

How Do Biodiversity and Culture Intersect?

Jules Pretty¹, Bill Adams², Fikret Berkes³, Simone Ferreira de Athayde⁴, Nigel Dudley⁵, Eugene Hunn⁶, Luisa Maffi⁷, Kay Milton⁸, David Rapport⁹, Paul Robbins¹⁰, Colin Samson¹, Eleanor Sterling¹¹, Sue Stolton⁵, Kazuhiko Takeuchi¹², Anna Tsing¹³, Erin Vintinner¹¹ and Sarah Pilgrim¹

¹University of Essex, ²University of Cambridge, ³University of Manitoba, ⁴University of Florida, ⁵Equilibrium, ⁶University of Washington, ⁷Terralingua, ⁸Queen's University Belfast, ⁹EcoHealth Consulting, ¹⁰University of Arizona, ¹¹American Museum of Natural History, ¹²University of Tokyo, ¹³UC Santa Cruz

Plenary paper for Conference “*Sustaining Cultural and Biological Diversity In a Rapidly Changing World: Lessons for Global Policy*”. Organized by American Museum of Natural History’s Center for Biodiversity and Conservation, IUCN-The World Conservation Union/Theme on Culture and Conservation, and Terralingua. April 2-5th 2008

Introduction

There is a common recognition around the world that the diversity of life involves both the living forms (biological diversity) and the world views and cosmologies of what life means (cultural diversity) (Posey, 1999; Berkes *et al.*, 2000; Maffi, 2001; Harmon, 2002). The importance of this diversity is increasingly recognised, as is knowledge of this diversity, even in industrialised societies where it is often heavily depleted (e.g. Mabey, 1997; Cocker & Mabey, 2005), and in urban areas where people are often disconnected from their traditional natural resource base (Cocks & Dold 2000, 2004, 2006; Wiersum & Shackleton 2006). However the division commonly made between nature and culture is not universal, and, in many cases, is a product of modern industrialised thought shaped by our need to control, or ‘manage’ nature (Berkes, 2008).

1. Why do Cultural Diversity and Biological Diversity Matter?

Our conceptualisations of the relationship between human societies and nature have historically shaped the way in which we see the world and our actions towards it. Berkes and Folke (2002) suggest that distinctions between social and natural systems are somewhat artificial and arbitrary. Traditional societies have, after all, interacted with biological diversity through adaptive and co-evolutionary processes for thousands of generations (Balée, 1994; Norgaard, 1994; Denevan, 2001; Toledo, 2001; Maffi, 2001; Gunderson & Holling, 2002; Harmon, 2002; Heckenberger *et al.*, 2007). Berkes and Folke (2002) suggest that the term ‘social-ecological system’ helpfully refers to this integrated concept of humans and nature.

A wide variety of sub-disciplines have emerged in recent years using many terms and definitions (see Box 1 and Annex A). These fields provide a kaleidoscope of perspectives on the many interactions between nature and culture, referring to historical, geopolitical, anthropological and resource management terms (Rapport, 2006). Some of these sub-disciplines are ‘bridging’ fields that explore the boundaries of different disciplines, particularly between the natural and social sciences (including biological, sociological, historical, economical and political sciences) to give rise to various possible combinations of theoretical assumptions, methods and applications (Berkes, 2004).

One aim of this paper is to go beyond potentially divisive definitions and demonstrate that most of these fields are working largely towards the same ends. These are to formulate ideas on how to achieve a symbiotic relationship between biological and social systems in the hope of achieving a sustainable future for humans and the rest of nature (Rapport, 2006). While it is recognised that cross- and trans-disciplinary approaches are essential, at present there are no generally accepted and recognised methodologies for achieving this relationship (Somerville and Rapport, 2000). At the same

time, all sub-disciplines have the potential to contribute to our understanding of the interactions between nature and culture. However, by being fragmented, they may lead to a lack of coordination and disconnection between the advancement of scientific knowledge and the development of local implementation as well as national and international policies drawn up to sustain what is left of our once enormous cultural and biological patrimony.

Box 1: Selection of sub-disciplinary fields concerned with intersection of nature and culture

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

Note: see Annex A for definitions of each of these terms

This paper seeks to explore how biological and cultural diversity intersect and how global policy could use this intersection as the basis for a dual approach to conservation in our rapidly changing world, thus reducing the gap between science and policy in practice (Kates *et al.*, 2001; Clark and Dickson, 2003). In order to do this, it is imperative to understand not only the dynamics by which human activities shape the natural environment, but also how environmental changes shape human behaviours and well-being (Rapport & Singh, 2006). As stated by Komiyama and Takeuchi (2006);

“Our common future” depends critically upon preserving the life-giving functions of the Earth’s ecosystems, landscapes, and biosphere. To achieve this requires the deepening of our understanding of the linkages between the “global system” (the planetary base for human survival), the “social system” (the political, economic, industrial, and other human-devised structures that provide the societal basis of human existence), and the “human system” (the sum total of all factors impacting the health of humans).

1.1. The importance of nature and biological diversity

Biological diversity is defined as the variation of life at the level of gene, species and ecosystem (CBD, 1992). Much has been written on the importance of biological diversity in terms of its intrinsic value, its anthropocentric uses (in terms of the goods and services it provides), its role in today’s economic market and its inextricable interdependence with the resilience of the natural environment (Constanza *et al.*, 1997; Gunderson & Holling, 2002; MEA, 2005).

Ecosystem health, referring to the extent to which complex ecosystems maintain their function in the face of human disturbance, is an essential precondition to sustainable livelihoods, human health, and many other social objectives, as reflected in the Millennium Development Goals (MEA, 2005; Rapport, 2006). Not only does biological diversity represent the product of thousands of years of evolution and a vital component of human society’s survival through to the present day (in terms of

healthy peoples, healthy communities and sustainable livelihoods), it also serves as an absorptive barrier, providing protection from environmental shocks and stresses.

1.2. The importance of cultural diversity

In the same way that biological diversity increases the resilience of natural systems, cultural diversity has the capacity to increase the resilience of social systems. Culture can be defined in a myriad of ways, such as a set of practices, a network of institutions or a system of meanings. Cultural diversity has been formally defined to comprise the variety of languages and ethnic groups present in the world (UNESCO/WWF/Terralingua, 2003). However, in practice, cultural systems contain a great deal more, coding for the knowledge, practices, beliefs, worldviews, values, norms, identities, livelihoods and social organisations of human societies. The maintenance of cultural diversity into the future, and the knowledge, innovations and outlooks it contains increases the capacity of human systems to adapt and cope with change (Maffi, 1999; Gunderson & Holling, 2002; Harmon, 2002). Different cultures, though, value nature in different ways and have different connections with their natural environments. In the next section, we consider these links and discuss how they bridge the modernist conceptualisation of the separation of nature and culture, and the non-industrialised world perspective that nature and culture are closely intertwined and often indistinguishable.

2. The Convergence of Biological and Cultural Diversity

Nature and culture converge on many levels that span values, beliefs and norms to practices, livelihoods, knowledge and languages. As a result, there exists a mutual feedback between cultural systems and the environment, with a shift in one often leading to a change in the other (Maffi & Woodley, 2007). For example, knowledge bases evolve with the ecosystems upon which they are based and languages comprise words describing ecosystem components. If plants or animals are lost then the words used to describe them are often lost from a language shortly after (though there is some question about which comes first – see Zent, 2001), and this will change the way the natural environment is shaped by the practices and livelihoods of those human communities. Nature provides the setting in which cultural processes, activities and belief systems develop, all of which feedback to shape the local environment and its diversity. This section will look at four key bridges interlinking nature with culture: beliefs and worldviews; livelihoods and practices; knowledge bases and languages; and norms and institutions. This paper will examine these connections in more depth amongst different human societies, drawing on examples from both developing and industrialised communities.

2.1 Humans place in nature: Beliefs, meanings and worldviews

Culture can be understood and described as systems of meaning, the way in which people interpret the world around them (Geertz, 1973). These meanings and interpretations are perhaps the most diverse in their linkage to the natural world, with the most conspicuous links often observable within traditional resource-dependent communities. Not only do these communities interact with biological diversity on a daily basis, but their values, knowledge and perceptions are strongly centred on nature. It has been suggested that the difference in cultural worldviews and cosmologies of nature between industrialised and resource-dependent (or subsistence-oriented) communities stems from a difference in need and purpose (Milton, 1998; Berkes, 2004). Whereas many indigenous and traditional communities regard nature as a force managing them (e.g. through droughts or famines), many industrialised communities strive to achieve the opposite and assert their dominance in managing nature. Thus the former will view themselves as interdependent components of nature, fluctuating with its rhythms, whereas the latter will view themselves as separate from nature, dislocated from its fluctuations and so independent of its evolution. Of course, human communities cannot be divided neatly into these two positions, but they do form a spectrum along which the different relationships human societies form with nature exist. With the coming challenges of climate change and peak oil, it

is conceivable that those whose industrialised livelihoods appear somewhat resource-independent may have to undergo substantial changes in the near future.

Another manifestation of different interpretations of our relationship with nature comes from attitudes within faiths. 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 amongst many faith groups.

Milton has discussed this issue in some depth, and has suggested that some human communities do feel a sense of oneness with nature. This can exist in both a weak and strong sense. To have a weak sense of oneness with nature is to adopt the worldview that humans are separate from nature, but that their relationship is a reciprocal one based on respect, caring and sharing. However, to have a strong sense of oneness with nature is to not recognise a distinction between nature and culture. Such people and cultures view themselves and other environmental components with which they interact as belonging to the same continuous holistic system. This is often depicted in artistic impressions of nature amongst tribal and traditional communities. They acknowledge relationships with non-human entities that inhabit the system, such as plants, animals, spirits and gods, but not with nature as such, as this connection is so intrinsic that it goes unspoken and almost unrecognised (Milton, 1998).

This oneness with nature is likely to have evolved from a continuous and direct dependence upon nature (Milton, 1998; Berkes, 2004). Such dependent relationships are more often depicted through actions rather than words and, thus, often taken for granted in everyday lives. This makes it hard to identify and articulate a specific role for biological diversity (Milton, 1998). For instance the Dene groups of the Western Subarctic use the term *ndé* to describe the land; however this has a deeper meaning to the Dene. It not only describes the land, but also conveys the interrelations between all ecosystem components (biotic and abiotic) based on the perception that they all have a life and a spirit (Berkes, 2001).

This inclusive view of nature, however, is not universal, and indeed many cultures have an exclusive view of nature, contributing to cultural diversity. Ellen (1996) proposed that three definitions of nature exist in the modern industrialised cosmos: nature as a category of ‘things’; nature as space that is not human; and nature as inner essence (Milton, 1998). Some believe that modernist views have gone beyond viewing nature and culture as two separate entities, but instead view them as opposing entities whose interaction generally leads to one or the other being damaged in some way.

Whereas many traditional communities fail to differentiate between nature and culture, many modernist societies perceive them as separate, and even opposing, entities. E.O. Wilson has, however, conjectured that all humans, no matter their culture, have an innate connection with nature based on our common histories as hunter-gatherers. This is termed the ‘Biophilia Hypothesis’ and may explain why this connection is more conspicuous today in communities that retain this direct dependence upon nature (Kellert & Wilson, 1993). In some traditional communities, natural elements are thought to be akin to humans and are respected as such. Therefore many traditional cultures base their views of nature on spiritual beliefs and worldviews, whereas industrialised cultures tend to base their beliefs on science and the teachings of formal education (humans as a biological species), although many modern people in industrialised countries still acknowledge a spiritual or affective relationship with nature and the outdoors (Milton, 1999), and all traditional cultures incorporate substantial bodies of empirically derived “ethnoscience.” Evidence also shows that exposure to nature has a positive effect on mental health (Pretty, 2004, 2007; Pretty *et al.*, 2005, 2006, 2007)

Goodin’s green theory of value (1992) suggests that all humans want to see some sense and pattern to their lives, and nature provides the backdrop against which this can occur. It enables human lives to be set in a larger context and explains why non-human nature is often thought of as sacred (Milton, 1999). This is demonstrated in the designation of protected areas and nature reserves, sacred groves in

India, tambu in Papua New Guinea and other faith-based or sacred designations of the land (Berkes, 2004). All of these reflect a cultural belief in the value of nature and this is reflected in peoples' actions and behaviours towards those environments. However, this sacredness reflects a belief in the mutual independence of humans and nature and the need to protect non-human nature from human influence in the future (Milton, 1999). Many protected areas (national parks or reserves) are, or at least contain, sacred natural sites (Dudley *et al.*, 2006); places that are important because of their link with a faith or faiths. They are often selected as protected areas precisely because local communities have set them aside for spiritual reasons and maintained high natural values as a result (which paradoxically sometimes suffer as a result of incorporation into a state-run reserve).

Although many cultural views exist, it is clear that belief systems about nature around the world have diverged depending on how people use it (Milton, 1998; Berkes, 2004). Even in apparently non-resource dependent communities, biological diversity is still highly valued as one of the world's most critical resources (CBD, 1992; Veitayaki, 1997). We will now go on to discuss the linkages between cultural and biological diversity in terms of environmental activities and practices, many of which stem from diverse worldviews of human-nature interactions (Turner & Berkes, 2006).

2.2 Managing nature: Livelihoods, practices and resource management systems

As a set of practices or ways of doing things, cultures shape biodiversity through the direct selection of plants and animals and the reworking of whole landscapes (Sauer, 1965). Such landscapes have been described as anthropogenic nature, their composition, be it of introduced species, agricultural monocultures or genetically modified crops, a reflection of local culture and a product of human history including the context in which individuals and groups live their lives (Milton, 1999). Adams (1996) described nature as a "*cultural archive, a record of human endeavour and husbandry*" (Milton, 1999). For this reason, many anthropologists perceive landscapes to be a product of the connection between people and place; they are spaces to which people feel they have a relationship and of which they hold memories.

The widespread role of cultural activities in shaping nature has led to non-human or near-pristine nature being viewed as sacred. However, growing archaeological and ethnographic knowledge of diverse cultures has demonstrated that many habitats previously thought to be pristine are in fact an emergent property of resource dependent livelihood practices. For instance, North American landscapes have been sustained through periodic burning (Cronon, 1983) and grazing regimes in mountain Asia have encouraged shrub-to-forest conversion (Brower & Dennis, 1998). These landscapes, once thought to be free from human influence, are neither identical nor similar to conditions that would occur in the absence of people. Instead, they represent a diversity of ecological profiles shaped by localised cultural practices. Thus few landscapes are considered to be non-human today, most having been shaped either directly or indirectly by human activities, except at least historically perhaps for the extremes of the poles or the depths of the oceans, although global climate change is bringing this assertion into question. This has been now acknowledged with the naming of our geological era as the "anthropocene".

This has led, amongst other things, to a sharp split in attitudes to the concept of "wilderness" (Callicott & Nelson, 1998). Wilderness societies are passionate advocates of its values (often without a clear idea of the role of traditional societies in shaping the ecology), while for traditional societies the word often causes anger because of its implication that traditional societies were irrelevant.

Traditional human cultures may have a subtler ecological footprint, but they are still nonetheless significant in moulding the landscape. This is a product of their continued resource dependence. Unlike industrialised countries, where cultures have recently tended to shape and manipulate the landscape without restraint, urbanisation being but one product of this dominance, many indigenous and traditional cultures have developed livelihood practices that inevitably alter the landscape, but do so with care so as to ensure natural resource security into the future. Such ethics-based practices have been key to the survival of many developing communities and their landscapes to the present day

(Callicott & Nelson, 1998). Recognising this, many scientists and policy-makers alike now acknowledge the role that traditional cultural practices could play in biodiversity conservation in the future, particularly in little known ecosystems and in the light of the failures of state-imposed management schemes in many parts of the world (CBD, 1992; Veitayaki, 1997).

This form of resource management by which local communities and their established practices play a central role is often termed community-based conservation. It is the process by which biodiversity is protected by, for and with the local community, and although the practices vary greatly between societies, it is based on the coexistence of culture and nature and derives from holistic systems that combine harvesting with resource management (Western and Wright, 1994; Turner & Berkes, 2006). Key to the success of community-based conservation is thought to be the adaptive feedbacks that exist within the system, enabling rapid observation and adaptation to change. That is not to say that all livelihood activities developed within traditional communities lead to biodiverse outcomes, but that within many traditional cultures there exist practices and skills, developed from worldviews and livelihoods, that sustainably manage ecological integrity more successfully than modern industrialised societies have managed (Nepstad *et al.*, 2006; Turner & Berkes, 2006). Thus, the loss of one means a concomitant loss of the other.

2.3 Knowledge about nature: Knowledge bases and languages

If diverse cultural practices and worldviews are central to the management of biological diversity, then the key linkage between nature and culture is the knowledge upon which these practices and worldviews are based (Posey, 1999; Maffi 2001, 2005; Harmon, 2002). How people know the world governs behaviours, understandings and values that shape human interactions with nature. Berkes (2001) describes this as a “knowledge-belief-practice” complex that is key to linking nature with culture.

Knowledge of nature, traditional knowledge, indigenous knowledge, local ecological knowledge or ecoliteracy is accumulated within a society and transferred through cultural modes of transmission, such as stories and narratives, and observation as people travel over the landscape (Pilgrim *et al.*, 2007, 2008a). It comprises a compilation of observations and understandings contained within social memory that try to make sense of the way the world behaves, and societies use this collective knowledge to guide their actions towards the natural world. As a body of knowledge, it is rarely written down, enabling this cultural resource to remain dynamic and current, adapting with the ecosystem upon which it is based (Berkes, 2001; Turner & Berkes, 2006).

The importance of traditional ecological knowledge to resource management has been well described in recent years, re-emphasising the inter-dependence of biological and cultural diversity. Cultural understandings of the environment not only give rise to sustainable management practices, but also to knowledge of species requirements, ecosystem dynamics, sustainable harvesting levels and ecological interactions (Pilgrim *et al.*, 2007, 2008a). If sustained through stories, ceremonies and discourse, this culturally-ingrained knowledge 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). Central to this is the ability to learn from and adapt to incremental changes in the environment efficiently and effectively.

This “knowledge capital” is perceived by some to be a cultural insurance for the future (UNESCO/WWF/Terralingua, 2003). It provides a source of creativity and innovation, as well as a range of solutions for coping with current and future challenges, all contained within a diversity of languages. Languages encode knowledge bases in a way that is often non-translatable into other languages but nonetheless bridges 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 (UNESCO/WWF/Terralingua, 2003). However, diverse languages and knowledge bases are threatened today by the dual erosion of biological and cultural diversity.

2.4 Culture as institutions: Norms and regulations

In addition to ethics, values and environmental practices, ecological knowledge bases, if culturally-ingrained, give rise to socially-embedded norms and institutions. These normative rule systems govern human interactions and behaviours towards the natural environment (Ostrom, 1990), and have often co-evolved to mutually sustain both people and nature. Such contextual systems of collective action are intimately linked to the land upon which they are based and, subsequently, are enormously diverse. They often take the form of common property rule systems that govern the use of resources across a wide range of contexts, from forests to fisheries. These rules define access rights and appropriate behaviours often known as tenure systems (Turner & Berkes, 2006). Where these are robust, they maintain the productivity and diversity of socio-ecological systems without need for legal enforcement sanctions, as compliance is believed to be in the best interests of the community as a whole or the best guarantee of individual and family interests in the long term. Such strong, long-evolved, normative institutions themselves demonstrate remarkable diversity (Ostrom, 2005), with each differing institutional form in turn influencing the development of co-evolved ecological system, with unique ecological characteristics (Robbins, 1998).

Just as the theoretical convergence of cultural and biological diversity has been realised, so has the physical convergence. Many of the world's core area of biodiversity are also core areas for cultural diversity represented through the density of ethnic groups and linguistic diversity (UNESCO/WWF/Terralingua, 2003; Skutnabb-Kangas *et al.*, 2003; Sutherland 2003). This is by no means a coincidence, as traditional peoples' diversity of institutions, livelihoods, values, land tenure and resource management systems are likely to have contributed to biodiversity levels. Therefore, by overlooking the role that culture has played and will play in shaping nature, many scientists and policy makers overlook perhaps the greatest variable in the biodiversity equation. To consider nature without culture is tantamount to considering genotypes without phenotypes in the evolution of the genetic make-up of a species, since there are few, if any, places on earth where either exists in isolation.

Human cultures build around and attribute meaning to natural systems and processes in various ways, including cosmologies, worldviews, and religious and spiritual beliefs (Berkes, 2008). These understandings fundamentally govern both individual and collective actions towards nature, connecting knowledge and understandings with behaviour. How we know the world, therefore, governs our behaviour and practices that, in turn, shape landscapes, which form a cultural archive of human endeavours. Amidst a diversity of cultures comes a diversity of meanings, leading to a diversity of actions, providing an array of biodiversity outcomes. This nature-culture continuum or interaction has existed through the past and into the present, and is therefore likely to be sustained in the future. The next section goes on to discuss the future of this dichotomy including mutual threats and drivers of change.

3. Common Threats and Drivers

There has been an unparalleled shift towards landscape monocultures and human monocultures in recent history, and many drivers causing this shift derive from common threats and pressures. It has been suggested that many of these pressures have evolved from capitalist economies that stress non-stop progress and economic growth. These include a shift in consumption patterns, even in traditional societies who interact with the capitalist economy, the globalisation of food systems (Berkes, 2001), and the commodification of natural resources. These drivers are reinforced by pressures of assimilation, attempting to integrate minority cultures into dominant society, and urbanisation, and are at their most damaging when they lead to rapid and unanticipated periods of socio-economic change, which jeopardises people's and ecosystems' resilience or ability to withstand disturbance.

Traditional societies are also being suppressed by culturally-inappropriate education systems, often based around an industrialised model of education, and the loss of linguistic diversity, subsequently eroding ecological knowledge bases. Increased deforestation, unsustainable agricultural production and land tenure arrangements resulting from market interests are significant drivers of change, threatening or altogether dismissing culturally-embedded ownership and management practices. Limited market opportunities are causing livelihood diversification away from traditional resource-based livelihood activities and towards environmentally-disconnected activities and cultures (Pilgrim *et al.*, 2008b). There are, however, concerns that commodification of subsistence resources can lead to more rapid destruction. The dominance of modern healthcare systems is also threatening the long-term interdependencies between nature and culture in many traditional societies.

One of the most rapid drivers of change includes extreme natural events, particularly when coupled with anthropogenic stressors (Rapport & Whitford, 1999). Tools used in resource management also create common drivers and threats, such as exclusive policies (e.g. some nature-reserves or state-imposed management systems). A lack of transboundary cooperation and geopolitical instability threatens global diversity, as do weak institutions and a lack of resources, particularly when developing management strategies in developing countries. Amplifying this is the widespread encroachment of traditional lands in search of rapid economic returns, particularly in the current fuel crisis. Combined, these threats are paving the way to the homogenization of cultures and landscapes as demonstrated by assessments of the state of global and sub-global environments and cultural systems (Maffi, 2001; MEA, 2005; Rapport, 2006; Pretty *et al.*, 2007).

4. Key Consequences

As well as the homogenisation of landscapes, these common drivers are likely to have destructive health outcomes, particularly for young people if they spend less time in nature. Time spent directly experiencing and interacting with nature (a problematic term to define) has been shown to improve psychological health and well-being, as well as increase physical activity levels (Pretty, 2004, 2007; Pretty *et al.*, 2005, 2006, 2007). Spending less time in nature subsequently comes at a cost to health. It can also create an intrinsic disconnection with nature, leading to feelings of biophobia and a fear of the outdoors, perceiving it to be a wild and unfamiliar environment. Feelings of estrangement create an inability to care for and connect with nature, as cultural worldviews, beliefs and narratives lose their meaning and context. From this extinction of experience (Nabhan & St Antoine, 1993; Pyle, 2003) may evolve a lost generation, disconnected to any place in particular and unable to feel the innate relationships with nature that E.O. Wilson suggested are within us all (Kellert & Wilson, 1993), also described as nature-deficit disorder (Louv, 2004). A further dimension is important: the connection between human health and ecosystem function. The degradation of ecosystems with its attendant issues of food security, spread of human pathogens, newly emerging and resurging infectious diseases, psychological ills, is a major cause of illness today (Rapport *et al.*, 1998; Rapoport & Lee, 2003; Rapport & Mergler, 2004).

The rate of disconnection with nature, particularly amongst young people in industrialised communities, is likely to be amplified by the growing virtualisation of nature through television and computer screens. For some children, these virtual encounters may be their only experience of nature, but many naturalists question whether these encounters can ever create the same bond that comes from directly experiencing an animal or ecosystem first-hand (Pyle, 2001, 2003).

The combination of these economic and political drivers has led to global climate change and other environmental threats including overexploitation and habitat destruction. This has led the world into what has been described as the sixth great extinction period. It has been said that species are currently being lost at a rate that exceeds the extinction of the dinosaurs (McNeely & Scherr, 2001; Pretty, 2002; UNESCO/WWF/Terralingua, 2003). Although current rates of extinction are widely disputed, it is certain that many of the threats listed in the last section are contributing to biodiversity loss across the world. This in turn is eroding the resilience of socio-ecological systems, particularly in resource

dependent societies, where food security is lacking and environmental conditions are unpredictable, as they become less well-adapted and more vulnerable to change.

In addition to biological monocultures, these threats are paving the way to cultural monocultures, as a result of cultural extinctions caused by assimilation, language loss and knowledge loss (Posey, 1999; Maffi, 2001). Rural communities are migrating to urban areas, cultural knowledge transmission between generations is declining, oral knowledge is being replaced with written knowledge just as classrooms are replacing direct experience, and traditional livelihoods are being replaced by modern occupations, all at the expense of cultural diversity and the diversity of global knowledge bases. This comes at a cost to human societies as a decline in knowledge causes a decline in the possible solutions that humanity holds to future global challenges.

In a similar way, the combined loss of biodiversity and ecological knowledge has implications for human health in the future, as we stand to lose the opportunistic uses and future potential of species, for instance in curing human diseases or feeding growing populations. With this loss of knowledge, we are subsequently losing the adaptive management systems embedded in traditional cultures that have sustained natural resource pools through to the present day and may be a key tool in the future of global biodiversity protection. With the realisation of the linkages between nature and culture, their mutual threats and parallel losses, the need for a dual approach to the conservation of biological and cultural diversity has recently been acknowledged in the Millennium Development Goals (MEA, 2005). However, policy responses to this paradigm have been slow to emerge.

5. Responses: Policies and Projects

The role of and need for effective policies in biodiversity protection has long been understood, however the importance of cultural protection policies is only just emerging. We suggest that since many common drivers exist between biological and cultural diversity and their existence is so inherently linked, policy responses should effectively target both in a new dual conservation approach. There are examples of policies emerging in this light, although efforts often remain fragmented, localised and small-scale.

Locally, efforts include local recovery projects, revitalisation schemes such as outpost and hunter support programs, culturally-appropriate education schemes, and language revitalisation. Other approaches include the revival of culturally-appropriate healthcare systems, the protection and careful commercialisation of traditional food systems (e.g. Royal Greenland), and the greening of businesses. Larger-scale movements that have contributed to the dual protection of biological and cultural diversity include the Fair-trade movement and the shift towards education for planetary citizenship. Land rights are being recognised as human rights as the integral relationship between nature and culture is realised. Investment into community-based conservation and the dissemination of power to grass-roots initiatives and institutions has increased, strengthening the mechanisms that favour socio-environmental sustainability. Recent years have also seen the emergence of a huge number of ecotourism schemes, both small and large scale, although some of these amount to little more than greenwash.

Perhaps most representative of these movements is the emergence of international policies which favour the dual protection of biological and cultural diversity (CBD, 1992), and international recognition of the links between biodiversity and cultural diversity is reflected in the program of work of IUCN/CEESP and UNESCO, and in UNEP's flagship report, the *Global Environment Assessment* [the 4th edition (2007) includes the topic of biodiversity and culture: Maffi and Woodley 2007]. This defines biodiversity as also incorporating "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"(p.160). Nonetheless, a great deal still needs to be done in the international arena to strengthen this movement and to ensure policies are filtered down to grass-roots communities. It has even been suggested that payment mechanisms should be put in place to reward traditional societies

for the diversity of environmental goods and services (the full functioning of ecosystems) their ways of life provide.

One important consequence has been a dramatic reshaping of the way in which protected areas are conceived. Responses have manifested in both formal and informal conservation practices. There is an increasing recognition of the importance of so-called Community Conserved Areas – places deliberately managed by local communities in ways that also support high levels of biodiversity but which usually have no official “protected” status (Borrini-Feyerabend *et al.* 2003). More formally, there is now widespread recognition of cultural landscapes as something worthy of protection (category V protected areas of IUCN) where the interaction of humans and nature over time has produced a particular set of natural and cultural values (Phillips, 2004). Emerging partnerships between faith groups and conservation organisations present another powerful opportunity. Furthermore, under agreements of the CBD, all protected areas should be established with the prior informed consent of local communities and policies of self-government and co-management of such areas are becoming more common.

Thus a diversity of policy options exist to pave the way towards the dual protection of nature and culture. However, to conserve global diversity effectively, policy efforts need to be internationally-driven, large scale, geographically targeted, 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 at the same time as retaining their own cultural distinctiveness and connectedness to the land (Fisher, 1994; Colchester, 2000; Schwartzman *et al.*, 2000; Peres and Zimmerman, 2001; Heckenberger, 2004; ISA, 2006; Athayde *et al.*, 2007).

6. Key Questions

In order to support this new direction in policy, we suggest ten key questions need to be addressed:

Persuasion and Policies

1. How can governments and societies be persuaded that maintaining and improving both cultural and biological diversity can be in their interests?
2. What are the best examples of enabling and effective national and international policies that allow development of new approaches by grass-roots communities and their sharing with others?
3. What are the best approaches to take when traditions change, and 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 of their own peoples?

Revitalisation Projects

5. What are the most effective recovery or revitalisation projects that can protect the cultures and values of both indigenous peoples and post-industrialised societies?
6. What are the best internal and external incentives for sustaining cultural and biological diversity? Can the benefits of existing capitals of cultural and biological diversity be maximised in terms of income streams (without commodifying nature)?

Participation and Power

7. How can indigenous peoples best be empowered whilst 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 processes?

Changing Aspirations

9. How can new aspirations be created for livelihoods and lifeways in all societies so as to change the consumption patterns that threaten natures and cultures worldwide?

Young People and Nature Disconnections

10. How can younger generations be attracted back into contact with their local natures so as to prevent any further extinction of experience and the growing disconnection with nature?

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. Ironically, it is precisely as our knowledge of this linkage is advancing that these cultures are receding. In the absence of an extensive and sensitive accounting of the mutual influences 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 'natural' extinction rates. While conserving nature alongside human cultures presents unique challenges (Dove *et al.*, 2005; Robbins *et al.*, 2006), any hope for saving biological diversity, or even recreating lost environments through restoration ecology, is predicated on a concomitant effort to appreciate, protect, and respect cultural diversity.

References

- Adams, W.M. 1996. *Future nature: A vision for conservation*. Earthscan, London
- Agnew J., D.N. Livingstone and A. Rogers 1996 *Human Geography: An Essential Anthology*. Blackwell
- Anderies, J. M., M. A. Janssen, and E. Ostrom. 2004. A framework to analyze the robustness of social-ecological systems from an institutional perspective. *Ecology and Society* **9**(1): 18. [online] URL: <http://www.ecologyandsociety.org/vol9/iss1/art18/>
- 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: M.N. Alexiades (ed) *Mobility and migration in indigenous Amazonia: Contemporary ethnoecological perspectives*. Berghahn Books, Oxford
- Balée, W. 1994. *Footprints of the Forest. Ka'apor Ethnobotany*. Columbia University Press, New York.
- 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. Traditional ecological knowledge and resource management*. Taylor & Francis. Philadelphia, 2nd Edition
- Berkes, F. and C. Folke. 2002. Back to the future: Ecosystem dynamics and local knowledge. In: L.H. Gunderson and C.S. Holling (eds) *Panarchy: Understanding transformations in human and natural systems*. Island Press, Washington, DC, pp.121-146
- Berkes, F., D. Feeny, B. J. McCay & J. M. Acheson 1989. The benefits of the commons *Nature* **340**, 91 – 93.
- Berkes, F., J. Colding and C. Folke. 2000. Rediscovery of traditional ecological knowledge as adaptive management. *Ecological Applications* **10**(5):1251-1262

- Borrini-Feyerabend, G., A. Kothari and G. Oviedo. 2004. *Indigenous and Local Communities and Protected Areas*, Cardiff University and IUCN, Cardiff and Cambridge, UK
- Brower, B. and A. Dennis. 1998. Grazing the forest, shaping the landscape? Continuing the debate about forest dynamics in Sagarmantha National Park. In: . K. S. Zimmerer and K. R. Young (eds) *Nature's geography: New lessons for conservation in developing countries*. University of Wisconsin Press, Madison, WI, pp.184-208
- Brush, S.B. 1993. Indigenous knowledge of biological resources and intellectual property rights. *American Anthropologist* 95(3):653-671.
- Callicott J B and Nelson M P (eds). 1998. *The Great New Wilderness Debate*. University of Georgia Press, Athens and London
- Castree, N. and B. Braun. 2001. *Social nature: Theory, practice and politics*. Blackwell Publishing.
- CBD. 1992. Convention on Biological Diversity. United Nations Environment Programme. Available at: <http://www.cbd.int/convention/>
- Clark, W. C. and N.M. Dickson. 2003. Sustainability science: the emerging research program. *Proc National Academy of Science USA* 100(14):8059–8061
- Cocker, M. and R. Mabey. 2005. *Birds Britannica*. Chatto and Windus, London
- Cocks, M.L. & Dold, A.P. 2004. A new broom sweeps clean. The economic and cultural value of grass brooms in the Eastern Cape Province, South Africa. *Forests, Trees and Livelihoods*. 14: 33-42.
- Cocks, M.L. and Dold, A.P. 2000. The role of 'African Chemists' in the health care system of the Eastern Cape Province of South Africa. *Social Science & Medicine* 51: 1505–1515.
- Cocks, M.L. and Dold, A.P. 2006. Conservation of bio-cultural diversity: the role of medicinal plants in Xhosa culture. *Journal of Ethnobiology* 26 (1): 60-80
- Colchester, M. 2000. Self-determination or environmental determinism for indigenous peoples in tropical forest conservation. *Conservation Biology* 14 (5):1365-1367
- Costanza, R. 1992. *Ecological Economics: The Science and Management of Sustainability*. Columbia University Press.
- Costanza, R., R. d'Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R.V. O'Neil, J. Paruelo, R.G. Raskin, P. Sutton, M. van den Belt. 1997. The value of the world's ecosystem services and natural capital. *Nature* 387:253-260
- Cotton, C. 1996. *Ethnobotany: Principles and Applications*. London:Wiley.
- Cronon, W. 1983. *Changes in the land*. Hill and Wang, New York
- Crumley, C. 1994. *Historical Ecology: Cultural Knowledge and Changing Landscapes*. SAR Press.
- Cuomo, C. 1994. Ecofeminism, deep ecology and human population. In *Ecological Feminism*, edited by Warren, K.J. Routledge.
- D'Andrade, R. 1995. *The Development of Cognitive Anthropology*. Cambridge: Cambridge University Press.
- Denevan, W.M. 2001. *Cultivated landscapes of native Amazonia and the Andes*. Oxford University Press, Oxford
- Descola, P. and G. Palsson. 1996. *Nature and Society: Anthropological Perspectives*. Routledge.
- Dove, M. and C. Carpenter. 2008. *Environmental Anthropology: A historical reader*. Wiley.
- Dove, M.R., P.E. Sajise and A.A. Doolittle (eds) 2005. *Conserving nature in culture: Case studies from Southeast Asia*. Yale University Press, New Haven
- 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. Gland Switzerland and Manchester UK.
- Dunlap, R.E. and Catton, W. 1979. "Environmental sociology." *Annual Review of Sociology*, 5, pp. 243-73.
- Dunlap, R.E. and Catton, W. 1994. "Struggling with human exemptionalism: The rise, decline, and revitalization of environmental sociology." *The American Sociologist*, 25(1):5-30.
- Ellen, R. 1982. *Environment, Subsistence and System: The Ecology of Small-Scale Social Formations*. New York: Cambridge University Press.
- Ellen, R.F. 1996. Introduction. In: R. Ellen and K. Fukui (eds) *Redefining nature: Ecology, culture and domestication*. Berg, Oxford
- Ember, C.R. and M. Ember, 2006. *Cultural anthropology* (11th ed). Pearson Higher Education.
- Fisher, W.H. 1994. Megadevelopment, environmentalism, and resistance: The institutional context of Kayapó indigenous politics in central Brazil. *Human Organisation* 53(3): 220-232
- Franklin, A. 2002. *Natural and Social Theory*. Sage.
- Geertz, C. 1973. *The interpretation of cultures*. Basic Books, New York
- Goodin, R.E. 1992. *Green political theory*. Polity Press, Cambridge
- Gramling, R. and Freudenburg, W.R. 1996. Environmental sociology: toward a paradigm for the 21st century. *Sociological Spectrum*:347-70.
- Gunderson, L.H. and C.S. Holling (eds) 2002. *Panarchy: Understanding transformations in human and natural systems*. Island Press, Washington, DC
- Harmon D. 2002. *In Light of Our Differences*. Smithsonian Institution Press, Washington DC
- 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.
- ISA. 2006. Instituto Socioambiental. Povos Indígenas no Brasil. Available at: <http://www.socioambiental.org/pib/portugues/quonqua/quantossao/indexqua.shtm> (consulted in 01/20/06).
- Kates, R. W. et al. 2001. Environment and Development: Sustainability science. *Science* 292:641-642.
- Kates, R. W., W.C. Clark, R. Corell, J.M. Hall, C.C. Jaeger, I. Lowe, J.J. McCarthy, H.J. Schellnhuber, B. Bolin, N.M. Dickson, S. Faucheux, G.C. Gallopin, A. Grubler, B. Huntley, J. Jager, N.S. Jodha, R.E. Kaspersen, A.

- Mabogunje, P. Matson, H. Mooney, B. Moore, T. O'Riordan and U. Svedlin. 2001. Sustainability science. *Science* 292(5517):641-642
- Kellert, S.R. and E.O. Wilson (eds) 1993. *The biophilia hypothesis*. Island Press, Washington, DC
- Kitching, R.L. 1983. *Systems ecology*, University of Queensland Press.
- Komiyama, H. and K. Takeuchi. 2006. Sustainability science: Building a new discipline. *Sustainability Science* 1(1): 1-6
- Kothari, U. 2005. A Radical History of Development Studies: Individuals, Institutions and Ideologies. London:Zed.
- Kottak, C.P. 1999. The new ecological anthropology. *American Anthropologist* 101(1):23-35.
- Light, A. and Rolston III, H. 2003. *Environmental ethics: An Anthology*: Blackwell
- Louv R. 2005. *Last Child in the Woods*. Algonquin Press, Chapel Hill
- Mabey, R. 1997. *Flora Britannica: The definitive new guide to Britain's wild flowers, plants and trees*. Sinclair-Stevenson, London
- Maffi, L. 1998. Language: A Resource for Nature. *Nature and Resources: The UNESCO Journal on the Environment and Natural Resources Research* 34(4): 12-21
- Maffi, L. (ed). 2001. *On Biocultural Diversity*. Smithsonian Institution Press, Washington, DC
- Maffi, L. 2005. Linguistic, cultural, and biological diversity. *Annual Review of Anthropology* 34:599-617.
- Maffi, L. and Woodley E. 2007. Culture section of Chapter 5, Biodiversity, in United Nations Environment Programme's 4th *Global Environment Outlook Report [GEO-4]*. Nairobi: UNEP
- Marsden, W.E. 1997. Environmental Education: Historical Roots, Comparative Perspectives, and Current Issues in Britain and the United States. *Journal of Curriculum and Supervision* 13(1), 6-29.
- McNeely, J.A. and S.J. Scherr 2001. *Common ground, common future: How ecoagriculture can help feed the world and save wild biodiversity*. IUCN and Future Harvest, Washington, DC
- McNeill, J.R. 2003. Observations on the nature and culture of environmental history. *History and Theory*, 5-43
- MEA. 2005. Current state and trends, vol 1: Ecosystems and well-being. In: *Millennium Ecosystem Assessment*. Island Press, London
- Milton, K. 1998. Nature and the environment in indigenous and traditional cultures. In: D.E. Cooper and J.A. Palmer (eds) *Spirit of the environment: Religion, value and environmental concern*. Routledge, London & New York, pp.86-99
- Milton, K. 1999. Nature is already sacred. *Environmental Values* 8:437-449
- Nabhan, G.P. and S. St. Antoine. 1993. The loss of floral and faunal story: The extinction of experience. In: S.R. Kellert and E.O. Wilson (eds) *The biophilia hypothesis*. Island Press, Washington, DC, pp.229-250
- Næss, A. 1973. The Shallow and the Deep, Long-Range Ecology Movement. *Inquiry* 16: 95-100.
- Næss, A. 1989. *Ecology, Community and Lifestyle: Outline of an Ecosophy* Translated by D. Rothenberg. Cambridge: Cambridge University Press.
- Nazarea, V.D. (2006). A view from a point: ethnoecology as situated knowledge, in Nora Haenn and Richard Wilk: *The Environment in Anthropology: A Reader in Ecology, Culture, and Sustainable Living*. New York: New York University Press, 34-39.
- Nepstad, D., S. Schwartzman, B. Bamberger, M. Santilli, D. Ray, P. Schlesinger, P. Lefebvre, A. Alencar, E. Prinz, G. Fiske, and A. Rolla. 2006. Inhibition of Amazon deforestation and fire by parks and indigenous lands. *Conservation Biology* 20:65-73.
- Norgaard, R.B. 1994. *Development betrayed: the end of progress and a coevolutionary revisioning of the future*. Routledge, London
- Ostrom, E. 1990. *Governing the commons: The evolution of institutions for collective action*. Cambridge University Press, Cambridge
- Ostrom, E. 2005. *Understanding Institutional Diversity*. Princeton (NJ): Princeton University Press.
- 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
- Phillips, A. 2002. *Management Guidelines for IUCN Category V Protected Areas: Protected Landscapes and Seascapes*. IUCN and the University of Cardiff. Cardiff and Cambridge UK
- Pieroni, A., L.L. Price and I. Vandebroek. 2005. Welcome to the Journal of Ethnobiology and Ethnomedicine. *Journal of Ethnobiology and Ethnomedicine* 1:1.
- 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., L. Cullen, D.J. Smith and J. Pretty. 2008a. Ecological knowledge is lost in wealthier communities and countries. *Environmental Science and Technology* 42(4):1004-1009
- Pilgrim, S., L. Cullen, D.J. Smith and J. Pretty. 2008b. The loss of ecological knowledge as a consequence of livelihood diversification in Indonesia: implications for natural resource management (in review)
- Pretty, J. 2002. *Agri-Culture: Reconnecting People, Land and Nature*. Earthscan, London
- Pretty J. 2004. How nature contributes to mental and physical health. *Spirituality and Health International* 5(2):68-78
- Pretty J. 2007. *The Earth Only Endures: On Reconnecting with Nature and Our Place in it*. Earthscan, London, pp 274
- Pretty J. 2007. Agricultural sustainability: concepts, principles and evidence. *Phil Trans Royal Society of London B* 363 (1491), 447-466
- 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
- Pretty, J., R. Hine and J. Peacock. 2006. Green exercise: The benefits of activities in green places. *The Biologist* 53(3):143-148
- Pretty, J., A. Ball, T. Benton, J. Guivant, D. Lee, D. Orr, M. Pfeffer and H. Ward (eds). 2007. *Sage Handbook on Environment and Society*. Sage Publications, London

- Pretty, J., J. Peacock, R. Hine, M. Sellens, N. South and M. Griffin. 2007. Green exercise in the UK countryside: Effects on health and psychological well-being, and implications for policy and planning. *Journal of Environmental Planning and Management* 50(2):211-231
- Pyle, R.M. 2001. The rise and fall of natural history: How a science grew that eclipsed direct experience. *Orion* 20:17-23
- Pyle, R.M. 2003. Nature matrix: Reconnecting people and nature. *Oryx* 37:206-214
- Rapport, D. et al. 1999. Ecosystem health: the concept, the ISEH, and the important tasks ahead. *Ecosystem Health* 5(2):82-90.
- Rapport, D.J. 2006. Sustainability science: An ecohealth perspective. *Sustainability Science* 2:77-84
- Rapport, D.J. and A. Singh. 2006. An ecohealth-based framework for state of environment reporting. *Ecological Indicators* 6:409-428
- Rapport, D.J. and Lee, V. 2003. Ecosystem approaches to human health: some observations on North/South experiences. *Environmental Health* (3) 2: 26-39
- Rapport, D.J. and Mergler, D. 2004. Expanding the practice of ecosystem health. *EcoHealth* (1, Supple 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
- Rapport, D.J., Costanza, R., and McMichael, A. 1998. Assessing ecosystem health: Challenges at the interface of social, natural, and health sciences. *Trends in Ecology and Evolution* 13 (10): 397-402
- Robbins, P. 1998. Authority and Environment: Institutional Landscapes in Rajasthan, India. *Annals of the 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
- Robbins, R. 2004. Political Ecology: A critical introduction. Blackwell Publishing.
- Rolston, H. 1988. Environmental Ethics: Duties to and values in the natural world. Temple University Press.
- Salzman, P.C. and D.W. Attwood. 1996. "Ecological Anthropology." In Encyclopedia of Social and Cultural Anthropology. Alan Barnard and Jonathan Spencer, eds. Pp. 169-172. London: Routledge.
- Sanga, G. and G. Ortelli. 2004. Nature Knowledge: Ethnoscience, cognition and utility. Berghahn Books.
- Sauer, C.O. 1965. The morphology of landscape. In: J. Leighly (ed) Land and life. University of California Press, Berkeley, pp.315-350
- Schwartzman, S., A. Moreira and D. Nepstad. 2000. Rethinking tropical forest conservation: Perils in parks. *Conservation Biology* 14(5):1351-1357
- Skutnabb-Kangas, L. Maffi, and D. Harmon 2003. Sharing a World of Difference: The Earth's Linguistic, Cultural, and Biological Diversity, and map The World's Biocultural Diversity: People, Languages, and Ecosystems. UNESCO, Paris.
- Skutnabb-kangas, T, L. Maffi, and D. Harmon. 2003. Sharing a world of difference: The Earth's linguistic, cultural, and biological diversity. UNESCO Publishing.
- Somerville, M. & Rapport, D J. (eds.) 2000 *Transdisciplinarity: Re-Creating Integrated Knowledge*. UNESCO/EOLSS Publishers, Oxford, UK (reprinted in Canada: Queens/McGill University Press)
- Steiner, F. 2002. Human ecology: Following nature's lead. Island Press.
- Stookes, P. 2005. A practical approach to Environmental law. Oxford University Press.
- Sutherland, W. 2003. Parallel extinction risk and global distribution of languages and species. *Nature* 423:276-279
- Toledo, V.M. 2001. Biodiversity and indigenous peoples. *Encyclopedia of Biodiversity* 3:451-463
- Townsend, P K., 2000. *Environmental Anthropology: From Pigs to Policies*. Prospect Heights, IL: Waveland Press, Inc.
- Turner, M G., Gardner, R H., & R.V. O'Neill 2001. *Landscape Ecology in Theory and Practice: Pattern and Process*. Springer
- Turner, N. and F. Berkes. 2006. Coming to understanding: Developing conservation through incremental learning in the Pacific Northwest. *Human Ecology* 34:495-513
- UNESCO/WWF/Terralingua. 2003. Sharing a world of difference: The earth's linguistic, cultural and biological diversity. UNESCO/WWF/ Terralingua, Paris
- Van der Ryn, S and S. Cowan. 2007. Ecological Design. Island Press.
- Veitayaki, J. 1997. Traditional marine resource management practices used in the Pacific islands: An agenda for change. *Ocean and Coastal Management* 37:123-136
- Walker, B., C. S. Holling, S. R. Carpenter, and A. Kinzig. 2004. Resilience, adaptability and transformability in social-ecological systems. *Ecology and Society* 9(2): 5. [online] URL: <http://www.ecologyandsociety.org/vol9/iss2/art5/>
- Western, D. and R.M. Wright (eds) 1994. *Natural connections*. Island Press, Washington, DC.
- Wiersum K.F. and Shackleton C. 2005. Rural dynamics and biodiversity conservation in southern Africa. In M.A.F. Ros-Tonen and T. Dietz (eds.), *African Forests between Nature and Livelihood Resources: Interdisciplinary Studies in Conservation and Forest Management*. Edwin Mellen Press: UK, pp. 67-92.
- 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 L. Maffi, editor. *On Biocultural Diversity: Linking Language, Knowledge, and the Environment*. Smithsonian Institution Press, Washington D.C.

Annex A: Definitions of disciplinary and sub-disciplinary terms

Anthropology of nature

The study of the nature-society interface or of the relationships of nature and culture (Descola & Palsson 1996; Franklin, 2002).

Agricultural Sustainability

The development of technologies that are effective for farmers, result in improvements and food productivity and do not have adverse effects on environmental goods and services (Pretty, 2002, 2007).

Biocultural diversity

Analyzes the relationship between language, culture and the environment as distinct but closely and necessarily related manifestations of the diversity of life on Earth (Skutnabb-kangas *et al.*, 2003; Maffi, 2005).

Cognitive anthropology

Building on work of ethnobotanists and ethnobiologists, has examined the structure and systematics of folk knowledge (Brush, 1993). Cognitive anthropology investigates cultural knowledge, knowledge which is embedded in words, stories, and in artifacts, and which is learned from and shared with other humans (D'Andrade, 1995).

Commons Studies

Focus 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 (Berkes *et al.*, 1989).

Cultural anthropology

The investigation, usually through long term, intensive field studies, of the beliefs, knowledge, practices, modes of social organization and forms of communication of defined social groups (Ember & Ember, 2006).

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

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 the domination of the environment (Sturgeon, 1997).

Ecological anthropology

Basic scientific study, using a systems approach, of the links between humans and ecosystems, with a focus on how culture mediates these interactions (Ellen, 1982; Salzmänn and Attwood, 1996; Kottak, 1999).

Environmental anthropology

Applied, cross-cultural study of relations between people and their environment over time and space (Townsend, 2000; Dove & Carpenter, 2008).

Ecological design

Field of design that integrates human purposes into wider patterns, principles, and flows of the natural world (Van der Ryn & Cowan, 1996).

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 *et al.*, 1999).

Environmental education

The organized teaching of the functioning of natural environments, and how human behavior and ecosystems can be managed in order 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 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 (Stokes, 2005).

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 (McNeil, 2003).

Environmental sociology

Study of the interactions between the environment and social organization and behavior (Dunlap and Catton 1979, 1994; Gramling & Freudenburg, 1996)

Ethnobiology

Study of culturally based biological and environmental knowledge and cultural perception of the natural world (Pironi *et al.*, 1995).

Ethnobotany

Study of the complex relationship between plants and cultures (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

Ethnoscience

Study of people's perception of their surroundings, 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, made manifest in landscape (Crumley 1994).

Human ecology

Multidisciplinary study of the relationship between humans and their environment (Steiner, 2002)

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 *et al.*, 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-soicail landscapes (Castree & Braun 2001).

Political ecology

Study of how political, economic, and social factors affect ecological processes and how ecologies can shape political and economic possibilities (Robbins, 2004).

Resilience (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 *et al.* 2004).

Resilience (cultural)

The adaptive capacity of a culture or cultural group to adjust to new conditions without losing structure and function resilience).

Symbolic ecology

Study which uses the nature-culture prism to make sense of myths, rituals, systems of classification, food and body symbolism, and other aspects of social life (Descola & Palsson 1996).

Social-ecological systems (SES)

Study of the diverse relationships between an ecological system and one or more intricately linked social systems (Anderies *et al.*, 2004; Walker *et al.*, 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 *et al.*, 2001; Clark & Dickson 2004).

Systems ecology An approach to the study of ecology of organisms that focuses on interactions between biological and ecological systems (Kitching, 1983).