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Meanings and robustness: Propositions for enhancing benefit sharing in social-ecological systems

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Abstract: Given increased pressure on natural resources to deliver benefits, complex trade-offs and the regulation of behaviours in relation to benefits is of key concern. Behaviours that signify resistance to the rules according to which benefits are allocated prompt us to consider causal links and feedbacks between benefits, perceptions of benefits, meanings attached to the benefits, and the regulatory instruments that mediate the distribution of benefits. An understanding of how meanings influence the perception of benefits exposes the complexity inherent in how people perceive and allocate value to natural resource benefits. Meanings are personal, sometimes overlapping, context dependent and variable across space and time. A challenge in directing resource user behaviour in common pool resources is that the relationship between the resource and resource use is typically not interpreted to include the manner in which users associate resource benefits with meanings. We propose that collective ordering of meanings and associated rules help to direct behaviours and in doing so they contribute to the purposeful maintenance of desirable elements of a social-ecological system (i.e. robustness). Using an example, we illustrate how tensions around benefit sharing are rooted in the emergence and changing prioritisation of contexts and meanings over time. The importance of eliciting, ordering and sanctioning of meanings

is emphasised. We conclude by discussing the implications for robustness and benefit sharing in social-ecological systems and we comment on the usefulness and limitations of the framework.

Keywords: Behaviour, benefit sharing, context, ecosystem services, institutional design, meaning, robustness

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1. Introduction

It is widely acknowledged that equity and sustainability are important goals in natural resource management (Smith and McDonough 2001; Brock and Carpenter 2007). Behaviours are indicative of how users perceive equity and sustainability as they realise what and how much they stand to benefit, or not, from the allocation and distribution of benefits. As demands for benefits grow, benefit sharing is increasingly characterised by complex trade-offs among beneficiaries (Rodríguez et al. 2006; Janssen and Anderies 2007; Nkhata et al. 2012). As pressures grow and competition between potential beneficiaries intensifies, it is common for users to challenge the rules and decisions that underpin benefit sharing schemes. An important issue in the management of these situations is that contestation and even supportive behaviours appear at times to be difficult to anticipate, recognise and understand. An appreciation of factors that underpin behaviours is therefore important for the management of benefit sharing schemes. The better we are able to understand the determinants of behaviour, the greater the prospect for designing benefit sharing schemes that encourage support rather than contestation. We acknowledge that the motivations for contestation of the rules that direct benefit allocation may originate from a variety of sources. In this paper, we emphasise two issues and offer propositions to enhance our ability to appreciate and direct behaviours in a social-ecological system (SES) in which users and decision makers are concerned with benefit sharing.

The first and most fundamental proposition is concerned with how users value the resource. We argue that perceptions of the value of benefits is an important factor underlying persistent contestation of, or support for the rules that influence benefit sharing. The valuing of natural resources has traditionally been considered from an economic perspective (de Groot et al. 2012). A problem with economic analysis (i.e. the allocation of scarce resources amongst competing ends) in a benefit sharing context is that it assumes collective agreement on benefits or ‘desirable ends’. This is because economic approaches are more concerned with

quantifying how much ecosystem structure should be converted to economic products and less concerned with the manner in which users perceive benefits and agree upon baskets of benefits (Farley 2012). A related issue is that non-material benefits, which are not easily measurable in economic terms, tend to be under-valued in attempts to illustrate the economic value of ecosystem services to human wellbeing (Daniel et al. 2012; Tengberg et al. 2012). In this paper we argue that value allocation is fundamentally shaped by meaning and context and that when users assign positive meaning to an ecosystem service, that service is perceived to be a human benefit. We also suggest that attention to meanings offers insights into why individuals take the positions they do when supporting or resisting the rules that govern benefit sharing schemes.

The second proposition is that SESs with benefit sharing schemes in which the rules and outcomes are continually contested, are less able to maintain social acceptability, and so become less reliable in the face of change. We propose that robustness (the maintenance of desirable elements) in SESs can be advanced through the collective design of rules that promote and reflect an understanding of meanings and their ordering within defined contexts; and that this may lead to resource users making behavioural adjustments that are in greater accordance with the rules. We argue that the regulatory instruments (rules) should be an outcome of how resource users collectively reflect on the meanings associated with ecosystem services, and the supply and demand for those services.

In this paper, we use an SES framework proposed by Anderies and colleagues (2004), expanding it to advance an understanding of the role of benefits, meanings and behaviours as elements that qualify the relationship between the resource, resource users and regulatory instruments. Using an example we illustrate the difficulties that emerge when systems are not collectively designed to promote opportunities to articulate and order meanings. We use insights around meanings as a way of valuing natural resources, as a basis for a novel proposition in relation to collective institutional design in SESs. We conclude by discussing the implications for robustness and benefit sharing in SESs and we comment on the usefulness and limitations of the framework.

2. Perceptions of resource value: meanings, benefits and behaviour

The Millennium Ecosystem Assessment (2003) and related scholarly works on ecosystem services have made significant conceptual advances in describing and quantifying benefit streams that explicitly link ecosystems and human wellbeing. Although a diversity of approaches is emerging, there is agreement that the manner in which users allocate value to resources and benefits is an important consideration when striving for equity, sustainability and efficiency in sharing benefits (Lockwood 1999; de Groot et al. 2002; Boyd and Banzaf 2007; Wallace 2007; Fisher and Turner 2008). But these scholarly works have focussed predominantly on the expert classification of ecosystem services for the purpose of economic comparison. They have not addressed the manner in which users

assign value to natural resources or how users perceive the benefits that flow from them.

Some scholars have proposed meaning as an element that fundamentally determines behavioural response (Stedman 2003; Davenport and Anderson 2005) and more generally as a way whereby people make sense of their world. This school of thought is based on the premise that human society is characterised by the use of meanings, or symbolic abstractions that denote significance to those who hold the meaning (Colton 1987). Scholars from the field of symbolic interactionism (rooted in sociology and social psychology) such as Mead (1934), Blumer (1969) and Greider and Garkovich (1994) provide foundational principles for the relationship between meanings and behaviour. Human beings act towards things on the basis of the positive or negative meanings assigned to those things. 'Things' can include physical objects, landscapes, other human beings, categories of human beings (e.g. environmentalists or community activists), institutions, ideals (e.g. integrity or independence) and activities and situations. For example, actors can assign meaning to any ecosystem element or service, whether it is classified as an abiotic input, an intermediate (process-oriented) or a final service, or some combination of those (Boyd and Banzaf 2007; Fisher and Turner 2008). The point we wish to convey is that from a behavioural perspective, the allocation of meaning to any ecosystem aspect will lead to a perception of that service or material as a benefit (positive meaning) or a perception that benefits are reduced (negative meaning) and that this will influence behaviour.

Meanings are held personally but are socially constructed, arising out of social interactions. Behaviour is not seen to be imposed by, and is not the product or outflow of social structures. Although meanings are understood to emanate from structures, i.e. the values, norms and cultures by which people define themselves (Saegert and Winkel 1990), behaviour is rather seen as conduct which is formed as actors handle and modify meanings as they encounter different situations or contexts (Blumer 1969). This perspective places deliberate emphasis on human volition and negotiation in the construction of meanings.

Because meanings are assigned, people and landscapes ('things') do not have inherent meaning. Rather, biophysical settings together with personal-social aspects specific to a situation give rise to context and provide the foundations upon which meanings are formed (Mishler 1979; Terkenli 2001; Gobster et al. 2007). This interpretation is similar to that of geographers who define 'place' to mean 'biophysical space imbued with meaning' (Tuan 1993; Vanclay 2008). Thus the construction and priority ordering of meanings is context-dependent, influenced by situational aspects which are themselves in part socially constructed. Through this process, landscapes and landscape attributes become the material manifestation of a system of meanings (Greider and Garkovich 1994). Robinson and Smith-Lovin (1992) state that "once an object becomes a symbolic representation of meaning for a person, it becomes important to maintain that meaning in order to sustain a coherent, cohesive view of the world" (p. 14). Thus meanings are dynamic, expressive of the interaction between natural and cultural forces and therefore

change over time (Antrop 2005). But, being rooted in values and beliefs, meanings have a persistence that gives them long-term continuity (Greider and Garkovich 1994). Scholarly works on 'place attachment' illustrate how meanings and context become tightly bounded such that place attachment tends to be persistent over time (Williams et al. 1992; Kaltenborn 1997; Davenport and Anderson 2005; Manzo and Perkins 2006; Walker and Ryan 2008).

Shore (1991) and Greider and Garkovich (1994) suggest that categories of shared meaning may emerge. One landscape or landscape aspect may embody multiple meanings that can be grouped due to meanings being shared by others in the same setting. Meanings convey significance in two ways. One component conveys distinctiveness, where one meaning is said to contrast with another, held either by the same person or held by others. The second component is concerned with the strength of the meaning held. When meanings are held strongly, they will prompt behaviours that give expression to that meaning and will serve to reinforce that meaning to be significant. When a group of people share the same meaning strongly, they may engage in collective action as a way of reinforcing the significance of their shared meaning, especially when that meaning, or set of shared meanings, is threatened by other meanings. If a proposed change conflicts with meaning, an actor may adjust, or reorder meanings in response to learning about the new context, or meanings held by others, and may then support the change. Alternatively, actors may insist on the priority position of their meaning and contest the change. Because different actors may hold different sets of meanings in relation to the same thing, a proposed change may evoke support from some and resistance from others. "Communities of shared meaning compete for how meaning will be assigned to a specific place or resource." (Williams and Patterson 1996, p. 512). Resource users therefore compete for which meanings will be assigned and given priority and which will subsequently be reflected in the regulatory instruments (rules).

The way in which a benefit is perceived can only be fully appreciated by recognising the manner in which meaning is personally constructed in association with a perceived benefit. For example, a forester earns an income (a benefit) from timber harvesting. For that person, the meaning of the plantation may be commodity, dependence and/or purposeful engagement associated with silvicultural practices, timber harvesting and sales. For a recreationist (e.g. hiker with dogs), the same plantation provides gains such as health through exercise and fresh air and the opportunity to express aesthetic and recreational values. For this person, sense of place (intimacy with the landscape) and scenic beauty and perhaps to a lesser degree purposeful engagement, may be more prominent meanings. If we take this view, then we can appreciate that within a defined landscape benefits are perceived and ordered through multiple and diverse meanings, and that when landscape attributes change, people respond not only to the change in benefits but also, and more fundamentally, to the meanings they may associate with the benefit (Hunziker et al. 2008). Another confounding factor in attempts to manage the sharing of benefits is that some meanings may be more easily substitutable

by changing landscape attributes, as compared to others. A shade tree removed can be replaced over time by a fast-growing tree species for those who associate shade comfort with the tree. But for those who attach heritage meaning to a tree, a replacement tree cannot invoke heritage meaning. Meanings are the fundamental drivers of the demand for benefits. As a consequence, actors will strive to sustain landscape attributes that provide the benefits that hold significant meaning to them.

We do not wish to suggest that the notion of meanings is the only concept that can explain behaviour in a shared resource scenario. However, this approach exposes the complexity inherent in how people perceive and allocate value in association with benefits, showing that meanings are personal, sometimes overlapping, context dependent and therefore variable across space and time. It also suggests that the popular concept of a benefit, or gain, is more fundamentally underpinned by the notion of meaning. If users perceive benefits through the allocation of meaning, then greater appreciation of meaning is necessary in order to understand the behaviours that underpin benefit sharing. Lastly, this approach provides a basis for value allocation which incorporates material as well as non-material value in relation to natural resources. We further wish to explore the incorporation of meaning, benefit and behaviour into ideas on institutional design to expose opportunities for enhancing stakeholder support for benefit sharing schemes.

3. Robustness in social-ecological systems

For this paper we wish to emphasise the linkages between the resource, meanings, behaviours and institutional design in SESs. We therefore draw on a definition by Janssen et al. (2007) who define an SES as composed of interacting biophysical and social components where (1) individuals have purposefully invested time and effort in developing and maintaining infrastructure that affects the patterns of resource use and distribution among stakeholders over time in the process of coping with diverse disturbances and (2) these biophysical and social components are embedded in a network of relationships among smaller and larger components. This interpretation emphasises the point that humans design some parts of the SES, for example the social rules that guide and constrain human action, whilst other parts of the system are self-organising, such as social networks and behaviours.

The SES framework proposed by Anderies and colleagues (2004) is a useful starting point to develop propositions about the relationships among resource users, between resource users and the resource and how these relationships relate to the regulatory infrastructure set up to direct user behaviour. Their framework is a ‘minimal representation’ of variables and linkages to broadly describe a social-ecological system. In that framework the resource is linked with resource users, public infrastructure providers (rule makers) and public infrastructure (regulatory instruments or institutions e.g. rules, trust, and physical infrastructure). The minimal representation provides opportunities for scholars to expand on elements and relationships of the framework across different natural resource contexts, and

to provide more detailed interpretations of subsets of relationships. Various authors have used this framework as a foundation to devise propositions and theories, mainly to develop ideas around vulnerabilities associated with the persistence of certain types of robustness (Anderies et al. 2007; Janssen and Anderies 2007; Janssen et al. 2007). We use an adaptation of the Anderies et al. (2004) SES framework (Figure 1) to emphasise and expand on the relationship between the resource (Figure 1A), resource users (Figure 1B) and the regulatory instruments (Figure 1C) designed to direct behaviours. We then use this interpretation to discuss implications for robustness in social-ecological systems that are also common pool resources.

Robustness is widely appreciated as a key concept when thinking about how SESs respond to change and is an important attribute of system resilience (Folke 2006). The concept is especially useful when wishing to address specific issues of design and decisions in a well-defined system (Anderies et al. 2013). Anderies and colleagues (2004) have defined robustness as "the maintenance of some desired system characteristics despite fluctuations in the behaviour of its component parts or its environment." (p. 7). Robustness in an SES therefore refers to the state of a system resulting from the purposeful design of an aspect of the system such that it

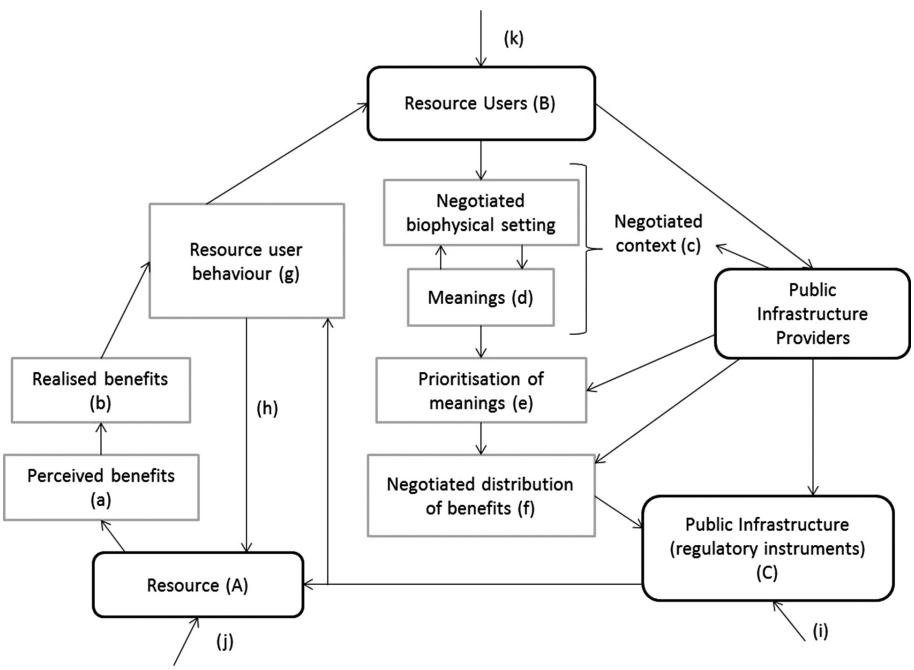

Figure 1: A conceptual framework, adapted from Anderies et al. (2004), showing resource user behaviour driven by the experience of benefits as well as the regulatory instruments that are designed to reflect a prioritisation of meanings and the negotiated distribution of benefits.

is consistent and reliable when subjected to change. The manner in which resource users relate to each other and behave in relation to the resource strongly influences the robustness of a social-ecological system (van der Leeuw and Aschan-Leygonie 2000). This is because coping with the uncertainties inherent in complex systems and making trade-offs among users requires on-going design of the formal and informal institutions that regulate behaviour, and individual and collective commitment to them. We argue that benefits are perceived as a consequence of the context and meanings users allocate to the resource. Following from this, we show that user behaviour is driven by the expectation of (Figure 1a) and by the actual experience of benefits (Figure 1b) as they relate to the constructed contexts (Figure 1c) and meanings (Figure 1d) associated with the resource (Figure 1A).

The intention of the collective design of the regulatory instruments is to facilitate shared understandings among users who have assigned different contexts and meanings to the benefits that emanate from the resource. This shared understanding is necessary to promote the negotiation and priority ordering of meanings (Figure 1e) to achieve collective action because commonly not all meanings can be accommodated nor can the necessary contexts for those meanings be created or sustained. Implied in this is that ordering meanings also serves to define the preferred contexts. During this process, stakeholders may be encouraged to accept that their meanings have been assigned a lower priority in the collective reordering of meanings, but would still behave in ways that are supportive of the rules that govern resource use. Once meanings are articulated and ordered (Figure 1e), and the distribution of benefits (who gets what) affirmed (Figure 1f), it is possible to design the formal and informal institutions (Figure 1c) that will regulate behaviours to align with prioritised contexts and meanings (Figure 1e). Legitimate resource use (Figure 1g) and the accrual of benefits flow from this process, which in turn affects the state of the resource (Figure 1h).

In common pool resources, ecosystem services and meanings can be diverse and therefore an array of user behaviours can result, which may or may not be compatible (Smith et al. 2011). Also, user demands on the resource can change and diversify rapidly. Disturbances may also originate from outside of the system such as policy changes (Figure 1i), ecosystem fluctuations such as floods or droughts (Figure 1j), or changes in the user group and user demands (Figure 1k) that may initially develop outside of the system (Dietz et al. 2003; York and Schoon 2011). The system is therefore dynamic and actors must continually cope with change in order to sustain system robustness. We propose that collective ordering of meanings and associated rules help to direct and regulate behaviours and in doing so these aspects contribute to robustness. We acknowledge that SESs may be characterised by different types of robustness. In particular robustness to one type of variability can lead to an SES developing vulnerability to new kinds of disturbances (Janssen et al. 2007). However, for this paper our aim is to contribute to an understanding of how a particular type of robustness can be developed. Next, we draw upon a case that has been treated in the scientific literature and the popular press to illustrate the conceptual framework.

4. Landscape change, meanings and behaviours

Cape Town is a coastal city at the foot of the iconic Table Mountain situated in the south western corner of South Africa. The City is renowned for easy access to outdoor recreation to visiting tourists and residents alike and a significant proportion of tourism in and around Cape Town is built upon this offering. The native vegetation consists of Mediterranean-type heathland ('fynbos') which does not offer much shade and so over the years people have come to enjoy spending time in commercial plantations of exotic conifer species situated on the mountain slopes within the City metropolis.

4.1. Evolution of collectively designed institutional arrangements

Fast-growing conifers were introduced into southern Africa following European colonisation in the 1650s to provide for a growing timber demand and to prevent over-exploitation of indigenous forests (King 1938; van Wilgen and Richardson 2012). In particular, formal plantations, primarily *Pinus* species, were established on a large scale early in the twentieth century. The plantations on the slopes of Table Mountain are some of the oldest in the country and when demand for this resource generated significant revenue from timber sold to repair ships after World War I, the government of the time created policies to encourage the expansion of plantation forests (Figure 1). Consequently indigenous forests received a greater degree of protection but the primary meanings associated with the plantation resource at this time reflected commercial benefits.

Initially recreational use was discouraged because of perceptions of the risk of fire and so users of the plantation forests, apart from forest managers were few. During the 1970s, responding to growth in public interest for recreation on state lands and plantations the Department of Forestry sought to actively encourage recreation in and public appreciation for plantation forests. This decision was based on the notion that the tax-paying public were 'owners' and should have access to and enjoy benefits from state-owned plantations (Olivier 2009). As a result, additional physical infrastructure such as hiking trails, overnight huts and picnic sites was created to facilitate recreational use. While some sections of the plantations were always being harvested on a rotational plan, the forests were extensive enough to always provide large areas for shaded recreation where trees were mature enough to create a closed canopy. Access was facilitated by the network of roads and tracks that existed to support forest management and the open structure of the plantations created a sense of personal safety. As people engaged and experienced the resource new meanings and associated behaviours emerged and the resource came to be defined differently by multiple users in ways that enhanced place attachment. Importantly, the institutional design evolved in a collective manner. As users responded to forestry policy and the development of infrastructure to further encourage recreation, the design of the social-ecological system reflected the collective meanings and benefits of both timber production and recreational use. During the latter part of the twentieth century, recreation

in plantation forests increased fuelled by urbanisation and improved social and economic circumstances (Bigalke 1983). In Cape Town, plantation uses included horse-riding, mountain-biking, dog-walking, hiking and mushroom harvesting. As a result heritage and recreation-related meanings and benefits, in addition to the utility and commercial benefits from plantations, evolved collectively and became entrenched as users continued to connect with these benefits over time. The plantations became integral to the context that defined resource use and the meanings people attached to the landscape. Policy and practice encouraged a sense of public ownership strengthening perceptions of plantations as common pool resources. This fostered system robustness that would be reflected in how users respond to policy changes that might affect the collectively designed institutional arrangements.

4.2. Robustness and resistance to change

As forestry expanded and was increasingly adopted by the private sector, government sought to redefine its role. In 1997 it issued without public consultation, a new policy that provided for the transfer of less profitable landholdings to national and provincial conservation agencies (White Paper on Sustainable Forestry Development in South Africa 1997; Louw 2012). This set the scene for conservation agencies to exert their influence in ways that would challenge the established collectively designed institutional arrangements of, among others, the Table Mountain SES. For those promoting an appreciation of 'fynbos' this created a chance to emphasise meanings associated with native vegetation in a number of places including urban settings like Cape Town (Rebelo et al. 2011; Anderson and O'Farrell 2012; Holmes et al. 2012). These motivations were stimulated by increased global awareness, particularly among scientists and conservationists, of the uniqueness of the flora of the Western Cape region and of the role of biodiversity in sustaining ecological resilience (Cowling et al. 1992; Goldblatt and Manning 2002).

Assessments of the economic value of biodiversity (Turpie et al. 2003) as well as analyses of the threats to biodiversity (Richardson et al. 1996) have been used to encourage support for conservation policy and practice. One of these threats was the self-seeding and spread of pine trees from plantations (Richardson 1998; Hoffmann et al. 2011; van Wilgen and Richardson 2012). In order to systematically conserve the 'fynbos', critical areas and targets for biodiversity conservation were identified (Cowling et al. 2003; Pressey et al. 2003). The scientists who studied 'fynbos' anticipated that the biodiversity benefits from this vegetation type would be lost unless public infrastructure was created to support 'fynbos' conservation. They lobbied successfully to government and conservation agencies for the control of spreading alien species, for the permanent removal of plantations, and for the re-establishment of indigenous vegetation in priority areas such as around Table Mountain. New regulatory instruments were devised to support biodiversity conservation, the benefits of which remain abstract to some (Conservation

of Agricultural Resources Act of 1983; South African National Water Act of 1998; National Environmental Management of Biodiversity Act of 2004; Table Mountain National Park 2009). The conservation-oriented policy that requires removal of plantations will change the landscape context, accommodating some meanings and behaviours while excluding others that evolved with the plantation forestry context.

Recreationists who use the plantation forests feel that the benefits and the meanings they associate with the plantation forests are threatened and that they are alienated from the process of renegotiating meanings. As a result many users have strongly resisted the decision to permanently remove the plantations. The counter-arguments have been the biodiversity gains (benefits) to be had by replacing the plantation forests with native 'fynbos'. Each is arguing for retaining or rebuilding the biophysical setting that can best support the meanings and contexts that they have prioritised. The debate is well documented (van Wilgen 2012; van Wilgen and Richardson 2012) and resource users and stakeholders have expressed their views through the local press.

"Urban people require woody shade and barrier plants to soften their homes and neighbourhoods. Today the mix of non-indigenous and other South African trees and shrubs make Cape Town the desirable city it has become. Without its non-indigenous woody plants Cape Town would be a hot dusty and wind-swept hell – with the south-easter in summer and the north-wester in winter making life most unpleasant. Unfortunately we have lost almost all our sand plain lowland Fynbos areas. By removing the plantations some people argue that they can return these areas to a low, scratchy, grey-green shrubland full of interesting and intriguing plants that, to thrive, will need to be burnt from time to time by hot fires, ideally in extreme weather conditions. So we are felling the pines to create, in my opinion, a wasteland." (Cape Times; February 2011).

"Although only a few areas have been burnt to date some 328 indigenous plants species of Cape Flats Sand Fynbos and 131 Peninsula Granite Fynbos species have been recorded. By any standards this is a spectacular tally made even more impressive by the 26 threatened IUCN Red List species found in the Cape Flats Sand Fynbos section. [This area] is the last opportunity to conserve Cape Flats Sand Fynbos as a viable ecosystem." And "A perfectly acceptable compromise would be to plant shade trees within 5 minutes' drive of the [restoration] area. This will provide shaded landscapes without compromising threatened Fynbos. Those who want shade can have shade. And South Africa can fulfil its legal obligation as a signatory to the Convention on Biological Diversity to protect 17% of terrestrial areas and to restore at least 15% of degraded areas." (Cape Times; March 2011).

Another issue affecting support for the conservation policy that requires removal of the plantations and restoration of native heathland rests to a large degree upon economic cost-benefit arguments. The economic value of native ecosystems had been highlighted (Turpie et al. 2003), the cost of clearing invasive alien plants had been estimated (de Wit et al. 2001; Marais et al. 2004) and pine plantation forestry is essentially being phased out of the Western Cape because it

is deemed more profitable in other parts of South Africa (Louw 2012). Still, ongoing resistance to the decision to remove the pine plantations frustrates efforts to secure public support. We argue that resource users feel that some meanings, in this case those associated with cultural benefits, are not amenable to economic valuation or language. As a result attempts to apply economic arguments to remove the plantation forests have fuelled frustration and interactions have become adversarial, compromising co-design of institutional arrangements that attract wide public support.

It is commonly assumed that when a policy (regulatory instrument) is established, people will appreciate the rationale, adjust their meanings and behaviours, and support policy intent, in this case, biodiversity conservation. The quotes suggest that while users appreciate policy intent and wish to support 'fynbos' conservation efforts, many contest the idea that this should be achieved through removal of all pine trees. This is especially so because the rationale for removal was first expressed as the need to control spread of pine trees into 'fynbos', a goal that could be and has been achieved through other means as demonstrated elsewhere in South Africa (Forestry Industry Environmental Committee 2002). The proposed transformed landscape without pine plantations and with limited, newly planted tree avenues for shade, will not substitute for the benefits and meanings associated with extensive stands of pine trees. While the land management agency holds a dominant meaning defined by conservation of biodiversity, users hold multiple meanings, including conservation of biodiversity, that they feel were being sustained through their behaviours in the landscape. For many, conservation of biodiversity and the control of spread of pine trees could be achieved simultaneously. In this light we suggest that had the conservation agency been more appreciative of meanings and rights of use established over time and facilitated a collective design process that took meanings and rights into account they would have encountered less opposition and more support regardless of the final policy decision. Showing appreciation for the meanings held by users and purposefully sustaining contexts for accommodating those meanings and the associated benefits would have strengthened the design process by building the social capital which forms an essential foundation for biodiversity conservation, particularly where this is to be achieved in an urban setting. We propose that those who motivate for conservation should appreciate that conservation is one of a number of options and to succeed, public support combined with the achievement of conservation targets may be seen as a desirable longer-term gain for the agency. These ideas are in agreement with work asserting that promoting biodiversity importance is not sufficient for motivating public support for conservation (Brechin et al. 2002; Miller 2005; Knight et al. 2006).

5. Discussion

We argue in this paper that a major issue for collective design and one which has not been given attention in scholarly works is the conceptualisation of the relationship

between resource users and the use and benefits perceived in association with the resource. Some scholars emphasise that these factors significantly influence people's willingness to engage in, and their acceptance of and support for land stewardship and conservation initiatives (Manzo and Perkins 2006; Walker and Ryan 2008; Lokocz et al. 2011). However these issues have not been well understood as being embedded in a complex system of benefits, resource users and the instruments designed to direct behaviours. Despite the contribution economic approaches have made to understanding the role of biodiversity in human wellbeing they have yet to find wide public acceptance particularly because it has proved difficult to acknowledge meanings and incorporate socio-cultural benefits (Appleyard 1979; Williams and Patterson 1996; Oreszczyn and Lane 2000; Philip and MacMillan 2005; Farley 2012).

We propose that the adaptation of the Anderies et al. (2004) framework offers several conceptual advances. Firstly, explicit attention to meanings creates opportunities in the institutional design process for resource users to appreciate the fundamental motivations underpinning the different positions adopted by a diverse range of users. This prompts resource users to learn about and appreciate others' meanings alongside their own. It is therefore reasonable to propose that benefit sharing has as much to do with equity in the distribution of costs and benefits as it has to do with recognising a diverse basket of meanings across contexts and scales that determine how people perceive benefits. The example shows that in situations where meanings are contested the use of conventional expert-analytical approaches to decision-making such as risk and cost-benefit analyses would on their own, most likely not garner public support. This is because they are not set up to expose and take account of meanings and the complex relationship between meanings and the perception of benefits. Rather, they are designed to simplify and aggregate elements of interest as defined by experts (Stirling et al. 2007).

Secondly, the ordering of meanings is necessary in the design process for the sanctioning of certain meaning prioritisations. Conversely, when meaning re-ordering is not sanctioned, resistance to the regulatory instruments may persist, eroding robustness of the SES. An appreciation of a diverse basket of meanings among resource users encourages the ordering of values and meanings among them such that individual resource users may accept or tolerate a decision to favour a certain set of meanings even though it may not have been their preferred meaning or set of meanings within the particular context.

Thirdly, our framework sets out to describe a dynamic social-ecological system. In common pool resources in particular, the resource typically delivers benefits to a diverse user group. And as the example illustrates, new contexts and new meanings may emerge as situations change. We argue that given the dynamic aspects of the system, it is likely to be more robust if the design process continually and reliably reflects an appreciation, ordering and re-ordering of a range of values and meanings. We acknowledge the risks of proposing single 'solutions' (for example robustness) to issues relating to natural resource governance systems (Ostrom et al. 2007). However, our work as well as that of

others (Wilson et al. 2007) suggest that given the personal nature and the diversity of meanings and perceived benefits, it may be feasible to place emphasis on users, the meanings they hold, their influence on the design of the regulatory instruments and the potential for user self-organisation around the monitoring and sanctioning of behaviours.

This study asserts that meanings are exposed when actors participating in the process of negotiating desired contexts are asked to describe motivations associated with certain benefits. Those meanings may have more influence and explanatory power related to user behaviour than the resource or policies or management action that is being discussed. We further assert that indicators of meaning such as symbols and emotions can be expressed verbally (Kaltenborn 1997). While 'meaning' is difficult to measure since meanings are held individually and personally, designing interview questions or prompts that elicit responses from resource users to be expressive of meanings or sets of meanings can be developed. It has also been suggested that some sets of meanings are more common and have more knowledge and expressive power such that some classes of meanings may be easier to study than others (Lockwood 1999; McCool 2001). We hope that these methodological challenges encourage scholars to explore possible ways to resolve these difficulties, test the theoretical constructs proposed here and to present further cases to strengthen our understanding of how robustness is enhanced in social-ecological systems for improved benefit sharing.

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