Design principles for social-ecological transformation toward sustainability: lessons from New Zealand sense of place

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Abstract. As society seeks to meet the needs of a growing human population and rising aspirations for consumption, many of the ecosystem services on which society depends have declined in the global aggregate. Although some local societies sustainably manage their natural resources for long time periods, the more frequent pattern is overuse of renewable resources and a trajectory toward degradation. How can this degradation be reversed? In this paper we draw on four New Zealand examples and the literature to posit a set of design principles and recommendations to foster transformation from social-ecological degradation toward more sustainable pathways. These include a strong sense of place, prioritizing long-term solutions over short-term benefits, collective engagement of all key stakeholders and willingness to compromise, right to organize and manage, negotiated consensus on sustainability goals, formal and informal monitoring, flexibility to renegotiate goals and adapt, and guidance by a skilled facilitator. We also identify guidelines that foster consensus-building in the face of contested solutions. Examples from New Zealand and the literature suggest that local social-ecological systems can self-organize to shift toward more sustainable trajectories and that society can foster conditions that increase the likelihood of favorable transformations.

Key words: New Zealand; resource management; sense of place; social-ecological; sustainability; transformation.

INTRODUCTION

As society seeks to meet the needs of a growing human population and rising aspirations for consumption, many of the ecosystem services on which society depends have declined (MEA 2005). These include reductions in marine fish stocks (Pauly et al. 2005, Berkes et al. 2006, Worm et al. 2006); conversion from unmanaged to managed ecosystems to supply forest and agricultural products at the cost of reduced capacity to regulate climate and disease spread (Foley et al. 2005, Ellis and Ramankutty 2008); intensification of agriculture with associated pollution of freshwater, marine, and downwind ecosystems (Carpenter and Biggs 2009); and inadvertent loss of biodiversity (Mace et al. 2005). These changes have accelerated in the last half-century (Steffen et al. 2004) and may be approaching or exceeding the limits of acceptable..
environmental change (Foley et al. 2005, Rockström et al. 2009). Given the extensive nature of these changes and the difficulty of establishing effective international and national governance of environmental change (Young and Steffen 2009, Ostrom 2010), there are urgent needs to radically redefine society’s relationship with the biosphere at local-to-regional scales (Chapin et al. 2011b). This requires a clear understanding of the circumstances that foster sustainable management of social-ecological systems (Berkes et al. 2003, Clark and Dickson 2003, Chapin et al. 2009). In this article we distinguish between sustainability (use of the environment and resources to meet the needs of the present without compromising the ability of future generations to meet their needs) and stewardship (actions that actively shape the trajectories of a social-ecological system to enhance ecosystem resilience and human well-being) (Chapin et al. 2009, Chapin et al. 2011b).

Some societies have historically maintained a relatively sustainable use of natural resources over long time periods (Ostrom 1990, MEA 2005, Agrawal et al. 2008, Pinkerton 2009). A more frequent situation is that resources have not been used sustainably and that scarcity caused by resource depletion and increased societal demands increases economic incentives for exploitation and reduces options for sustainability. Certain properties of both the resources and their governance increase the likelihood of sustainable use (Dietz et al. 2003, Ostrom 2009), although no single formula or strategy has been identified that guarantees sustainability (Ostrom 2007).

How can society shift from a spiral of degradation toward a more sustainable trajectory? Laws and regulations that reward sustainable behavior or punish unsustainable behavior (e.g., regulation of water or air pollution, fisheries catch limits) provide important, but generally insufficient, motivation for sustainable behavior (Kinzig et al. 2011). Estimating the economic value of the benefits derived from ecosystems (ecosystem services) and incorporating these values into decisions about land and resource use can, under some circumstances, foster economically rational choices that support more sustainable patterns of resource use (Daily 1997, Daily et al. 2009).

However, human resource-use decisions are not motivated solely by economic self-interest or fear of punishment. A complementary approach is to capitalize on sense of place as a motivation for stewardship actions and sustainable behavior. Sense of place has been defined as “the collection of meanings, beliefs, symbols, values, and feelings that individuals and groups associate with a particular locality” (Williams and Stewart 1998; also quoted by Yung et al. 2003). The meanings embedded in a sense of place may contribute to the sense of identity of individuals and groups associated with a place, build attachment to that place, and help frame environmental debates surrounding that place, although these elements are not always linked (Tuan 1977, Williams and Stewart 1998, Yung et al. 2003, Ardoin 2006, Lewicka 2011). Sense of place is multi-dimensional (Gieryn 2000, Yung et al. 2003, Ardoin 2006) and depends on the biophysical attributes of the place (Steele 1981, Stedman 2003a); the lived experiences of people with a place and the meanings these create (Stedman 2003b, Yung et al. 2003); personal and psychological responses of individuals based on those experiences and meanings (Low and Altman 1992, Vaske and Kobrin 2001, Williams and Vaske 2003); the social, ideological, and cultural perspectives of stakeholder groups (Jackson 1994, Basso 1996); and the political and economic contexts in which issues are framed (Agnew 1987, Yung et al. 2003). Given these multiple dimensions of sense of place, places can create a spectrum of potential responses to resource issues, as often seen in debates over conservation vs. development among people who feel strongly about a particular place (Cheng et al. 2003, Stedman 2003b, Yung et al. 2003, Ardoin 2006). The challenge in using sense of place as a motivation for stewardship actions is to draw on those attributes that unite people in their commitment to place and to negotiate acceptable solutions to those political, ideological, and social issues that are contested and create conflicts about how people should interact with these places (Cheng et al. 2003, Stedman 2003b, Yung et al. 2003, Ardoin 2006).

How might sense of place be translated into sustainable behavior? One model is that visionary leaders, governments, or non-governmental organizations (NGOs) recognize the importance of conserving ecological and cultural values of a
particular place and provide top-down leadership, organizational structure, and funding to conserve the systems that they value (Huxham and Vangen 2000, Bonnell and Koontz 2007, Campbell-Hunt et al. 2010). These initiatives include the establishment of national parks, reserves, and sites of cultural value (Olsson et al. 2004). Most places, however, lack the full complement of leadership, authority, consensus, and funding to implement a planned shift to a more sustainable trajectory (Margerum 2007). In these situations, building collaborations among stakeholders that facilitate social learning about sustainable practices and barriers to sustainability could catalyze a shift toward sustainability (Huxham and Vangen 2000, Schusler et al. 2003, Margerum 2008). Social learning is particularly critical when participants agree that they do not individually have all the answers (Wondolleck and Yaffee 2000).

In this article we focus on the linkage between sense of place and transformation toward sustainability without attempting to review, synthesize, or resolve the many issues that are actively debated in the underlying disciplines. We must first, however, define what we mean by “transformation toward sustainability.” Transformation is a fundamental change in a social-ecological system resulting in different controls over system properties, often mediated by changes in feedbacks that govern the state of the system (Chapin et al. 2009, Chapin et al. 2010). Transformability is the capacity to create a fundamentally different system when existing ecological, economic or social structures make the existing system untenable (Walker et al. 2004, Folke et al. 2010). These definitions imply that transformation to a more sustainable pathway is essential if the current system is locked into a trajectory of environmental degradation that reduces opportunities for future generations to meet their needs.

When a system is transformed, it contains many of the same elements (species, regulations, institutions, etc.) from the antecedent system from which it is derived. In this article, we consider a system as transformed if it is characterized by new feedbacks that cause fundamentally different trajectories of human-environment interaction. Degrading and sustainable trajectories generally differ in institutions—both formal (i.e., regulations) and informal (i.e., patterns of behavior)—that are key components of social-ecological feedbacks. Consequently, transformation toward a more sustainable trajectory generally requires both regulated and self-motivated changes in human behavior. The question addressed by this paper is whether sense of place can motivate these regulatory and behavioral changes.

In a directionally changing world, sustainability does not imply that everything stays the same, but rather that natural, built, human, and social capital are sustained or enhanced so future generations can meet their needs. A transformation toward sustainability therefore implies a shift from behaviors and outcomes that reduce opportunities for future generations to ones where these opportunities are enhanced through maintenance of natural, built, human, and social capital (Chapin et al. 2009). Stewardship is the active shaping of trajectories of social-ecological change to enhance ecosystem resilience and human well-being (Chapin et al. 2011a, Chapin et al. 2011b). Under conditions of environmental degradation, stewardship requires transformation to sustain certain core societal values such as ecosystem resilience and human well-being.

Building on the design principles for sustainable management of common pool resources under steady state (Ostrom 1990, Dietz et al. 2003), principles for developing multi-stakeholder collaborations for social learning (Schusler et al. 2003, Margerum 2008), and principles for social-ecological transformation (Olsson et al. 2008, Chapin et al. 2010), we draw on four case studies from the South Island of New Zealand and on the literature to posit a set of design principles motivated by sense of place that can lead to a transformation toward sustainability. Sense of place is not independent of economic motivations and regulatory frameworks but provides a useful lens that can catalyze action.

Methods

We selected four case studies in the South Island of New Zealand that had transitioned from a pathway of environmental deterioration toward a more sustainable trajectory. The Manapouri, Monowai, and Te Anau Lakes Guardians case study was a high-profile conservation issue
contested at both local and national levels. Fiordland Marine Guardians was a high-profile development of a marine environmental (particularly fisheries) management plan that was successful to the point of possibly serving as a model for marine and perhaps wider management issues in other areas of New Zealand. Consequently, both guardian exercises have been relatively well documented in the published literature and government reports, which we analyzed and cite in the text. In addition, one of us (AFM) was a member of both Guardian groups (and Chair of the Lake Guardians for their initial 26 years) and so is directly familiar with the steps by which each situation evolved. Although the Waikawa Catchment study has not been formally documented in publications or reports, one of us (RAM) was directly involved in drawing up a restoration plan through community consensus and ensuring that its goals were feasible and would likely provide the desired ecological health outcomes. The more recent Mackenzie Basin issues are representative of environmental and social changes associated with intensification of dairy-based agriculture in New Zealand. This case has been well documented in newspapers and other published media and is still awaiting resolution.

For each case study, we triangulated among all available sources of information (Schrader-Frechette and McCoy 1994, Yin 2003). We analyzed government research reports, newspaper accounts, and other published information to document events and the identity of stakeholder groups that participated in the process. These documentary sources were supplemented by notes maintained by those authors who actively participated in each case. These notes documented points of agreement and disagreement among stakeholders, rules by which compromises were reached, and the role of competent facilitators in the negotiation process. We found no major inconsistencies among the information sources used for triangulation.

RESULTS

Manapouri, Monowai, and Te Anau Lakes Guardians

In 1963 the New Zealand Government agreed to build a hydropower facility to provide electricity for a multinational aluminum smelter that the government considered important for diversifying the national economy, providing local employment, and reversing a northward population drift within New Zealand (Peat 1994, Mark et al. 2001). This development diverted New Zealand’s second-largest waterway (Waiau River) through a tunnel via a hydroelectric generation station into a pristine marine fiord, Doubtful Sound, in Fiordland. In order to maximize power generation, the government planned a second phase that would raise, by up to 24 m, the levels of two major lakes (Lakes Manapouri and Te Anau) that form the main gateway to Fiordland National Park, New Zealand’s largest and most prestigious national park and part of the South West New Zealand World Heritage Area (Figs. 1 and 2). No environmental restrictions were initially imposed on these engineering-designed development plans.

Major public outrage (MCI 1970) over the ecological and aesthetic implications of raising the lake levels to maximize power output, even beyond the smelter’s initial demand, led to a petition that was signed by about 10% of the nation’s adult population, demonstrating a widespread commitment to the sustainability of this region, particularly the national park with its special protective legislation, among New Zealanders. This petition demanded that the hydroelectric contract with the smelter be renegotiated to prevent lake raising and thus avoid adverse environmental impacts. These concerns eventually led to ecological studies of the lake shorelines that documented the likely serious consequences of exceeding the historical lake-level variations (Mark et al. 2001). This research described the predicted tree mortality that would result from prolonged raised lake levels and lakeshore slumping associated with unnaturally rapid draw-down to unnaturally low levels. Subsequent events supported the predicted substantial and highly detrimental environmental consequences of such proposed lake-level manipulation. The debate over this pivotal issue contributed to a change in central government in 1972 and the consequent establishment of a mainly local group of lake guardians from among the campaign leaders by the newly elected central government. These Guardians of Lakes Manapouri and Te Anau were to recommend ecologically based guidelines to minimize
environmental impacts while meeting the smelter’s power needs within the recorded natural range of lake-level variation, 4.8 m for Manapouri and 3.5 m for Te Anau.

The concept of sustainable management of natural resources, inherent in the Fiordland Lakes controversy was subsequently applied more generally in the form of the Resource Management Act in 1991, which was born out of the Brundtland Report (WCED 1987). Required by the central government to obtain resource consents consistent with this Act, the government’s Electricity Department, as managers of the Manapouri Power Station, invited all local stakeholder groups who were directly or indirectly affected by the outcome of water management to participate in the working party, and some 20 groups did so, under the direction of a skilled facilitator. These included business, conservation, agricultural, and indigenous (Māori) representatives. This group undertook formal renegotiation of the resource management of the water-related ecosystem services associated with the Manapouri-Te Anau hydroelectric development. During this implementation phase, it became clear that many stakeholder groups differed strongly in their views about how water from these lakes should be managed. After five years of negotiation and the collection of additional information, consensus was reached about water management to maximize ecological integrity and to produce acceptable levels of
electricity for the smelter. These agreements included maintaining lake levels within their natural historic limits, a guaranteed minimum flow of the (lower) Waiau River draining Lake Manapouri in order to restore habitat for fish and other aquatic biota, funding for the restoration of wetlands that had been modified by the associated river management, compensation to local Māori people for loss of traditional food resources, and optimizing power production within these constraints. All 20 stakeholder groups accepted the final negotiated agreement as a reasonable compromise, although no group achieved all of its initial goals. The agreement sustained about 95% of each ecosystem service under discussion. The Guardians of the Lakes now have three lakes under their jurisdiction: Manapouri, Te Anau, and the nearby Lake Monowai, also within Fiordland National Park, which had been raised about 1.6 m in 1926 as part of an earlier much smaller hydroelectric development. The Guardians of Lakes Manapouri, Monowai and Te Anau are now enshrined in law, and they continue to monitor and advise on water management to ensure an acceptable balance between ecological sustainability and power delivery.

This case study illustrates the importance of a national identity associated with what this region means to New Zealanders—i.e., their sense of place. The central government had initiated development activities that were demonstrably unsustainable and would cause degradation to some of New Zealand’s most iconic scenery, indigenous ecosystems, and ecotourism potential within a prestigious national park. This case study also shows that a major nationwide campaign could achieve satisfactory resolution through the democratic process and provide for power production adequate for the smelter’s needs while using the lakes within their natural range of levels. Initial impetus for the campaign came from a national sense of place; final resolution came when central government directed that the existing empowering legislation be replaced by the necessary consents issued under the sustainability clauses of the subsequent (1991) Resource Management Act. An acceptable compromise was eventually agreed to, such that there were no formal objections when the consents were issued by the local authority (Mark et al. 2001). This illustrates the contested...
nature of social, cultural, and political dimensions of sense of place (Yung et al. 2003, Ardoin 2006) and the importance of broad stakeholder participation and skilled facilitation in developing plans and prioritizing issues to achieve durable solutions (Koontz and Johnson 2004).

**Fiordland Marine Guardians**

Fiordland in southwest New Zealand was one of the last areas of the country to be heavily exploited for marine resources because of its remoteness from commercial ports and roads and its exposure to frequent westerly storms. Nonetheless, the region, despite its unique marine biodiversity (Wing 2003), experienced excessive exploitation of most of its commercially valuable marine resources in patterns that paralleled those observed earlier in other parts of New Zealand. This included uncontrolled harvest and massive reductions in stocks of fur seals (1800–1825), right whales (1830–1850), blue cod (1890–1950), and rock lobster (1948–1960s) (GFFME 1999). Paua (abalone) harvest in Fiordland intensified in the mid-1980s, but harvest restrictions and other legislation introduced in the 1990s prevented substantial over-exploitation of these stocks.

Road access to western Fiordland (Milford Sound in 1952 and Deep Cove, Doubtful Sound in 1971) initiated a recreational fishery and other forms of ecotourism that had the potential to further conflict with the sustainable management of the region’s fisheries resources. This fishery expanded rapidly from the mid-1980s onward, with road improvements that permitted boat-trailer access and technological developments that allowed more efficient and extensive recreational fishing. Terrorism and armed conflicts in the Mediterranean Basin caused a shift in cruise ship destinations beginning in 1985 to safer locations, such as New Zealand and particularly the spectacular Fiordland region in the country’s southwest (Fig. 3). Half of the cruise ships that visit New Zealand go to Fiordland, causing additional crowding and concerns over potential pollution events.

Fiordland is one of New Zealand’s 10 Fisheries Management Areas. The Quota Management System, established in 1986, assigned quotas to commercial fishermen within this and other regions but did not address potential conflicts among commercial, recreational, customary (Māori), and other stakeholders (GFFME 1999). By the mid-1990s it was clear that potential conflicts over the use of marine resources for both consumptive and non-consumptive purposes would likely continue to intensify, to the detriment of both the marine stocks and aesthetic values of the region. In 1995, a group that represented the major stakeholders in the Fiordland marine area created an informal group known as the Guardians of Fiordland’s Fisheries and Marine Environment with the objective to sustainably manage and conserve Fiordland’s fisheries resources and general marine environment for the use and enjoyment of present and future generations. The Guardians consisted of at least one member of each of the Fiordland stakeholder groups concerned with the future of the region (commercial and recreational fishers, conservation groups, and Māori). This grass-roots effort was inspired by their shared concern for the future of the region. Although the Guardians self-identified because of their interest in sustainability, each was respected and trusted by other members of the Guardians group (e.g., commercial fishers, recreational fishers, etc.) and the wider regional community. The formation of this group contrasts strikingly with the Lakes Manapouri-Te Anau case, where government-sponsored development activities inspired actions that eventually gave rise to a sustainable trajectory through a change of government and the subsequent establishment of an advisory group, the Lake Guardians.

The Guardians of Fiordland’s Fisheries and Marine Environment received financial support from the central government’s Ministry for the Environment environmental sustainability fund, which was sufficient to retain a part-time experienced facilitator with a background in marine fisheries. This, with support from the central government’s Ministry of Fisheries, allowed assembly of all the relevant historical, ecological, and fisheries literature for the region (GFFME 1999, 2001). Their search for a sustainable solution to which all stakeholders might agree was based on two key ground-rules, which have prevailed through a public submission process and subsequent formalization in legislation (FMG 2010):
“Gifts and gains”: each stakeholder group that was granted opportunities must be prepared to make some sacrifice(s) for the general benefit of the group. This power sharing contributed substantially to goodwill and built trust among groups.

“Fish for a feed, no accumulation”: recreational fishers were to be set limits adequate for their consumption while in the area but not to be refrigerated and taken away in bulk. Quotas for commercial fishers were already in place.

After some eight years of discussion and negotiation, aided by the experienced facilitator, legislation was drafted at the request of central government (Teirney 2003). The Fiordland Marine Management Act of 2005 formally established the Fiordland Marine Guardians and required them to liaise with the relevant government agencies (Conservation, Environment, Fisheries, Biosecurity, and regional government) to establish catch limits for recreational fishers within the fiords, to advise government on resource management activities, and to facilitate and promote the integrated sustainable management of the Fiordland marine area (Fig. 4) through regulation and the collection (monitoring) and dissemination (education/outreach) of information (FMG 2010). The eight Fiordland Marine Guardians were selected by central government from among those of the earlier informal group who had expressed an interest, and who also provided adequate representation among the various stakeholder groups. The Guardians are widely regarded as a model for sustainable resource management in New Zealand and lauded as a leading example of success.
Fig. 4. Map of the Fiordland Marine Area, extending out for 12 nautical miles around the coast of Fiordland, showing location of the ten marine reserves (purple) and four no-anchoring areas (red) that were formalized in special legislation (Fiordland (Te Moana o Atawhenua) Marine Management Act in 2005). Image supplied by the Department of Conservation.
coming from a community-driven (bottom-up) initiative.

This case study illustrates the importance of sense of place at the regional scale and shows that a shift from environmental deterioration or degradation toward sustainability can arise through shared local concerns and initiatives without intervention by government or other external parties. As in the case of Lakes Manapouri and Te Anau, the success of the Fiordland Marine Guardians depended on the active involvement of all major stakeholder groups and on the dedicated engagement of a skilled and respected facilitator, who kept parties at the table in the formative stages of the process when negotiations were often difficult. The process was not easy, requiring a decade from inception to legislation, but the commitment of those directly involved never wavered.

Waikawa Catchment

The Waikawa River is a rain-fed river arising from a relatively small catchment in the Catlins region of southeast New Zealand (Fig. 1). The river has two main branches that extend about 10 km before joining and flowing another 10 km into a tidal estuary that empties into the Foveaux Strait in the far southeast of the South Island (Fig. 1). The Waikawa valley floor was intensively logged for native timber and subsequently cleared for pastoral use by the late 1800s, in a fashion that was typical of much of lowland New Zealand (Young 2004). A further wave of clearcut logging to supply woodchip for the Japanese paper industry cleared many areas of cut-over and uncut forest from the valley sides as late as the 1980s. Nonetheless, unlike most lowland agricultural catchments in New Zealand, the tributaries have remained in primary forest cover.

Fig. 5. Riparian forest vs. exotic pasture. The contrast between mature native riparian forest cover and pasture along a stretch of the upper Waikawa River is stark, and the cumulative catchment-scale effects on ecological values of forest clearance right to the river’s edge, and stock access, are intuitive.
In the Waikawa catchment, the combined effects of logging and intensive pastoral farming practices led to higher sediment loads and lower river water quality, which in turn reduced estuarine health. The estuary is a regionally important nursery for many native fish species and also supports highly productive cockle (Austrovenus stuchburyi) beds. Many residents within the catchment fish locally, either for recreation or subsistence, and fishing is an important cultural and social tradition in the area. Perhaps deterioration in the fishery was noticed by residents (Fig. 5) at an earlier juncture than has occurred elsewhere in New Zealand because this fishery was exploited largely for local consumption and because the knowledge of the local iwi (Māori tribe) provided a historic baseline for the numbers of species such as the endemic lamprey (Geotria australis).

Following the consistent yet infrequent involvement of an able local facilitator over a period of five years, the vast majority of landowners in the catchment joined to develop a catchment-wide restoration plan, with the assistance of a professional ecologist and other stakeholders. This plan aims to restore wetlands and riparian margins; it incorporates the concerns of all stakeholders by including objectives to improve riparian fish habitat and fishing access, protect rare plant communities, reduce flooding and prevent erosion, as well as to reduce sediment and nutrient inputs to the estuary. These plans are currently being implemented. Monitoring of the outcomes is being conducted informally by the farmers, semi-formally by iwi members, and formally by the
Fig. 7. Aerial view of intensive land development with irrigation for dairying in the lower Mackenzie Basin alongside the highway between Omarama and Twizel. Photo provided by Abovehawkesbay.
local government in its state-of-the-environment reporting. Such multi-stakeholder monitoring is recognized within the wider group involved in the restoration plans as a key strength, and the involvement of indigenous groups in sustainable development monitoring is in particular perceived to be of great value (Jollands and Harmsworth 2007).

In this case study, a strong sense of place among all local stakeholders played a critical role in the shift from gradual but persistent degradation toward a more sustainable trajectory. The local iwi have an intimate connection to the land through their cultural history, and the largely non-Māori pastoral farming families have developed a similarly strong connection by virtue of most being multi-generational residents. Of immediate practical concern is river-bank stabilization, yet the choice to use a diversity of slower growing and more costly native trees for reestablishment of riparian woody cover, rather than faster growing (but problematic in the long-term) exotic willows (Salix spp.), provides a clear example of the prioritization of long-term solutions over short-term benefits that is characteristic of a sustainable stewardship relationship. As in the case of the Fiordland Marine Guardians, the initiative was locally generated in response to informal monitoring of a decline in an ecosystem service that was socially and culturally valuable to local residents. Again, a skilled facilitator kept the process on track.

Mackenzie Basin
The Mackenzie Basin in south-central New Zealand is a large semi-arid mid-catchment in the rain shadow of the Southern Alps (Fig. 1). Since the mid-1800s this basin has mainly supported sheep grazing. Stocking densities were extremely high after the land was first settled by Europeans in the mid-1800s but have declined continuously since then. Soil degradation and a semi-arid climate account for current low stocking densities in the region. Farmers often irrigate lowlands for hay to supplement winter grazing (Figs. 6 and 7). Land intensification and dairying in particular, have increased dramatically in New Zealand in the past twenty years (PCE 2004, Basset-Mens et al. 2009), finally penetrating the Mackenzie Basin. This shift increased the demand for irrigation water and nutrient additions and in places caused substantial pollution of freshwaters (Baskaran et al. 2009) and increased threats to native biodiversity (Lee et al. 2010).

In 2009, several farmers applied for, on behalf of a corporation owned by businessmen in Australia and northern New Zealand, a permit to build an industrial-scale dairy operation, in which cows would be housed in barns year-round, a practice similar to industrial stockyards in the U.S. This would be the first such intensive dairy operation in New Zealand and, if the practice became widespread, would likely substantially increase both demands for, and pollution of, water. Considerable opposition to this plan developed from several quarters: (1) farmers in the basin who are concerned about both the water availability for other agricultural uses and the deterioration of waters where they and their forebears swam and fished; (2) the dairy industry, which views New Zealand’s “clean, green” and “100 per cent pure” images as important to its effective promotion and competition on the international market; and (3) the general public, many of whom value the scenery and indigenous biodiversity of the basin, and are proud of New Zealand’s “clean green” reputation. The case was taken to New Zealand’s High Court, and the application that was to initiate such intensive dairying was declined in July 2010, although it remains part of the planning for the companies involved, with future applications likely.

Pasture-based dairying in New Zealand has already led to increased irrigation, large nutrient inputs, and resultant aquatic pollution, causing public concern in many quarters, despite its major export earnings (Baskaran et al. 2009). Under what conditions might farmers consider sustainability an important issue in the semi-arid Mackenzie Basin? What is the threshold of change that might trigger a shift toward or away from sustainable patterns of use here? The Mackenzie Basin example suggests that the development of very productive dairying on permanent pastures elsewhere in New Zealand has not triggered a shift to more sustainable practices in the Mackenzie Basin, but the threat of industrial-scale dairying here might do so. The Mackenzie case also suggests that many local farmers here have an intuitive threshold of environmental deterioration above which they become concerned about sustainability. There is
also an issue of adequate protection for the basin's unique indigenous biodiversity. Remote corporate owners who have no local sense of place or vested interest in long-term sustainability appear to have a different (or perhaps no) threshold for tolerable levels of environmental impacts.

In response to the prospect of an intensive dairy operation, the Mackenzie Basin farmers established a Forum and applied to the central government’s Minister for the Environment for funding to develop an inclusive approach, a “shared vision process”, whereby any community organization with an interest in the issue would be able to nominate their own accountable representative. The Forum determined that the governance would involve a Mackenzie Sustainable Futures Trust that would be chaired by the local Member of Parliament (political representative) and be responsible for funding the collaborative process and managing those funds. It would also contract a chair after consultation with the participants and also arrange such other contractors as may be requested by the Forum. A public meeting in the region, convened and attended by 45 people (plus eight apologies), decided on a “shared vision forum” with the following objectives: identify issues; develop a shared vision and strategy for future management (economic, social, cultural and environmental) of the region and express this vision and strategy in part through a high-level spatial plan and report; and identify preferred mechanisms for their implementation. The parties agreed to enter the collaborative process in good faith and that a landholder’s property rights under existing law would not be affected by the process without their individual consent. There was to be a departure from the majority voting rule whereby a “consensus rule” would apply and all decisions were to be made in a truly collaborative way where all delegates must agree. The Forum was set up with a total of 28 organizations participating in three broad groups: Land use and business interests (15), Community interests—environmental and recreation (7); Community interests—others (6). An “Active Observers” (interested government advisers) group (10) was also accepted, plus an opportunity for other interested observers to attend any meeting. The news media do not attend meetings, and the chairman of the Trust is the only media spokesperson for the meetings. Only full members were to have voting rights. The initial meeting also agreed on membership of the Trust, to include nominees of the three local governments, a representative of the indigenous (“First Nation”—Ngāi Tahu) people, and also a representative of the three main groups. The meeting also selected its Chair from a short list of five based on competence and previous experience. The Chair, who also acts as the facilitator, is from outside the region, while an experienced environmental researcher and adviser, also from outside the region, acts as Project Manager. Funding for one year from early 2011 became available and the system seems to be working well, based on general comments and attendance of one of us (AFM) at one meeting. The exercise now approaches the end of its term and is nearing completion, but the final outcome of this broad-based deliberation is yet to be decided.

**DISCUSSION**

The four New Zealand case studies that we present illustrate potential or actual transitions from a spiral of environmental degradation toward a more sustainable trajectory supported by a stewardship ethic held by local residents. In each case, stewardship emerged locally from a strong sense of place among residents. In each example, the transformation was triggered by public concern, and solutions were locally generated rather than imposed by an external authority or motivated by infusion of funds from an externally based NGO with its own agenda.

The multidimensional nature of sense of place in these four cases was a source of both challenges and opportunities. In each case an inspiring biophysical environment to which people felt strong personal and cultural attachments provided motivation for stewardship (Stedman 2003a, Yung et al. 2003, Ardoin 2006). However, contested views about appropriate solutions surfaced as people entered the planning and implementation phases (Yung et al. 2003, Ardoin 2006). In the three cases where a skilled facilitator kept the focus upon mutually accepted goals (i.e., the importance of a transformation toward sustainability) and process (power-sharing and compromise), the shared dimensions of
sense of place trumped divergent political and socioeconomic dimensions of sense of place. In the Mackenzie Basin, where the strength of local sense of place among stakeholders is still unclear and a facilitated discussion among stakeholder groups is only beginning, the outcome is still uncertain.

Geographic scale and diversity of stakeholder views strongly influence the likelihood that sense of place will motivate stewardship. The planning and implementation process occurred most rapidly and was least contentious in the Waikawa catchment, because the collaboration occurred at the level of actions by individual landowners, each representing him- or herself (Margerum 2008). The small size of the region and relative homogeneity of residents’ concerns and desired outcomes facilitated agreement for appropriate actions. The two Fiordland cases, by contrast, were negotiated at an organizational level (Margerum 2008), requiring each participant to negotiate both with the organization that they represented and with other stakeholder groups. These negotiations were hierarchically nested with important interactions occurring at the levels of actions and information sharing by individuals within a stakeholder group, negotiations among stakeholder groups, and policy formation at the national level. This polycentric process contributed to durable solutions (Folke et al. 2005, Ostrom 2010), because influential individuals and stakeholder groups bought into the final solutions, and the formation of national policies enhanced the integrity of locally derived solutions over the long term (Reed 2008). Collaborations among multiple stakeholder organizations also facilitated social learning, opening the door for similar solutions in other regions with hopefully less complex and contentious negotiations (Schusler et al. 2003).

We suggest that there can be sense of place even at national and larger scales, given the definition of Williams and Stewart (1998): ‘‘the collection of meanings, beliefs, symbols, values, and feelings that individuals and groups associate with a particular locality.’’ With the Fiordland Lakes, national sentiment certainly reflected symbols, values, and feelings, although it is difficult to assess meanings and beliefs retrospectively. The important point is that national concern for degradation of these national park lakes motivated actions that led to a transformation toward sustainability.

The relative structural simplicity of government and favorable economic conditions that characterize New Zealand may have contributed to the success of transformation toward stewardship in our four case studies. The most rapid and least complex transition occurred in the Waikawa catchment where decisions were made by individual landowners within a single catchment. In addition, New Zealand has a simpler govern-

**Table 1. Design principles for managing common-pool resources and for transforming management of these resources to a more sustainable trajectory.**

| Management of a commons† | Transformation to a sustainable trajectory |
|--------------------------|--------------------------------------------|
| Clearly defined boundaries within which resources are harvested | Commitment to long-term sustainability of the place or region (sense of place) |
| Collective choice arrangements in which key stakeholders develop and modify rules | (1) Collective engagement of all key stakeholders and (2) willingness to compromise for the collective good (‘‘gifts and gains’’) |
| Proportional equivalence between benefits and costs of harvest | Priority of long-term solutions over short-term benefits (near-zero discount for long-term benefits) |
| Rights to organize and manage are recognized by government and other parties | Rights to organize and manage are recognized by government and other parties |
| Monitoring that informs users whether harvesting rules are being obeyed | (1) Consensus on long-term sustainability goals (what do you want to sustain?) |
| (2) Monitoring that informs users of progress toward or away from these goals | Opportunities to renegotiate sustainability goals to allow adaptation to changing conditions |
| Graduated sanctions that make penalties proportional to the offense, so individuals and the social system as a whole can respond to changes and learn from experience | Facilitator or leader, who is skilled in conflict resolution and keeps the group focused on appropriate compromises and sustainability goals |
| Conflict-resolution mechanisms that provide easy access to users to solve disputes | |

† Ostrom 1990, Dietz et al. 2003.
mental structure than many larger countries. Its central government sets general policies and makes nationally relevant decisions, but many of the specific decisions are made by relatively autonomous regional authorities. Nonetheless, transformation toward stewardship has occurred at many scales and in many nations, as noted below. Transformation strategies are most likely to be successful when designed with an awareness of the structural context and politics of decision making (Yung et al. 2003).

These case studies and the relevant literature suggest a set of guiding principles and recommendations that identify conditions facilitating local transformation to more sustainable trajectories (Table 1). These design principles for sustainability transformation build on principles developed previously for steady-state management of common pool resources (Ostrom 1990, Dietz et al. 2003), multi-stakeholder collaborations that foster social learning (Schusler et al. 2003, Margerum 2008), guidelines for successful public participation (Reed 2008), and social-ecological transformations (Olsson et al. 2006, Chapin et al. 2010).

**Sense of place** is a critical pre-condition for stewardship because, without it, people have no motivation for enhancing ecosystem resilience and human well-being of the region they frequent (Patterson and Williams 2005). A strong sense of place characterized all four of our case studies, ranging in scale from local catchments (Waikawa) to the nation of New Zealand (Fiordland’s iconic Manapouri-Te Anau Lakes). Sense of place is a key foundation for successful management of the commons (Ostrom 1990, Agrawal et al. 2008) and for stewardship transformations that have occurred in Swedish wetlands and western U.S. rangelands (local scale) (Olsson et al. 2004, Sayre 2005) and in the Great Barrier Reef in Australia and old-growth forests of the western U.S. (regional to national scales) (Olsson et al. 2008, Swanson and Chapin 2009). A strong sense of place motivates people to negotiate differences in the political and socioeconomic dimensions of sense of place and to invest the substantial effort (transaction costs) needed to explore and negotiate sustainable solutions (Koontz and Johnson 2004). Sense of place also increases the likelihood of **prioritizing long-term solutions over short-term benefits** because people are less likely to strongly discount the value of long-term benefits (Heal 2000). Sense of place can be enhanced by shared experiences, stories, or education that strengthens personal and cultural attachment to place (Cruikshank 1998, Stedman 2003b, Louv 2005, Ardoin 2006) or by shaping the trajectory of changes in directions that are consistent with stakeholder values (Chapin et al. 2011b), as in rapidly urbanizing landscapes. Perceived impacts or trends toward degradation in valued places often motivate efforts to transform toward sustainability. There are, however, often people that care about places for their potential value for economic development or resource extraction, so sense of place does not guarantee a commitment to sustainability (Cheng et al. 2003, Yung et al. 2003, Ardoin 2006). **Recommendation:** Identify broadly shared dimensions of sense of place with potential to motivate stewardship, and strengthen these through shared experiences, stories, or education that strengthens and shares personal and cultural attachment to place.

**Collective engagement of all key stakeholders and willingness to share power and compromise** for the common good facilitates a commitment to stewardship and increases the likelihood of robust and durable solutions. Solutions that are imposed from outside or that exclude key groups are more likely to be undermined when political power shifts or unforeseen setbacks occur (Koontz and Johnson 2004, Robbins 2004, Reed 2008), as observed in the establishment of African wildlife parks that excluded local people who traditionally used these lands (Berkes et al. 2009). On the other hand, broadening participation to include stakeholder groups with opposing agendas or tangential goals complicates the negotiation of solutions. Groups with broad stakeholder representation are particularly effective in identifying and prioritizing issues, developing plans, and moving toward restoration (Koontz and Johnson 2004), i.e., the accomplishments most needed in triggering a shift toward stewardship. **Recommendation:** Engage those stakeholder groups that have a commitment to the place or have the power to influence the outcome of key decisions governing sustainability.

**Democratic rights to organize and manage** (and the informal capacity to do so) are an important precondition to any collective effort to sustain
valued resources over the long term (Dietz et al. 2003). The lack of these rights may trigger demands for more sustainable solutions. The agreement between government and industry, without public input, to allow large, and predictably highly damaging fluctuations in the water levels for Lakes Manapouri and Te Anau, for example, triggered a chain of events that created the opportunity of local stakeholders to devise a modification to achieve a sustainable solution. Recommendation: Foster policies and capacity building in situations where local people have limited rights or capacity to manage the places that they value.

Negotiated consensus on long-term sustainability goals is one of the greatest challenges in transformation toward stewardship, because stakeholders often hold different values based on different ideologies or have vested interest in the status quo (Stedman 2003b, Yung et al. 2003). In the case studies we examined, the negotiation process either involved a small set of stakeholders with relatively homogeneous goals (Waikawa) or was a challenging and time-consuming process that succeeded either because of the commitment of all stakeholders to a sustainable solution (both Fiordland cases), or a mix of governmental requirements, economic incentives, and stakeholder commitments that required a mutually acceptable compromise solution (Lakes Manapouri-Te Anau). The most striking feature of the Lakes Manapouri-Te Anau outcome was that all groups accepted the final, scientifically based solution, although it entailed compromises by each group. Recommendation: We return below to processes that facilitate consensus building.

Once a consensus for a transition toward sustainability is reached, formal and informal monitoring, both social and environmental, is important to document progress toward or away from stewardship goals (e.g., both Fiordland cases and the Waikawa case). Recommendation: Engage in the monitoring efforts local stakeholders who are committed to solutions, and seek government funding that guarantees long-term support for the monitoring.

When monitoring suggests failure of management to achieve these goals, there must be opportunity to renegotiate the goals or adapt to changing conditions. Opportunities to renegotiate and adapt are an important feature under conditions of rapid or directional change (Chapin et al. 2010, Adger et al. 2011). Recommendation: Allow sufficient flexibility in governance to adjust practices when current policies no longer support long-term goals (adaptive management and multiple loop learning) (Armitage et al. 2007).

The likelihood of transformation toward sustainability is sensitive to political structure and availability of economic resources, either of which may limit the potential to apply these design principles. Authoritarian governments, for example, may constrain the rights of people to organize and manage for their views of stewardship. Economic hardships necessitate the meeting of immediate needs for survival and well-being, despite the longer-term implications for sustainability. Nonetheless, many Indigenous Peoples with limited income have traditions of respect for the land (including the associated fresh waters) and sea that foster sustainability and stewardship (Berkes 2008), and high-technology land uses often degrade the surrounding landscape, suggesting a complex, culturally mediated relationship between income and stewardship.

The global demographic transition from rural areas to cities, where half of Earth’s population now lives and votes, raises important stewardship issues. In addition, people are migrating at unprecedented rates to new places, where they have a short history of interaction with the landscapes they inhabit. The rates at which sense of place develops or deteriorates, when people move, are highly variable. Research suggests that sense of place can develop and stabilize within a couple of years in some urban situations (Lewicka 2011), whereas some rural residents may consider multiple decades or even generations as a precondition for belonging to a place (Yung et al. 2003). We have observed that many immigrants to New Zealand, especially from Europe, soon become involved and then committed to promoting conservation issues here, mainly because of the satisfying contrast in the extent of formal protection of natural areas—some 34% of the country’s land area is reserved and managed by the Department of Conservation. Experiential learning, social networks, and outreach are likely to enhance sense of place (Ardoin
2006), but the conditions that predispose or facilitate a strong sense of place are not well known.

All of the successful transformations toward a stewardship trajectory involved a skilled facilitator, who earned the confidence of all stakeholders through demonstration of an understanding of the spectrum of viewpoints and concerns; invested passion, energy, and persistence in the outcome; was viewed by all parties as someone who was both trustworthy and impartial; prioritized generally acceptable and equitable compromise through consensus above their own personal or group agenda; and recognized when consensus could be destructive in practice and hard decisions had to be made (Huxham and Vangen 2000).

When design features suggest that a transformation toward stewardship is plausible, the process by which it is negotiated strongly influences the outcome (Young 2002). There is no recipe for certain success because the probabilities and transformation pathways are context-specific (Folke et al. 2009). The following guidelines foster consensus-building (Ostrom 1990, Jollands and Harmsworth 2007, Agrawal et al. 2008, Olsson et al. 2008, Pinkerton 2009, Chapin et al. 2010):

- Recognition and acceptance by all stakeholders of multiple cultural, social, and environmental contexts and values and of the interdependence of people and the rest of nature
- Willingness to understand and communicate with all relevant stakeholders, including policy makers
- Creation of a safe environment for people to express their reasoning and beliefs, and to relate to one another as people rather than bearers of ideologies
- Ability to listen and communicate patiently, respectfully, and non-confrontationally with people of disparate viewpoints
- Respect for both traditional and scientific ways of knowing and evaluating ecosystems
- Valuing the gathering of information and seeking of knowledge at relevant scales (monitoring and education)
- Ability to clearly articulate the issues at hand and to synthesize and constructively summarize a diversity of views in an accessible and balanced way
- Willingness to compromise, when necessary, for the common good (“gifts and gains”)
- Ability to focus on solutions, while being pragmatic about the difficulties and challenges that may make solutions challenging
- Planning with flexible guidelines for operation and adaptation
- Identifying funding that is tied to achieving a desired and durable outcome rather than the goals of a subset of stakeholders.

CONCLUSION

One of the most urgent needs facing society today is to transform from trajectories of cultural, social, and/or environmental degradation toward more sustainable pathways. Degradation at the global scale is primarily the aggregate result of local or regional events and processes and can therefore be substantially reduced by local- and regional-scale transformation to more sustainable practices. We conclude that local and regional transformation is feasible and that certain design features and guidelines strongly influence the likelihood and successful outcome of these transformations. As these principles are refined and improved, they can and should provide a framework for fostering favorable design principles and thereby increase the frequency and extent of transformations needed to achieve combined cultural, social, and environmental sustainability.

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