6 On common ground: designing strategic spatial governance to advance integrated natural resource management and environmental outcomes[1]

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Abstract

Despite a growing body of theory that emphasises the importance of socio-spatial aspects in the representation of community interests, regionalisation for natural resource governance remains dominated by river catchments. At the same time, across many nations, local governments are being given increasing responsibilities for environmental and resource management, but work within boundaries that are largely historical artefacts. The confluence of these trends suggests that it is timely to examine the requirements for spatial definition of resource governance regions. A considerable body of research on 'place' attachment, social networks, and participatory resource management combined with institutional theory and political science suggests that joining forces to take responsibility for collective action towards sustainability is more likely within particular social-ecological contexts and scales.

[1] This paper summarises several pieces of research that have benefited from input from many colleagues, in particular: Ian Reeve, Graham Marshall, Phil Morley, Elaine Barclay, Lin Ostrom, Meg McKean, Karl Bock, Michael Coleman, Margaret Shannon, Justine Graham, Richard Stayner, Phil Coop and Judith McNeil. Local governments, government agencies, community groups and individual farmers have also contributed. Elements of this research have been funded by Land and Water Australia, Rural Industries R&D Corporation, the Australian Research Council, New South Wales Department of Lands, and the Heinz Foundation (through US Department of Agriculture and US Fish & Wildlife).

This paper outlines some conceptual background, and then briefly describes three policy-relevant examples from recent research. The first two relate to 'on-ground', cross-property resource collaborations; the first at a quite small 'local' landscape scale across four grazing properties (totaling 1 300 ha) within a small first-order stream sub-catchment on the New England Tablelands of New South Wales, and the second across several large ranches and National Forest Land in Idaho, United States (totaling around 700 000 ha). The third briefly describes the application of a new technique developed to delineate more appropriate spatial units, reflecting social-ecological context and other institutional design principles, at three nested scales. The Eco-Civic regionalisation technique could be applied across the continent to develop an improved regional framework for natural resource management (NRM), environmental stewardship, planning and regional development, and service delivery.

6.1 Spatial resource governance across landscapes of property and policy: 'Tilbuster Commons … beyond the boundary fence'

Under conventional property rights regimes, primary producers are required to fully utilise the resources available within their own property title boundaries in order to survive economically. Properties have tended to be 'split up', with reduced resource or economic viability. A typical landholding may comprise some high quality soil that is suitable for cropping, grazing land that is generally not suitable for cropping, and some poorer areas barely suited to grazing. The type and mix of these areas will vary depending on the topography and soils of the region. Faced with various family and economic pressures and with only these resources at the landholder's disposal, there is often no option but to overuse, or inappropriately use, each type of resource. The productive riparian land is inevitably cropped, possibly for summer as well as winter feed for livestock. But grazing land might need to be cropped also. Stock will usually have access to the creek for water. The mid-quality land will be grazed throughout the year and the poorer areas will slowly decline due to the impacts of livestock 'wintering over'. Input costs tend to increase to help production and counter negative trends of water quality, parasite load and reducing production from both farmed and grazed areas.

Developing a cross-property or 'common' resource collaboration

The 'Tilbuster Commons' project embarked on the challenging experiment of forming a contemporary 'common', simply by agreeing to a collaborative grazing enterprise across their individual landholdings (to which they retained title).

Individual graziers contributed land, livestock, infrastructure and labour to form the common-property grazing resource arrangement. The project, developed as an 'on-ground learning-by-doing' experiment, aimed to understand how such a collaborative model might be established and evolve in a way which might be acceptable, in some situations, to 'traditional' farming families. The model needed to be able to demonstrate equivalent financial returns plus other benefits to collaborating landholders, or better, while delivering improved sustainability of the productive resource through the allocation of resources for the maintenance of ecological integrity, achievable only through an integrated management regime at a more appropriate scale (Brunckhorst and Marshall 2007). While the Tilbuster Commons group of collaborating landholders and their families 'self-selected' their participation on the basis of their shared values, concerns and future aspirations, the project area was selected as it contained many of the social and ecological issues and challenges that face rural communities. The four grazing families involved in the Tilbuster Commons experiment own adjacent properties of varying size totalling a land resource base of approximately 1300 ha. The land types associated with each member's land parcel vary greatly. The smaller properties were not insignificant, because they consist almost entirely of very high quality alluvial soils. Two of the larger landholdings consist of more variable soil types, but also contribute some high value conservation areas. Whilst there are larger single landholdings on the New England Tablelands, these four farms are typical of many of the landholdings managed in the area and issues associated with small farm size.

Considerable discussion and planning led the group to consider the kind of legal structures and corporate arrangements they needed. The group felt strongly, however, that a simple company structure, which farm families are generally comfortable with, would also provide both the flexibility required and a means to expand or 'disassemble' the Commons in response to future pressures of change. The range of issues discussed included livestock management, planned grazing and pasture management, the strategic allocation of conservation and environmental rehabilitation areas, and the issues associated with the operation of the Commons (such as management structure, bookkeeping and accounting). Other issues at the forefront of discussions included the allocation of land to the Commons (small areas are retained for private use, primarily the areas around each member's home), the selection of key infrastructure, the development of a 'formula' which represents the interests of each member in the common and the allocation of land or resources to the maintenance of ecosystem function which is recognised as underpinning the productive sustainability of the common. The arrangement of landholders as equal directors of the company, however, established a 'conflict of interest', because the landholders are also directors of the company. This is a valuable and useful tension between the individual landholder's interests and the collective interests of the group of landholders represented in the company. With both hats on, individuals are

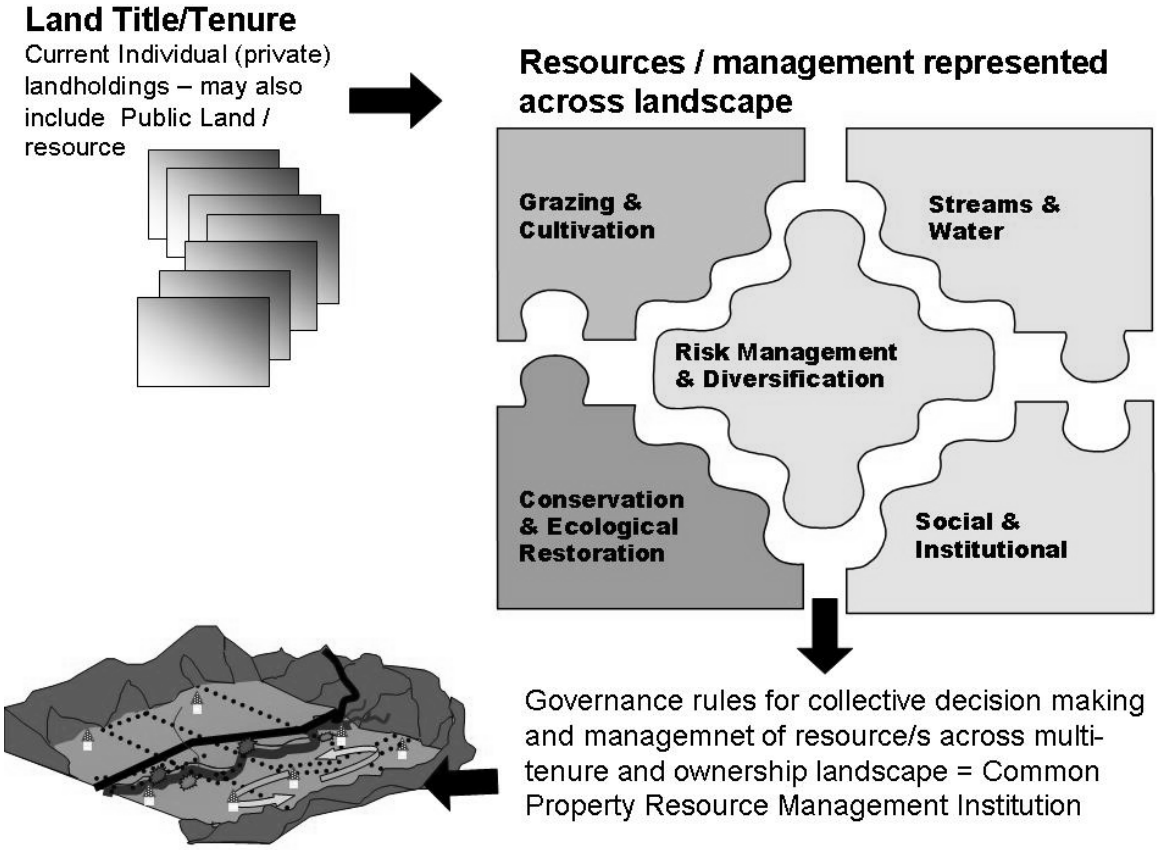
always considering the best options of benefit to themselves and the other members through the company. Informal operational rules can be enforced; when the livestock are on your property, for instance, you are responsible for managing them. The landholders, as directors of the company, have a share issue based on the formula agreed by all (representing proportional contributions of land, stock, equipment and so on contributed by individual landowners), which also forms the basis for sharing profits. As company directors they are making the collective decisions for running the enterprises of the collective and managing the whole resource base that their land, and the creek that runs through it, represents across the landscape (Williamson, Brunckhorst and Kelly 2003).

Individual and collective benefits of collaboration

Individual and collective social benefits of collaboration include freeing up of time and labour and pooling of various expertise. This in turn helps build flexibility and resilience. For example, some simple but highly regarded benefits enjoyed by the participating landholders include more efficient accounting and management practices, shared labour (but also less labour such as eliminating the need to crop for winter feed), the chance for families to 'get away' to have a real holiday and being able to leave the gate open when the livestock herd are on another property (for detailed discussion see Marshall 2005, Brunckhorst and Marshall 2007).

A valuable aspect of cross-property resource management collaborations is the ability to allocate the available resources more efficiently, but within their functional capacity. By recognising the distinction between resource allocation and utilisation (the geographical elements) and land tenure (a part of the institutional elements), these landholders may consolidate their herds and graze them across all collaborating properties (figure 6.1). This allows the utilisation of grazing techniques such as planned grazing regimes over a much wider area (across all properties). Input costs were greatly reduced and production increased, offering benefits including improved pasture and weed management, water and drought management (Brunckhorst and Coop 2003). In addition, pest issues such as external and internal parasite control are now managed far more effectively, but with reduced costs in terms of fencing or chemical needs. No cropping for winter feed (nor purchase of feed; trace minerals are provided for livestock health and soil replenishment) has been necessary so far and, while essential natural minerals are provided for stock, no superphosphate or similar fertilizer applications are now used.

Figure 6.1 **Separation and allocation of landscape resources for collective management across landscapes of property and policy**



The Tilbuster Commons collaboration managed to completely remove the impacts of livestock on the creek system across properties. Water quality in the creek has measurably improved. This is partly due to the landscape scale of pasture management and the grazing plan which allows long rest periods and generally a high standing biomass of pasture, together with fencing and rehabilitation of the creek across the properties. Alternative stock water could be made available, even piped (cost-effectively) across properties as necessary. Collectively these farming enterprises are more efficient and include the potential for scaling up to more suitable resource use across all properties of the collective. Finally, reducing input costs, freeing up labour and time, increasing pasture production and drought resilience all add up to better financial returns and well-being while building a more sustainable (resilient) landscape.

6.2 Regional resource governance across landscapes of property and policy: Idaho ranchers and Forest Service … 'dancing with wolves'

Policy-makers, planners, landscape ecologists and conservation scientists are increasingly finding themselves at odds with property and policy systems that create barriers to effective ecological management and conservation. Rather than fighting such embedded institutions, innovative approaches to circumvent such barriers might be more efficient and effective for 'scaling-up' landscape planning and management. Combining lessons from successful — old or new — cross-tenure management arrangements and collective (cross-property or common property) resource management institutions can provide a means of collaboratively managing landscapes.

A variety of land and resource tenures, and policy decrees, have a considerable influence on social-ecological systems resilience. Various forms of property and resource rights (private, public, collective) are a key influence on landscape change and the degradation (or potential resilience) of ecological resources and ecosystem services at regional scales. Property rights play an important role in resource management, but create problems in the management of externalities. Our systems of property rights, administrative jurisdictions, policy and resource-management institutions, need to be more seamlessly integrated at various levels of resource governance and institutional arrangements to match landscape scales of social-ecological interdependencies. An increasing number of examples demonstrate novel arrangements for cross-tenure and cross-jurisdictional resource management and conservation. Building flexible adaptive capacity from novel 'on-ground', cross-tenure and cross-jurisdictional, collective action will also provide transferable and adaptive solutions with appropriate incentives to enhance multiple scales of resource and environmental management. The following project is one of several which have developed through adapting knowledge about cross-property institutions for collective, integrated NRM, building further on the lessons from the Tilbuster Commons experiment.

Collaborating for grazing and environmental restoration across public and private tenure

A group of public and private land managers have joined forces to collectively manage such areas along with more sustainable rotational livestock grazing practices across properties and tenure. Along these adjoining private ranches and public land of the National Forest Service in Idaho in the Unites States, the riparian areas and wetlands have been enormously degraded in recent decades, not simply

from domestic livestock, but more from large wild grazing ungulates such as elk, moose and deer. The Lava Lake Land and Livestock Collaborative in southern Idaho manages almost 310 000 ha of public and private land for sheep and cattle ranching, conservation, and river and wetland restoration. Therefore, one component of the conservation and restoration of wetlands and streams has been the reintroduction of the wolf — along with adopting new ways of planning and managing livestock grazing to avoid the wolves. The wolves keep large native herbivores such as elk from continuously 'camping' on, and degrading, stream-side vegetation. Over the past four years, to everyone's delight, there have been no livestock losses to wolves, probably due to the use of different grazing management techniques. These management strategies include keeping stock in tight groups, giving them long grazing rotations, and protecting them at night with temporary electric fencing.

Some of the keys to success, however, include good communication, planning, and clear rules of engagement designed — and upheld — by all the collaborating parties (see Ostrom 1990, McKean 1996, Marshall 2005). The ranchers and public land managers have adapted well to managing their land and livestock differently. They are enthusiastically observing the surprisingly fast regeneration of pasture and other grasslands (prairie), streams and wetlands.

Two other similar projects, one in northern Oregon and another in Idaho, are also providing insights into successful cross-property collaborations across public and private tenure for regional landscape-scale integration of community development, sustainable grazing, forest use, ecological restoration and biodiversity conservation. Similar adaptations, for example, kangaroo-based enterprises — very large scale, across property and tenure — could assist sustainable environmental management in Australia's rangelands.

6.3 Strategic regional governance — institutions and landscapes in understanding regions as cross-scale Eco-Civic frameworks

Along with many areas of public policy, integrated catchment management has shifted from technocratic planning to various forms of participative planning. In Australia, this shift took place in the late 1980s and early 1990s, with little consideration either of the implications for the definition of resource governance regions, or of the considerable body of theory in the social sciences that is relevant to the regionalisation issue, such as theories of place attachment, central places, gravity modelling, institutional design and hierarchy theory. During the same period, local government has increasingly been given a considerable responsibility

for local environmental planning and management. The emergence of catchments and watersheds as the dominant method to delineate regions for resource governance has assumed that soils, vegetation, other biodiversity, land use, and ground water, along with community engagement and collective action, are best defined by such entities. Within the integrated catchment management literature, most authors accept unquestioningly that catchments should form the areal units within which natural resource governance takes place.

There is a growing weight of evidence, however, against the assumption that catchment-based regions or local government areas automatically incorporate all environmental and resource governance issues and their communities of interest. Accordingly, there are an increasing number of critiques of catchment boundaries as spatial frameworks for integrating multiple resource governance. At least part of the reason for these shortcomings is that catchments usually do not represent very well either the 'place attachment' and communities of interest for civic engagement and participation, or the ecological resource base (Brandenburg and Carroll 1995, Barham 2001, Cheng, Kruger and Daniels 2003, Blomquist and Schlager 2005). Ecological and biophysical regionalisations and land-use regions also demonstrate that similar biophysical attributes, land use and climate have little correlation to watershed topography or to areas of interest to land use communities (Omernik and Bailey 1997, Getches 1998, Brunckhorst 2000, Ewing 2003, Lane, McDonald and Morrison 2004, O'Neill 2005). In practice, catchment management has a history of inefficiency, inappropriate monitoring and high transaction costs associated with it. Syme, Butterworth and Nancarrow (1994) went so far as to suggest that organisation of community involvement on catchment boundaries acts against the achievement of the stated goals and purposes of integrated catchment management.

Three principles might underpin the development of regionalisations for government administration of, and community participation in, natural resource governance. The principles relate to the spatio-social context representing communities of interest, optimised for homogeneity of the ecological landscape, and spatially bounded in a nested hierarchy to facilitate scaling of institutional arrangements for management of externalities. While a few small catchments and watersheds might possess these characteristics, most do not. The majority of non-metropolitan local government areas do not reflect these characteristics either, especially in relation to local-to-regional 'communities of interest' in the twenty-first century. Policy makers would be wise to match a nested framework for natural resource governance with local government and other service delivery 'regions' that best capture the area of interest to local residents for representation, economic activity, resource activity and civic engagement.

Eco-Civic regionalisation for resource governance

Despite the mounting criticisms of catchments as natural resource governance regions, and the growing conceptual and theoretical development in socio-spatial aspects of natural resource governance, there have been surprisingly few attempts to propose and apply empirical techniques of regionalisation that might address some of these criticisms and build on this growing body of theory around the concept of 'Social Catchments' and 'Communities of Interest'.

What is a 'region' for resource governance? The placement of boundaries to define regions for integrated resource governance warrants more careful analysis than it has been accorded in the past. With growing emphasis on community engagement, there is also increasing understanding by both scientists and policy makers that many resource governance issues relate to the complex interdependencies of social and ecological systems operating at various scales (Berkes and Folke 1998). Concepts of federalism (polycentric governance) for efficiencies in ecological and economic management, useful in simplifying complexity and assigning levels of responsibility, have been employed to demonstrate design of administrative and spatial units for planning and management. In developing the Eco-Civic regionalisation technique, it was necessary to distil from the growing literature on socio-spatial aspects of natural resource governance some principles that could inform the detailed methodological development.

Three key principles are considered to be of particular importance in defining spatial boundaries of regions for resource governance. The first required condition is for regional boundaries that maximise the representation of 'place identity', community social networks and the local areas of most interest to community residents (Hillery 1955, Brandenburg and Carroll 1995, Feld and Brasso 1996). The second condition that assists with planning and resource management is the relative homogeneity of multiple biophysical characteristics of regional landscapes. The third condition is for optimal collective representation of social-ecological contexts at multiple scales, as nested local-to-regional contexts for decision-making levels and institutional design in order to deal with social-ecological interdependencies including externalities (Brunckhorst, Coop and Reeve 2006).

Empirical derivation of resource governance regions

The method developed for empirical derivation of resource governance regions required the formulation of the concept of a 'social surface' or 'social topography' which geographically represents (by height and extent) the shared community area of interest (see Brunckhorst, Coop and Reeve 2006, Reeve and Brunckhorst 2007). The technique consisted of three major components:

1. derivation of a hierarchy of biophysical regions (to satisfy Principles 1 and 3)
2. derivation of a social surface and a hierarchy of 'civic' regions defined by the 'valleys' in social surface (to satisfy Principles 1 and 2)
3. optimisation of the boundaries of the two hierarchical regionalisations so that all three Principles are satisfied to the maximum degree possible.

The biophysical regionalisation was based on elevation, soil moisture, soils, and climate data at scales of 1 km or finer, using the ERDAS Imagine 8.5 classification routine. The result was a hierarchical biophysical regionalisation comprising eight major regions (level 1), each of which was divided into sub-regions (level 2). The level 2 sub-regions were further subdivided into two or more level 3 sub-regions.

Derivation of a social surface or topography of communities of interest was approached through development of a modelling technique that initially used primary data to inform secondary data and modelling parameters specific to different regional contexts (for example, coast, tablelands, slopes, plains). This modelling approach was founded on results from an earlier study, focused on northern New South Wales, based entirely on primary data gathered via a spatially even, social survey that included maps for respondents to correlate with a variety of question framings (Brunckhorst, Coop and Reeve 2006), and which utilised insights from theories of place and cognitive mapping (for example, Brandenburg and Carroll 1995, Feld and Brasso 1996, Cheng, Kruger and Daniels 2003). The shape, orientation and sizes of the community areas which respondents had drawn suggested that it would be possible to model community areas for extension of the methodology to a study of the whole of the state (for methodological details, see Brunckhorst, Coop and Reeve 2006, Reeve and Brunckhorst 2007). To avoid excessive population of home points in metropolitan areas, a continuously variable population fraction was used, where the fraction was an inverse function of population density (for details refer to further reading list). The State was divided into five regions, each region having different modelling parameters in accord with contextual variables chosen to reflect the variation known from the earlier study. The final step in the modelling procedure was to assign each simulated community area a height of one unit in a third dimension at right angles to the north-south and east-west dimensions of the map of New South Wales. Working in this three-dimensional space, the simulated community areas were summed to produce a 'social surface' (see Brunckhorst, Coop and Reeve 2006). High points on this surface corresponded to points that lay within the community areas of relatively large numbers of people (strictly, large numbers of simulated home points). Low points on the surface corresponded to points that lay within the community areas of relatively few people. As proposed in Principle 2 above, it is these low points in the

social surface that are suitable areas through which resource-governance region boundaries might pass (figure 6.2).

To produce a hierarchy of regions based on the simulated social surface it is necessary to locate major and minor 'valleys' in the social topography. Boundaries based on the major 'valleys' will define larger level-1 regions, and boundaries following the 'valleys' within these regions will define the smaller level-2 sub-regions. Once again, boundaries on minor 'valleys' within the level-2 sub-regions will define the yet smaller level-3 sub-regions. In some areas, the 'topography' of the social surface did not necessarily give a strong indication as to the placement of boundaries. This was a consequence of broad shallow 'valleys' in the surface, or the presence of several 'valleys' in close proximity that were equally good candidates for the location of a boundary. For this reason, verification via a telephone survey of a number of community organisations with hierarchical structures of local, regional and state branches was undertaken. In addition, 'key informants' were also surveyed as an efficient way of gathering surrogate data and for 'on ground verification'. More than 400 interviews with key informants of the Country Women's Association, Hockey Associations, Soccer Associations and Netball Associations were completed. Interviewees were asked about the localities where their organisation interacted as part of social activities and/or sporting competitions. Information from the telephone survey of community organisations and the 'network of social valleys' were combined to produce a three-level hierarchical regionalisation of the modelled social surface.

The accuracy boundaries derived from the combined modelling approach were compared against boundaries derived from primary spatial survey data. The earlier studies provided primary data to measure empirically the social surface and associated set of civic regions for north eastern New South Wales, against which the modelled civic regions could be tested. A classification matrix was used to record, for each civic region, the proportion of home points that were assigned to the same civic region when the modelled surface was used to derive the boundaries between the regions. The level of agreement between the modelled boundaries and the measured boundaries in north eastern New South Wales was extremely good, with correct classifications of more than 98.6 per cent of the 1 973 home points in the region for which primary data was available (Kappa = 0.982, $p<0.0005$).

Optimisation of derived Eco-Civic regions

The boundaries that define the biophysical regionalisation do not necessarily coincide with the boundaries of the civic regionalisation, although the coincidence is fairly good along the eastern escarpment of the northern tablelands. This is because a sparsely settled area coincides with a major climatic, floral and faunal

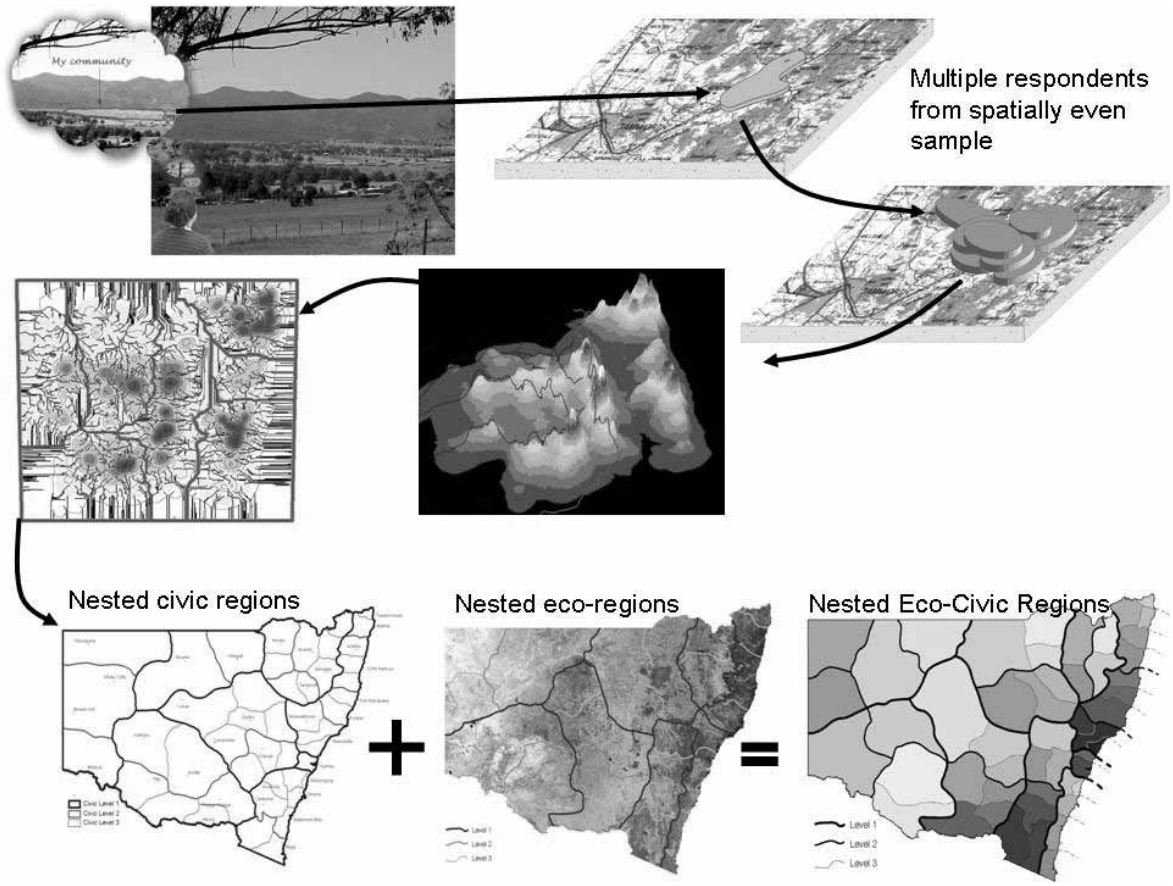
discontinuity in the landscape. In many areas, it is necessary to adjust the boundaries of the civic regions to bring them into closer coincidence with the boundaries of the 'eco-regions' of the biophysical regionalisation. Flexibility in options for boundary placement is possible because the 'valleys' in the social surface can be quite broad. This is particularly so for the 'valleys' at lower 'altitudes' in the social surface. A boundary can therefore be moved reasonable distances within the confines of a 'social valley', without causing a significant increase in the number of community areas that are intersected (that is, dividing communities of interest) by the boundary. At broader scales (that is, level 1), therefore, the optimisation routine can give more weight to the biophysical boundaries. However, at finer scales (that is, level 3), it is necessary to ensure that the optimisation routine does not shift boundaries into relatively high areas on the social surface. The general procedure and results of the Eco-Civic regionalisation for New South Wales are shown in figure 6.2. (Details of the method and results can be found in the listed published papers and the Institute website (www.ruralfutures.une.edu.au).)

Comparing the performance of 'regions'

For any given administrative region, some community areas will be wholly within the region boundary, while others will be intersected by the region boundary. The proportion of a local resident's community that is wholly within a region boundary, compared to the total number of people living within that boundary, provides an index of the performance of the particular resource governance region's boundaries, in terms of its ability to include the areas that are of interest to residents. The 'Community Capture Index' (CCI) provides a means of comparing the performance of different regions in terms of the extent to which people's community areas are intersected by region boundaries. In conformity with Principle 2 above, a regionalisation with boundaries that intersect fewer community areas (higher value of the CCI), is preferable to a regionalisation that intersects a greater number of community areas (lower value of CCI).

Comparison of CCIs of the three levels of the Eco-Civic regionalisation, and for a range of current administrative regions in New South Wales, including the Catchment Management Authority (CMA) regions which are based on catchment boundaries, was undertaken. The results demonstrate that the current administrative boundaries and those of the CMAs are poorly located if the intersection of people's community areas by these boundaries is to be minimised. They do not encompass the majority of the areas of interest to local communities for civic engagement in NRM and governance. Indeed, local government boundaries and CMA boundaries

Figure 6.2 **Summary diagram of the Eco-Civic regionalisation method and results for the state of New South Wales**
(After Reeve and Brunckhorst 2007)

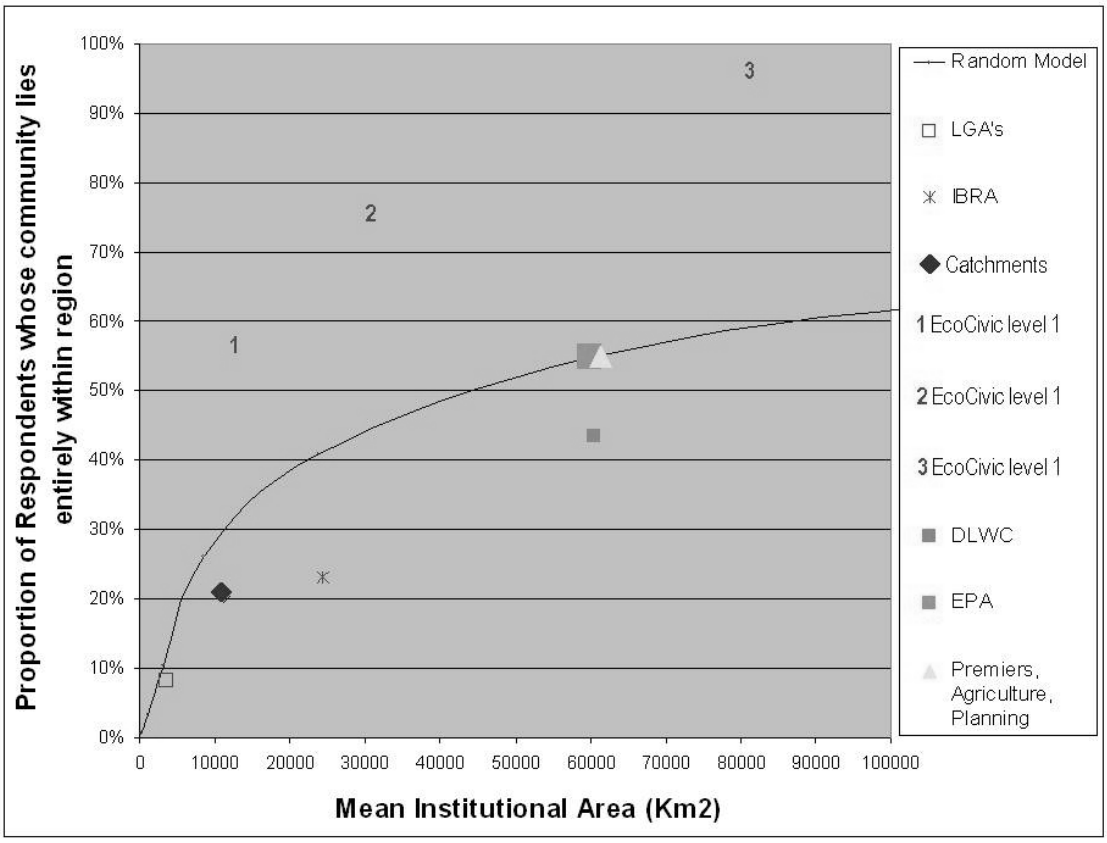


perform worse than a random allocation of regional boundaries would in representing communities of interest, whereas the Eco-Civic regions perform well (figure 6.3). Fragmentation of residents' areas of collective interest reduces participation and effectiveness of planning, creates logger-heads and increases transaction costs. Potential institutional (re-)design is likely to be more effective given the spatially-nested 'common grounds' provided by the Eco-Civic regionalisation technique (Reeve and Brunckhorst 2007).

The Eco-Civic research has established a practical method to produce a hierarchical regionalisation that will satisfy the proposed principles. This approach involves identifying where boundaries between resource governance regions should pass so as to minimise the fragmentation of the areas of the landscape with which local people identify and in which they have an interest for civic participation. Boundary placement is further optimised to ensure that natural resource issues and ecosystem

Figure 6.3 **Community Capture Index (CCI) for various administrative regions and Eco-Civic regions**

The line tracks CCI values that would be achieved by a random allocation of regions



functions are as homogeneous as possible within the regions defined by the boundaries. Applied nationally, an Eco-Civic regionalisation of Australia would improve civic engagement and integrative capacity of policy. In particular, it would provide for the design of spatial frameworks for local-to-regional governance, within which to plan and manage towards sustainability across multiple scales of human living areas, communities and natural resource management including water management.

6.4 Conclusions

Ecological systems, services and resources need to be managed to increase resilience and sustainability of interdependent social-ecological systems across landscapes of property, policy and place. While adaptation to climate change, including trading schemes for adjustment to carbon and water futures, are of necessity in the long term, Australian governments and communities currently face

crippling environmental degradation of the nation's already limited resources base and natural capital for food production and other resource use and management. The spatial context of social-ecological interactions is critically important for building institutions leading to resilience and sustainability.

Novel approaches to strategic spatial governance, coupled with institutional design at appropriate cross-scale levels, are likely to improve engagement with and outcomes from environmental and natural resource management. Australian NRM regions are in need of re-thinking and re-design to represent levels of social-ecological systems and externalities appropriately within matching institutions. A national Eco-Civic regionalisation would contribute to this purpose and facilitate new policy directions to improve environmental outcomes of NRM, regional planning and local government.

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