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## REVIEW ARTICLE



### A model integrating social-cultural concepts of nature into frameworks of interaction between social and natural systems

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Existing frameworks for analysing interactions between social and natural systems (e.g. Social-Ecological Systems framework, Ecosystem Services concept) do not sufficiently consider and operationalize the dynamic interactions between people's values, attitudes and understandings of the human-nature relationship at both individual and collective levels. We highlight the relevance of individual and collective understandings of the human-nature relationship as influencing factors for environmental behaviour, which may be reflected in natural resource management conflicts, and review the diversity of existing social-cultural concepts, frameworks and associated research methods. Particular emphasis is given to the context-sensitivity of social-cultural concepts in decision-making. These aspects are translated into a conceptual model aiming not to replace but to expand and enhance existing frameworks. Integrating this model into existing frameworks provides a tool for the exploration of how social-cultural concepts of nature interact with existing contexts to influence governance of social-ecological systems.

**Keywords:** human-nature relationship; social-ecological system; environmental behaviour; governance

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## 1. Introduction

Frameworks for analysing relationships and interactions between social and natural systems, also described as Human–Environment Interactions or Coupled Social-Ecological Systems, have become mainstream paradigms for the science, practice, and policy of sustainability (Binder *et al.* 2013). Prominent examples are the Social-Ecological Systems Framework (Ostrom 2007, 2009) and the Millennium Ecosystem Assessment Framework (Millennium Ecosystem Assessment 2003), which included and popularized the Ecosystem Services concept. A more recent addition is the framework proposed by the Intergovernmental Platform on Biodiversity and Ecosystem Services IPBES, which strives to reach beyond traditional formalized Western science thinking (Díaz *et al.* 2015).

Figure 1 illustrates the general structure of such frameworks. Differences between individual variants relate to: (1) the understanding of the social-cultural system as being separate from or part of the natural system, (2) the understanding of the linkages between the social-cultural and the natural system (e.g. focus on material flows, economic benefits, symbolic meanings), and (3) the complexity of feedback mechanisms within and between social-cultural and natural systems. For a detailed analysis of commonalities and differences between various concepts, see Binder *et al.* (2013), and for a critical discussion of the extensive use of such frameworks see Stojanovic *et al.* (2016).

While such frameworks are widely regarded as useful for both research and governance, they have also been criticized for various reasons: (1) Most existing frameworks do not sufficiently consider the diversity of motivations for modifying, managing, protecting, or restoring ecosystems. These motivations are rooted in different individual and collective understandings of the human-nature relationship, as extensively studied in social sciences such as environmental psychology, social psychology, sociology, and anthropology (Fabinyi, Evans, and Foale 2014; Mathez-Stiefel, Boillat, and Rist 2007; Greider and Garkovich 1994; Eder 1996; Daniel *et al.* 2012). (2) Many frameworks under-recognize the effects of social-cultural features, particularly how interactions between individual features (e.g. attitudes and values) interact with collective features (e.g. institutions, norms, customs, symbols) to influence environmental behaviour (Manfredo *et al.* 2014; Romero and Agrawal 2011). (3) Some frameworks tend to ignore the role of situational aspects, particularly technocratic, economic and managerial discourses that might lend a privileged voice to some understandings of human-nature relationships while crowding out others (see Raymond *et al.* 2013; Rode, Gómez-Baggethun, and Krause 2015; Turnhout *et al.* 2012).

There is a growing recognition among scientists that it is essential to consider the interactions of social and ecological aspects across multiple disciplines, systems of

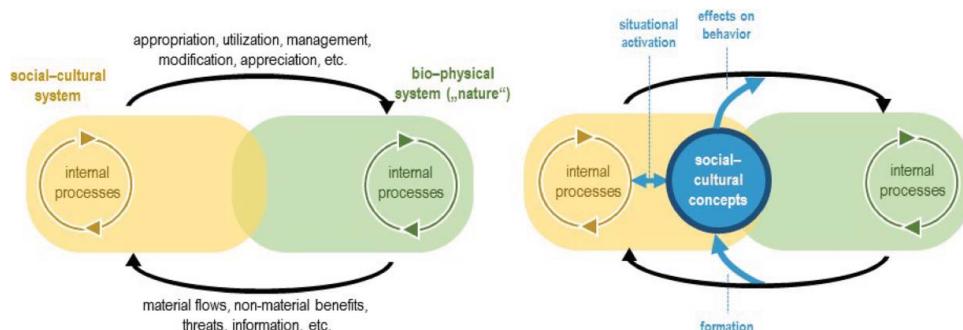


Figure 1. General structure of frameworks to analyse interactions between social and natural systems (left) and proposed add-on module to integrate social-cultural concepts of nature (right).

knowledge and policy contexts to understand changes in ecosystem services and human well-being (Carpenter *et al.* 2009; Davies *et al.* 2015). Empirical evidence shows that disregard of social-cultural concepts of nature can even lead to project failure. In a seminal analysis of World Bank financed development projects of the 1980s, Kottak (1990) found that projects that did not sufficiently consider cultural values of the population were less likely to be successful in economic terms such as income generation. A more recent literature review of publications on community-based conservation interventions (Waylen *et al.* 2010) showed that the consideration of local cultural contexts is a key factor for the success of such projects. Resources found in agricultural crops (Barnes *et al.* 2011) and water systems (Andolina 2012) might be seen as simple commodities by Western standards; however, the spiritual meanings of these resources may differ among indigenous groups and ultimately result in the adoption of different management practices. Different sacred values between primary stakeholders, managers and the government, or the missing reflection of these values in decision-making processes, can lead to conflicts (Daw *et al.* 2015). The various bonds between people and their places of residence can stimulate resistance against infrastructure developments (McCreary and Milligan 2014). New technologies will be more readily accepted by indigenous people when there is a cultural match with the respective understanding of nature. For example, acceptance of photovoltaics in certain traditional communities could be facilitated by adopting local terms for describing the sun as the universal source of energy (Dreveskracht 2013). A recent literature review (Rode, Gómez-Baggethun, and Krause 2015) showed that economic incentives for nature conservation can either undermine (crowd out) or reinforce (crowd in) people's intrinsic motivations to engage in biodiversity projects. While the majority of scholarly literature in this field focuses on social-cultural concepts of indigenous people in the context of development projects, similar examples can also be found in Western industrialized societies, e.g. when controversies about conservation projects are rooted in different understandings of the human-nature relationship among the various actors (Couix and Hazard 2013).

Individual disciplines are now addressing some of the concerns reviewed above by improving understanding of the interactions between culture and the environment. For example, within the ecological economics scholarship, researchers have developed: (1) frameworks showing connections between environmental spaces, culture and ecosystem management practices (e.g. Church *et al.* 2014; Fish, Church, and Winter 2016); (2) methods for assessing shared and social values for ecosystems within and between individuals and groups (Kenter *et al.* 2016; Raymond *et al.* 2014), and; (3) measurement models for assessing the effect of these values on behaviour formation and change (Raymond and Kenter 2016).

The objectives of our paper are to (1) present and discuss the diversity of existing social-cultural concepts for addressing the human-nature relationship, (2) highlight the relevance of individual and collective understandings of the human-nature relationship as influencing environmental behaviour, and (3) propose a model for the integration into established frameworks of coupled social-ecological systems that particularly addresses the sensitivity regarding individual, social or institutional contexts within which processes and actions are embedded.

Our work is based on a broad scoping of the literature and our own research experiences from a large number of individual projects across the developed and developing world. The literature review focuses on relevant review articles for each subtopic, but also includes selected single case studies for illustration. Within this journal's special issue on "Human-nature relationships and their implications for environmental management", our article has also been designed as a reference point

regarding fundamental literature, thus avoiding redundancies in other individual contributions. The idea of providing a model for a better consideration of social-cultural concepts of nature in social-ecological systems frameworks is per se interdisciplinary. However, the literature review had to consider a wide range of disciplines such as social psychology, environmental economics, and governance, each with their individual terminologies and sometimes inconsistent definitions.

Within this paper, we use the term “social-cultural concepts of nature” as an umbrella term for a number of concepts describing and operationalising the individual or collective understanding of nature and of the complex relationship between humans and their natural environment (see Section 2). “Environmental behaviour” is used here in a neutral sense as any kind of behaviour that has a direct or indirect positive or negative impact on natural environments, such as individual consumption, land-use practices or engagement in conservation activities (Poortinga, Steg, and Vlek 2004).

## 2. Social-cultural concepts in the context of human-nature relationships

Social-cultural concepts of nature are a specific subset of general social-cultural concepts such as worldviews, collective traditions and experiences, beliefs, values and attitudes (Luloff *et al.* 2007; Qin and Flint 2017), and therefore also need to be seen in relation to those (see Figure 2).

Most of the key concepts reviewed in recent literature have acted as paradigms, gathering researchers around them without much inter-paradigmatic traffic. Consequently, different scholarships may have the same name for a given concept, but define or apply it in various ways. For example, there are diverse intellectual origins

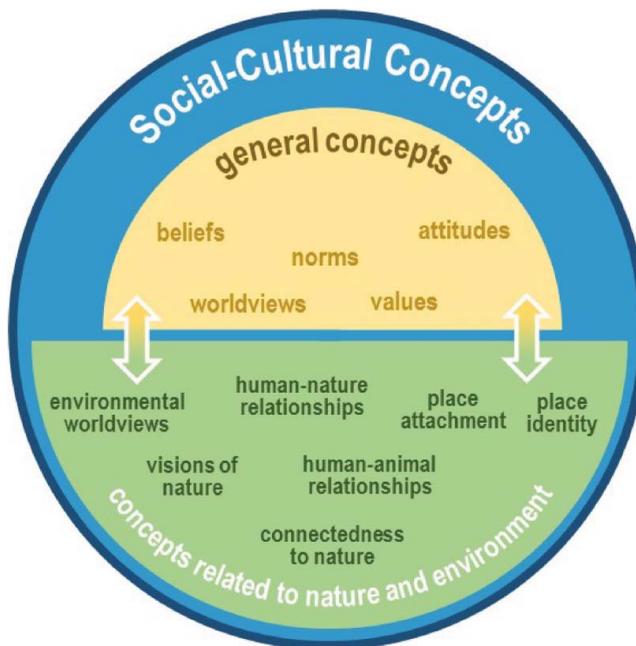


Figure 2. Overview of representative social-cultural concepts in the context of human–nature relationships.

behind the ‘sense of place’ concept, which has resulted in ‘place’ being considered a centre of meaning, a locus of attachment, as well as from phenomenological, discursive and information processing approaches (Williams 2014a, 2014b). In this way, human-nature relationship concepts are not mutually exclusive but tend to organize research in specific ways, starting out from different initial foci, be it nature in general or selected parts of nature such as animals or specific locations, and focusing on different aspects, as summarized in Table 1. This pattern implies that the human-nature relationship research field is still dynamic with a growing number of publications originating from many different disciplines and developed for diverse applications.

Social-cultural concepts of nature become manifest at all levels of human organization: individual people, communities, collective actors such as corporations, NGOs or government agencies, and the general macro level of cultural patterns and public discourse (Manfredo *et al.* 2014). However, within each level these social-cultural concepts are expressed, reflected and documented in different ways. For example, governmental discourses on human-nature relationships are generally more dominated by rational, often economically determined frames such as the ecosystem services approach, compared to the individual or the group level, where people’s connectedness to nature can also include emotional or spiritual dimensions. The multifarious dynamics between the individual and the collective level can be a determinant for the success of resource management and conservation measures (Kenter *et al.* 2014).

### 3. Established methods for investigating human-nature relationships

Methods employed for investigating and discussing human-nature relationships in the context of natural resource management vary according to the purpose of their application and the disciplines in which they are grounded. These methods can address either individuals or groups, facilitate different degrees of interaction between participants or with the researchers, and stimulate discussions and reflection of different intensity and duration.

Quantitative approaches to investigate social-cultural concepts of nature at the individual level mostly use standardized survey instruments with predefined sets of dichotomous or continuous response options (Bauer, Wallner, and Hunziker 2009; Braitto *et al.* 2017; de Groot and de Groot 2009; van den Born 2006), often referring to established measurement scales such as the Humans and Nature (HaN) scale (de Groot and van den Born 2007), the Connectedness to Nature (CTN) scale (Mayer and Frantz 2004) or the New Environmental Paradigm (NEP) scale (Dunlap *et al.* 2000). At the group level, interactive quantitative instruments such as discourse-based valuation (Wilson and Howarth 2002) are less common in this research tradition. Studies relying on spatial analysis and on-site behavioural observations are employed to complement surveys and acquire generalizable knowledge about people, objects, events, and processes.

Qualitative approaches such as semi-structured interviews with individuals (van den Born 2008) or focus groups discussions at the collective level (Buijs *et al.* 2008; Fischer and Young 2007) allow for inductive reasoning, interaction and reflection, and take into account the context and cultural background of respondents. This is particularly useful when the research process should prepare grounds for decision-making in natural resource management (Lynam *et al.* 2007; Davies *et al.* 2015). Discussion processes conducted over several sessions can exhibit a shift from more distant argumentation toward deeper immersion into the topic (Ahnström *et al.* 2009), thus also providing space

Table 1. Summary of widely used concepts of the human–nature relationship and their analytical dimensions.

Objects of attention and concepts	Description	Operationalization of concept
PLACE		
Place attachment	<p><u>Definition:</u> The emotional bonds a person develops with various places. It can be organized along multiple dimensions of person (the actor who is attached), the psychological process (how affect, cognition and behaviour are manifest in attachment) and place (the nature of the area which the person is attached to) (Scannell and Gifford 2010).</p> <p><u>Evolution of concept:</u> Research consists of methodological and theoretical traditions of the geographical dimensions of “sense of place” (qualitative) and “psychometric” dimensions (quantitative) (Lewicka 2011). The most common distinction is between place attachment (affective bonds and symbolic meaning) and place dependence (instrumental bonds with place).</p>	<p>From a psychometric perspective, a range of dimensions have been measured (see (Raymond, Brown, and Weber 2010) for an overview):</p> <p><i>Place identity</i> – the mixture of feelings about specific physical settings and symbolic connections to place</p> <p><i>Place dependence</i>– degree to which the physical setting provides conditions to support an <i>intended use</i></p> <p><i>Social bonding</i> – feelings of belongingness or membership to a group of people, such as friends and family, as well as the emotional connections based on shared history, interests or concerns.</p>
NATURE		
Social representations of nature	<p><u>Definition:</u> The images of nature that are developed in the encounters of people and the natural environment. The images are culturally (Kloek <i>et al.</i> 2017) and historically contingent systems of values, ideas, and practices that are used by social groups to understand the natural environment (Buijs <i>et al.</i> 2012).</p> <p><u>Evolution of concept:</u> Early work focused on normative elements of images (values and value orientations) and cognitive elements (beliefs and definitions) (Buijs, Elands, and Langers 2009). The current concept also considers expressive elements, such as perceived beauty and fascination (Kloek 2015).</p>	<p><i>Values of nature</i> – the reasons why nature is perceived to be important. Usually divided into anthropocentric, ecocentric and biocentric values (Buijs 2009).</p> <p><i>Definitions and boundaries of nature</i> – what people consider as nature and what types of nature they distinguish (Buijs 2009).</p> <p><i>Nature related beliefs</i> – associations people establish between nature and the attributes they ascribe to it (Buijs 2009).</p> <p><i>Psychological experiences</i> – how people experience nature emotionally or feel about nature (Kloek 2015).</p>

(continued)

Table 1. (Continued)

Objects of attention and concepts	Description	Operationalization of concept
Visions of nature	<p><u>Definition:</u> Images derived from environmental philosophy of the human–nature relationship, and guiding principle for the appropriate relationship with nature (van den Born <i>et al.</i> 2001).</p> <p><u>Evolution of concept:</u> Three concurrent developments, such as guiding principle for the appropriate relationship with nature, images of nature and values of nature.</p>	<p><i>Images of Nature</i> – what people consider as nature and what types of nature they distinguish</p> <p><i>Values of Nature</i> – the reasons why nature is perceived to be important</p> <p><i>Images of the human–nature relationship</i> – the images of the appropriate relationship between humans and nature:</p> <ul style="list-style-type: none"> <li>• Master over nature</li> <li>• Steward of nature</li> <li>• Partner with nature</li> <li>• Participant in nature</li> </ul> <p>Images are measured with the <i>Humans and Nature scale</i> (HaN) (van den Born 2006; De Groot and van den Born 2007; De Groot 2012).</p>
Connectedness to nature	<p><u>Definition:</u> The extent to which individuals include nature as part of their identity, on three key levels: cognition (how integrated one feels with nature), affect (an individual’s sense of care for nature) and behaviour (an individual’s commitment to protect the natural environment) (Schultz 2002). Also known as nature relatedness, connectivity with nature, emotional affinity toward nature, or inclusion of nature in self.</p> <p><u>Evolution of concept:</u> Has evolved to distinguish between Nature-Relatedness (Self) representing an internalized identification with nature; Nature-Relatedness (Perspective) representing an external, nature related worldview, and Nature-Relatedness (Experience), representing a physical familiarity with the natural world.</p>	<p>Measurement scales include:</p> <p><i>Connectedness to Nature Scale [CNS]</i> (Mayer and Frantz 2004) – measuring conscious emotional connection to the natural world.</p> <p><i>Implicit Associations Test [IAT]</i> (Schultz <i>et al.</i> 2004) and Inclusion of Nature in Self [INS] (Schultz 2001) – measuring how much nature is included in an individual’s identity.</p> <p><i>Nature Relatedness Scale [NRS]</i> (Nisbet, Zelenski, and Murphy 2008) – measures a broader set of concepts than CNS including physical interaction, comfort level and familiarity with nature.</p> <p>Strong correlations between different measures of connectedness to nature scales have been demonstrated (Tam 2013).</p>

(continued)

Table 1. (Continued)

Objects of attention and concepts	Description	Operationalization of concept
Environmental worldviews	<p><u>Definition:</u> Nature-based, “primitive” beliefs that reflect an individual’s fundamental priorities about human–environment interactions (Oskamp and Schultz 2005).</p> <p><u>Evolution of concept:</u> Was initially developed to understand the social basis of environmental concern (Dunlap and Van Liere 1978; Van Liere and Dunlap 1980) but more recently to understand environmental behaviour (Stern <i>et al.</i> 1999). A large body of research suggests that underlying belief systems predispose people to act in support or opposition of policy change (Milfont and Duckitt 2004; Nooney <i>et al.</i> 2003). However, the construct has been contested (Amburgey and Thoman 2011).</p>	<p>The New Ecological Paradigm (NEP) (Dunlap <i>et al.</i> 2000) scale indicates potential endorsement of an environmental worldview. It is comprised of statements about living in harmony with (i.e. biocentrism) or having mastery over nature (i.e. anthropocentrism).</p>
ANIMALS		
Wildlife value orientations	<p><u>Definition:</u> Consist of networks of basic beliefs that organize around values and provide contextual meaning to those values in relation to a particular domain such as wildlife. Value orientations are seen as part of a value – attitude –behaviour hierarchy (Manfredo, Teel, and Henry 2009).</p> <p><u>Evolution of concept:</u> There is a long-lasting discourse on human–animal relationships (see e.g. Kellert (1985), with subdiscourses focusing on specific groups such as birds (Ainsworth 2014) or domestic animals (Vining 2003). For a comprehensive review see Hosey and Melfi (2014).</p>	<p>Early research measured wildlife value orientations across the dimensions of: wildlife use, wildlife rights, recreation wildlife experience, bequest and existence, hunting/anti-hunting, residential wildlife experience, wildlife education, fishing/anti-fishing (Fulton, Manfredo, and Lipscomb 1996).</p> <p>These orientations have since been clustered into two higher-level dimensions of <i>domination</i> (extent to which an individual or group’s value are shaped by human mastery over nature) and <i>mutualism</i> (extent to which life forms have rights like humans and deserving care and compassion) (Manfredo, Teel, and Henry 2009; Teel and Manfredo 2010).</p>

for more personal, emotional or spiritual expression. Such a mode shift can also be achieved by implementing approaches such as role playing (Bourgoin and Castella 2011) or the production of artworks such as sculptures or videos (Gibbs 2014; Kagan 2013; Edwards, Collins, and Goto 2016). These approaches help to overcome challenges in communicating issues of human-nature relationships and allow a rich, multi-faceted reflection.

For the analysis of explicitly stated or implicit human-nature relationship aspects in policy papers, newspaper articles, books and other written sources, well-established methods of document or content analysis can be implemented (Daugstad, Svarstad, and Vistad 2006; Stremlow and Sidler 2002).

#### **4. The situational dependence of linkages between human-nature relationship and behaviour**

A host of cognitive and affective processes shape individual and collective decisions. In this context, human-nature relationship concepts work in tandem with situational factors to induce or constrain behaviour (Flint *et al.* 2013; Braito *et al.* 2017). If these combined effects of social-cultural concepts and situational factors are ignored, estimates of human behaviour may be rendered invalid or unreliable. There are also various methodological and conceptual challenges to modelling environmental behaviour, such as the compatibility among survey items (Ajzen and Fishbein 2005), different levels of specificity in the questions asked to stakeholders (Tarrant and Cordell 1997) and language used in survey instruments (Kaiser, Schultz, and Scheuthle 2007). These uncertainties may affect a researcher's ability to understand, anticipate and guide governance of human behaviours, which are crucial for the long-term success of conservation initiatives and sustainability (Mascia *et al.* 2003; Schultz 2011).

A variety of universal theories and models have been developed in social psychology to better understand the processes that influence behaviour (Bamberg and Möser 2007). Under the assumption of rationality, the Theory of Planned Behaviour (Ajzen 1985) is one example of a social psychological model that provides insight into the predictors of behavioural intentions including general attitudes, perceived behavioural control, and subjective norms, as well as belief structures that antecede these constructs. Another approach to estimating actions that can affect the environment relies on moral normative concerns (rather than self-interest). The Value-Belief-Norm Theory of Environmentalism (Stern *et al.* 1999) and the Norm-Activation Model (Schwartz 1977) are two example frameworks that have provided conceptual roadmaps for a longstanding body of research to disentangle the complexities of human behaviour.

When trying to understand environmental behaviour, the interactions between human-nature relationship concepts and a range of situational factors must be considered (see Figure 3). These interconnected factors are crucial to understand the human-nature relationships and resultant behaviours (Manfredo and Yuan 1992). These various factors are described below.

##### **4.1. Thematic and spatial focus**

First of all and relevant for all other factors, the thematic focus of a decision process, i.e. the natural resource that may be affected by human activities is a critical consideration. For example, research has suggested that farmers who own both cropland and forests tend to act according to a "stewardship of nature" (van den Born 2006) orientation in forests,

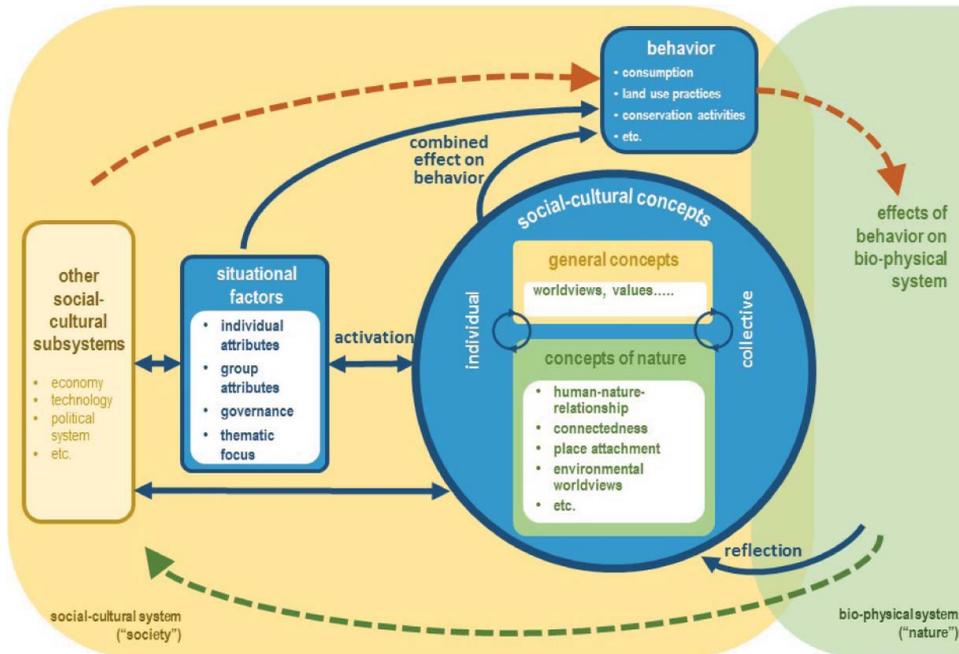


Figure 3. Detailed structure of the add-on module to integrate social-cultural concepts into frameworks of interaction between social and natural systems: dashed lines refer to the structure of existing frameworks (see Figure 1) and solid lines indicate the proposed extension.

while on cropland their behaviours are guided more by “mastery of nature” orientations (Huber 2012; Yoshida, Flint, and Dolan 2017). Another example is the concept of flagship species in biodiversity conservation that is based on the observation that certain species can more easily activate participation in conservation initiatives than others (Jepson and Barua 2015). Also the spatial dimension of the thematic focus can be relevant. For example, Van Riper and Kyle (2014) identified differences in national park visitors’ environmental worldviews and the perceived values of places across spatial scales. Results from this study indicated that survey respondents who endorsed an environmental worldview were more likely to ascribe values to places not experienced first hand. Thus, incidents in an individual’s immediate personal vicinity (as opposed to experiences occurring farther away) can trigger different behavioural responses (Kubo and Shoji 2014).

#### 4.2. Individual attributes

Individual characteristics such as values, and personality remain relatively stable over the course of a person’s life (Dietz, Fitzgerald, and Shwom 2005), however, other individual-level attributes such as attitudes and, in particular, emotions are relatively sensitive to situational contexts. For example, in the case of attitudes towards flood control, personal involvement in recent extreme events can activate concepts of control rather than concepts of partnership with nature (Shaw 2016; Muhar and Böck 2017). This is insofar relevant as planning processes for disaster management are often initiated immediately after extreme events when actors might still be emotionally affected. These individual attributes have important direct and indirect effects on

behavioural intention and self-reported conservation behaviour (for an overview, see Raymond and Kenter 2016) and participation in biodiversity conservation programmes (Moon, Marshall, and Cocklin 2012).

#### **4.3. Group attributes**

Group-level characteristics such as shared experiences, power relationships, peer pressure and social control also affect behaviour (Kenter *et al.* 2014). Culture (e.g. norms, traditions, ideas, material objects, and symbols) and social structures of societies (e.g. race, gender, ethnicity, class) are important considerations for groups that comprise the contexts surrounding individuals and management entities (Brennan, Flint, and Luloff 2009; Flint *et al.* 2013; Wildavsky 1987). In the context of natural resource management, state-funded programmes often target and support community-based action, where the internal dynamics within action groups can be significant determinants for the success of such programmes, as e.g. shown by (Kingwell, John, and Robertson 2008) in a review of conservation projects addressing land degradation in Australia.

#### **4.4. Governance**

The governance regime incorporates the organizational setup of stakeholder involvement in decision-making, the management tactics that support message framing, and the establishment of formal and informal policy instruments that shape natural resource use (Jordan, Wurzel, and Zito 2005). The framing of a governance process towards a certain human-nature relationship concept can either attract or deter certain stakeholder groups (Rode, Gómez-Baggethun, and Krause 2015). For example, Van Riper *et al.* (2016) found that informal policy instruments were particularly instrumental in co-creating knowledge and reflecting the place meanings of key stakeholder groups in the Great Barrier Reef Marine Park. In line with past research (Ostrom 2000), this study found a variety of institutional arrangements worked in tandem with group and individual level processes that encouraged and constrained decisions about human–environment interactions.

### **5. Integration into existing frameworks of social-ecological systems**

We suggest that social-cultural concepts of nature should be better considered in existing frameworks analysing social-ecological systems. Figure 3 presents a model that is designed to function as an “add-on module” or extension to such frameworks, rather than proposing to replace them. We intended to set the level of detail to leave sufficient leeway for adaptation and integration into a wide range of frameworks.

The model operationalizes the relationship between various aspects discussed in previous sections of this paper: Social-cultural concepts of nature are embedded in general social-cultural concepts such as worldviews and values, indicating there is always an interaction between the individual and the collective level. Effects of human behaviour on the biophysical system and their relationship to other social-cultural subsystems (e.g. economy, technology, religion, political system) are reflected in the formation of different understandings of the human-nature relationship. These concepts can be activated by a number of situational factors such as governance arrangements, which together then influence certain behaviour. Both the social-cultural concepts and the

situational factors are, of course, linked in various ways to other components or subsystems of the social-cultural system such as economy, technology, and politics.

## **6. Discussion and conclusions**

### **6.1. Challenges and opportunities for implementation in individual frameworks and project designs**

The module proposed here can serve as a guide for researchers, to consider how human-nature relationship dimensions fit within broader frameworks of human–environment interactions. The module accommodates a wide range of epistemological approaches and research methodologies, although it will need testing and assessment across cultures and disciplines. Our social-cultural model is also useful for better understanding of how ‘culture’ is inherently linked to individual and collective aspects of the social-ecological system (as opposed to how culture is presented as an independent unit in the ecosystem services framework).

Given that empirical research in this field tends to rely upon the integration of qualitative and quantitative methods, approaches that recognize the complementarity of qualitative and quantitative data offer the greatest promise. In [Table 2](#), we provide an overview of the potential contributions of our add-on module to some selected social-ecological frameworks.

### **6.2. Suggestions for further research**

Our add-on module exists at a conceptual level and warrants empirical investigation. We particularly encourage researchers to consider how individual and collective psychological processes interact with each other to drive behaviour formation and change within the individual ([Manfredo \*et al.\* 2014](#)). Existing behavioural models within environmental psychology rarely account for such multi-level effects, which may explain why much of the variance in conservation behaviour ([Gosling and Williams 2010](#); [Raymond, Brown, and Robinson 2011](#)), as well as in other forms of behaviour remains unexplained ([Gifford 2014](#)).

Temporal and spatial dimensions of the human-nature relationship and behaviour formation also require more attention ([Restall and Conrad 2015](#)). Such research may also include mapping how spatial factors relevant to people’s places of interest interact with their understanding the human-nature relationship, as well as how these interactions develop over time ([Dvorak and Brooks 2013](#); [Pagès, Fischer, and Van der Wal 2017](#)).

### **6.3. Implications for practice**

Managers of planning and governance processes in natural resource management at all scales need to be aware of the role that social-cultural concepts of nature play in different contexts. This requires a translation of the scientific terms around human-nature relationships into plain language. Stakeholders in such processes should be encouraged to reflect on their own and others’ positions ([Raymond \*et al.\* 2010](#)). In addition, managers and researchers have to recognize that their positions of power may discourage open communication regarding local beliefs and practices. Therefore, participatory and

Table 2. Options for integrating the add-on module into selected existing frameworks of interaction between social and natural systems.

Framework	Ecosystem services (Millennium Ecosystem Assessment 2003)	Social-ecological systems (Ostrom 2007, 2009)	IPBES (Diaz et al. 2015)
Key principles	Biophysical systems generate goods and services that are crucial for human well-being. Accurate valuation of services is assumed to lead to better awareness of the importance of ecosystems, enable exchange payments between resource users, and improve ecosystem stewardship.	The Social Ecological Systems (SES) Framework was developed to understand and improve the management of common-pool resources. Accordingly, a system is comprised of resource systems (biophysical component), resource units (goods or services being extracted), governance systems (rules and actions regarding the regulation and management of the system), and users (people who extract and benefit from the resource units).	The IPBES framework can be viewed as a recent extension and expansion of the ecosystem services framework. It is far broader than traditional ecosystem services frameworks, considering multiple forms of knowledge, worldviews and different framings of human–environment interactions.
Potential contributions from integrating the HNR module	Defines well what constitutes a service and how socio-cultural concepts influence the importance of particular services. Considers clearly situational factors that create benefits from ecosystem services for individuals, rather than focusing on abstract societal benefits only. Shows the importance of economic considerations for explaining and influencing environmental behaviour. Appreciates gradually what well-being is and how it can be achieved.	Suggests that not all environmental features need to be considered as “resources”. Highlights different ways of perceiving landscapes and valuing biophysical features. Stresses that “users” are not a homogenous group of people, but individuals with different HNR concepts, values and histories. Provides guidance on tools and methods to understand the interplay between individuals, groups of actors and management systems.	Highlights the centrality of worldviews and concepts of nature in shaping a socio-cultural system. This, in-turn, can influence the conceptual structure of the model. Could assist the IPBES framework in capturing the differences between individual concepts of nature and collective concepts of nature. Can expand on how nature’s benefits influence people’s quality of life by accounting for the complexities of human behaviour, its antecedents and effects.

(continued)

Table 2. (Continued)

Framework	Ecosystem services (Millennium Ecosystem Assessment 2003)	Social-ecological systems (Ostrom 2007, 2009)	IPBES (Diaz et al. 2015)
Challenges for integrating the HNR module	<p>Defining the purpose of ecosystem services assessment so HNR concepts can be targeted appropriately.</p> <p>Availability of information on individual and group attributes and situational factors</p> <p>Consider the complexity of interactions between individual and collective processes influencing behaviour</p> <p>Difficulty of mapping of the spatio-temporal dynamics of human–nature relationships</p> <p>Reduced clarity of individualized (compared to expert-based) definitions of ecosystem services</p> <p>Accounting for the relevance of ecosystem services to diverse populations.</p> <p>Assessing how access to, and experience of, ecosystem services affect nature connectedness, values and worldviews</p>	<p>Incorporate socio-cultural concepts of nature into the structure of first and second tier variables adopted in SES.</p> <p>Dealing with increasing model complexity</p> <p>Translating the complexity and nuance of human–nature connections into practical recommendations for resource governance.</p>	<p>Communicating socio-cultural concepts of human–nature relationships to policy.</p> <p>Relating indigenous perspectives on nature to scientific knowledge</p>

collaborative engagements that share power can improve management decisions and foster better conservation outcomes (Reid *et al.* 2009).

While there is still a need to further develop methods for addressing and operationalizing human-nature relationships in research projects, this is even more relevant for improving the practice of natural resource management. “Human–nature relationship toolkits” prepared by international organizations such as UNEP or UNESCO, various Convention secretariats, and globally acting NGOs to be used by government agencies, practitioners, NGOs, and citizens’ groups could therefore be very useful. Such toolkits could also be tailored for certain ecosystem types or cultural contexts, and be included in manuals for specific management issues, such as aquatic ecosystem management (Ruettinger *et al.* 2014). Education for Sustainable Development platforms, such as the UNECE Steering Committee on ESD are several examples of international multi-stakeholder avenues for raising awareness about the role and application of social-cultural concepts of nature, and promoting further development of methods and practices.

Considering the role of social-cultural concepts of nature is particularly useful in the context of UNESCO’s work on the links between biological and cultural diversity striving to achieve a holistic approach consistent with cultural and spiritual values, worldviews, knowledge systems and livelihoods that contribute to conservation and sustainable and equitable use of biodiversity (Persic and Martin 2008; UNESCO 2010). Future research could benefit from applying the add-on module in different real-world decision contexts in order to better understand how environmental policies and strategies may influence the relational dynamics among individuals, societies and the environment, and how these relations contribute to individual and collective behaviour and decision-making.

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