

## The Intersections of Biological Diversity and Cultural Diversity: Towards Integration

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### Abstract

There is an emerging recognition that the diversity of life comprises both biological and cultural diversity. In the past, however, it has been common to make divisions between nature and culture, arising partly out of a desire to control nature. The range of interconnections between biological and cultural diversity are reflected in the growing variety of environmental sub-disciplines that have emerged. In this article, we present ideas from a number of these sub-disciplines. We investigate four bridges linking both types of diversity (beliefs and worldviews, livelihoods and practices, knowledge bases and languages, and norms and institutions), seek to determine the common drivers of loss that exist, and suggest a novel and integrative path forwards. We recommend that future policy responses should target both biological and cultural diversity in a combined approach to conservation. The degree to which biological diversity is linked to cultural diversity is only beginning to be understood. But it is precisely as our knowledge is advancing that these complex systems are under threat. While conserving nature alongside human cultures presents unique challenges, we suggest that any hope for saving biological diversity is predicated on a concomitant effort to appreciate and protect cultural diversity.

**Keywords:** biodiversity, conservation, cultural diversity, culture, nature, policy, sub-disciplines

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### INTRODUCTION

Human societies have interacted with nature for thousands of generations (Balée 1994; Norgaard 1994; Denevan 2001;

Toledo 2001; Maffi 2001; Gunderson & Holling 2002; Harmon 2002; Heckenberger *et al.* 2007). This is reflected in all cultures by long histories of regimes and rules to protect or preserve natural places, and often manifests in the form of sacred sites,

national parks, nature reserves and community conserved areas. Community conserved areas constitute the oldest form of protected area, and include sites such as sacred groves and community managed commons (Stevens 1997; Kothari 2006; Schaaf & Lee 2006; Turner & Berkes 2006). Today, there is an emerging recognition that the diversity of life comprises both living forms (biological diversity) and human beliefs, values, worldviews and cosmologies (cultures) (Posey 1999; Berkes *et al.* 2000; Maffi 2001; Harmon 2002). Nonetheless, the division commonly made between nature and culture is not universal, and in many societies has been borne from our need to manage and control nature.

Previously, connections between biological and cultural diversity have often been considered separately from one another (Maffi 1998; Berkes 2001; Dudley *et al.* 2006). In this article, we take an integrative approach, combining ideas from many different sub-disciplines. We investigate four bridges linking biological and cultural diversity, seek to determine the common drivers of loss that exist, and suggest a novel pathway towards integration. Cultures exist in many different contexts today, for instance in science, policy and business, and by no means are all cultural ideas and practices good for nature. However, this article focuses on cultural arrangements (largely of resource-dependent communities) that do have positive synergies with nature, and how these synergies can be actively fostered for the future.

## WHY DO CULTURAL DIVERSITY AND BIOLOGICAL DIVERSITY MATTER?

### Importance of Biological Diversity

Biological diversity is defined as the variation of life at the levels of genes, species and ecosystems (CBD 1992). Much has been written on the importance of biological diversity in terms of its intrinsic value, its anthropocentric uses (in terms of goods and services provided), its role in markets, and its political origins and uses (Takacs 1996; Constanza *et al.* 1997; Gunderson & Holling 2002; MEA 2005). Ecosystem health refers to the extent to which complex ecosystems maintain their function in the face of disturbance. This resilience is an essential precondition to sustainable livelihoods, human health and other social objectives, as reflected in the Millennium Development Goals (MEA 2005; Rapport 2006). Biological diversity is the key to ecosystem health, as it serves as an absorptive barrier, providing protection from environmental shocks and stresses (Stolton *et al.* 2008).

### Importance of Cultural Diversity

Cultures are complex and have the capacity to change rapidly, emerging as well as dying out in both industrialised and pre-industrialised contexts. In the same way that biological diversity underpins the resilience of natural systems, cultural diversity has the capacity to increase the resilience of social systems (Maffi 1998; Gunderson

& Holling 2002; Harmon 2002). Cultural diversity is the diversity of human cultures, where a culture can be defined as "*the system of shared symbols, behaviours, beliefs, values, norms, artefacts and institutions that the members of a society use to cope with their world and with one another, and that are transmitted from generation to generation through learning*" (Brey 2007). However, a culture holds more than just a utilitarian function as indicated here. Smith (2001) captures this in his definition of cultural change as "*a form of co-evolution between cultural information and the social and natural environment*". This depicts a culture to be a complex and intrinsic system of interlinked components that contribute to an individual's identity by representing relationships with the surrounding environment. Thus a culture is neither static nor tenable, but rather represents elements that lead to the distinctiveness of a group or society.

The maintenance of cultural diversity into the future, and the knowledge, innovations and outlooks it contains, increases the capacity of human systems to adapt to change (Maffi 1998; Gunderson & Holling 2002; Harmon 2002). Different cultures interact with nature in different ways and forge different relationships with their local environments (Milton 1998; Berkes 2008). We now consider these interactions and how they bridge the modernist separation of nature and culture.

**Table 1**  
*Selection of sub-disciplinary fields concerned with the intersection of nature and culture*

Agricultural sustainability	Environmental law
Anthropology of nature	Environmental sociology, Ethnobiology
Biocultural diversity	Ethnobotany
Cognitive anthropology	Enthnoecology
Commons studies	Ethnolinguistics
Cultural anthropology	Ethnoscience
Cultural geography	Historical ecology
Cultural (landscape) ecology	Human ecology
Deep ecology	Human geography
Descriptive historical particularism	Indigenous knowledge
Development studies	Intercultural education
Ecofeminism	Landscape ecology
Ecological anthropology	Nature society theory
Ecological design	Political ecology
Ecological economics	Resilience sciences (ecological and cultural)
Ecosystem health	Science and technology studies
Environmental anthropology	Social-ecological systems
Environmental education	Sustainability science
Environmental ethics	Symbolic ecology
Environmental history	Systems ecology

See Annex A for definitions of each term

## The Emergence of New Sub-Disciplines

A wide variety of environmental sub-disciplines have emerged to address the interconnections between biological and cultural diversity (Table 1; Annex A). Core social science disciplines have developed terms to describe different subfields of environmental conservation, such as environmental or ecological anthropology, environmental politics, ecological economics and environmental history (Kates *et al.* 2001; Clark & Dickson 2003; Rapport 2006; Dove & Carpenter 2008). Some help to explore bridges between different disciplines, particularly between the natural and social sciences, and so give rise to many combinations of theories, assumptions, methods and applications (Mascia *et al.* 2003; Berkes 2004; Mascia 2006).

By being non-integrative and autonomous, these sub-disciplines may lead to a lack of coordination between the advancement of scientific knowledge and the development of national and international policies drawn up to protect<sup>1</sup> cultural and biological capital. This article seeks to go beyond potentially divisive definitions and demonstrate that most of these fields are working towards a very similar end (Rapport 2006). This is to formulate ideas on the relationship between biological and cultural systems in the hope of achieving a sustainable future where both ecological and social systems are resilient to external pressures through the maintenance of diversity (Rapport 2006). Here, we explore the multiple ways in which biological and cultural systems intersect and then how global policy could use this as the basis for a combined approach to diversity conservation, thus reducing the gap between science and policy in practice (Kates *et al.* 2001; Clark and Dickson 2003).

## CONVERGENCE OF BIOLOGICAL AND CULTURAL DIVERSITY

Nature and culture converge on many levels that span values, beliefs, norms, livelihoods, knowledge and languages (Milton 1998; Posey 1999; Turner & Berkes 2006; Berkes 2008). The natural environment provides a setting for cultural processes, activities and belief systems to develop, and subsequently, landscapes form a diverse cultural archive of human endeavours (Adams 1996; Milton 1999; Schaaf & Lee 2006; Berkes 2008). As a result of these interconnections, a feedback system exists, whereby a shift in one system often leads to a change in the other (Berkes & Folke 2002; Maffi & Woodley 2007; Pretty 2007a).

The links between cultural and biological diversity are reflected in physical convergence. Many of the world's core areas of biodiversity are also important for cultural diversity, represented by the density of ethnic groups<sup>2</sup> and linguistic diversity (frequently used as proxies for cultural diversity) (Skutnabb-Kangas *et al.* 2003; Sutherland 2003). Early observations of this geographical association were made by a number of researchers working in the field, including Nietschmann (1992), Nabhan (1997) and Stevens (1997). Chapin (1992), in particular, pioneered this area by mapping

forest cover and indigenous homelands in Central America (1992). Groups like Terralingua and WWF took his ideas forward by conducting projects that attempted to map these physical associations on a global scale and identify diversity hotspots. Here we assess four bridges linking nature with culture; beliefs and worldviews, livelihoods and practices, knowledge bases and languages, and norms and institutions.

## Humans Place in Nature: Beliefs, Meanings and Worldviews

Human communities have many different ways to interpret the world around them (Geertz 1973; Milton 1998; Posey 1999; Pretty 2007a). These meanings and interpretations are most diverse in their relationships to the natural world, with the most conspicuous links seen in indigenous and non-industrialised communities (Pilgrim *et al.* 2007, 2008). Not only do many of these communities interact with biological diversity on a daily basis, but their ever-evolving values, knowledge and perceptions strongly centre on nature (Berkes 2008). It has been suggested that the ongoing difference in the cultural cosmologies of nature, between pre- or non-industrialised and industrialised communities, stems from a difference in need and purpose (Milton 1998; Berkes 2001). The former are more likely to view themselves as interdependent components of nature, whereas the latter tend to view themselves as separate from and even dominant over nature (Berkes, 2008). Clearly, human communities are too complex to be divided between these two extremes, but they do form a spectrum along which different human societies are positioned. A range of authors have explored this spectrum (Posey 1999; Berkes 2008).

Milton (1998) suggests that human communities can be divided according to the strength of their feeling of oneness with nature. Those that feel a weak sense of connection perceive humans as separate from nature. However, those feeling a strong sense recognise no distinction between nature and culture, instead they comprise one continuous system and the relationship is so intrinsic that it goes unspoken (Milton 1998; Berkes 2004). The Dogrib Dene of NW Canada, for example, use the term ndé to describe the land, however, this word conveys a deeper interaction between all ecosystem components (biotic and abiotic) based on the perception that they all have life and spirit (Berkes 2008).

Ellen (1996) proposed that just three definitions of nature exist in the modern industrialised cosmos: nature as a category of 'things', nature as space which is not human, and nature as an inner essence (Milton, 1998). Some authors today believe that modernist views have gone beyond viewing nature and culture as separate entities and instead view them as opposing entities whose interaction generally leads to one or the other being damaged in some way (Milton, 1998). Wilson, on the other hand, conjectures that all humans have an innate connection with nature based on our common histories as hunters-gatherers (Kellert & Wilson 1993). His "biophilia hypothesis" may explain why the connection is more conspicuous today in communities that retain a direct dependence upon nature, although many people in industrialised countries still acknowledge a spiritual

or affective relationship with nature and the outdoors (Milton 1999). This idea is supported by recent evidence showing that exposure to nature has a positive effect on physical and mental health (Pretty 2004, 2007a; Pretty *et al.* 2005, 2006, 2007a).

Goodin's green theory of value (1992) suggests that all humans need some sense and pattern in their lives, and nature provides the backdrop against which this can occur. It sets human lives in a larger context and explains why non-human nature is often considered sacred, as demonstrated by sacred groves in India, tambu in Papua New Guinea and other sacred designations of land and water (Milton 1999; Schaaf & Lee 2006; Smith *et al.* 2007). Many protected areas (national parks or reserves) are, or contain, sacred natural sites (Dudley *et al.* 2006). They are often selected as protected areas precisely because local communities have set them aside for spiritual reasons and as a result created a refuge for a diversity of species (Mascia 2006). Long established protected areas that are widely visited and admired can acquire quasi-spiritual values (Eg., related to a sense of beauty or wildness) (Adams 1996; Milton 1999; Berkes 2008). This emphasises the importance of place and is reflected in the growing interest in bioregionalism and even suggestions of anti-globalisation (Adams 1996; Pretty 2007a).

Attitudes within faiths are another manifestation of different interpretations of our relationship with nature. The three large monotheistic faiths arising from the Middle East (Judaism, Christianity and Islam) have in the past taught that humans have "dominion" over nature, whereas faiths such as Hinduism and Buddhism stress the inter-relationships between humans and the rest of nature. A reinterpretation of the meaning of dominion in this context is quietly being undertaken among many faith groups (Dudley *et al.* 2006).

### **Managing Nature: Livelihoods, Practices and Resource Management Systems**

Many scholars perceive landscapes to be a product of the connection between people and a place; they are spaces which people feel they have a relationship with, and of which they hold memories and build history (Adams 1996; Pretty 2007a). Human populations have shaped these physically through the direct selection of plants and animals and the reworking of whole habitats and ecosystems (Sauer 1925; Pretty 2007b). Such landscapes have been described as anthropogenic or cultural, and their composition, be it of introduced species, agricultural monocultures or genetically modified crops, a reflection of local culture and human history (Milton 1999). Hence Adams describes nature as a "*cultural archive, a record of human endeavour and husbandry*" (Milton 1999).

The widespread role of cultural activities in shaping nature has led to non-human or near-pristine nature being viewed as sacred (Callicott & Nelson 1998). Growing archaeological and ethnographic knowledge, however, has demonstrated that many habitats previously thought to be pristine result from resource dependent livelihood practices. Consequently, most landscapes today are considered to be anthropogenic having been shaped directly or indirectly by human activities. The only possible

exceptions being the extremes of the poles or the depths of the oceans, although global climate change is now bringing this assertion into question. Human dominance is acknowledged in the naming of this geological era as the "anthropocene" (Pretty *et al.* 2007a). This has led, among other things, to sharp debates about the use of the term "wilderness" to refer to undeveloped biodiverse land (Callicott & Nelson 1998).

Although pre- and non-industrialised human cultures may have a lesser ecological footprint, they are still significant in moulding landscapes (Callicott & Nelson 1998; Milton 1999; Berkes 2008). Many have learnt, however, to utilise and alter the landscape with some level of conscious or unconscious restraint, ensuring natural resource security for their communities in the future (Stevens 1997; Borrini-Feyerabend *et al.* 2004; Kothari 2006). Such self-limiting practices have been central to the survival of resource-dependent societies and their landscapes (Callicott & Nelson 1998). Today, many scientists and policy-makers are learning a great deal from these diverse cultural practices and now acknowledge the role that local practices can play in biodiversity conservation, particularly in little known ecosystems and where state-imposed management schemes have failed (Posey 1984, 1985; CBD 1992; Veitayaki 1997).

This 'new' form of resource management by which local communities and their established practices play a central role is often termed community-based conservation. Sites managed under these conditions are termed Community Conserved Areas or Indigenous and Community Conserved Areas (ICCAs). The latter are now considered a form of protected area recognised by the International Union for Conservation of Nature (IUCN) and Parties to the Convention of Biological Diversity (CBD) (Western and Wright 1994; Borrini-Feyerabend *et al.* 2004; Kothari 2006; Turner & Berkes 2006; Smith *et al.* 2007; Pilgrim *et al.* 2008). That is not to say that all activities and practices developed locally lead to biodiverse outcomes, or that poor management does not occur, but the worldviews of many pre- and non-industrialised societies have contributed to the development of practices and skills that sustainably manage ecological integrity (Redford 1992; Diamond 2005; Nepstad *et al.* 2006; Turner & Berkes 2006). Thus, the loss of one (e.g. local knowledge and practices) could result in a concomitant loss of the other (e.g. ecological integrity), and although replacement will occur, it is unlikely to be as complex or refined.

### **Knowledge About Nature: Knowledge Bases and Languages**

If diverse cultural practices and worldviews are central to the management of biological diversity, this supports the need to consider the dynamic knowledge bases upon which these practices and worldviews are based (Posey 1999; Maffi 2001, 2005; Harmon 2002). Knowledge of nature is accumulated within a society and transferred through cultural modes of transmission, such as stories, narratives and observations, as people travel through the landscape (Pilgrim *et al.* 2007, 2008; Pretty 2007a). It, therefore, comprises of a non-static compilation of observations and understandings

contained within social memory that constantly evolve to try and make sense of the way the world behaves, and which societies can use to guide their actions towards the natural world. Berkes (2008), describes this as a “knowledge-belief-practice” complex that is central to linking nature with culture.

The importance of local ecological knowledge to resource management has been well described in recent years and has been a key theme of cultural ecology for decades (Berkes *et al.* 2000; Gadgil *et al.* 2000; Gilchrist *et al.* 2005; Pilgrim *et al.* 2007, 2008; Berkes 2008). Cultural understanding of the environment can not only give rise to sustainable management practices, but also to in-depth knowledge about species requirements, ecosystem dynamics, sustainable harvesting levels and ecological interactions (Pilgrim *et al.* 2007, 2008). If sustained through stories, ceremonies and discourses, this culturally ingrained capital can enable people to live within the constraints of their environment in the long-term, without the need for catastrophic learning in the event of major resource depletion (Turner & Berkes, 2006). It can therefore be viewed as a form of cultural insurance (Skutnabb-Kangas *et al.* 2003).

Languages encode collective knowledge bases in a way that is often non-translatable, but links its speakers to their landscape inextricably. In this way, language can be described as a resource for nature (Maffi 1998). As a result of this, a growing body of literature exists on the interlinkages between linguistic, cultural and biological diversity (Maffi 1998, 2005; Skutnabb-Kangas *et al.* 2003). However, diverse languages and knowledge bases are threatened today by the dual erosion of biological and cultural diversity (Maffi 1998).

### Culture as Institutions: Norms and Regulations

Local knowledge bases give rise to socially embedded norms and institutions (Feit 1988; Agrawal & Gibson 1999; Rudd *et al.* 2003; Smith *et al.* 2007). These contextual systems of collective action are intimately linked to the land on which they are based, and subsequently, are enormously diverse (Stevens 1997; Borrini-Feyerabend *et al.* 2004; Ostrom 2005; Kothari 2006). They comprise informal institutional frameworks that are legitimised from within communities and may include location-specific rules on resource extraction limits, zoning of harvesting areas, and appropriate behaviours for the use and management of natural resources (Stevens 1997; Pretty 2003; Borrini-Feyerabend *et al.* 2004; Cinner *et al.* 2005; Ostrom 2005; Kothari 2006; Smith *et al.*, 2007). Often known as land tenure systems, these frameworks regulate the use of private and common property in many parts of the world (Turner & Berkes 2006).

Where land tenure systems are robust, they can maintain the productivity and diversity of social and ecological systems without the need for formal legal enforcement sanctions (Smith *et al.* 2007). Community compliance is derived from shared values and internally derived community sanctions, such as moral influence from elders, particularly where land is perceived to be a common property (Cinner *et al.* 2005). In these communities, compliance is believed to be in the best interests of society as a whole or the best guarantee for sustaining

individual and family interests in the long-term (Dietz *et al.* 2003). Formalised payment mechanisms have been suggested as tools to reinforce these norms and reward traditional societies for the diversity of environmental goods and services their ways of life provide. For instance, Costa Rica and Mexico have reduced forest loss by the use of payments for environmental services (PES) to landowners and communities (Pagiola & Platais 2002; Pagiola *et al.* 2005; Zbinden & Lee 2005).

Human cultures attribute meaning to natural systems and processes in various ways, including livelihoods, cosmologies, worldviews and spiritual beliefs (Berkes 2008). These cultural understandings fundamentally govern both individual and collective actions which, in turn, shape the nature and composition of landscapes (Milton 1999; Smith *et al.* 2007). However, this evolving web of interconnections means that cultural and biological diversity are frequently eroded by the same drivers and threats.

### COMMON THREATS AND THEIR CONSEQUENCES

There have been unparalleled losses in biological and cultural diversity in recent decades (Maffi 2001; McNeely & Scherr 2001; Skutnabb-Kangas *et al.* 2003; MEA 2005; Rapport 2006; Pretty *et al.* 2007b; Pilgrim *et al.* 2008), arising from a number of common drivers (Table 2). Threats include the culturally inappropriate modernisation of services such as healthcare and education. This can lead to language erosion, decrease in cultural knowledge transfer and a shift in local knowledge bases, and less time spent experiencing nature with community elders and family members (Pilgrim *et al.* 2007). Privatisation of lands, exclusion policies and urban migration create a shift away from traditional resource management, often at the cost of biodiversity. This also leads to the erosion of place-based cultures as they are physically separated from the lands that their beliefs and worldviews are centred upon. Stories, narratives, ceremonies and rituals all lose their meaning when placed out of context, often leading to cultural collapse (Samson 2003).

The globalisation of traditional food systems is causing a decline in biodiversity, as monocultures are favoured over farm and wild diversity. This, in turn, leads to the loss of ecological knowledge including skills and practices developed and refined locally (Samson & Pretty 2006). Livelihood diversification and resource commodification are threatening global diversity by causing a departure from cultural resource use and management practices, the loss of land-based livelihoods and the local knowledge they are based upon (Chambers & Conway 1992; DFID 1999; Ellis 1999; Pilgrim *et al.* 2008). Such shifts may result from aspirations for consumer lifestyles or, indeed, new commercial resource uses being introduced into an area (WWF 2007).

Extreme natural events and environmental destruction (including deforestation and unsustainable agricultural production) are also rapid drivers of biodiversity loss and the erosion of local land-based cultures, particularly when coupled with anthropogenic, economic, or political stressors (Rapport & Whitford 1999). A lack of transboundary cooperation and geopolitical instability threaten global diversity, as do weak

**Table 2**  
**Common drivers or threats and outcomes for biological and cultural diversity**

Driver or threat	Outcomes for biological diversity	Outcomes for cultural diversity
New commercial resource use (e.g. timber, biofuels, energy)	Loss of habitat and species (e.g. tropical forest)	Conflict, loss of livelihoods, erosion of cultural identity
Extended commodification of natural resources	Loss of biodiversity due to shift towards unsustainable management practices	Departure from traditional resource use and management strategies
In-migration of new economic actors (e.g. settlers, ranchers)	Accelerated loss of habitat or species	Conflict, disease, competition for basis of livelihoods, erosion of cultural identity
Pollution of water courses (e.g. mercury from dams)	Degradation of wetland and freshwater habitats	Loss of livelihoods, erosion of cultural identity
Aspirations for consumer lifestyles worldwide	Increased exploitation of natural resources as economic incentives replace subsistence incentives	Loss of traditional management strategies and local knowledge; loss of biological basis for culture and economy
Continuing globalisation of food systems	Loss of on and between farm habitats and species due to monocultures, resulting in loss of agro-biodiversity, more isolated protected areas	Loss of traditional diets and knowledge of famine foods
Urbanisation and rural-urban migration	Habitat destruction leading to loss of green spaces and species, ecological footprint effects remote from urban areas	Erosion of rural cultures; loss of land on which stories and culture centre upon, contributing to loss of identity and understanding
Modernisation of healthcare	Reduced pressure on wild species, but departure from traditional medicine may lead to these species being devalued and lost	Shift away from traditional resources, loss of ecological knowledge and practices that have long been central to culture and identity
Spread of formal education including the expansion of dominant belief systems	Departure from traditional management techniques and knowledge, natural resources becoming devalued; links to other processes (e.g. migration)	Changes in mechanisms of knowledge transmission, devaluation of traditional knowledge, inter-generational conflicts, loss of traditional stories and worldviews
Language erosion and loss	Loss of knowledge and traditional management strategies previously passed on verbally between generations	Reduced communication with elder generations leading to loss of knowledge of cultural heritage, local resources and management techniques
Formalisation and privatisation of land rights	Loss of biodiversity supported by traditional management systems, reduced communal cohesion and common sense of ownership, leading to lack of local support for conservation	Loss of land that stories and culture centre upon, loss of identity and understanding, changes in social organisation sometimes leading to conflicts
State territorialisation and “nation building”	Shift from traditional to external state management of resources, at the expense of local species and habitats dependent upon local management regimes	Cultural hybridisation including the loss of knowledge, beliefs and practices where individual territories are no longer recognised for their significance to a particular group of people
Expansion of transport networks, including roads	Loss of biodiversity and habitats where construction occurs, heightened levels of pollution	Cultural erosion due to increased access to and interaction with other cultural groups leading to hybridisation or assimilation into the more dominant culture
Assimilation	Decline of biodiversity and habitats dependent upon cultural knowledge, community values and the traditional management systems derived from them	Departure from traditional practices and knowledge, leading to the loss of land-based management systems, cultural values and worldviews

institutions and a lack of resources (Feit 1988; Smith *et al.* 2007). The combined impacts of these drivers have caused us to enter what has been termed as the sixth great extinction period (McNeely & Scherr 2001; Pretty 2002; Skutnabb-Kangas *et al.* 2003).

Many of these drivers evolve from capitalist economies that stress on non-stop economic growth, which results in shifts in consumption patterns, the globalisation of markets, and the commercialisation of resources (Berkes 2001; Samson 2003; Pretty 2007a). These emergent threats are reinforced by pressures of assimilation and urbanisation, and are by no means mutually exclusive. They are at their most intense when they lead to rapid and unanticipated periods of socioeconomic

change. Combined, these threats are paving the way to the homogenization of cultures and landscapes, as demonstrated by the assessments of the state of global and sub-global environments and cultural systems (Maffi 2001; MEA 2005; Rapport 2006; Pretty *et al.* 2007).

The combined loss of biodiversity and local ecological knowledge has long-term implications as we lose the uses and future potentials of species, for instance in curing diseases or feeding populations (Gadgil *et al.* 1993; Pfeiffer 2002; Shrestha & Dhillon 2003; Hamwey 2004; Le Quy 2004; Mhame 2004; Ruiz Muller 2004; Zhang 2004; MEA 2005). At the same time, we are losing adaptive management systems embedded in pre- and non-industrialised cultures that may offer insights

for global biodiversity protection in the future (Feit 1988; Agrawal & Gibson 1999; Rudd *et al.* 2003; Smith *et al.* 2007).

Beyond impacts on landscapes and cultural diversity, these drivers of change can also have destructive health outcomes. The degradation of ecosystems is related to loss of food security, the spread of human pathogens and the emergence and resurgence of infectious disease and psychological ills (Rapport *et al.* 1998; Rapport & Lee 2003; Rapport & Mergler 2004). More fundamentally, time spent directly experiencing and interacting with nature has been shown to improve physical and mental health (Pretty 2004, 2007a; Pretty *et al.* 2005, 2006, 2007a).

## RESPONSES: POLICIES AND PROJECTS

The role of and need for effective policies in biodiversity protection has long been understood, but the importance of cultural protection policies as they relate to the environment is only just emerging (Feit 1988; CBD 1992; Maffi 2001; MEA 2005). As many common drivers exist between biological and cultural diversity and their existence is so inherently linked, future policy responses should effectively target both in a new integrative conservation approach. The need for an integrated approach to the conservation of biological and cultural diversity has been acknowledged in Millennium Development Goals (MEA 2005). That is not to say that cultures should be maintained in a steady state, but that cultures should be permitted to evolve as necessary without forced assimilation (direct or indirect) into the dominant culture. Thus cultures may indeed adapt and evolve (for instance, adopting modern practices and emergent economies while maintaining traditional values), but they remain distinct entities.

Policy responses to this paradigm, however, have been slow to emerge and put into practice. Responses to date include local revitalisation projects such as outpost and hunter-support programs (Bersamin & Simpson 2005), culturally-appropriate education schemes (Takano 2004; Pember 2007), ecotourism projects (Bathurst Inlet Lodge 2008; Elu Inlet Lodge 2008; Inari Event 2008) and language revitalisation initiatives (Hirata-Edds *et al.* 2003). Other efforts include the revival of culturally appropriate healthcare systems (Mohatt & Rasmus 2004), the protection and careful commercialisation of traditional food systems (Eg. Royal Greenland: Marquardt & Caulfield, 1996; Nuttall 1998) and the greening of businesses (Yupari *et al.* 2004). Most resurgence efforts to date, however, have been small-scale and limited in both capacity and funding (Pilgrim *et al.* 2009)

Larger-scale movements that have contributed to the dual protection of biological and cultural diversity include the fair-trade movement, certification programmes and the shift towards education for planetary citizenship (Seyfang 2006). The land rights of indigenous and other rural people are being recognised in some locations, for instance in the designation of the Nunavut Inuit territory, Canada (Nuttall 1998; Jull 2001). Investment into community-based conservation and the dissemination of power to grass-root institutions has

increased, strengthening the mechanisms that favour long-term social and ecological sustainability (Colchester 2000). Entrepreneurship-based conservation development projects, such as the UNDP Equator Initiative, are also emerging (UNDP 2007). Despite their diversity, however, many efforts remain fragmented, localised and small-scale.

Perhaps the most promising is the emergence of international policies which favour the joint protection of biological and cultural diversity (CBD 1992). International recognition of the links between biodiversity and cultural diversity is reflected in the program of work of IUCNC/EESP and UNESCO, and in the UNEP's (2007) flagship report, *Global Environment Outlook*. This describes biodiversity as encompassing "human cultural diversity, which can be affected by the same drivers as biodiversity, and which has impacts on the diversity of genes, other species, and ecosystems" (UNEP, 2007).

Nonetheless, most of these initiatives focus on biological diversity primarily, perceiving cultural diversity as a secondary objective or a stepping stone to protecting biodiversity. A great deal still needs to be accomplished in the international arena to strengthen this movement and to ensure that truly integrative policies are filtered down to grass-root communities. More fundamentally, a paradigm shift is needed to transform the way people think about global diversity, whereby biological and cultural diversity are thought of as one. This is emerging in the literature, but has yet to emerge in protection policies, for instance states could implement Biocultural Protection Plans or designate Sites of Biological and Cultural Importance.

One important development has been a dramatic reshaping of the way in which protected areas are conceived (Phillips 2003; Kothari 2006). There is increasing recognition of the importance of Community Conserved Areas. These are places managed by local communities in ways that support high levels of biodiversity, but which often have no official "protected" status (Borrini-Feyerabend *et al.* 2004). There is also growing agreement that cultural landscapes are worthy of protection (i.e. IUCN Category V protected areas) where the interaction of humans and nature over time has produced a particular set of natural and cultural conditions (Phillips 2002, 2003). Emerging partnerships between faith groups and conservation organisations present another powerful opportunity.

A range of policy options do now exist to pave the way towards the joint protection of nature and culture. However, to conserve global diversity effectively, policy efforts need to be driven both locally and internationally, and be large-scale, multi-level and inclusive. For instance, policies emphasising political empowerment, self-governance and territorial control at the grass-roots level have the potential to provide a solid platform from which communities can play a central role in biodiversity conservation, and at the same time retain their own cultural distinctiveness and connectedness to the land (Stevens 1997; Colchester 2000; Schwartzman *et al.* 2000; Peres and Zimmerman 2001; Heckenberger 2004; Athayde *et al.* 2007).

The degree to which the diversity of the world's ecosystems

is linked to the diversity of its cultures is only beginning to be understood, and there is a great deal about this connection yet to be learnt [Annex B]. However, it is precisely as our knowledge of this linkage is advancing that these complex systems are receding (Maffi 2001; Skutnabb-Kangas *et al.* 2003). In the absence of an extensive and sensitive accounting of the mutual threats and effective policies targeting these issues, endangered species, threatened habitats, dying languages and vast knowledge bases are being lost at rates that are orders of magnitude higher than the “natural” extinction rates (McNeely & Scherr 2001; Pretty 2002). While conserving nature alongside human cultures presents unique challenges (Dove *et al.* 2005; Robbins *et al.* 2006), any hope of saving biological diversity, or even recreating lost environments through restoration ecology, is predicated on a concomitant effort to appreciate and protect cultural diversity (Nietschmann 1992; Stevens 2007; Maffi 2001; Zent 2001; Pretty 2007a).

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## Notes

1. In this paper, we use the terms ‘protect’ and ‘conserve’ not to describe the maintenance of cultures in a steady state, but instead these terms are used to describe the protection of a communities’ right to evolve and adapt its culture to external pressures (such as environmental change or new markets) at its own pace, and retain traditional elements of its culture (such as values or beliefs) wherever it sees fit.
2. In this paper, the authors have purposely not used the term indigenous peoples or groups so as not to exclude pre- and non-industrial societies that are rich in culture but fail to fall under Jose R. Martinez Cobo’s working definition of indigenous peoples adopted by the UN, “Indigenous communities, peoples and nations are those which, having a historical continuity with pre-invasion and pre-colonial societies that developed on their territories, consider themselves distinct from other sectors of the societies now prevailing on those territories, or parts of them. They form at present non-dominant sectors of society and are determined to preserve, develop and transmit to future generations their ancestral territories, and their ethnic identity, as the basis of their continued existence as peoples, in accordance with their own cultural patterns, social institutions and legal system”(UN, 2004). Here, cultural diversity stretches beyond the diversity of indigenous groups to include all social groupings.

## REFERENCES

- Adams, W.M. 1996. *Future nature: A vision for conservation*. London: Earthscan.
- Agrawal, A and C.C. Gibson. 1999. Enchantment and disenchantment: The role of community in natural resource conservation. *World Development* 27: 629-649.
- Athayde, S.F., A. Kaiabi, K.Y. Ono and M.N. Alexiades. 2007. Weaving power: Displacement and the dynamics of artistic knowledge amongst the Kaiabi in the Brazilian Amazon. In: *Mobility and migration in indigenous Amazonia: Contemporary ethnoecological perspectives*. (ed. Alexiades, M.N.). Oxford: Berghahn Books.
- Balée, W. 1994. *Footprints of the forest. Ka' apor ethnobotany*. New York: Columbia University Press.
- Bathurst inlet lodge. 2008. Welcome to bathurst inlet lodge. <http://www.bathurstinletlodge.com/index.htm>. Accessed on August, 2008.
- Berkes, F. 2001. Religious traditions and biodiversity. *Encyclopaedia of Biodiversity* 5: 109-120.
- Berkes, F. 2004. Rethinking community-based conservation. *Conservation Biology* 18(3): 621-630.
- Berkes, F. 2008. *Sacred Ecology, 2nd Edition*. New York: Routledge.
- Berkes, F., J. Colding and C. Folke. 2000. Rediscovery of traditional ecological knowledge as adaptive management. *Ecological Applications* 10(5): 1251-1262.
- Berkes, F. and C. Folke. 2002. Back to the future: Ecosystem dynamics and local knowledge. In: *Panarchy: Understanding transformations in human and natural systems*. (eds. Gunderson L.H. and C.S. Holling). Pp.121-146. Washington, DC: Island Press.
- Bersamin, A. and A. Simpson. 2005. Reindeer meat is a healthy food. UAF Newsroom. <http://www.uaf.edu/news/featured/05/reindeer/meat.html>. Accessed on February, 2008.
- Borrini-Feyerabend, G., A. Kothari and G. Oviedo. 2004. *Indigenous and local communities and protected areas, towards equity and enhanced conservation: Guidance on policy and practice for co-managed protected areas and community conserved areas*. Gland: Best Practice Protected Area Guidelines Series No. 11, World Commission on Protected Areas, IUCN. Cardiff University and IUCN.
- Brey, P. 2007. Theorizing the cultural quality of new media. *Technè* 11(1). <http://scholar.lib.vt.edu/ejournals/SPT/v11n1/pdf/v11n1.pdf>. Accessed on February, 2008.
- Callicott, J.B. and M.P. Nelson (eds.). 1998. *The Great New Wilderness Debate*. Athens: University of Georgia Press.
- CBD. 1992. Convention on biological diversity. United Nations Environment Programme. [URL] <http://www.cbd.int/convention/>. Accessed on February, 2009.
- Chambers, R. and G.R. Conway. 1992. Sustainable rural livelihoods: Practical concepts for the 21<sup>st</sup> century. *Institute of development studies discussion paper* 296. London: Institute of Development Studies.
- Chapin, M. 1992. The co-existence of indigenous peoples and environments in Central America. *Research and Exploration* 8(2): Map supplement.
- Cinner, J.E., M.J. Marnane and T.R. McClanahan. 2005. Conservation and community benefits from traditional coral reef management at Ahus Island, Papua New Guinea. *Conservation Biology* 19: 1714-1723.
- Clark, W.C. and N.M. Dickson. 2003. Sustainability science: The emerging research program. *Proceedings of the National Academy of Science USA* 100(14): 8059-8061.
- Colchester, M. 2000. Self-determination or environmental determinism for indigenous peoples in tropical forest conservation. *Conservation Biology* 14(5): 1365-1367.
- Costanza, R., R. d'Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, *et al.* 1997. The value of the world's ecosystem services and natural capital. *Nature* 387: 253-260.
- Denevan, W.M. 2001. *Cultivated Landscapes of Native Amazonia and the Andes*. Oxford: Oxford University Press.
- DFID. 1999. Sustainable Livelihoods Guidance Sheets. London: Department for International Development.
- Diamond, J. 2005. *Collapse*. New York: Viking Books.
- Dietz, T., E. Ostrom and P.C. Stern. 2003. The struggle to govern the commons. *Science* 302: 1907-1912.
- Dove, M. and C. Carpenter. 2008. *Environmental anthropology: A historical reader*. Boston: Blackwell.
- Dove, M.R., P.E. Sajise, and A.A. Doolittle (eds.). 2005. *Conserving nature in*

- culture: Case studies from Southeast Asia. New Haven: Yale University Press.
- Dudley, N., L. Higgins-Zogib and S. Mansourian. 2006. *Beyond belief: Linking faiths and protected areas to support biodiversity conservation*. WWF and Alliance of Religions and Conservation. Switzerland and Manchester: Gland.
- Ellis, F. 1999. Rural livelihood diversity in developing countries: Evidence and policy implications. Overseas development institute natural resource perspectives 40. London: Overseas Development Institute.
- Ellen, R.F. 1996. The cognitive geometry of nature: A contextual approach. In: *Nature and society: Anthropological perspectives*. (eds. Palsson, G. and P. Descola). London and New York: Routledge.
- Elu Inlet Lodge. 2008. Welcome to Elu Inlet Lodge. <http://www.elulodge.com/>. Accessed on August, 2008.
- Ember, C.R. and M. Ember. 2006. *Cultural anthropology*. New Jersey: Prentice Hall.
- Feit, H.A. 1988. Self-management and state-management: Forms of knowing and managing northern wildlife. In: *Traditional knowledge and renewable resource management in northern regions*. (eds. Freeman, M.M.R. and L.N. Carbyn). Pp. 72-91. Edmonton: Boreal Institute for Northern Studies, and International Union for the Conservation of Nature and Natural Resources.
- Gadgil, M., F. Berkes and C. Folke. 1993. Indigenous knowledge for biodiversity conservation. *Ambio* 22: 151-156.
- Gadgil, M., P.R. Seshagiri Rao, G. Utkarsh, P. Pramod, A. Chhatre and members of the People's Biodiversity Initiative. 2000. New meanings for old knowledge: The people's biodiversity registers program. *Ecological Applications* 10: 1307-1317.
- Geertz, C. 1973. *The interpretation of cultures*. New York: Basic Books.
- Gilchrist, G., M. Mallory and F. Merkel. 2005. Can local ecological knowledge contribute to wildlife management? Case studies of migratory knowledge. *Ecology and Society* 10 (20) [URL] <http://www.ecologyandsociety.org/vol10/iss1/art20/>. Accessed on February, 2008.
- Goodin, R.E. 1992. *Green political theory*. Cambridge: Polity Press.
- Gunderson, L.H. and C.S. Holling (eds.). 2002. *Panarchy: Understanding transformations in human and natural systems*. Washington, DC: Island Press.
- Hamwey, R. 2004. Traditional knowledge and the environment: Statement by the United Nations Environment Programme. In: *Protecting and promoting traditional knowledge: Systems, national experiences and international dimensions*. (eds. Twarog, S. and P. Kapoor). Pp. 345-346. Geneva: United Nations.
- Harmon, D. 2002. *In light of our differences*. Washington, DC: Smithsonian Institution Press.
- Heckenberger, M.J. 2004. Archeology as indigenous advocacy in Amazonia. *Practicing Anthropology* 26: 34-38.
- Heckenberger, M.J., J.C. Russell, J.R. Toney and M.J. Schmidt. 2007. The legacy of cultural landscapes in the Brazilian Amazon: Implications for biodiversity. *Philosophical Transactions of the Royal Society B* 362: 197-208.
- Hirata-Edds, T., M. Linn, L. Peter and A. Yamamoto. 2003. Language training in Oklahoma & Florida. *Cultural Survival Quarterly* 27.4 (Winter).
- Inari Event. 2008. Winter activities in Inari. <http://www.saariselka.fi/inarievent/winteractivities.html>. Accessed on August, 2008.
- Jull, P. 2001. Nunavut: The still small voice of indigenous governance. *Indigenous Affairs* 3/01: 42-51.
- Kates, R.W., W.C. Clark, R. Corell, J.M. Hall, C.C. Jaeger, I. Lowe, J.J. McCarthy, et al. 2001. Sustainability science. *Science* 292(5517): 641-642.
- Kellert, S.R. and E.O. Wilson (eds.). 1993. *The biophilia hypothesis*. Washington, DC: Island Press.
- Kothari, A. 2006. Community conserved areas. In: *Managing protected areas: A global guide*. (eds. Lockwood, M., G.L. Worboys and A. Kothari). Pp. 549-573. London: Earthscan.
- Le Quy, A. 2004. The use and commercialization of genetic resources and traditional knowledge in Vietnam: The case of crop and medicinal plants. In: *Protecting and promoting traditional knowledge: Systems, national experiences and international dimensions*. (eds. Twarog, S. and P. Kapoor). Pp. 7-14. Geneva: United Nations.
- Maffi, L. 1998. Language: A resource for nature. *Nature and resources. UNESCO Journal on the Environment and Natural Resources Research* 34(4): 12-21.
- Maffi, L. (ed.). 2001. *On biocultural diversity*. Washington, DC: Smithsonian Institution Press.
- Maffi, L. 2005. Linguistic, cultural, and biological diversity. *Annual Review of Anthropology* 34: 599-617.
- Maffi, L. and E. Woodley. 2007. Biodiversity and culture. UNEP's 4<sup>th</sup> Global Environment Outlook Report. Nairobi: UNEP.
- Marquardt, O. and R.A. Caulfield. 1996. Development of West Greenlandic markets for country foods since the 18<sup>th</sup> century. *Arctic* 49(2): 107-119.
- Mascia, M. 2006. Conservation social science: What's in the black box? *Society for Conservation Biology Newsletter* 13(2).
- Mascia, M., J.P. Brosius, T.A. Dobson, B.C. Forbes, L. Horowitz, M.A. McKean and N.J. Turner. 2003. Conservation and the social sciences. *Conservation Biology* 17(3): 649-650.
- McNeely, J.A. and S.J. Scherr. 2001. *Common ground, common future: How ecoagriculture can help feed the world and save wild biodiversity*. Washington, DC: IUCN and Future Harvest.
- MEA. 2005. *Current state and trends. Vol. 1: Ecosystems and well-being*. Millennium Ecosystem Assessment. London: Island Press.
- Mhame, P.P. 2004. The role of traditional knowledge in the national economy: Traditional medicine in Tanzania. In: *Protecting and promoting traditional knowledge: Systems, national experiences and international dimensions*. (eds. Twarog, S. and P. Kapoor). Pp. 17-20. Geneva: United Nations.
- Milton, K. 1998. Nature and the environment in indigenous and traditional cultures. In: *Spirit of the environment: Religion, value and environmental concern*. (eds. Cooper, D.E. and J.A. Palmer). Pp. 86-99. London and New York: Routledge.
- Milton, K. 1999. Nature is already sacred. *Environmental Values* 8: 437-449.
- Mohatt, G.V. and S.M. Rasmus. 2004. "My way to myself": Preserving the healing power of voice in a community-based participatory research project on Alaska native pathways towards sobriety. Proceedings of the 14<sup>th</sup> Inuit Studies Conference, Calgary, August 2004.
- Nabhan, G.P. and S.L. Buchmann. 1997. Pollination services: Biodiversity's direct link to world food stability. In: *Nature's Services* (ed. Daily G.C.). Pp. 133-150. Washington, DC: Island Press.
- Nepstad, D., S. Schwartzman, B. Bamberger, M. Santilli, D. Ray, P. Schlesinger, P. Lefebvre, et al. 2006. Inhibition of Amazon deforestation and fire by parks and indigenous lands. *Conservation Biology* 20: 65-73.
- Nietschmann, B.Q. 1992. The interdependence of biological and cultural diversity. Center for World Indigenous Studies: Occasional Paper no. 21.
- Norgaard, R.B. 1994. *Development betrayed*. London: Routledge.
- Nuttall, M. 1998. *Protecting the arctic: Indigenous peoples and cultural survival*. Amsterdam: Harwood Academic Publishers.
- Ostrom, E. 1990. *Governing the commons: The evolution of institutions for collective action*. Cambridge: Cambridge University Press.
- Ostrom, E. 2005. *Understanding institutional diversity*. Princeton: Princeton University Press.
- Pagiola, S., A. Arcenus and G. Platais. 2005. Can payments for environmental services help reduce poverty? *World Development* 33(2): 237-253.
- Pagiola, S. and G. Platais, G. 2002. Payments for environmental services. environmental strategy notes. <http://earthday.worldwildlife.org/fellowships/fuller/Pagiola-2.pdf>. Accessed on February, 2008.
- Pember, M.A. 2007. A mandate for native history: The Montana Indian education for all act may be setting a national precedent for America's

- schools, but colleges and universities are not yet on board. *Diverse Issues in Higher Education*. <http://www.highbeam.com/doc/1G1-164421874.html>. Accessed on February, 2008.
- Peres, C. and B. Zimmerman. 2001. Perils in parks or parks in peril? Reconciling conservation in Amazonian reserves with and without use. *Conservation Biology* 15(3): 793-797.
- Pfeiffer, J. 2002. Gendered interpretations in eastern Indonesia: Ethnoecology in the transition zone. In: *Communities in Southeast Asia: Challenges and responses*. (eds. Lansdowne, H., W. Neilson and P. Dearden). Pp. 43-63. Victoria: Centre for Asia Pacific Initiatives.
- Phillips, A. 2002. *Management guidelines for IUCN category V protected areas: Protected landscapes and seascapes*. Cambridge and Cardiff: IUCN and the University of Cardiff.
- Phillips, A. 2003. Turning ideas on their head: The new paradigm for protected areas. *The George Wright Forum* 20(2): 8-32.
- Pilgrim, S., L. Cullen, D.J. Smith and J. Pretty. 2008. Ecological knowledge is lost in wealthier communities and countries. *Environmental Science and Technology* 42(4): 1004-1009.
- Pilgrim, S., D.J. Smith and J. Pretty. 2007. A cross-regional assessment of the factors affecting ecoliteracy: Implications for policy and practice. *Ecological Applications* 17(6): 1742-1751.
- Pilgrim, S., C. Samson and J. Pretty. 2009. Rebuilding lost connections: How revitalisation projects contribute to cultural continuity and improve the environment. Interdisciplinary Centre for Environment and Society Occasional Paper 2009-01. UK: University of Essex. [URL] <http://www.essex.ac.uk/ces/esu/occ-papers.shtm>.
- Posey, D.A. 1984. Indigenous ecological knowledge and development of the Amazon. In: *The Dilemma of Amazonian Development*. (ed. Moran E.). Pp. 225-257. Colorado: Westview Press.
- Posey, D.A. 1985. Indigenous management of tropical forest ecosystems: The case of the Kayapo Indians of the Brazilian Amazon. *Agroforestry Systems* 3: 139-158.
- Posey, D.A. (ed.). 1999. *Cultural and spiritual values of biodiversity*. Nairobi: UNEP and Intermediate Technology Publications.
- Pretty, J. 2002. *Agri-culture: Reconnecting people, land and nature*. London: Earthscan.
- Pretty, J. 2003. Social capital and the collective management of resources. *Science* 302: 1912-1915.
- Pretty, J. 2004. How nature contributes to mental and physical health. *Spirituality and Health International* 5(2): 68-78.
- Pretty, J. 2007a. *The earth only endures: On reconnecting with nature and our place in it*. London: Earthscan.
- Pretty, J. 2007b. Agricultural sustainability: Concepts, principles and evidence. *Philosophical Transactions of the Royal Society B* 363(1491): 447-66.
- Pretty, J., A. Ball, T. Benton, J. Guivant, D. Lee, D. Orr, M. Pfeffer, et al. (eds.). 2007b. *Sage Handbook on Environment and Society*. London: Sage.
- Pretty, J., R. Hine and J. Peacock. 2006. Green exercise: The benefits of activities in green places. *The Biologist* 53(3): 143-8.
- Pretty, J., J. Peacock, R. Hine, M. Sellens, N. South and M. Griffin. 2007a. Green exercise in the UK countryside: Effects on health and psychological well-being, and implications for policy and planning. *Journal of Environmental Planning Management* 50(2): 211-231.
- Pretty, J., J. Peacock, M. Sellens and M. Griffin. 2005. The mental and physical health outcomes of green exercise. *International Journal of Environmental Health Research* 15(5): 319-337.
- Rapport, D.J. 2006. Sustainability science: An ecohealth perspective. *Sustainability Science* 2: 77-84.
- Rapport, D.J., R. Costanza and A. McMichael. 1998. Assessing ecosystem health: Challenges at the interface of social, natural, and health sciences. *Trends Ecology and Evolution* 13(10): 397-402.
- Rapport, D.J. and V. Lee. 2003. Ecosystem approaches to human health: Some observations on North/South experiences. *Environmental Health* 3(2): 26-39.
- Rapport, D.J. and D. Mergler. 2004. Expanding the practice of ecosystem health. *EcoHealth* 1(2): 4-7.
- Rapport, D.J. and W.G. Whitford. 1999. How ecosystems respond to stress? Common properties of arid and aquatic systems. *Bioscience* 49(3): 193-203.
- Redford, K.H. 1992. The empty forest. *Bioscience* 42: 412-422.
- Robbins, P. 1998. Authority and environment: Institutional landscapes in Rajasthan, India. *Annals Association of American Geographers* 88(3): 410-435.
- Robbins, P., K. McSweeney, T. Waite and J. Rice. 2006. Even conservation rules are made to be broken: Implications for biodiversity. *Environmental Management* 37(2): 162-169.
- Rudd, M.A., M.H. Tupper, H. Folmer and G.C. van Kooten. 2003. Policy analysis for tropical marine reserves: Challenges and directions. *Fish and Fisheries* 4: 65-85.
- Ruiz Muller, M. 2004. Regulating bioprospecting and protecting indigenous peoples' knowledge in the Andean community: Decision 391 and its overall impacts in the region. In: *Protecting and promoting traditional knowledge: Systems, national experiences and international dimensions*. (eds. Twarog, S. and P. Kapoor). Pp. 241-262. Geneva: United Nations.
- Samson, C. 2003. *A way of life that does not exist*. Canada: ISER.
- Samson, C. and J. Pretty. 2006. Environmental and health benefits of hunting diets and lifestyles for the Innu of Labrador. *Food Policy* 31(6): 528-553.
- Sauer, C.O. 1925. The morphology of landscape. *University of California Publications in Geography* 2(2): 19-53.
- Seyfang, G. 2006. Sustainable consumption. CSERGE working paper EDM 06-12. [URL] [http://www.uea.ac.uk/env/cserge/pub/wp/edm/edm\\_2006\\_12.pdf](http://www.uea.ac.uk/env/cserge/pub/wp/edm/edm_2006_12.pdf). Accessed on February, 2008.
- Schaaf, T. and C. Lee (eds.). 2006. Conserving cultural and biological diversity: The role of sacred natural sites and cultural landscapes. Proceedings of the Tokyo Symposium. Paris: UNESCO.
- Schwartzman, S., A. Moreira and D. Nepstad. 2000. Rethinking tropical forest conservation: Perils in parks. *Conservation Biology* 14(5): 1351-1357.
- Shrestha, P.M. and S.S. Dhillon. 2003. Medicinal plant diversity and use in the highlands of Dolakha district, Nepal. *Journal of Ethnopharmacology* 86: 81-96.
- Skutnabb-Kangas, T., L. Maffi and D. Harmon. 2003. *Sharing a world of difference: The Earth's linguistic, cultural, and biological diversity*. Paris: UNESCO.
- Smith, D.J., S. Pilgrim and L. Cullen. 2007. Coral reefs and people. In: *Sage Handbook on Environment and Society*. (eds. Pretty, J., A. Ball, T. Benton, J. Guivant, D. Lee, D. Orr, M. Pfeffer, et al.) Pp. 500-516. London: Sage Publications.
- Smith, E.A. 2001. On the coevolution of cultural, linguistic, and biological diversity. In: *On biocultural diversity* (ed. Maffi, L.). Pp. 95-117. Washington, DC: Smithsonian Institution Press.
- Stevens, S. (ed.). 1997. *Conservation through cultural survival: Indigenous peoples and protected areas*. Washington, DC: Island Press.
- Stolton, S., N. Dudley and J. Randall. 2008. *Natural security: Protected areas and hazard mitigation*. Gland: WWF International.
- Sutherland, W. 2003. Parallel extinction risk and global distribution of languages and species. *Nature* 423: 276-279.
- Takacs, D. 1996. *The idea of biodiversity*. Baltimore and London: John Hopkins University Press.
- Takano, T. 2004. Meanings of 'connection' with the environment: Findings from outdoor educational programs in Scotland, Alaska and Nunavut. [http://www.latrobe.edu.au/oent/OE\\_conference\\_2004/papers/takano.pdf](http://www.latrobe.edu.au/oent/OE_conference_2004/papers/takano.pdf). Accessed on February, 2009.
- Toledo, V.M. 2001. Biodiversity and indigenous peoples. *Encyclopaedia of Biodiversity* 3: 451-463.
- Turner, N. and F. Berkes. 2006. Coming to understanding: Developing conservation through incremental learning in the Pacific Northwest. *Human Ecology* 34: 495-513.

- UN. 2004. The concept of indigenous peoples. Background paper prepared by the secretariat of the permanent forum on indigenous issues. Department of Economic and Social Affairs. [http://www.un.org/esa/socdev/unpfii/documents/workshop\\_data\\_background.doc](http://www.un.org/esa/socdev/unpfii/documents/workshop_data_background.doc). Accessed on February, 2009.
- UNDP. 2007. UNDP equator initiative. [http://www.equatorinitiative.org/index.php?option=com\\_content&view=article&id=150&Itemid=460&lang=en](http://www.equatorinitiative.org/index.php?option=com_content&view=article&id=150&Itemid=460&lang=en). Accessed on July, 2008.
- UNEP. 2007. *Global Environment Outlook 4 (GEO-4)*. Nairobi: UNEP.
- Veitayaki, J. 1997. Traditional marine resource management practices used in the Pacific islands: An agenda for change. *Ocean and Coastal Management* 37: 123-136.
- Western, D. and R.M. Wright (eds.). 1994. *Natural connections*. Washington, DC: Island Press.
- Wright, A. 1985. Marine resource use in Papua New Guinea: Can traditional concepts and contemporary development be integrated? In: *The traditional knowledge and management of coastal systems in Asia and the Pacific*. (eds. Ruddle, K. and R. Johannes). Pp. 79-100. Jakarta Pusat: UNESCO.
- WWF. 2007. Rainforest for biodiesel? WWF Germany. [http://www.wwf.de/fileadmin/fm-wwf/pdf\\_neu/wwf\\_palmoil\\_study\\_english.pdf](http://www.wwf.de/fileadmin/fm-wwf/pdf_neu/wwf_palmoil_study_english.pdf). Accessed on January, 2009.
- Yupari, A., L. Jaramillo, R.K. Lojenga, S. Briceño and R. Sánchez. 2004. UNCTAD's BIOTRADE initiative: Some considerations on access benefit sharing and traditional knowledge. In: *Protecting and promoting traditional knowledge: Systems, national experiences and international dimensions*. (eds. Twarog, S. and P. Kapoor). Pp. 325-36. Geneva: United Nations.
- Zent, S. 2001. Acculturation and ethnobotanical knowledge loss among the Piaroa of Venezuela: Demonstration of a quantitative method for the empirical study of TEK change. In: *On biocultural diversity: Linking language, knowledge, and the environment*. (ed. Maffi L.). Washington, DC: Smithsonian Institution Press.
- Zbinden, S. and D.R. Lee. 2005. Paying for environmental services. *World Development* 33(2): 255-272.
- Zhang, X. 2004. Traditional medicine: Its importance and protection. In: *Protecting and promoting traditional knowledge: Systems, national experiences and international dimensions*. (eds. Twarog, S. and P. Kapoor). Pp. 3-6. Geneva: United Nations.

#### Annex A *Definitions of disciplinary and sub-disciplinary terms*

Agricultural sustainability	The development of technologies that are effective for farmers, which result in improvement and food productivity and do not have adverse effects on environmental goods and services (Pretty 2002, 2007b).
Anthropology of nature	The study of the nature-society interface or of the relationships of nature and culture (Descola & Palsson 1996; Franklin 2002).
Biocultural diversity	Analyses the relationship between language, culture and the environment as distinct, but closely and necessarily related to the manifestations of the diversity of life on earth (Skutnabb-Kangas <i>et al.</i> 2003; Maffi 2005).
Cognitive anthropology	Investigates how people learn things and what learning mechanisms are embedded in a culture. It studies cultural knowledge, knowledge which is embedded in words, stories, and in artefacts, and which is learned from and shared with other humans (D'Andrade 1995).
Commons studies	Focuses on the social and institutional bases of common property systems and the role of common property regimes in contributing to productive ecological dynamics and sustainable use in a variety of settings (Ostrom 1990, 2005)
Cultural anthropology	The investigation of the beliefs, knowledge, practices, modes of social organisation and forms of communication of defined social groups (Ember & Ember 2006).
Cultural geography	The study of cultural products and norms and their variation in spaces and places.
Cultural (LANDSCAPE) ecology	A branch of cultural anthropology and cultural geography that studies culture as the primary adaptive mechanism used by human societies to deal with, understand, give meaning to, and generally cope with their environment. Recent approaches have stressed the role of local knowledge in adapting to specific physical conditions (Brush 1993).
Deep ecology	A branch of ecological philosophy (or ecosophy) that considers a holistic relationship between humans and the natural world and espouses the intrinsic equality of all species (Naess 1973, 1989).
Descriptive historical particularism	Emphasizes the uniqueness of each culture as demonstrated in its knowledge of plants, animals, astronomy and weather (Brush 1993).
Development studies	A multidisciplinary social science branch that studies issues related to social and economic development. (Kothari 2005).
Ecofeminism	A philosophy and movement that joins feminist and ecological thinking to assert that the patriarchal structures that produce the domination and oppression of women are the same forces that lead to domination of the environment (Sturgeon 1997).
Ecological anthropology	Scientific study, using a systems approach, of the links between humans and ecosystems, with a focus on how culture mediates these interactions (Ellen 1982; Salzmann and Attwood 1996; Kottak 1999).
Ecological design	Field of design that integrates human purposes into wider patterns, principles and flows of the natural world. (Van der Ryn & Cowan 2007).
Ecological economics	Transdisciplinary field that addresses relationships between ecosystems and economic systems in the broadest sense (Costanza 1992).
Ecosystem health	A systematic approach to the preventive, diagnostic and prognostic aspects of ecosystem management and to the understanding of relationships between ecosystem health and human health (Rapport <i>et al.</i> 1999).

Environmental anthropology	Applied, cross-cultural study of relations between people and their environment over time and space (Townsend 2000; Dove & Carpenter 2008).
Environmental education	The organised teaching of the functioning of natural environments, and how human behaviour and attitudes can be oriented to contribute to environmental sustainability (Marsden 1997).
Environmental ethics	A branch of environmental philosophy that considers the ethical relationship between human beings and the natural environment (Light and Rolston III 2003).
Environmental history	A branch of history that focuses on changes in the biological and physical environment, connections between material change and changes in ideological representations of the environment and the development of government regulation, law and official policy (McNeill 2003).
Environmental law	The study and establishment of statutes, regulations, and common-law principles covering air pollution, water pollution, hazardous waste, the wilderness and endangered wildlife, at a variety of regional, national and international levels (Stookes 2005).
Environmental sociology	Study of the interactions between the environment and social organisation, and behaviour (Dunlap and Catton 1979, 1994; Gramling & Freudenburg 1996).
Ethnobiology	Study of culturally-based biological and environmental knowledge and cultural perception of the natural world (Pieroni <i>et al.</i> 2005).
Ethnobotany	Study of the relationship and interactions between plants and people (Cotton 1996).
Ethnoecology	Study of the way different groups of people in different locations understand their environment, and their relationship with their environment (Nazarea 2006).
Ethnolinguistics	A branch of linguistic anthropology that studies relationships between language and culture, and the way different ethnic groups perceive the world.
Ethnoscience	Study of people's perception of their surroundings, which presumes no difference between indigenous knowledge and the sciences of nature (Sanga & Ortelli 2004).
Historical ecology	Traces the ongoing dialectical relations between human acts and acts of nature, manifested in landscape. (Crumley 1994, Balée 1998).
Human ecology	Multidisciplinary study of the relationship between humans and their environment (Steiner 2002).
Human geography	Focuses on the study of patterns and processes that shape human interaction with the built environment, with reference to the causes and consequences of the spatial distribution of human activity.
Indigenous knowledge	Broadly defined as the knowledge that an indigenous (local) community accumulates over generations of living in a particular environment. This definition encompasses all forms of knowledge — technologies, know-how skills, practices and beliefs — that enable the community to achieve stable livelihoods in their environment.
Intercultural education	Educational activity that focuses on the nature of culture, intercultural communication and alternative worldviews.
Landscape ecology	An interdisciplinary field concerned with the study of the distribution and abundance of elements within landscapes, the origins of these elements, and their impacts on organisms and processes (Turner <i>et al.</i> 2001).
Nature society theory	Branch of geography that studies the ways in which societal processes, shape, alter and transform the physical environment and the resulting production of complex natural-social landscapes (Castree & Braun 2001).
Political ecology	Study of how political, economic and social relations and factors affect ecological processes and human uses of the environment, and how ecologies can shape political and economic possibilities (Bates & Lees 1996; Robbins 2004).
Resilience science (cultural)	The adaptive capacity of a culture or cultural group to adjust to new conditions without losing structure or function (Gunderson & Holling 2002).
Resilience science (ecological)	The adaptive capacity of an ecosystem to tolerate disturbance without collapsing into a qualitatively different state that is controlled by a different set of processes (Walker <i>et al.</i> 2004).
Science and technology studies	The study of how social, political and cultural values affect scientific research and technological innovation, and how these in turn affect society, politics and culture.
Social-ecological systems (SES)	Study of the diverse relationships between an ecological system and one or more intricately linked social systems (Berkes <i>et al.</i> 2003; Anderies <i>et al.</i> 2004).
Sustainability science	Integrated, place-based study that seeks to understand the fundamental character of interactions between nature and society and to encourage those interactions along more sustainable trajectories (Kates <i>et al.</i> , 2001; Clark & Dickson 2003).
Symbolic ecology	Study which uses the nature-culture prism to make sense of and interpret cosmologies of the natural environment, including myths, rituals, systems of classification, food and body symbolism, and other aspects of social life, and the precepts and effects of these belief systems (Biersack 1999; Descola & Palsson 1996).
Systems ecology	An approach to the study of ecology of organisms that focuses on interactions between biological and ecological systems (Kitching 1983).

**Annex B**  
***Ten key questions to be addressed in order to support this new policy direction***

Persuasion and policies	1. How can governments and societies be persuaded that maintaining and improving both cultural and biological diversity can be in their interest? 2. What are the best examples of enabling effective national and international policies that allow development of new approaches by grass-root communities and their sharing them with others? 3. What are the best ways to deal with a change in traditions, such as, when cultures and cultural traditions evolve and adapt?
Barriers to rights	4. What are the barriers to governments adopting and strengthening human rights declarations and land rights policies for all their own people?
Revitalisation projects	5. What are the most effective recovery or revitalisation projects that can protect the cultures and values of both indigenous people and post-industrialised societies? 6. What are the best internal and external incentives for sustaining cultural and biological diversity? Can the benefits of the existing capitals of cultural and biological diversity be maximised in terms of income streams (without commodifying nature)?
Participation and power	7. How can indigenous people and minority groups best be empowered while maintaining their own cultural values? How should conservation efforts respond to the fact that the cultural values of nature vary from place to place and also over time? 8. How can the promotion of increased participation by cultural minorities and a wider range of partners (Eg. responsible industry, faith groups, social action groups and youth) be achieved in different political decision-making instances and processes?
Changing aspirations	9. How can new aspirations be created for livelihoods and ways of life in all societies so as to change the consumption patterns that threaten nature and cultures worldwide?
Young people and nature disconnections	10. How can younger generations be attracted back into contact with their local environment so as to prevent any further extinction of experience and the growing disconnection with nature?