Armitage, D., C. Béné, A. T. Charles, D. Johnson, and E. H. Allison. 2012. The interplay of well-being and resilience in applying a social-ecological perspective. *Ecology and Society* **17**(4): 15. http://dx.doi.org/10.5751/ES-04940-170415

Synthesis

The Interplay of Well-being and Resilience in Applying a Social-Ecological Perspective

Derek Armitage [1], Chris Béné [2], Anthony T. Charles [3], Derek Johnson [4] and Edward H. Allison [5]

ABSTRACT. Innovative combinations of social and ecological theory are required to deal with complexity and change in human-ecological systems. We examined the interplay and complementarities that emerge by linking resilience and social well-being approaches. First, we reflected on the limitations of applying ecological resilience concepts to social systems from the perspective of social theory, and particularly, the concept of well-being. Second, we examined the interplay of resilience and well-being concepts in fostering a social-ecological perspective that promises more appropriate management and policy actions. We examined five key points of interplay: (1) the limits of optimization thinking (e.g., maximum sustainable yield), (2) the role of human agency and values, (3) understandings of scale, (4) insights on "controlling variables," and (5) perspectives on thresholds and boundaries. Based on this synthesis, we offer insights to move incrementally towards interdisciplinary research and governance for complex social-ecological systems.

Key Words: *adaptation; agency; governance; integration; interdisciplinarity; policy; sustainability; thresholds; transdisciplinarity; uncertainty*

INTRODUCTION

The premise of this paper is that "social-ecological resilience is about people and nature as interdependent systems" (Folke et al. 2010:2). In resilience thinking, however, the ecological dimensions have been more influential and better theorized than the social ones. Recent syntheses of resilience, vulnerability, and political ecology (Nelson et al. 2007, Leach 2008, Miller et al. 2010, Turner 2010) emphasize the social dimensions of resilience and help in part to redress this imbalance. These and other reviews point to the importance of power and the role of human agency (Davidson 2010), the manner in which different actors construct and frame trade-offs associated with specific strategies to sustain ecosystem services and meet livelihood needs (Campbell et al. 2010), and the challenge of articulating desirable pathways of change given the influence of complex relational networks (Crona and Bodin 2010). While progress has been made on these themes, key challenges must be addressed to unpack the social dimensions of resilience in the context of specific places and problems, and to move towards interdisciplinary understanding of social-ecological systems (Adger 2000, Armitage 2008, Davidson 2010).

The objectives of this paper are two-fold. First, we reflect on the limitations of applying ecological resilience concepts to social systems from the perspective of social theory, and particularly, in relation to the concept of well-being (White 2009, Brown and Westaway 2011, Coulthard et al. 2011). Well-being is at once an objective of development (e.g., MA 2005) and an approach to understanding experiences and perceptions of people in their effort to "live well" (cf. Gough and McGregor 2007, Copestake 2008). Although resilience thinking is predicated upon a social-ecological systems view, an entrée into the "social" is required that moves beyond material assets, economic incentives, and individual rational behavior. In this regard, the social conception of well-being offers a holistic lens to understand the relational and subjective dimensions of the social world (along with the material). A social conception of well-being thus has the potential to enrich our understanding of social-ecological systems.

Our choice to use a social conception of well-being is intentional. This conception of well-being has evolved from, but is distinct in relation to, several related approaches, including the livelihoods approach and ideas from human psycho-social development. As Deneulin and McGregor (2010) elaborate, a social conception of well-being involves more than an individualistic notion of what it means to live well because it puts emphasis on relational and collective processes (see also Coulthard et al. 2011). The concept also goes beyond the material (assets) and basic needs conception as found in the livelihoods and human development literature, and reflects the importance of social, psychological, and cultural needs required to thrive (McGregor et al. 2009, White 2010). In sum, a social conception of well-being synthesizes and clarifies the contributions from diverse sources of development thinking and social theory (Deneulin and McGregor 2010). In exploring the potential of this well-being framework with reference to resilience, however, some of the limitations of that social conception of well-being are also revealed. In particular, we highlight the value of weaving social well-being together with a more ecologically centered and explicitly dynamic perspective.

[1]University of Waterloo, [2]IDS Sussex, [3]Saint Mary's University, [4]University of Manitoba, [5]The WorldFish Center and the University of East Anglia

Table 1. Resilience concepts from the more narrow interpretation to the broader social–ecological perspective.

Resilience concepts	Characteristics	Focus on	Content
Engineering resilience	Return time, efficiency	Recovery, constancy	Vicinity of a stable equilibrium
Ecological/ecosystem resilience and social resilience	Buffer capacity, withstand shock, maintain function	Persistence, robustness	Multiple equilibria, stability landscapes
Social-ecological resilience	Interplay of disturbance and reorganization, sustaining and developing	Adaptive capacity transformability, learning, innovation	Integrated system feedback, cross-scale dynamic interactions

Adapted from Folke (2006); Badjeck (2010, *personal communication*)

Second, we seek to examine the interplay of resilience and well-being concepts in fostering a social-ecological perspective that, we hope, can be used for more appropriate management and policy actions. Resilience and well-being concepts are increasingly being discussed in policy arenas (for example, Folke et al. 2002, Stiglitz et al. 2008, Otto-Zimmerman 2010, Andor et al. 2011) and are being considered as a basis for new policy frameworks in an growing number of countries (e.g., UK, Canada, France, Sweden), despite the challenges of doing so. In this context, we examine five key points of interplay: (1) the challenge to optimization thinking (e.g., pursuit of maximum sustainable yield) as revealed in both concepts, (2) the potential of the social conception of well-being to illustrate in a more systematic way the role of human agency and values, and thereby to provide a way to better understand the normative context for resilience thinking, (3) the different but productive ways in which scale can be considered through social and ecological frames, (4) the emergent insights on "controlling variables" in a social-ecological system that are provided by combining the well-being and resilience perspectives, and (5) the issue of thresholds and boundaries considered from the integration of both concepts. While resilience and the well-being concept used in this article have important differences (as reflected in their different conceptual starting points), our work will show that they also intersect in ways that are valuable in theorizing and more effectively applying a social-ecological perspective for governance in complex social-ecological systems, such as coastal-marine environments, water resources, or agricultural landscapes. From this synthesis we will propose four insights to move towards interdisciplinary research and governance for complex social-ecological systems.

Linking resilience with social well-being represents an attempt to bridge divisions rooted in disciplinary and epistemological traditions, namely the historically structural-functionalist traditions of systems thinking with that of agency that underpins well-being theory. Our essay is exploratory, and by identifying the ways in which the two theoretical starting points can reinforce each other, we seek to add value to current debates (e.g., Brand and Jax 2007, Leach 2008, Bottom et al. 2009, Crane 2010, Brown and Westaway 2011) rather than propose an alternative framework. We believe strongly that interdisciplinary engagement with theory is required to meet the challenges of global environmental change. Resilience and the well-being concept we use encompass a richness of perspectives, and their hybrid application provides a constructive foundation upon which to (1) better understand linked systems of people and nature, and (2) frame the learning processes and knowledge sharing required among resource users, researchers, and practitioners in ways that can contribute transdisciplinary understandings and novel options for sustainability (sensu Hirsch Hadorn et al. 2006; Pohl 2010).

OVERVIEW OF RESILIENCE AND WELL-BEING CONCEPTS

Resilience thinking

In ecological systems, the concept of resilience emerged in the early 1970s as a challenge to stability thinking (Holling 1973). Resilience thinking has since evolved from this initial narrow definition (the ability to bounce back or return to equilibrium following disturbance, or "engineering resilience") into a more elaborated theory in which adaptability and transformability are key ingredients (Table 1) (Folke et al. 2010). Adaptability refers to the capacity of a system (or parts of a system) to learn and adjust within a range of variability, or within a stability domain. Transformability is the capacity to evolve into a fundamentally new system when existing conditions are untenable (Walker et al. 2004, Folke et al. 2010). In this regard, transformability (like resilience; Carpenter et al. 2001) has a strong normative component (i.e., untenable as decided by whom?).

In systems linking people and nature, resilience now refers to the amount of change the system can undergo and still retain its function and structure; the degree to which the system is capable of self-organization; and the ability to build and increase the capacity for learning, adapting, and where necessary, transforming (Berkes et al. 2003, Folke 2006). We make a distinction between social-ecological resilience and a larger body of research in social and psychological sciences that focuses on the resilience of individuals (e.g., a child) to recover or bounce back from stress, shocks, disorder, or poverty (e.g., Glantz and Thompson 1999).

In social-ecological systems, resilience is determined by the dynamic interactions of slowly changing (e.g., climate, nutrients, traditions) and fast changing (e.g., markets, weather variation, fashions) variables (Folke 2006). Ignoring or resisting change may reduce resilience and in fact increase vulnerability of a system (e.g., a forest) to change when it does occur (e.g., through fire, pest outbreak). Feedback loops between social and ecological systems are thought to affect the scope, intensity, and nature of change, and thus, linked systems of humans and nature are best viewed as complex systems adapting through continuous change. Efforts to foster resilience in social-ecological systems depend on identifying and managing "controlling" variables that determine the dynamics of the system, identifying the shocks or processes that may destabilize these variables, and identifying the points at which thresholds are reached (Walker and Salt 2006).

The choice of scale is particularly important when considering resilience, adaptability, and transformability. Scale affects the identification of systems variables and processes, and influences perceptions and choices about the desirability of system properties or configurations. A primary (and normative) goal for system actors (resource users, managers) is typically to prevent social-ecological systems from moving towards, or further into, undesirable system state configurations or conditions that meet neither ecological nor socioeconomic needs. Most management settings, however, must consider multiple scales to deal with seasonal and intra-annual fluctuations in resources and exploitation patterns, and account for exogenous and endogenous drivers of change or shocks. In practical terms, an understanding of resilience (and adaptability and transformability) can enable system actors to better evaluate the likelihood and desirability of shifts or transitions among different system configurations (Peterson 2000, Charles 2004, Garcia and Charles 2008).

Resilience thinking provides a bridge between natural and social sciences by using the same terminology when referring to social and ecological systems. Transferring resilience concepts from the ecological sciences to social systems, however, may fail to recognize that essential differences in behavior, processes, and structures exist between social systems and ecological systems (Adger 2000). Moreover, social dimensions of resilience are often reflected mainly in material terms: resource users, governance structures, physical infrastructure, and institutions (rules, networks) (Anderies et al. 2004, Crane 2010). Further reflection on how to better incorporate and apply social theory within resilience thinking is required, particularly when resilience thinking is employed as a way to understand social change, evaluate social-ecological trajectories, foster social mobilization, and encourage learning, adaptation, and transformation (Nelson et al. 2007, Folke et al. 2010), all of which move us beyond the material.

A social conception of well-being

Well-being has origins in development economics and social psychology. In development economics, well-being reflects a desire to move beyond narrow utility-based assumptions about individual rationality and mono-dimensional poverty indicators, such as the poverty line (e.g., Alkire 2002), and to go beyond the concept of quality of life (Costanza et al. 2007). In social psychology, well-being reflects a shift from treating psychological problems to examining the conditions for human flourishing (Ryan and Deci 2001, Gasper 2004). Well-being is gaining increased traction in public policy (e.g., in the UK) and in international environment and development discourse (e.g., Stiglitz et al. 2008, Diener et al. 2009). The synthesis report of the Millennium Ecosystem Assessment (MA 2005), *Ecosystems and Human Well-Being: Current State and Trends*, is one of the first efforts to substantially incorporate considerations of human well-being into how ecosystem dynamics are comprehended.

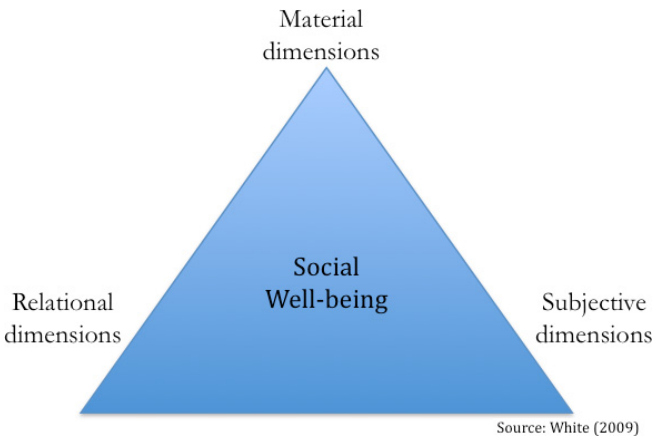
In the MA (2005) approach, human well-being is defined as an aggregation of five components: basic material needs, health, security, good social relations, and freedom of choice and actions (with the latter component being seen as an emergent property of the other components). However, this view is one where well-being is framed largely as a desired target or an outcome of the intersection of direct and indirect drivers of change on ecosystem services (as illustrated by the direction of the arrows in Figure 1.1 on p. 28 of the MA report). Just as importantly, well-being, as proposed in this framework, also largely reflects an individualistic and basic needs orientation.

Rather than the MA definition of well-being, we use the "social conception of well-being" developed by the Research Group on Well-being in Developing Countries (WeD) (Gough and McGregor 2007) for its promise in dynamically linking human interests and ecological systems. Building upon the WeD work, we define social well-being as "A state of being with others and the natural environment that arises where human needs are met, where individuals and groups can act meaningfully to pursue their goals, and where they are satisfied with their way of life" (adapted from McGregor 2008).

A social conception of well-being nests the individualistic and basic needs aspects of well-being within the wider social-

psychological and cultural needs required to live well (Deneulin and McGregor 2010, Coulthard et al. 2011). This definition recognizes human well-being as an outcome and a process, in which three dimensions are taken into account, reflecting both the development and social psychology perspectives (Gough et al. 2007): (1) a material dimension, (2) a relational dimension, and (3) a subjective dimension (Fig. 1). This multi-dimensional perspective is consistent with Sen's (1999) capabilities approach (and sustainable livelihoods approach) and the recognition that development cannot be captured solely in narrow income or commodity ownership terms. Rather, development is seen as the ongoing effort to establish and deepen a wide set of entitlements, including most broadly, the freedom of individuals to make choices based on what they value (Sen 1999).

Fig. 1. Conceptual view of social well-being.



In that context, the material component of well-being may encompass physical requirements of life, such as income, wealth, assets, or physical health, and the ecosystem services provided by the physical environment. The relational component of well-being emphasizes social interactions, collective actions, and the relationships involved in the generation and maintenance of social, political, and cultural identities. These include relations to the state and to formal and informal societal structures which determine the scope for personal action and influence in the community. Lastly, the subjective dimension of well-being incorporates cultural values, norms, and belief systems, and importantly, accounts for notions of self; individual and shared hopes, fears, and aspirations; expressed levels of satisfaction or dissatisfaction; trust; and confidence (White 2009).

In contrast to the strong scalar perspective in resilience thinking, scale is not explicitly addressed as such in the social conception of well-being. However, the material, relational, and subjective factors and processes influence individual and collective behaviors, and thus, the potential trade-offs implicit in achieving well-being at different scales are recognized. In sum, a social conception of well-being is recognized as a scale-sensitive and emergent property of the interplay of the objective (e.g., people's circumstances shaped by material and relational dimensions) and the subjective (e.g., values and perceptions) dimensions of agency and capabilities (Coulthard 2012).

The three dimensions (material, relational, subjective) are particularly useful in understanding ways in which the different facets of a "life well lived" come together. A social conception of well-being therefore extends the MA (2005) well-being idea in an important direction. Under this approach, well-being is not perceived just as a targeted or desired state of being; it is also a framework for the analysis of human thriving, and the concept helps unpack some of the main elements that drive people's choices and behavior. First, its material dimension accommodates the fact that physical and financial assets are entitlements essential to well-being. Second, the concept recognizes that relational interactions between people (e.g., reputation, sense of being part of a community, positive and negative reciprocity) are also critical elements that determine what people choose (or are "forced") to do. It explains, for instance, why some fishers continue to fish certain species simply to maintain their reputation as "good fishers" even if a so-called "rational" economic behavior would involve a shift to other species (Béné and Tewfik 2001). Third, the concept emphasizes how subjective dimensions (e.g., sense of happiness, contentment with a "way of life") play a central role in people's day-to-day, as well as longer term, decisions. The latter is reflected in the literature showing, for example, that many fishers choose to be, or to stay, fishers not for financial reasons but for multi-faceted reasons that lead to job satisfaction (Pollnac et al. 2001, Pollnac and Poggie 2008:199). Overall, a social conception of well-being and the three dimensions of well-being provide a helpful framework to articulate and understand people's motivation and behavior both in short and longer terms.

Finally, an emphasis on the social, as opposed to the ecological, aspect of well-being ("well-being is a state of being with others") derives from the empirical recognition that what we need as individuals and communities, our capacity for meaningful action, and what satisfies us, are ultimately influenced by our relationships with others (Sen 1999). In this sense, a social conception of well-being recognizes the variability, multidimensionality, and dynamic nature of human development and quality of life. The well-being concept we use (much like resilience) is dynamic and a moving target subject to changing conditions and personal capacities.

INTERPLAY OF RESILIENCE AND WELL-BEING CONCEPTS

A basis for integrating social-ecological thinking comes from ideas of complexity, uncertainty, and change in ecological and

Table 2. Optimization and resilience thinking.

	Optimization for conservation	Resilience thinking
Strengths (inherent)	Recognizes resource scarcity Encourages transparency in resource allocation	Recognizes system complexity Recognizes interdependence of social and biophysical systems
Strengths (in practice)	Can provide specific answers to a well-defined problem Fits well with how business and governments operate	Encourages anticipation of undesirable surprises or thresholds Encourages reflection on how a system works
Weaknesses (inherent)	Sensitive to accuracy of underlying assumptions and system model	Potentially difficult to apply to systems without identifiable alternate states
Weaknesses (in practice)	Targets or budget constraints are often informed by politics rather than by an in-depth understanding of underlying system dynamics	Reliant on tools from other disciplines to be operational to inform policy
	The term "optimal" can sound absolute to policy-makers and the general public	The term "resilience" can appear vague to policy-makers and the general public

Adapted from Fischer et al. (2009)

social theory (Folke et al. 2010). The three dimensions of social well-being provide an approach to integrating a rich understanding of the complexity of the social world into social-ecological systems thinking, and to communicating the complexity of the "social" more effectively. We examine five points of interplay between well-being and resilience and offer an assessment on how combining the two concepts offers one possible pathway towards applying a social-ecological perspective. Point one begins by highlighting the foundational complementarity of the two perspectives in their approach to optimality. Point two explores an area where intersection with a social conception of well-being promises to address an identified deficiency in resilience thinking. Points three to five are central contributions of resilience thinking that are strengthened through their association with well-being.

Challenge to optimization thinking

Resilience thinking draws attention to the importance of change (gradual, rapid, or unexpected), and the role of feedback and multiple system states (Gunderson 2000). This view has challenged the notion of optimization as applied, for example, in the maximum sustainable yield approach to resource management. Empirical studies have demonstrated how system characteristics and high levels of uncertainty challenge sector-specific management approaches as conventionally adopted in forestry or fisheries, and make resource management framed in terms of efficiency and utility maximization problematic and risky (Holling and Meffe 1998, Béné et al. 2010). Resilience thinking correspondingly highlights the importance of diversity and redundancy in buffering disturbance and the effects of interactions across scales (Gunderson and Holling 2002).

Applied to management, resilience thinking poses a challenge to conventional command and control approaches that seek to constrain the role of disturbance regimes in self-organizing systems or optimize a part of a system in an effort to maximize utility (Walker and Salt 2006, Scheffer 2009, Walker et al. 2010). Fischer et al. (2009) show that optimization approaches can be advantageous, for example, in terms of improving transparency in resource allocation and providing clarity among trade-offs where system parameters are well established and systems are relatively simple (Table 2). However, as system complexity increases, optimization approaches then increasingly tend to rely on "black box" models, which become less and less transparent. In this context, resilience thinking provides an important counterpoint to optimization thinking by highlighting the uncertainty and interdependence of social-ecological systems and the possibility of threshold effects and undesirable (ecological and social) "surprises" across scales.

As Fischer et al. (2009) note, it is particularly challenging to assess resilience-optimization trade-offs involving "social issues". This challenge provides a useful link to the potential role of the social conception of well-being as we use it here: it challenges conventional economic policy narratives that position individuals as pure or rational economic actors and/or address a wide range of social-ecological contexts with a single policy orientation (McGregor 2004). In a conventional view, optimal outcomes in relation to natural resource

management are often measured largely on the basis of rent maximization and material economic gain (e.g., Clark 1990), and using criteria that fit with a broader narrative of global capitalism—competition for economic resources and a search for new sources of supply and market opportunity (e.g., Collier 2010). These views tend to aggregate social contexts, while "industrial" resource extraction exhibits a normative attention to single-objective analyses in which economic efficiency and export earnings are privileged (Collier and Venables 2010). In fisheries, for instance, Charles (1988) points to a long history of narratives framed around several assumptions, including (1) rent maximization is the most appropriate objective, and (2) the calculus of human factors is largely about the minimization of labor costs (see also Béné et al. [2010] for a recent discussion on these issues). These assumptions unduly constrain the policy space of fisheries governance by excluding other highly valued priorities.

A social conception of well-being provides a helpful tool to recognize the limitations of policy and management that are too narrowly focused on only limited criteria and do not adequately reflect trade-offs. This may include the reconsideration of material well-being when subjective values of a fishery may be just as or more important in some communities (Coulthard et al. 2011). In this sense, social well-being is consistent with the "multi-objective" perspective that more conventional socioeconomic analysis proposes, and in which a broader set of social concerns are recognized, such as food security and employment (Charles 2001). Still, the relational and subjective dimensions of the social world remain largely outside the calculus of trade-offs made by policy-makers in a conventional socioeconomic analysis (see McGoodwin 2001, and Pollnac and Poggie 2008 in a fishery context).

In sum, both resilience and well-being as defined here can be used as analytical perspectives from which to frame the limits of models, instruments, or strategies premised on an optimization narrative. Specifically, resilience and well-being approaches offer foundations for an intertransdisciplinary perspective that articulates more clearly how optimal outcomes at one scale or in regards to one variable may diminish overall effectiveness of an intervention or lead to unintended outcomes (i.e., in resilience or well-being) at another scale or for another variable. Understanding and dealing with trade-offs has always been a major part of research on, and governance of, social-ecological systems (for example, Brown et al. 2001, Maness 2007), but there remains a need to better integrate the social and the ecological systems dimensions of trade-offs, which have so far too often been decoupled (Campbell et al. 2010). In that context, resilience and well-being can together point to a set of social-ecological variables that can be used to assess and compare those trade-offs, including (1) those that involve critical ecosystem services and their feedbacks across scales, and (2) those that involve the material, relational, and subjective dimensions of the social world linked with an ecological context.

Agency, values, and normative considerations

Critiques of resilience thinking have highlighted an inattention to "power" (Nadasdy 2007, Hornborg 2009), and more specifically, the need to better articulate the role of values and the normative dimension of resilience. A critical feature of resilience, which is often not acknowledged, is that resilience can be "a good" or "a bad", and for some, thinking about resilience in the absence of political-economic or cultural theory poses an intractable conceptual challenge (Armitage and Johnson 2006, Davidson 2010, Duit et al. 2010). For instance, understanding resilience of a particular system configuration does not necessarily indicate if and how a system is in a socially preferred ecological or socioeconomic state. The resilience of a particular resource to disturbance (specified resilience) may be desirable but may lead to a loss of general resilience (resilience of the whole social-ecological system in which the resource is but one part) (Folke et al. 2010, Miller et al. 2010).

These conceptual challenges raise several key issues: (1) from a policy perspective, the discourse is often about "building resilience," "increasing resilience," or "maintaining resilience," thus implicitly (or even explicitly) implying that resilience is a "good" thing; (2) without enough attention paid to the role of human values in shaping the historical and future trajectories of social-ecological systems and in specifying desirable resilience, there remains an uneasy fit with the social world; and (3) values are reflected fundamentally in human agency or the ability of people to act consciously. Our intent here, however, is not to engage with wider debates about the utility of resilience, per se, but rather to highlight how a social conception of well-being can support a richer engagement with values, agency (Brown and Westaway 2011, Coulthard 2012), and the normative dimension of resilience thinking, historically dominated by ecological theory.

Adger et al. (2002:358) defined social resilience as "the ability of communities to absorb external changes and stresses while maintaining the sustainability of their livelihoods." Despite theoretical advances in the field (Gunderson and Holling 2002), the utility of the social resilience concept for practical management has remained so far largely underdeveloped (Olsson et al. 2004, Walker and Meyers 2004). Part of the reason for this is that resilience is complex, context-specific, and highly dynamic—all characteristics that make it hard to operationalize and measure through simple proxies (Walker et al. 2002, Kallstrom and Ljung 2005). Carpenter and Brock (2004) noted for instance, "many indicators, in many dimensions, are necessary to adequately represent resilience."

Of particular difficulty is the question of "resilience of what, for whom" (Robards and Greenberg 2007; Leach 2008).

Marshall and Marshall (2007) illustrate this point through the example of fishers who may decide that the ecological, social, or economic conditions within the existing system have become untenable and that they would be better off leaving the sector. In that case, they may still be demonstrating resilient properties at a wider, societal level, while not demonstrating resilience within the fishery system. At the same time, other fishers may remain within the fishery not because they are resilient but because they lack other employment opportunities. Such fishers are nonresilient and have entered into an undesirable state, even though they appear to be maintaining their structure and function within the resource extractive industry. These examples emphasize the conceptual difficulties associated with the term "social resilience," coupled with an examination of the ecological components of a system. The examples also illustrate the importance of system definition and the scale being considered (e.g., in the example above, it can be about individuals or subsets of people in a community or a wider system).

A social conception of well-being that stresses the importance of relational (the interactions between people) and subjective (values) dimensions may bring a new perspective to this debate, while helping to highlight more explicitly some of the trade-offs inherent in the question of the "resilience of what, for whom." This is consistent with recent arguments for greater attention to the cultural foundations of resilience where the subjective and normative experiences of people can be sustained through change (Doubleday 2007, Leach 2008, Crane 2010). For example, a well-being lens has been used to help operationalize the "social" in social-ecological resilience. Marschke and Berkes (2006) examined the "social" dimension of the social-ecological resilience in a Cambodian context through a link to the livelihood approach, and by drawing on Chambers and Conway (1992:6), who defined a sustainable livelihood as one that "can cope with and recover from stresses and shocks, maintain or enhance its capabilities, assets and entitlements, while not undermining the natural resource base." However, rather than analyzing a community's or household's resilience from an outsider's perspective, Marschke and Berkes (2006) explored how community members in the Tonle Sap region of Cambodia assessed their own resilience by asking individuals about their "well-being" and the sustainability of their livelihoods. Their analysis suggests that although community members recognized that livelihoods can be enhanced by having money and diverse income-generating choices, villagers also highlighted that their notions of well-being are not restricted to economic opportunities. The multiple values of local resources for livelihoods and for future generations were also considered important for well-being (and by extension for resilience). Pride in replanting mangroves and in sustaining an abundant flooded forest was evident. Several respondents also hinted at the spiritual significance of having natural resources close by.

Marschke and Berkes' (2006) results highlight a few key points. First, individuals and communities often have a clear understanding of the values they see as a starting point for management interventions. Without necessarily formal reference to social theory, people naturally focus on interventions or policy that reflect or build on their values. The concept of well-being as used here, then, provides a means to explore more systematically and make more explicit those values, as they are reflected in trade-offs among the material, relational, and subjective. Making these values more explicit to those who may not share them but whose actions may impinge on them—such as government bureaucrats, and aid agency and nongovernmental organization workers—is one way that social well-being concepts can better inform natural resource governance. The Cambodian example thus reinforces the proposition that concepts and frameworks that weave meaningful accounts of agency and values are critical if one wants to really embrace a social-ecological systems perspective. Second, scrutiny of these ideas makes it clear that well-being and resilience are not always positively correlated, an assumption that is, unfortunately, often made in the literature, either implicitly or explicitly. Indeed, we need to realize that increasing well-being, especially when it is framed in individualistic terms, may erode ecological resilience (or vice versa).

Considering scale through social and ecological frames

Notions of "scale" and "cross-scale" are central in social-ecological resilience thinking. Carpenter et al. (2006), for instance, in their reflections about research needs in relation to social-ecological systems and the Millennium Ecosystem Assessment, remind us of the importance of cross-scale effects. They cite the example of the loss of buffering coastal ecosystems that can eventually expose extensive regions of coastline to catastrophic damage, as in the 2004 Asian tsunami and recent hurricanes in the Gulf of Mexico.

Gibson et al. (2000) use the term "scale" to refer to the "spatial, temporal, quantitative, or analytical dimensions used by scientists to measure and study objects and processes." Scale is thus a reflection of objective reality (some fisheries are small, others are big) as well as a social construction (i.e., how scale is perceived reflects subjective, relational, and normative factors). Recognition of the constructed as well as objective basis of scale is important because it provides a foundation upon which decisions about the measurement of ecological and social phenomena can be made. Definitions of scale also influence choices about the diversity of variables and cross-scale interactions to be considered (Scoones 1999, Peterson 2000), and affect decisions related to the governance of social-ecological systems.

Efforts by human actors to achieve resilience or well-being have effects across scale and are influenced, equally, by factors emanating from other scales. However, the emphasis of each

concept with regard to understanding scale is somewhat different, although complementary. While well-being can be seen primarily as relating to the individual, our social conception of well-being shifts attention to the interplay of individuals, including the social and cultural dimensions that they judge as contributing to a life well lived. In this context, different configurations of well-being may be expressed within different communities or at different scales. A connection may be made here to the question of inter-generational equity when considering well-being trade-offs (Sumner and McGregor 2010). In contrast to the social emphasis of well-being, resilience thinking was initially driven by "system" (or subsystem) dynamics taken from ecology (Holling 1973, 2001). More recent works (e.g., Gunderson and Holling 2002, Carpenter et al. 2006) draw attention to the importance of cross-scale effects of "key variables" and to the hierarchy of linked social-ecological processes operating at different temporal and spatial scales.

In a constructive way, both a social conception of well-being and resilience reveal—and can be used to identify and communicate—trade-offs when focusing on one scale or set of variables. For example, as mentioned earlier, one can imagine resilience of a large ecosystem being enhanced (general resilience) through policy interventions or other measures at the expense of the resilience of a subsystem (specified resilience), whether as an explicit trade-off or as unplanned externalities. Similarly, what is good for the well-being (material, relational, subjective) of a community or some other group may not be good for every individual within that community. These are indeed classic trade-offs and have been examined in numerous other contexts (Charles 2001). Yet, we see emerging a form of complementarity in combining a resilience lens and a social well-being lens as they point to different material, subjective, and relational trade-offs in potentially new ways, and with a more dynamic and scale-sensitive (i.e., systems) manner. Here, the social concept of well-being's attention to agency and values at the individual and societal levels makes an essential contribution to resilience thinking by helping to further "soften" an historically determinist or functionalist view of systems (Armitage and Johnson 2006, Crane 2010, Davidson 2010).

Insights on "controlling" variables

Resilience results from the interaction between nested cycles of change (adaptive cycles) and the impact of slow- and fast-moving variables in different systems and at different scales (Holling 2001). In most systems, three to five controlling ecological variables are said to determine the system's overall behavior (Gunderson and Holling 2002). Changes to these controlling variables, in turn, determine system persistence and trajectory and the potential to change or cross thresholds.

Walker and Salt (2006) posit that controlling ecological variables tend to be slow (e.g., connectivity in forest ecosystems) and influence the dynamics of faster variables (for example, pest outbreaks). In contrast, controlling social variables may be slow or fast, and the examples the same authors offer are ideas, products, or services (fast), and culture and beliefs (slow) (see also Gladwell 2000). In some contexts where the social, economic, and environmental effects of globalization are prevalent, however, distinguishing between slow and fast changes in markets, cultures, or institutions is difficult and may turn out to be arbitrary (Armitage and Johnson 2006).

In effect, slow and fast ecological variables that shape social-ecological systems are better understood than their social counterparts. For example, resilience thinking is perhaps leading to a better identification of dynamic social processes than it is at actually understanding and interpreting these social "state variables." Thus, in the emerging discussion about the link between (social) resilience and well-being, an important question is to investigate to what extent well-being concepts and metrics could represent a useful entry point to better describe and analyze potential controlling social variables (slow and fast) that influence resilience.

To explore this issue, it is necessary to reflect on the complexity of the relationship between well-being and resilience as it pertains to understanding "controlling variables." A good way to illustrate this is to go back to the analysis that Marshall and Marshall (2007) conducted in fishing communities in North Queensland. Looking at the social resilience of these communities to policy change, the authors found that the response of fishers to changes (their social resilience) is determined by four key characteristics: (1) perception of risk associated with change, (2) perception of the ability to plan, learn, and reorganize, (3) perception of the ability to cope with change, and (4) individual's interest in change. These findings point to key social variables that relate explicitly to the relational (e.g., learning) and subjective (e.g., perception about risk, interest in change) dimensions of well-being, as opposed to the material (income, assets, property right) dimensions, which are often emphasized to be key elements in the ability of people to buffer shocks. The results thus suggest that subjective perceptions of risk, knowledge, and experience are important variables at the individual and societal level in determining whether and how adaptation takes place.

Such insights reinforce other empirical analyses that suggest that individual and collective perspectives and perceptions matter when it comes to resilience, adaptation, and transformation (e.g., O'Brien and Wolf 2010, Schwarz et al. 2011), and emphasize in particular the importance of the relational and the subjective dimension of well-being. What people feel they can do or can be influences (but does not always control) what people will actually be able to be and to do. In turn, these feelings and perceptions are determined by people's experiences as well as by the norms and values that

are culturally and socially determined or constructed (Deneulin and McGregor 2010). This means in particular that actions or behaviors that are considered to be successful, effective, or legitimate—and thus, which potentially contribute to resilience—depend to a large extent on what people perceive to be worth achieving and protecting. There is a growing body of empirical evidence to show how values and perspectives play a critical role in individual and collective decision-making of adaptation options (Grothmann and Patt 2005, Adger et al. 2009, Heyd and Brooks 2009, O'Brien 2009, Weber 2010, Schwarz et al. 2011).

Two insights can be drawn from this. First, in order to meaningfully identify controlling variables influencing social-ecological system behavior, it is crucial to understand what constitutes individual and social well-being and the implications for responses and decision-making patterns. Values that underpin the conception of well-being may reflect a class of social controlling variables that fundamentally influence a social-ecological system (Table 3). Second, and somewhat paradoxically, human agency poses a challenge to the premise of a "controlling variable" as applied to social systems. Parsing slow from fast variables in a social context is indeed problematic. Because it may involve human agency, any social variable (e.g., values, the effect of markets, role of institutions) is far more likely to be transient and open to change, thus making the identification of controlling social variables particularly challenging and complex.

Table 3. Examples of potential controlling social variables (fast, slow).

Dimension	Example variables
Material	Income, wealth, assets
	Physical health
	Ecosystem services (natural capital access)
	Institutions
	Markets
Relational	Social ties (e.g., strength, diversity)
	Trust
	Social learning
	Equity
	Leadership
Subjective	Identity
	Perceptions, aspirations
	Beliefs, values, norms
	Satisfaction

Thresholds and boundaries

Resilience thinking highlights the importance of thresholds in controlling variables. Rockstrom et al. (2009), for instance, emphasize the global reach of anthropogenic pressures, and suggest that a number of earth systems have approached the point at which abrupt global environmental change may not respond to further mitigation efforts. To examine the challenge of global sustainability, these authors develop the notion of "planetary boundaries," or the boundaries within which humanity can operate safely. Moving beyond one or more of these planetary boundaries may have profoundly negative and uncertain outcomes, and may trigger nonlinear, abrupt continental to planetary-scale environmental change. They also recognize that knowing the distance to a threshold is a challenge, and that it is often not possible to identify when a threshold has been crossed until it has happened (Walker and Salt 2006).

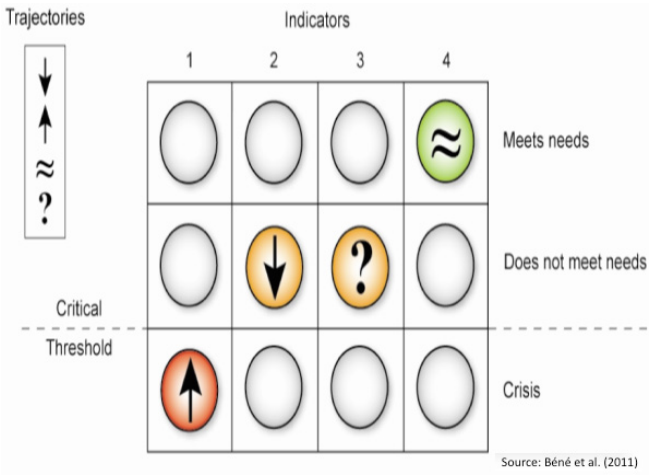
This notion of thresholds (as applied in resilience) is not explicitly highlighted in the well-being literature. We speculate, however, that a social conception of well-being could become useful to both characterize social thresholds and boundaries, and to communicate the implications of these social thresholds in social-ecological systems. Over time, for instance, it may be possible to define a "safe operating space" or "acceptable boundaries" for social well-being using material, relational, and subjective parameters (Table 3). Qualitative and/or quantitative metrics can be identified as a way to recognize approaching thresholds in social-ecological variables through time and space, beyond which well-being of individuals and groups may be lost (temporarily or permanently). A key challenge (one of several) is to scale up from the individual to identify and understand thresholds of well-being in communities and societies in meaningful ways. In aggregate form, for instance, the erosion of civil liberties has been shown to reach a threshold in some societies and not others, and may catalyze radical change, as took place in Tunisia, Egypt, and Libya in 2011. Over time, the erosion of trust and failure of institutions in such forms as corruption, lack of accountability, and social norms can lead to an unacceptably low level of societal overall well-being, and result in a sudden change or surprise, or quite literally, a regime shift.

Such analysis should not be viewed as a replacement for other analytical approaches, such as poverty, human development, livelihoods, governance, or political economy, that may provide useful insights. Well-being can, however, encourage reflection on values, perceptions, and beliefs as potentially important controlling variables, along with relational and material considerations, with measurable thresholds that, when crossed, lead to a loss of resilience, a shift to alternative (undesirable?) social-ecological configurations, and unsustainable trajectories of change.

It is worth emphasizing, however, that human agency and diverse values make it intrinsically difficult to operationalize the threshold concept in a social context (and also with respect to controlling variables) for obvious reasons: what may be considered as culturally "unacceptable" in one society may be the norm in another. As a result, a participatory process where

questions about boundaries and thresholds are asked in relation to the diverse aspirations, objectives, and knowledges—whether scientific, local, or traditional—of individuals and communities would be important in this regard (Armitage et al. 2011). For instance, Béné et al. (2011) used a "threshold dashboard" developed with communities in conjunction with a parallel expert-led dashboard to compare desirable, undesirable, and crisis states, thresholds, and trajectories at different scales in an attempt to evaluate social-ecological systems. Their analysis shows some overlaps and differences in the choice of indicators/measures used by the communities and the experts, reflecting an emphasis on different key subsystems and variables. A useful aspect of this process was the development of visual tools to express the threshold concept in a nonmathematical way (Fig. 2).

Fig. 2. Visual approach to social thresholds.



Based on this experience, it is certainly possible to imagine that explicit attention to well-being would have further drawn out the role of subjective and relational dimensions of the social-ecological systems examined in that particular context. Still, more effort is required to think about scaling up to contexts where participatory processes would be different and more complex than those used at a community level.

SYNTHESIS: IMPLICATIONS OF THE INTERPLAY OF WELL-BEING AND RESILIENCE

Our intention in this essay has been (1) to acknowledge the limitations of applying ecological resilience concepts to social systems, and to see how some of these limitations can be addressed through increased attention to social theory primarily as articulated in the concept of social well-being, and (2) to examine the interplay of resilience and social conceptions of well-being in applying a social-ecological perspective that can be translated over time into more appropriate management and policy actions. We recognize, however, that much work remains with regard to the translation of this intertransdisciplinary view into operationalized decision-making and policy. It is beyond the scope of this paper to formally operationalize this hybrid thinking, although incremental steps in this direction can be made. For example, it may be instructive to consider how a social conception of well-being can add to the suite of methods associated with the Resilience Alliance (2010) workbooks (Box 1). Regardless, we can identify specific research and policy directions or action-oriented principles that emerge from this analysis:

Box 1: The Resilience Assessment (2010) workbooks provide, for practitioners and scientists, a strategy to operationalize resilience by outlining how to define and assess a system of interest, identify key variables, and document interactions across scales. Similarly, the Social-Ecological Inventories workbook (Schultz et al. 2011) provides guidance to "systematically map out actors, their values, roles, activities, knowledge, experiences over time, and networks." However, we hypothesize that a more explicit attention to a social conception of well-being could strengthen the social-ecological system inventories and assessment tool kits and further extend the potential they embody. This might include:

- strengthening the process of identifying what social thresholds and variables are assessed and at which scale
- articulating more clearly the social and ecological trade-offs associated with governance choices
- promoting an explicit identification and consideration of stakeholders' nonmaterial values in governance reform processes
- pointing to the unique challenge that human agency brings to operationalizing controlling variables and thresholds in resilience analysis
- providing a means to systematically incorporate relations of power into resilience analysis
- generating additional insights on how choices of scale shape understandings of resilience and well-being
- fostering a hybrid social-ecological perspective on the limits of the optimization narrative in many management settings

Our point here is preliminary, and identifying how to put these ideas into practice (as is intended in the workbooks) would reflect an important direction for ongoing research.

Bridge the gap in current social-ecological system thinking

A better understanding of the social dimension of resilience is emerging (e.g., Adger 2000, Crane 2010, Miller et al. 2010). Still, social-ecological system thinking is strongly influenced

by the ecologically centered notion of resilience from which it was initially derived. As a consequence, the social dimension of the framework is less developed. In particular, agency, values, and aspirations, which are of central importance in understanding human behavior in relation to the environment, are not yet fully integrated in current approaches. The concept of well-being as defined in this paper offers a complementary lens to better unpack the material, relational, and subjective dimensions of individuals and their reference groups, in relation to the wider social-ecological system context (see also Brown and Westaway 2011).

We do not claim, however, that social well-being as presented in this article is a panacea. For example, the well-being approach is, somewhat surprisingly, not explicit in dealing with power. In addition, the concept emphasizes human dynamics, and therefore, possibly human interests over ecosystem sustainability. A singular focus on well-being, however defined, may thus mask or ignore ecological decline (e.g., stock decline) or feedbacks (e.g., approaching thresholds in biophysical systems) within ecosystems, such as when more pressure is exerted on ecosystem services to maintain social well-being in the short term. Even more, it is critical to acknowledge that "being well in harmony with our surrounding natural environment" (which we may reasonably assume is contributing to our well-being), may be linked but is not necessarily equivalent to ensuring environmental sustainability or ecological resilience. For example, what we know or perceive to know about our environment or the ecosystem services upon which we depend is still incomplete and evolving through time and space.

Like any other analytical framework (including resilience thinking), well-being is not all inclusive and does not "operate" well on its own. In particular, the social conception of well-being as proposed here must be situated in a dynamic ecological view to facilitate social-ecological thinking. Nevertheless, we are arguing that the attention to the diversity of experience and interest that this social conception of well-being brings is a salutary check to policies that are too often based on individual economic rationality assumptions.

Identify the complementarities in different theoretical frameworks

Resilience thinking is (or has been so far) principally influenced by ecological principles and operates essentially at system and subsystem levels. Well-being stresses the importance of social (as opposed to ecological) dynamics and places an emphasis on individual agency, and interpersonal and group dynamics. What seems to emerge, therefore, is a form of complementarity between resilience thinking and the social conception of well-being. We believe this complementarity helps in the application of a social-ecological systems perspective, and serves as an example of the hybrid approach required to deal with local to global change.

Some degree of caution is required, however, as this complementarity is not equivalent to the assumption, often found in the literature, that resilience and well-being go hand in hand and are positively correlated. There is no reason to expect this to be the case in general. Conflicts around marine parks or land-based natural reserves, for instance, would be a typical case where this decoupling of resilience and well-being is apparent (e.g., Graham et al. 2009, Rinzin et al. 2009).

Social-centered approaches and frameworks such as well-being, which allow for a fuller analysis of the material, relational, and subjective aspects of people's lives are necessary to define resilience of "what, to what, and for whom." These approaches are thus crucial in helping to determine the extent to which different actors may seek to persist under certain conditions, adapt to change, or more fundamentally transform the systems in which they are a part. Such approaches are also required to help navigate the uncertain—and yet not well recognized—terrain of good and bad resilience (general and specified). Finally, in many management situations, resilience risks becoming a single-objective "pursuit" (as has occurred with rent maximization); adding complementary approaches like that of well-being as outlined here, reveal diverse social preferences and can help alleviate the limits of that threat.

Recognize the role of narratives and metaphors to communicate change

Articulating alternative narratives of complexity and change based on both social and ecological theory is crucial to build interdisciplinary understanding. The interplay between resilience and well-being can help to do this. For instance, a resilience perspective fosters a dynamic and cross-scale view of systems that can serve as a valuable heuristic for adaptability, transformability, and notions of thresholds and safe boundaries. In turn, well-being draws attention to social complexity and the central role of subjective and relational agency in shaping social-ecological system change and responses to change (i.e., adaptability), and in determining system configurations within an evolving and dynamic social context. Policy-making and the formulation of legal frameworks that account for those dynamics will depend on "new" narratives about social-ecological systems and their complexity. Richer narratives of change that include an understanding of thresholds, boundaries, and tipping points derived from resilience and a social conception of well-being will complement and should, in some cases, supplant existing policy narratives that are shaped only by the language of economics, demography, and institutions.

Enhance the focus on knowledge co-production and sense-making

With rich narratives of complexity and change that can emerge from hybrid theory and empirical validation, opportunities for deliberation and sense-making are enhanced. These

opportunities take us into the realm of knowledge co-production and learning for governance (Armitage et al. 2011). In this regard, several insights can be identified. First, the complexity and dynamism highlighted by both resilience and well-being offer a stark warning that restricting attention to just one scale or subset of variables will undermine governance opportunities in the long term. However, because managers and decision-makers will in many cases continue to make decisions based on partial comprehension of the system or time-bounded frameworks, more attention is required to develop practical and participatory strategies to facilitate social-ecological system understanding (Andrew and Evans 2008). Second, policy interventions and governance processes that continue to separate the social and ecological (even in an effort to enhance analysis) will lead to outcomes that fail to adequately address both, thus highlighting the importance of hybrid approaches. Third, as revealed by the assessment of controlling social variables, human agency implies that the social can be transient and extremely dynamic. This should not be taken as grounds for inaction. As we show in this paper, an approach that combines social well-being and resilience offers conceptual tools to think through social-ecological complexity and its implications.

Identify new questions and research areas

Further empirical work to test the ideas explored in this paper are required, as are efforts to extend some of these concepts and work towards their application (Box 1 provides an example of this). Avenues to explore include improved understanding of ecological and social threshold concepts (for example, identifying safe boundaries from an ecological and social perspective) (Fig. 2), and working towards a more complete and theoretically informed understanding of the social variables (fast and slow) that exert, at particular points in time and space, a strong influence on social-ecological system trajectories. Béné et al. (2011) provide an example of how to operationalize some of these ideas. The development of hybrid measures or indicators to better articulate social variables operating at different scales remains a conceptual and practical challenge—they must be sufficiently sensitive to detect approaching thresholds and be linked with ecological contexts to be meaningful for social-ecological system understanding.

CONCLUSIONS

Davidson (2010:1146) suggests that the "Conceptual frameworks predominant today in the study of social-ecological systems are of limited utility for informing research on the social implications of global environmental crisis, rendering urgent our pursuit for theoretical insight." We concur with this assessment. However, as we suggest in this paper, no one framework will be adequate to the task. Development of hybrid approaches and innovative combinations of social and ecological theory are necessary to provide signposts and analytical tools to understand complexity and change.

Linking resilience and well-being is one example of such a hybrid approach aimed at unpacking the shared complexity of ecological and social systems while remaining sensitive to their fundamental differences and the manner in which these differences manifest in interdependent systems of people and nature. We have argued that linking a social conception of well-being to resilience provides a better understanding of how complex systems evolve and how individuals and societies are simultaneously embedded within and act as agents of change in those systems, as well as a better understanding of the processes and structures that influence social-ecological resilience, adaptability, and transformability (see also Brown and Westaway 2011). This understanding is useful in providing guidance for adaptive governance.

Our intention has been to explore opportunities for the social-ecological thinking required to deal with global change. As we highlight, there are numerous points of interplay between well-being and resilience that might be utilized within a dynamic approach to better understand social-ecological systems—one that would draw on equivalent social and ecological theory and frames opportunities to navigate through change. Maintaining resilience, enhancing adaptiveness, improving the fit between ecosystems and institutional arrangements, and creating opportunities for shared learning and transformability is a pressing need, but one that can be achieved only with a social-ecological systems perspective.

Responses to this article can be read online at:
http://www.ecologyandsociety.org/issues/responses.php/4940

Acknowledgments:

This work has been undertaken as part of the project "Governance of Small-Scale Fisheries for Wellbeing and Resilience" and is supported by the CGIAR-Canada Linkage Fund of the Canadian International Development Agency. We appreciate the contributions and insights from discussions with colleagues in this project: Marie-Caroline Badjeck, Ratana Chuenpagdee, Sarah Coulthard, Nireka Weeratunge, and Allister McGregor. We are thankful for the constructive comments on the manuscript from two anonymous reviewers.

LITERATURE CITED

Adger, W. N. 2000. Social and ecological resilience: are they related? *Progress in Human Geography* 24(3):347–364. http://dx.doi.org/10.1191/030913200701540465

Adger, W. N., S. Dessai, M. Goulden, M. Hulme, I. Lorenzoni, D. R. Nelson, L. O. Naess, J. Wolf, and A. Wreford. 2009. Are there social limits to adaptation to climate change? *Climatic Change* 93:335–354. http://dx.doi.org/10.1007/s10584-008-9520-z

Adger, W. N., P. M. Kelly, A. Winkels, L. Q. Huy, and C. Locke. 2002. Migration, remittances, livelihood trajectories and social resilience. *Ambio* 31(5):358–366.

Alkire, S. 2002. Dimensions of human development. *World Development* 30(2):181–205. http://dx.doi.org/10.1016/S0305-750X(01)00109-7

Anderies, J. M., M. A. Janssen, and E. Ostrom. 2004. A framework to analyze the robustness of social-ecological systems from an institutional perspective. *Ecology and Society* 9(1):18. http://www.ecologyandsociety.org/vol09/iss1/art18/

Andor, L., A. Arnaudova, P. Berès, V. Birkavs, C. Dhéret, G. Götz, A. Hemerijck, A. Hubert, A. Larsson, H. Martens, C. McCartney, S. McLoughlin, E. Molino, A.-S. Parent, Y. Pascouau, C. Saraceno, W. Wong, and F. Zuleeg. 2011. *Growth, well-being and social policy in Europe: trade-off or synergy?* Challenge Europe 21 European Union, European Policy Center.

Andrew, N., and L. Evans. 2008. *Approaches and frameworks for management and research in small-scale fisheries in the developing world*. The WorldFish Center Working Paper 1914. The WorldFish Center, Penang, Malaysia.

Armitage, D. 2008. Governance and the commons in a multi-level world. *International Journal of the Commons* 2(1):7–32.

Armitage, D., F. Berkes, A. Dale, E. Kocho-Schellenberg, and E. Patton. 2011. Co-management and the co-production of knowledge: learning to adapt in Canada's Arctic. *Global Environmental Change* 21(3):995–1004. http://dx.doi.org/10.1016/j.gloenvcha.2011.04.006

Armitage, D., and D. Johnson. 2006. Can resilience be reconciled with globalization and the increasingly complex conditions of resource degradation in Asian coastal regions? *Ecology and Society* 11(1):2. [online] URL: http://www.ecologyandsociety.org/vol11/iss1/art2/

Béné, C., L. Evans, D. Mills, S. Ovie, A. Raji, A. Tafida, A. Kodio, F. Sinaba, P. Morand, J. Lemoalle, and N. Andrew. 2011. Testing resilience thinking in a poverty context: experience from the Niger River basin. *Global Environmental Change* 21:1173–1184. http://dx.doi.org/10.1016/j.gloenvcha.2011.07.002

Béné, C., B. Hersoug, and E. H. Allison. 2010. Not by rent alone: analyzing the pro-poor functions of small-scale fisheries in developing countries. *Development Policy Review* 28(3):325–358. http://dx.doi.org/10.1111/j.1467-7679.2010.00486.x

Béné, C., and A. Tewfik. 2001. Fishing effort allocation and fishermen's decision making process in a multi-species small-scale fishery: analysis of the conch and lobster fishery in Turks and Caicos Islands. *Human Ecology* 29(2):157–186. http://dx.doi.org/10.1023/A:1011059830170

Berkes, F., J. Colding, and C. Folke. 2003. *Navigating the dynamics of social-ecological systems: building resilience for complexity and change*. Cambridge University Press, Cambridge, UK.

Bottom, D. L., K. K. Jones, C. A. Simenstad, and C. L. Smith. 2009. Reconnecting social and ecological resilience in salmon ecosystems. *Ecology and Society* 14(1):5. [online] URL: http://www.ecologyandsociety.org/vol14/iss1/art5/

Brand, F. S., and K. Jax. 2007. Focusing the meaning(s) of resilience: resilience as a descriptive concept and a boundary object. *Ecology and Society* 12(1):23. [online] URL: http://www.ecologyandsociety.org/vol12/iss1/art23/

Brown, K., W. N. Adger, E. Tompkins, P. Bacon, D. Shim, and K. Young. 2001. Trade-off analysis for marine protected area management. *Ecological Economics* 37(3):417–434. http://dx.doi.org/10.1016/S0921-8009(00)00293-7

Brown, K., and E. Westaway. 2011. Agency, capacity and resilience to environmental change: lessons from human development, wellbeing, and disasters. *Annual Review of Environment and Resources* 36:321–342. http://dx.doi.org/10.1146/annurev-environ-052610-092905

Campbell, B. M., J. A. Sayer, and B. Walker. 2010. Navigating trade-offs: working for conservation and development outcomes. *Ecology and Society* 15(2):16. [online] URL: http://www.ecologyandsociety.org/vol15/iss2/art16/

Carpenter, S. R., E. M. Bennett, and G. D. Peterson. 2006. Scenarios for ecosystem services: an overview. Ecology and Society 11(1): 29. [online] URL: http://www.ecologyandsociety.org/vol11/iss1/art29/

Carpenter, S. R., and W. A. Brock. 2004. Spatial complexity, resilience and policy diversity: fishing on lake-rich landscapes. *Ecology and Society* 9(1):8. [online] URL: http://www.ecologyandsociety.org/vol9/iss1/art8/

Carpenter, S. R., B. Walker, J. M. Anderies, and N. Abel. 2001. From metaphor to measurement: resilience of what to what? *Ecosystems* 4:765–781.

Chambers, R. and G. Conway. 1992. Sustainable rural livelihoods: practical concepts for the 21st century. IDS Discussion Paper 296, IDS, Brighton, UK.

Charles, A. 1988. Fishery socioeconomics: a survey. *Land Economics* 64:276–295. http://dx.doi.org/10.2307/3146251

Charles, A. 2001. *Sustainable fishery systems*. Blackwell Science, Oxford, UK. http://dx.doi.org/10.1002/9780470698785

Charles, A. 2004. *Sustainability and resilience in natural resource systems: policy directions and management institutions*. Encyclopedia of Life Support Systems (EOLSS). UNESCO, Paris, France.

Clark, C. W. 1990. *Mathematical bioeconomics: the optimal management of renewable resources*. Second edition. Wiley-Interscience, New York, USA.

Collier, P. 2010. *The plundered planet: how to reconcile prosperity with nature*. Allen Lane, London, UK.

Collier, P., and T. Venables. 2010. International rules for trade in natural resources. *Journal of Globalization and Development* 1(1). http://dx.doi.org/10.2202/1948-1837.1027

Copestake, J., editor. 2008. *Wellbeing and development in Peru: local and universal views confronted*. Palgrave Macmillan, New York, USA.

Costanza, R., B. Fischer, S. Ali, C. Beer, L. Bond, R. Boumansa, N. L. Danigelis, J. Dickinson, C. Elliott, J. Farley, D. E. Gayer, L. MacDonald Glenn, T. Hudspeth, D. Mahoney, L. McCahill, B. McIntosh, B. Reed, S. Abu Turab Rizvi, D. M. Rizzo, T. Simpatico, and R. Snapp. 2007. Quality of life: an approach integrating opportunities, human needs, and subjective well-being. *Ecological Economics* 61:267–276. http://dx.doi.org/10.1016/j.ecolecon.2006.02.023

Coulthard, S. 2012. Can we be both resilient and well, and what choices do people have? Incorporating agency into the resilience debate from a fisheries perspective. *Ecology and Society* 17(1):4. http://dx.doi.org/10.5751/ES-04483-170104

Coulthard, S., D. Johnson, and J. A. McGregor. 2011. Poverty, sustainability and human wellbeing: a social wellbeing approach to the global fisheries crisis. *Global Environmental Change* 21(2):453–463. http://dx.doi.org/10.1016/j.gloenvcha.2011.01.003

Crane, T. A. 2010. Of models and meanings: cultural resilience in social-ecological systems. *Ecology and Society* 15(4):19. [online] URL: http://www.ecologyandsociety.org/vol15/iss4/art19/

Crona, B., and Ö. Bodin. 2010. Power asymmetries in small-scale fisheries: a barrier to governance transformability? *Ecology and Society* 15(4):32. [online] URL: http://www.ecologyandsociety.org/vol15/iss4/art32/

Davidson, D. J. 2010. The applicability of the concept of resilience to social systems: some sources of optimism and nagging doubts. *Society & Natural Resources* 23:1135–1149. http://dx.doi.org/10.1080/08941921003652940

Deneulin, S., and J. A. McGregor. 2010. The capability approach and the politics of a social conception of wellbeing. *European Journal of Social Theory* 13(4):501–519. http://dx.doi.org/10.1177/1368431010382762

Diener, E., R. Lucas, U. Schimmack, and J. Helliwell. 2009. *Well-being for public policy*. Oxford University Press, New York, New York, USA. http://dx.doi.org/10.1093/acprof:oso/9780195334074.001.0001

Doubleday, N. 2007. Culturing adaptive co-management: finding "keys" to resilience in asymmetries of power. *In* D. Armitage, F. Berkes, and N. Doubleday, editors. *Adaptive co-management: collaboration, learning and multi-level governance*. University of British Columbia Press, Vancouver, British Columbia, Canada.

Duit, A., V. Galaz, , K. Eckerberg, and J. Ebbesson. 2010. Governance, complexity, and resilience. *Global Environmental Change* 20:363–368. http://dx.doi.org/10.1016/j.gloenvcha.2010.04.006

Fischer, J., G. D. Peterson, L. J. Gordon, S. Dovers, I. Fazey, A. Felton, T. Elmqvist, C. Folke, T. Gardner, and A. D. Manning. 2009. Integrating resilience thinking and optimisation for conservation. *Trends in Ecology and Evolution* 24:549–554. http://dx.doi.org/10.1016/j.tree.2009.03.020

Folke, C. 2006. Resilience: the emergence of a perspective for social-ecological systems analyses. *Global Environmental Change* 16:253–267. http://dx.doi.org/10.1016/j.gloenvcha.2006.04.002

Folke C., S. Carpenter, T. Elmqvist, L. Gunderson, C. S. Holling, B. Walker, J. Bengtsson, F. Berkes, J. Colding, K. Danell, M. Falkenmark, L. Gordon, R. Kasperson, N. Kautsky, A. Kinzig, S. Levin, K.-G. Mäler, F. Moberg, L. Ohlsson, P. Olsson, E. Ostrom, W. Reid, J. Rockström, H. Savenije, and U. Svedin. 2002. *Resilience and sustainable development: building adaptive capacity in a world of transformations*. Scientific background paper on resilience for the process of The World Summit on Sustainable Development on behalf of The Environmental Advisory Council to the Swedish Government.

Folke, C., S. R. Carpenter, B. Walker, M. Scheffer, T. Chapin, and J. Rockström. 2010. Resilience thinking: integrating resilience, adaptability and transformability. *Ecology and Society* 15(4):20. [online] URL: http://www.ecologyandsociety.org/vol15/iss4/art20/

Garcia, S. M., and A. Charles. 2008. Fishery systems and linkages: implications for science and governance. *Ocean & Coastal Management* 51:505–527. http://dx.doi.org/10.1016/j.ocecoaman.2008.05.001

Gasper, D. 2004. *The ethics of development: from economism to human development*. Edinburgh University Press, Edinburgh, Scotland.

Gibson, C., E. Ostrom, and T. K. Ahn. 2000. The concept of scale and the human dimensions of global change: a survey.

*Ecological Economic*s 32:217–239. http://dx.doi.org/10.1016/S0921-8009(99)00092-0

Gladwell, M. 2000. The tipping point: how little things can make a big difference. Little Brown and Company, New York, New York, USA.

Glantz M. D., and J. L. Johnson, editors. 1999. *Resilience and development: positive life adaptations*. Kluwer Academic, New York, New York, USA. http://dx.doi.org/10.1007/b108350

Gough, I., and J. A. McGregor, editors. 2007. *Wellbeing in developing countries: from theory to research*. Cambridge University Press, Cambridge, UK.

Gough, I., J. A. McGregor, and L. Camfield. 2007. Theorising wellbeing in international development. Pages 3–44 *in* I. Gough and J. A. McGregor, editors. *Wellbeing in developing countries: from theory to research*. Cambridge University Press, Cambridge, UK. http://dx.doi.org/10.1017/CBO9780511488986.002

Graham, M., I. Douglas-Hamilton, W. M. Adams, and P. C. Lee. 2009. The movement of African elephants in a human-dominated land use mosaic. *Animal Conservation* 12:445–455. http://dx.doi.org/10.1111/j.1469-1795.2009.00272.x

Grothmann, T., and A. Patt. 2005. Adaptive capacity and human cognition: the process of individual adaptation to climate change. *Global Environmental Change* 15:199–213. http://dx.doi.org/10.1016/j.gloenvcha.2005.01.002

Gunderson, L. H. 2000. Ecological resilience—in theory and application. *Annual Review of Ecology and Systematics* 31:425–439. http://dx.doi.org/10.1146/annurev.ecolsys.31.1.425

Gunderson L. H., and C. S. Holling, editors. 2002. *Panarchy: understanding transformations in human and natural systems*. Island Press, Washington, D.C., USA.

Heyd, T., and N. Brooks. 2009. Exploring cultural dimensions of adaptation to climate change. Pages 269–282 *in* W. N. Adger, I. Lorenzoni, and K. L. O'Brien, editors. *Adapting to climate change: thresholds, values, governance*. Cambridge University Press, Cambridge, UK. http://dx.doi.org/10.1017/CBO9780511596667.018

Hirsch Hadorn, G., D. Bradley, C. Pohl, S. Rist, and U. Wiesmann. 2006. Implications of transdisciplinarity for sustainability research. *Ecological Economics* 60:119–128. http://dx.doi.org/10.1016/j.ecolecon.2005.12.002

Holling, C. S. 1973. Resilience and stability of ecological systems. *Annual Review of Ecology and Systematics* 4:1–23. http://dx.doi.org/10.1146/annurev.es.04.110173.000245

Holling, C. S. 2001. Understanding the complexity of economic, ecological, and social systems. *Ecosystems* 4:390–405. http://dx.doi.org/10.1007/s10021-001-0101-5

Holling, C. S., and G. K. Meffe. 1996. Command and control and the pathology of natural resource management. *Conservation Biology* 10:328–337. http://dx.doi.org/10.1046/j.1523-1739.1996.10020328.x

Hornborg, A. 2009. Zero-sum world: challenges in conceptualizing environmental load displacement and ecologically unequal exchange in the world-system. *International Journal of Comparative Sociology* 50(3–4):237–262. http://dx.doi.org/10.1177/0020715209105141

Kallstrom, H. N., and M. Ljung. 2005. Social sustainability and collaborative learning. *Ambio* 34:376–382.

Leach, M., editor. 2008. *Re-framing resilience: a symposium report*. STEPS Working Paper 13, STEPS Centre, Brighton, UK.

Maness, T. 2007. Trade-off analysis for decision making in natural resources: where we are and where we are headed. *Journal of Ecosystems and Management* 8(2):1–16.

Marschke, M. J., and F. Berkes. 2006. Exploring strategies that build livelihood resilience: a case from Cambodia. *Ecology and Society* 11(1):42. [online] URL: http://www.ecologyandsociety.org/vol11/iss1/art42/

Marshall, N. A., and P. A. Marshall. 2007. Conceptualizing and operationalizing social resilience within commercial fisheries in northern Australia. *Ecology and Society* 12(1):1. [online] URL: http://www.ecologyandsociety.org/vol12/iss1/art1/

McGoodwin, J. R. 2001. *Crisis in the world's fisheries: people, problems and policies*. Stanford University Press, Palo Alto, California, USA.

McGregor, J. A. 2004. Researching well-being: communicating between the needs of policy makers and the needs of people. *Global Social Policy* 4(3):337–358. http://dx.doi.org/10.1177/1468018104047491

McGregor, J. A. 2008. *Wellbeing, poverty and conflict*. WeD Policy Briefing 01/08.

McGregor, J. A., L. Camfield, and A. Woodcock. 2009. Needs, wants, and goals: wellbeing, quality of life and public policy. *Applied Research in Quality of Life* (4):135–154. http://dx.doi.org/10.1007/s11482-009-9069-7

Millennium Ecosystem Assessment (MA). 2005. *Ecosystems and human well-being: current state and trends*. Island Press, Washington, D.C., USA.

Miller, F., H. Osbahr, E. Boyd, F. Thomalla, S. Bharwani, G. Ziervogel, B. Walker, J. Birkmann, S. Van der Leeuw, J. Rockström, J. Hinkel, T. Downing, C. Folke, and D. Nelson. 2010. Resilience and vulnerability: complementary or conflicting concepts? *Ecology and Society* 15(3):11. [online] URL: http://www.ecologyandsociety.org/vol15/iss3/art11/

Nadasdy, P. 2007. Adaptive co-management and the gospel of resilience. *In* D. Armitage, F. Berkes, and N. Doubleday, editors. *Adaptive co-management: collaboration, learning and multilevel governance*. University of British Columbia Press, Vancouver, British Columbia, Canada.

Nelson, D. R., N. Adger, and K. Brown. 2007. Adaptation to environmental change: contributions of a resilience framework. *Annual Review of Environment and Resources* 32:395–419. http://dx.doi.org/10.1146/annurev.energy.32.051807.090348

O'Brien, K. 2009. Climate change and values: Do changing values define the limits to successful adaptation? *In* W. N. Adger, I. Lorenzoni, and K. O'Brien, editors. Adapting to climate change: thresholds, values, governance. Cambridge University Press, Cambridge, UK.

O'Brien, K., and J. Wolf. 2010. A values-based approach to vulnerability and adaptation to climate change. *WIREs Climate Change* 1(March/April):232–242.

Olsson, P., C. Folke, and F. Berkes. 2004. Adaptive comanagement for building resilience in social-ecological systems. *Environmental Management* 34(1):75–90. http://dx.doi.org/10.1007/s00267-003-0101-7

Otto-Zimmermann, K., editor. 2010. *Resilient cities, cities and adaptation to climate change*. Proceedings of the Global Forum 2010, ICLEI Local Government for Sustainability, Boon Germany, Springer, Dordrecht.

Peterson, G. 2000. Scaling ecological dynamics: self-organization, hierarchical structure, and ecological resilience. *Climatic Change* 44:291–309. http://dx.doi.org/10.1023/A:1005502718799

Pohl, C. 2010. From transdisciplinarity to transdisciplinary research. *Transdisciplinary Journal of Engineering and Science* 1(1):74–83.

Pollnac, R., and J. J. Poggie. 2008. Happiness, well-being and psycho-cultural adaptation to the stresses associated with marine fishing. *Human Ecology Review* 15(2):194–200.

Pollnac, R. B., R. S. Pomeroy, and I. H. T. Harkes. 2001. Fishery policy and job satisfaction in three southeast Asian fisheries. *Ocean & Coastal Management* 44:531–544. http://dx.doi.org/10.1016/S0964-5691(01)00064-3

Resilience Alliance. 2010. Assessing resilience in social-ecological systems: workbook for practitioners. Version 2.0. [online] URL: http://www.resalliance.org/3871.php

Rinzin, C., W. Vermeulen, M. Wassen, and P. Glasbergen. 2009. Nature conservation and human well-being in Bhutan: an assessment of local community perceptions. *Journal of Environment Development* 18(2):177–202. http://dx.doi.org/10.1177/1070496509334294

Robards, M. D., and J. A. Greenberg. 2007. Global constraints on rural fishing communities: Whose resilience is it anyway? *Fish and Fisheries* 8(1):14–30. http://dx.doi.org/10.1111/j.1467-2979.2007.00231.x

Rockström, J., W. Steffen, K. Noone, Å. Persson, F. S. Chapin III, E. F. Lambin, T. M. Lenton, M. Scheffer, C. Folke, H. J. Schellnhuber, B. Nykvist, C. A. de Wit, T. Hughes, S. van der Leeuw, H. Rodhe, S. Sörlin, P. K. Snyder, R. Costanza, U. Svedin, M. Falkenmark, L. Karlberg, R. W. Corell, V. J. Fabry, J. Hansen, B. Walker, D. Liverman, K. Richardson, P. Crutzen, and J. A. Foley. 2009. A safe operating space for humanity. *Nature* 461:472–475. http://dx.doi.org/10.1038/461472a

Ryan, R. M., and E. L. Deci. 2001. On happiness and human potentials: a review of research on hedonic and eudaimonic well-being. *Annual Review of Psychology* 52:141–166. http://dx.doi.org/10.1146/annurev.psych.52.1.141

Scheffer, M. 2009. *Critical transitions in nature and society*. Princeton University Press, Princeton, New Jersey, USA.

Schultz, L., R. Plummer, and S. Purdy. 2011. Applying a social-ecological inventory: a workbook for finding the key actors and engaging them. Supplement to Resilience Alliance Workbook for Practitioners. [online] URL: http://www.resalliance.org/index.php/resilience_assessment

Schwarz, A. M., C. Béné, G. Bennett, D. Boso, Z. Hilly, C. Paul, R. Posala, S. Sibiti, and N. Andrew. 2011. Vulnerability and resilience of remote rural communities to shocks and global changes: empirical analysis from Solomon Islands. *Global Environmental Change* 21:1128–1140. http://dx.doi.org/10.1016/j.gloenvcha.2011.04.011

Scoones, I. 1999. New ecology and the social sciences: what prospects for a fruitful engagement? *Annual Review of Anthropology* 28:479–507. http://dx.doi.org/10.1146/annurev.anthro.28.1.479

Sen, A. K. 1999. *Development as freedom*. Oxford University Press, Oxford, UK.

Stiglitz, J. E., A. Sen, and J.-P. Fitoussi. 2008. *Report by the Commission on the Measurement of Economic Performances and Social Progress*.

Sumner, A., and J. A. McGregor. 2010. Beyond business as usual: What might 3-D wellbeing contribute to MDG momentum? *IDS Bulletin* 41.1:104–112. Wiley-Blackwell, Brighton, UK.

Turner, B. L. 2010. Vulnerability and resilience: coalescing or paralleling approaches for sustainability science? *Global Environmental Change* 20:570–576. http://dx.doi.org/10.1016/j.gloenvcha.2010.07.003

Walker, B., S. Carpenter, J. Anderies, N. Abel, G. Cumming, M. Janssen, L. Lebel, J. Norberg, G. D. Peterson, and R.

Pritchard. 2002. Resilience management in social-ecological systems: a working hypothesis for a participatory approach. *Conservation Ecology* 6(1):14.

Walker, B., and J. A. Meyers. 2004. Thresholds in ecological and social-ecological systems: a developing database. *Ecology and Society* 9(2):3. [online] URL: http://www.ecologyandsociety.org/vol9/iss2/art3/

Walker, B., and D. Salt. 2006. *Resilience thinking: sustaining ecosystems and people in a changing world*. Island Press, Washington, D.C., USA.

Walker, B., J. Sayer, N. Andrew, and B. Campbell. 2010. Should enhanced resilience be an objective of natural resource management research for developing countries. *Crop Science* 50(March–April):S10–S19.

Weber, E. 2010. What shapes perceptions of climate change? Wiley Interdisciplinary Reviews. *Climate Change* 1(3):332–342. http://dx.doi.org/10.1002/wcc.41

White, S. 2009. Reflecting on wellbeing and development. *In*: *Wellbeing and development in Sri Lanka.* University of Colombo, Sri Lanka.

White, S. C. 2010. Analysing wellbeing: a framework for development practice. *Development in Practice* 20(2):158–172. http://dx.doi.org/10.1080/09614520903564199