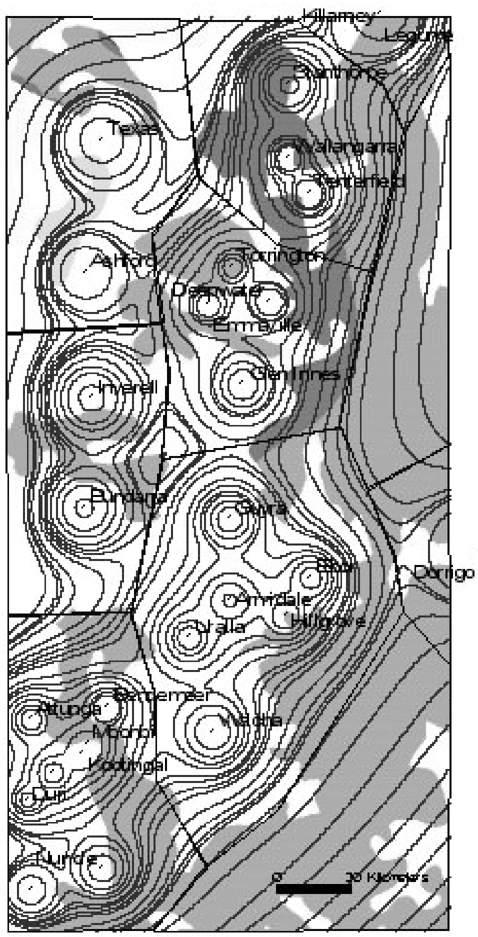

Figure 6. Management areas at any scale may be derived from the social surface based on socially determined variables. These bioregions will in turn nest within a broader spatial hierarchy (ecoregions).

In addition, Figure 6 also provides insight into management regimes that utilise a nested approach to resource management in order to cope with the broader scale issues of environmental management where problems may be physically beyond the capacity of any one management area (Ostrom 19990). An influence function approach to resource management therefore provides opportunities to better match social and ecological processes within a bio-regional framework, enhancing the opportunities for sustainable outcomes.

Conclusions

Studies of landscape ecosystems must address not only biophysical relationships, but also social and institutional processes and functions that cause anthropogenic impacts which ultimately manifest in socio-economic consequences.

This might best be accomplished if social science and policy studies are conducted in tandem with large-scale ecological research. The information generated from policy studies can then be incorporated into other models of the interactions among socio-economics, policy decisions and ecosystem functions (see Bird 1987; Brown & Macleod 1996). The complementary nature of these efforts will also be important to identifying key issues, related scientific questions and, readapting or refining management strategies.

We have outlined a theoretical model and research framework that seeks to spatially couple the influences of ecological functions and social functions across regional landscapes to identify an appropriate regional context to facilitate the emergence of more sustainable systems of land management. The model is concerned with direct and indirect influences of changes in ecosystem function on economies and communities. In particular, how criteria for maintaining ecological processes across landscapes and regions might direct the local and civic capacities for resource governance at the scale of regional landscapes. It should help elucidate the linkage between ecological processes, perceived ecosystem change, responses by institutions and organisations, and formal decision processes that may or may not appropriately interpret these changes and initiate planning to improve the pattern of human influenced, ecosystem changes.

Application of the model aims to investigate:

1. operational bioregions reflecting ecologically functional domains for land management;

2. the extent to which existing institutions could be used in governance systems;

3. the existence of potential advocacy coalitions needing to be included in participative processes to develop governance systems; and

4. an indication of what means of establishing governance capabilities might be consonant with the values and issues-framings of stakeholders in the region.

Preliminary work presented suggests this ambitious approach holds promise. Its application in discussions on local government amalgamations and boundary changes has demonstrated its practical application. Such a process involving stakeholders might actually affect change or adaptation towards new institutional forms for a sustainable future.

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