

A Review of the Elements of Human Well-Being with an Emphasis on the Contribution of Ecosystem Services

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Abstract Natural ecosystems perform fundamental life-support services upon which human civilization depends. However, many people believe that nature provides these services for free and therefore, they are of little or no value. While we do not pay for them, we pay significantly for their loss in terms of wastewater treatment facilities, moratoriums on greenhouse gases, increased illnesses, reduced soil fertility and losses in those images of nature that contribute to our basic happiness. Little is understood about the well-being benefits of the natural environment and its ecosystem services. The interwoven relationship of ecosystems and human well-being is insufficiently acknowledged in the wider philosophical, social, and economic well-being literature. In this article, we discuss an approach to examine human well-being and the interactions of its four primary elements—basic human needs, economic needs, environmental needs, and subjective well-being—and ecosystem services.

Keywords Ecosystem services · Human well-being · Sustainability · Ecological economics · Subjective happiness

INTRODUCTION

Natural ecosystems perform fundamental life-support services upon which human civilization depends. However, many people believe that nature provides these services for free and therefore, they are of little or no value. These services may not cost the world's population in dollars but everyday decisions almost always have some effect on the magnitude and quality of ecosystem services provided. While we (in this case we is a nation) do not pay for them, we pay significantly for their loss in terms of wastewater

treatments facilities, moratoriums on greenhouse gases, increased illnesses, reduced soil fertility, and losses in those images of nature that contribute to our basic happiness. So, what we do not want is to have to worry or deal with losses in nutrient regulation, toxic contamination, poor soil productivity, climatic disasters, or illness (physical or mental).

Life itself, as well as the entire human economy, depends on goods and services provided by earth's natural systems (Daily 1997). The processes of cleansing, recycling, and renewal, along with goods such as seafood, forage, and timber, are worth many trillions of dollars annually, and nothing could live without them. Yet growing human pressures on the environment profoundly disrupt the functioning of natural systems and significantly reduce the delivery of these services. Humans have changed ecosystems more rapidly and extensively in the last 50 years than in any comparable period of human history (Daily 1997). We have done this to meet the growing demands for food, freshwater, timber, fiber, and fuel. While a cursory evaluation of these changes to ecosystems have appeared to enhance the well-being of billions of people, they have also caused a substantial and largely irreversible loss in diversity of life on Earth, have strained the capacity of ecosystems to continue providing critical services, altered our perception of place and our comfort level with nature and, in the long-term, significantly will reduce human well-being.

Nutrient recycling, habitat for plants and animals, neutralization of pollutants, protection from natural disasters, control of pest outbreaks and diseases, and water supply are among the many beneficial services provided by aquatic ecosystems. In making decisions about human activities, such as draining a wetland for a housing development, it is essential to consider both the value of the development and

the value of the ecosystem services that could be lost. Despite a growing recognition of the importance of ecosystem services, their value is often overlooked in environmental decision making. In this manuscript, we examine the contribution of ecosystem services to the maintenance and improvement of human well-being based on literature from the last 20 years. Until recently, little has been written specifically connecting ecosystem services and well-being. We will examine the contributing elements of well-being namely, basic human needs, economic needs, and subjective well-being and then examine the potential linkages between human well-being and its components to ecosystem services.

HUMAN WELL-BEING

“Human well-being” is receiving much attention by academics, policy-makers, and practitioners throughout the world; however, little is understood within the well-being literature about the well-being benefits derived from the natural environment and its ecosystem services. The Millennium Ecosystem Assessment (MEA 2005) provides a useful framework for exploring these links. From a well-being perspective, the MEA’s value is its recognition of how well-being cannot be considered in isolation from the natural environment. This is insufficiently acknowledged in the wider philosophical, social, ecological, and economic well-being literature. The MEA developed a typology of ecosystem services—the goods and services the natural environment provides to people—and linked this to the constituents of human well-being. However, the MEA failed to capture all the well-being dimensions as advocated by well-being literature including physical, mental, and social well-being. We will address our present understanding of all four elements of human well-being—basic needs, economic needs, environmental needs, and subjective happiness—and the potential influences of ecosystem services upon them.

There is no single agreed definition of human well-being: it is a broad and contested term, interpreted in many different ways with significant overlap. At a generalized level, it is useful to distinguish between objective and subjective dimensions of well-being. Objective dimensions capture material and social attributes (recognized as important for fostering well-being) that contribute or detract from individual or community well-being. These dimensions include the level of wealth, provision of education and health care, infrastructure and so on. Broadly speaking, they include many basic human needs, economic needs, and environmental needs—factors deemed important for society’s welfare—and are easily measured at the population level (e.g., Parris and Kates 2003; Talberth et al.

2006). In contrast, subjective dimensions capture an individual’s assessment of their own circumstances—what they think and feel. Well-being is an abstract concept that refers to the *state* of a person’s life (Clark and McGillivray 2007). Subjective well-being research has shown a great deal of activity recently in the psychology and economics literature (e.g., Kahnemann et al. 1999; Layard 2005).

The literature suggests that well-being should be treated as a multidimensional phenomenon that captures a mixture of people’s life circumstances, how they feel and how they function. Elements of this are visible in Diener and Seligman’s (2004) definition of well-being: “Peoples’ positive evaluations of their lives include positive emotion, engagement, satisfaction, and meaning”. They recognize that well-being incorporates several separable concepts. This raises concerns regarding the tendency of well-being to be conflated with happiness which, according to mainstream understanding, is only one element of well-being.

Well-being is a positive physical, social, and mental state; it is not just the absence of pain, discomfort, and incapacity. It requires that basic needs are met, that individuals have a sense of purpose, and that they feel able to achieve important personal goals and participate in society. It is enhanced by conditions that include supportive personal relationships, strong and inclusive communities, good health, financial and personal security, rewarding employment, and a healthy attractive environment. Policy-makers see a well-being perspective as valuable in challenging accepted ways of viewing policy and thus encouraging innovative approaches (Clark and McGillivray 2007). In a number of contexts, a well-being focus has promoted an increased awareness and recognition of the combined effects of social, economic, and environmental factors. It has helped to promote a more holistic approach to policy-making.

COMPONENTS OF HUMAN WELL-BEING

As described in Fig. 1, human well-being is composed of four primary components—basic human needs, economic needs, environmental needs, and subjective happiness. The components of human well-being are similar to Maslow’s pyramid of self-actualization (Maslow 1954) or hierarchy of needs (Fig. 2). In our conceptualization, basic human needs equate to physiological and some safety needs. Economic needs equate to those safety needs described by employment that meets basic economic needs, costs of education, earning power, personal wealth, household infrastructure, and non-paid work—as well as some socially based needs—community/national wealth and productivity, public infrastructure, economic diversity, economic growth, economic sustainability, and trade.

Fig. 1 Conceptual model for human well-being

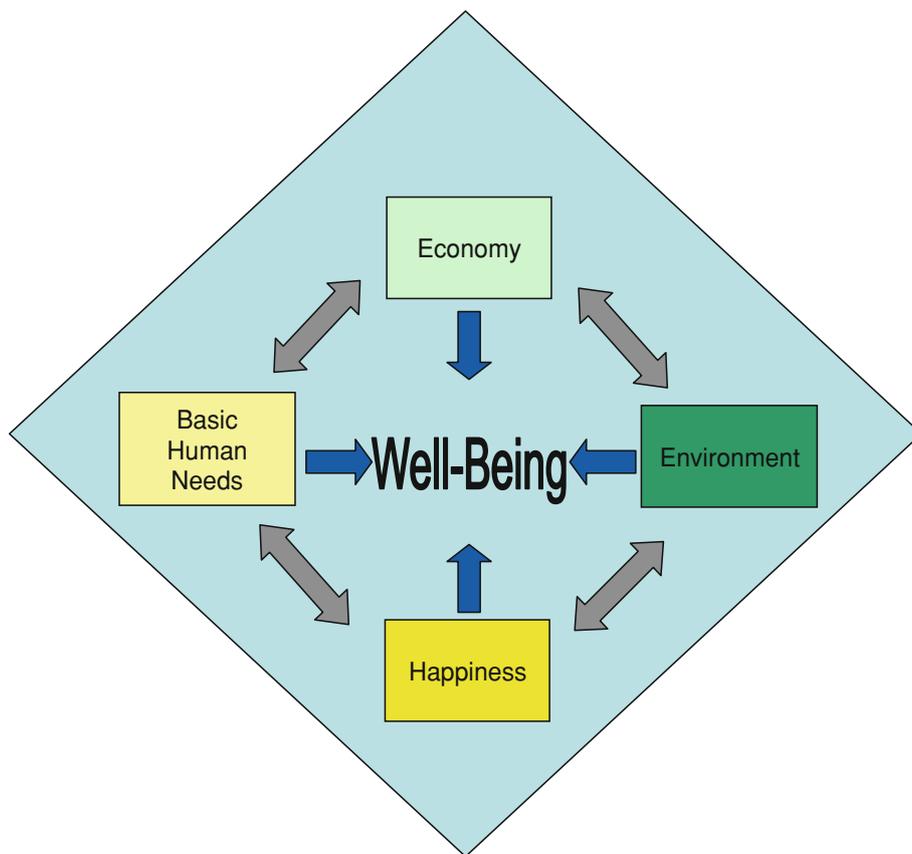
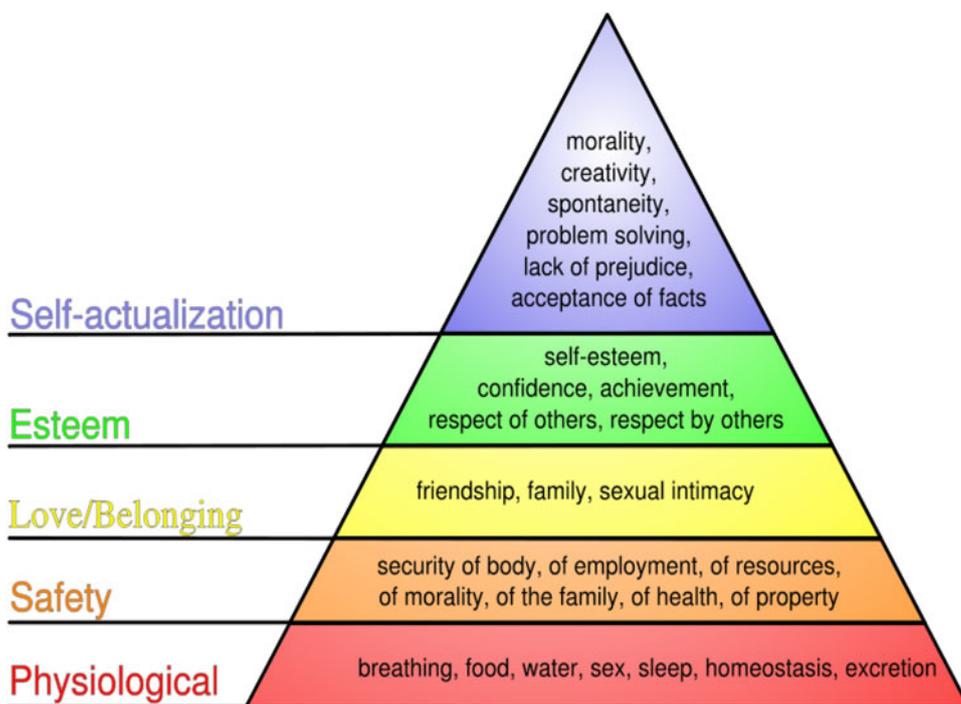


Fig. 2 Maslow’s (1943, 1954, 1998) hierarchy of needs



Environmental needs also equate to safety needs and include the availability of clean air, the availability of clean water, low health risks due to toxic contamination, and

acceptable distances from critical ecological thresholds. In addition, one environmental need—biophilia (Kellert and Wilson 1993)—equates to belongingness/love needs.

Subjective happiness equates to the remaining hierarchical needs from belongingness/love through aesthetic needs. These include life satisfaction and freedom, sense of place, identity, community vitality and cohesion, access to nature, access to diversity of nature, affection/respect toward nature, value/importance of leisure time, mutual respect, cultural and spiritual beliefs, and aesthetics.

The New Economics Foundation (nef) project (2005) has and continues to explore the link between physical and psychological well-being and the environment and ecological services. Climate change, resource degradation, ozone depletion, global elemental cycles, biodiversity loss, chemical contamination of food, air and water, alien/invasive species have all been shown to have negative effects on physical well-being at localized and global scales. Positive impact through engagement with the natural environment and its services has been documented on psychological well-being individually and at the community level. Communal green spaces in urban areas have been linked to higher levels of community cohesion and social interaction among neighbors (Kuo and Sullivan 2001). Pretty et al. (2007) demonstrated the impact of access to green space on both physiological and psychological well-being.

The Millennium Ecosystem Assessment (2003) identified a framework for categorizing ecosystem services—provisioning services, regulating services, cultural services, and supporting services. The MEA recognized that changes in ecosystem services have a direct effect on human well-being through impacts on security, the basic materials for a good life, health and social and cultural relations. Together these elements are influenced by and have an influence on the freedoms and choices available to people. The relationship between ecosystem change (interchangeable with changes in ecosystem services) and human well-being has both current and future dimensions and short-term impacts may not even have the same direction as longer-term impacts, much less the same magnitudes. For example, the overexploitation of an ecosystem may temporarily increase material well-being and alienate immediate poverty, yet prove to be unsustainable and in the end severely reduce material well-being and increase levels of poverty (MEA 2003).

In the following sections, the components of human well-being are examined in detail with a discussion within each component of the relationships between changes in that component and changes in environment and ecosystem services.

Basic Human Needs

It is clear that the first step toward well-being is the provision of basic physical and psychological needs. The

environment and ecosystem services can play some role in this process and evidence is mounting regarding the magnitude of that influence. Table 1 lists the myriad of well-being elements that are included in basic human needs.

The most basic of human needs include food, water, and shelter. A major ecosystem provisioning service is to provide food through agricultural soil interactions (Daily et al. 1997; Sandhu et al. 2007), pollination (Losey and Vaughan 2006), and animal and fish stocks (Holmuhund and Hammer 1999). Similarly, the production of water for drinking, irrigating, and manufacturing is a primary provisioning services of numerous ecosystems (Daily et al. 1997; Wilson and Carpenter 1999). In addition, ecosystem services provide for the production of supplies (wood, peat, fossil fuels, and running water) for heating, electrical production, fuel generation, and hydropower generation (Daily et al. 1997; Guo et al. 2000) and the production of fiber and building materials from ecosystems (Raffestin and Lawrence 1990).

Basic employment is a clear and vital requirement for human well-being. While the act of employment may have little to do with ecosystem services, numerous job-types are directly related to ecosystem services. Employment involved with agriculture and food production (e.g., see citations above), food distribution (Daily et al. 1998), forestry (Daily et al. 1997), green architecture and design (Jackson 2003), and environmental protection (Daily 2000) all have a dependence upon basic ecosystem services. Basic human livelihoods are often supported by natural ecosystem services.

Interactions among physical health, mental health, and ecosystem services have been discovered and described (and continue to be) for the last several decades. If physical and mental health is tied to quality of life (QOL) (Guyatt et al. 1993) then relationships between ecosystem services and enhanced physical or mental health indicate a direct influence on human well-being. Furthermore, influences of these services on childhood development, cognitive learning, and education also represent a linkage between ecosystem services and well-being. Many studies have described effects of ecosystem services on physical health and exposure to disease. Reduced recovery times from surgery and reduced pain have been associated with the simple service of trees and functioning ecosystems being in view of the patients (Diette et al. 2003). Incidence and exposure to Lyme disease (Jackson et al. 2006), changes in the geographical range and incidence of vector parasite borne diseases (Rapport et al. 1998), and the human impacts of poor quality irrigation water (Srinivasan and Ratna Reddy 2009) have been shown to have an ecosystem service component. Natural ecosystems and their services control >95 % of all the potential pests of crops and carriers of disease to human beings. The simple service of complete darkness at night has been shown to enhance the amount

Table 1 The primary drivers of the four elements of human well-being

Basic human needs	Personal wealth
Food	Trade
Clothing	Non-monetary value
Mental health	Environmental well-being
Participation	Availability of clean air
Personal and psychological development	Low health risks due to toxics
Shelter	Distance from critical ecological thresholds
Employment	Availability of clean water
Natural space	Species diversity (biophilia)
Parental care	Subjective well-being
Water	Life satisfaction
Education	Choice
Eldercare	Solastalgia
Security	Community vitality
Building materials	Access to nature
Physical health	Affection/respect toward nature
Access to information	Cultural requirements
Child development	Happiness
Economic well-being	Freedom
Wealth and/or productivity (GNP, GDP)	Sense of place (topophilia)
Public and household infrastructure	Identity
Economic diversity	Social cohesion
Growth and sustainability	Access to diverse nature
Cost of education/profit of education	Value/importance of leisure time
Non-paid work (e.g., housework, parenting, volunteerism, elder care)	Aesthetics
Level of income	

and quality of sleep; thereby, enhancing elements of physical health (Naiman 2006). Destruction of this service through light pollution appears to have the reverse effect. Thus, human population health should be understood within an ecological and ecosystem services framework as an expression of the life-supporting capacity of the environment (a service).

The connections between ecosystem services and mental health have been equally well documented. Kaplan (1995) discusses the restorative benefits of nature and suggests an integrative framework that places both directed attention and stress in the larger context of human–environment relationships. Natural environments turn out to be particularly rich in the characteristics necessary for restorative experiences. Horticultural experiences have been utilized successfully in the treatment of dementia (Gigliotti et al. 2004) and decreasing recovery times from a variety of maladies (Ulrich 1999), green play has increased attention spans in ADD children (Faber Taylor et al. 2001a) and interactions with nature have restored attention and promoted recovery from mental fatigue (Kaplan 1995).

The connection between nature and children’s development has been among the most important areas of communication in the last decade (Schneider 2009). The

interactions of natural settings and childhood development are not completely understood but the absence of this interaction has been dubbed nature-deficit disorder (Louv 2005). This disorder has stimulated legislative (No Child Left Inside Act of 2009) grassroots community efforts,¹ and “right of bills” types of manifestos. Interactions with nature and its ecosystem services have been shown to enhance cognitive and problem-solving abilities, promote independence, focus attention, promote better environmental awareness, generally benefit early childhood development (Cohn and Horm-Wingerd 1993; Kahn and Kellert 2002; Moore et al. 2004; Louv 2005; van Noy 2008); and even, reduce obesity by reducing time spent interacting with stationary media like television and video games (Kaiser Family Foundation 2005) or increasing exercise times (Pretty et al. 2007). Natural interactions with ecosystems have been shown to have enhanced educational benefits through wilderness interactions for inner city youth (Faber Taylor et al. 2001b), improved educational skills and enhanced educational and developmental skills (Lieberman and Hoody 1998).

¹ (Children and Nature Network, www.childrenandnaturenetwork.org).

Relationships between ecosystem services and personal and community security (particularly in the inner city) have been demonstrated through green design projects (Kuo 2001). Aggression and crime reduction has been documented in areas with some natural greenery or parks (Kuo and Sullivan 2001). Ecosystem services have even become a focus in some national security issues involving water resources and poverty and agricultural security (Sandhu et al. 2010).

It is clear that ecosystem services can play a role, sometimes a significant role, in the basic needs associated with human well-being. Ranging from a somewhat minor role in employment to a major role in childhood development, the role of ecosystem services in this element of well-being should not be ignored. Nevertheless, in many seemingly non-environmental decisions regarding education, housing, health, and security issues, the role of ecosystem services is presently ignored. This omission has often resulted in unintended consequences, particularly for ecosystem condition and services.

Economic Needs

In Maslow's hierarchy of needs (Fig. 2) once physiological needs are met, safety, belongingness, and esteem needs are the next series of needs that human strive to acquire to develop a strong sense of well-being. For many, particularly in the Western World, these levels are attained via economic advancement. While in concept these levels of needs involve many other inputs and achievements, both psychological and social, much of Western well-being at these levels relates to perceived economic needs (Table 1). While many of the contributors to economic well-being do not often result from ecosystem services, the achievement of economic well-being can have significant effects on ecosystem services. Much of the debate regarding the value of ecosystem services is driven by economic approaches. In fact until recently, much of the undervaluing of services is the result of using traditional cost-benefit ratios and valuing procedures that do not account for non-dollar values associated with the existence of ecosystems (Kumar and Kumar 2007). As the Millennium Ecosystem Assessment (2003, 2005) reminded us, without ecosystem services, there would be no human life, much less human society, economies, or well-being.

We measure national economic performance with indicators such as the gross domestic product (GDP), indices of stock and commodity markets, and many others, as well as individual economic performance by their individual equivalents—net wealth, investment portfolios, and others. The reliability, utility, and popularity of these indicators are rooted in what they have in common, that is, units that are easily measured, understandable to most, and

comparable across sectors—typically in dollars. Further, we tend to expand these measures to rate national and individual well-being ignoring the non-economic elements of well-being. However, these traditional measures of economic well-being tend to ignore all but the immediate or, at best, short-term benefits or value, non-paid work (e.g., housework, parenting, volunteerism, elder care), the long-term economic benefits of education, and the non-monetary value of ecosystems and ecosystem services (i.e., non-resource value).

Ecosystem services play a direct role in several drivers of economic well-being and the indirect interactions ecosystem services have on this element of well-being can be widespread (Jordan et al. 2010). Examples of direct interaction of ecosystem condition and services and economic well-being include renewable and non-renewable natural resources, tourism, fisheries, and agriculture, tourism, recreation, fisheries, and agriculture (Rockel and Kealy 1991; Parks and Bonifaz 1994; Losey and Vaughan 2006; Stoll et al. 2006; Southwick Associates 2007). Indirect interactions of services and economic well-being are demonstrated by the value of undiscovered pharmaceuticals (Mendelsohn and Balick 1995), effects of greenways and trees on housing and property values (Nicholls and Crompton 2005), and introduction of invasive species (Pimental et al. 2005).

Valuation of Ecosystem Services

Underlying the value of our ecosystem services is the asset value of the country's natural resource base (the stock of forests, wetlands, minerals, and so on). As non-renewable resources disappear, their services become more valuable. Currently, our national income accounts do not reflect changes in these natural assets. A recent forum, convened by the General Accountability Office and National Academy of Sciences, called for development of environmental accounts that incorporate environmental degradation, which can be linked to economic or social consequences (US GAO 2007).

There is an extensive and expanding literature on economic valuation of natural resources and ecosystem services. See, for example, the books by Costanza (1991), Dasgupta (2001), Freeman (2003), and Aronson et al. (2007). The methods described include direct and indirect methods, applying both observed behavior and hypothetical markets. Numerous economists and ecologists have tried to embrace aspects of ecosystem services within more traditional economic methods—cost-benefit ratios, economics of choice, contingent valuation, return on investment, discount rates and willingness to pay, valuation of non-market goods, attribute-based choice, production function, equity, credits, benefits-based transfer functions,

and modeling (Englin et al. 1997; Chichilnisky and Heal 1998; Boyd et al. 2001; Chambers and Whitehead 2003; Poudyal et al. 2003; Ackerman et al. 2007; Fisher and Erickson 2007; Boyd 2008; Arana and Leon 2009; Bond et al. 2009; Colombo et al. 2009; Hoyos et al. 2009). Some economists believe the pricing structure for valuing ecosystems and their services are simply limited or wrong (Boyd and Banzhaf 2007; Boyd 2008). Existing neo-classical economic approaches have been deemed inadequate by some to address current environmental policy needs (Cropper 2000) and new approaches for determining the value of nature have been necessary (Faber et al. 2006; Boyd and Banzhaf 2007). Alternative non-monetary value metrics have emerged such as emergy, exergy, happiness, and life satisfaction (Jørgensen et al. 1995; Campbell 2000; Frey et al. 2009; Welsch 2009) but these have not been embraced by economists.

Some countries, notably those in the European Union, are experimenting with the use of payments for the loss or gain of ecosystem services based on valuation systems deemed appropriate by their governments (Wunscher et al. 2006; Sanchez-Azofeifa et al. 2007; de Groot and Hermans 2009). Other researchers are examining assessing values and trade-offs for fisheries, biodiversity, coastal areas and coral reefs, noise pollution, wildfires, environmental indices, sustainability, and overall costs of inaction (Harris 2007; Kaval and Loomis 2007; Costanza et al. 2008; Akpalu 2009; Bellenger and Herlihy 2009; Chavas 2009; Dekkers and van der Straaten 2009).

Environmental Needs

It can be easy to confuse ecosystem services with the environmental needs associated with human well-being (Table 1). Ecosystem services are the services actually provided by the ecosystems in question (e.g., reductions in nitrogen concentration in water, reductions in carbon concentrations in the air). Environmental needs would fall into Maslow's hierarchy at multiple levels (i.e., physiological, safety, and aesthetic needs) and would relate to an individual's, community's or nation's desire to have clean water and air, minimal exposure to toxic contaminants, minimal light and noise pollution, acceptable levels of biodiversity, environmental conditions that are significantly distant from ecological tipping points (e.g., stability, sustainability, climate change, sea level rise) so as not to be on the brink of a major environmental problem and the right to have natural systems available for individual interaction (Louv 2008). In general, this need for environmental well-being can be translated into minimization of an individual's, community's or nation's ecological footprint (Wackernagel et al. 2002). The ecological footprint is a complex sustainability indicator that answers a simple question: How much of the Earth's

resources does your lifestyle require? Existing, official statistics that quantify the resources people consume and the waste they generate can be used to translate this consumption and waste flow data into a measurement of the biologically productive area required to sustain that flow (Jorgenson 2003).

The environmental benefit of ecosystem services have been described by many (e.g., Daily 1997). The direct influence of services on the quality of air and water is obvious (de Groot et al. 2002) and the desire of individuals to have air and water quality that is as good as possible seems simplistic. However, this desire must often be balanced against other needs that can result in degradation to the environment and ecosystem services (Vitousek et al. 1997). The benefits of ecosystem services to air quality have been documented from urban regions and globally. Air quality can be improved by air purification services that remove airborne particulates, moderate air temperature, and sequester carbon (Lubchenco 1998). Similarly, the benefits of ecosystem services to water quality are well documented (e.g., Postel and Carpenter 1997).

The desire by individuals and society to minimize exposure to toxic contaminants clearly relates to desires for good physical health. Toxicants can affect ecosystem services in numerous ways (Soares and de Souza Porto 2009) with many of them ultimately relating to human health. Ecosystems can provide filtering and sequestering services to reduce human exposure although these processes may endanger health indirectly through food consumption (Peterson and Lubchenco 1997) or reductions in biodiversity (Snelgrove 1999). Human health has been shown to be greatly affected by reductions in sleep duration and depth (Naiman 2006). Light pollution or night sky pollution directly affects an ecosystem service (darkness) that has been shown to impact sleep and potentially human health (Chepesiuk 2009) as well as causing deaths of migratory birds and sea turtle hatchlings (Longcore and Rich 2004).

One of the current debates regarding ecosystem services involves the relationship between services and biodiversity, including the concept of biophilia (Kellert and Wilson 1993). Kahn (1999) described the human relationship with nature asserting that direct and indirect experience with nature has been and may possibly remain a critical component in human physical, emotional, intellectual, and even moral development. Verbeek and de Waal (2002) suggest that if the idea of biophilia (the proposition that humans have a fundamental, genetically based human need and propensity to affiliate with nature) has merit, aspects of biophilia should be detectable in the natural behavior of nonhuman primates. Drawing on an impressive body of empirical research with nonhuman primate, Verbeek and de Waal (2002) support the hypothesis of biophilia. Heerwagen and Orians (2002) extend evolutionary biophilia to

characterize the ecological relationships of children and human developmental patterns.

Of similar interest is the relationship between biodiversity and ecosystem services. Changes in biodiversity, through changes in species traits, can have direct consequences for ecosystem services and, as a result, human economic and social activities. The consequences of biodiversity loss for ecosystem functioning, for the provision of ecosystem services, and for human well-being is a growing concern. Experimental evidence for a relationship between biodiversity and ecosystem process rates is compelling (Balvanera et al. 2006). Marine biodiversity loss is increasingly impairing the ocean's capacity to provide food, maintain water quality, and recover from perturbations (Worm et al. 2006). The realization of these losses in biodiversity has resulted in regulatory and management decisions that suggest biodiversity or conservation banking (Carroll et al. 2008). One important reason for the decline in ecosystems and species is that markets and policies tend not to value biodiversity and other ecosystem services. There are often few rewards for conserving biodiversity and often no penalties for destroying it. Conservation banking and biodiversity offsets (Carroll et al. 2008) provide a new awareness and innovative tools to address this gap.

The final environmental need discussed here is a desire to be assured that environmental conditions are sufficiently far from ecological tipping points to ensure environmental safety. An example of such an occurrence in today's world is global climate change and its attendant ecological impacts (e.g., sea level rise, weather pattern changes, and species distribution pattern changes). Long-term climate change may well affect the physical, biological, and biogeochemical characteristics of ecosystems (particularly oceans and coasts). These changes could result in changes in ecosystem services providing fisheries production, shoreline protection, species distributions, and biodiversity or the reduction of the spread of human disease (Perry et al. 2005; Costanza et al. 2008).

Subjective Happiness

Subjective happiness is the final element of human well-being discussed here. It impacts several of Maslow's hierarchies but particularly the need to know and understand, aesthetics needs and esteem needs (Fig. 2). The drivers of subjective happiness are listed in Table 1. Much of the academic literature distinguishes between hedonic and eudaimonic approaches to well-being (Waterman 1993; Kahnemann et al. 1999). It is these debates that have had the most influence over attempts to develop measures of well-being, largely in the realm of subjective well-being.

Likely the two more important drivers of subjective well-being are life satisfaction (Vemuri and Costanza 2006) and happiness (Costanza et al. 2007). Life satisfaction or QOL is a focal point for subjective happiness with satisfaction being gauged at the individual, community, and national levels (Kahnemann et al. 1999; Vemuri and Costanza 2006). Costanza et al. (2007) used QOL as an integrator of the opportunities that are provided to meet human needs in the forms of built, human, social, and natural capital (in addition to time) and the policy options that are available to enhance these opportunities while Vemuri and Costanza (2006) used these sources of capital to preliminarily develop an index of national well-being (NWI) based on life satisfaction.

There are numerous indicators of the QOL, many of which have been discussed already and some are simply taken for granted in the United States (e.g., freedom, democracy). Whether they are related to the economy, education, security, health, the natural environment (all discussed earlier), the social environment, politics/government, mobility or culture/recreation, the various parts of QOL are interwoven and interdependent.

Happiness is one of the primary components of the subjective well-being element of overall human well-being. One nation—Bhutan—created a Gross National Happiness Index based upon its Buddhist traditions (Daskon 2008) and Buddhist concepts of happiness. However, the index seems to have become somewhat problematic recently with the introduction of television and Western advertising into Bhutan. Much of the basic debate concerning happiness focuses on exactly what constitutes happiness. The debate concerning the bases of happiness—objective hedonism (Kahnemann et al. 1999)—based in Aristotelian eudaimonia and more subjective Benthamite utilitarianism (Collard 2006) is academically important but the role of happiness in well-being is paramount regardless of that outcome (Layard 2005). Bentham (1995) believed that the best society is one where the citizens are happiest. So, using this view, the best public policy would be that which produces the greatest happiness. Also, when it comes to private behavior, the right moral action is that which produces the most happiness for the people it affects. This is the Greatest Happiness principle. It is fundamentally egalitarian, because everyone's happiness counts equally. It is fundamentally humane, because it says that what matters ultimately is what people feel.

There have been efforts in the past several years to include happiness as a factor in governmental policy-making. Europe's Political Economy Programme (Theodoropoulou and Zuleeg 2009) has questioned what citizens want in terms of the inclusion of well-being and happiness embodiment in EU social policy-making. Part of the discussion examines whether to use interpersonal,

intrapersonal happiness, or some combination of the two as the primary indicator of happiness. Unlike the EU which appears to be embracing happiness as a primary contributor to social and other policy-making, other countries seem more reluctant to include happiness as an important element for policy. Recent social surveys of happiness have given new stimulus to utilitarian political theory by providing statistically reliable measures of individual happiness that can be correlated with other variables. These surveys and research are prompting the re-examination of traditional principles that the maximization of happiness should be adopted by governments as an aim of law and public policy. This approach is hardly a new idea and is best epitomized by Paine (1996)—“Whatever the form or Constitution of Government may be, it ought to have no other object than the general happiness”. Veenhoven (2004) gives some of the most carefully considered examples of the case for happiness in public policy. In short, freedom and choice rank among the important indicators of popular choice. Veenhoven (2004) concludes that the happiness of a society could be raised through the application of appropriate public policies.

Other contributors to subjective well-being include solastalgia, topophilia, affection, respect, or access to nature, and aesthetics. Solastalgia is a neologism coined by the Australian philosopher Glenn Albrecht in 2003 with the first article published on this concept in Albrecht (2005). It describes a form of psychic or existential distress caused by environmental change, such as mining or climate change. Topophilia is the feeling of affection which individuals have for particular places, a term introduced by Tuan (1961). Places in this sense may vary in scale from a single room to a nation or continent. Topophilia is an important aspect of the symbolic meaning and significance of landscapes or sense of place. Affection and respect toward nature is often a basic element of many indigenous cultures, a basis for communications about landscapes, and the root of a new approach to environmental ethics. Taylor’s (1986) environmental ethic is a substantial and significant one which, among other things, requires that there be harmony between human civilization and living nature. Indigenous cultures worldwide seem to share a common view—Treat the Earth and all that dwell thereon with respect! Environmental aesthetics is one of the major new areas of aesthetics to have emerged in the last part of the twentieth century. Environmental aesthetics explores the meaning and influence of environmental perception and experience on human life. Berleant (1992), arguing for the idea that environment is not merely a setting for people but fully integrated and continuous with us, explores the aesthetic dimensions of the human–environment continuum in both theoretical terms and concrete situations.

Sense of place holds important status in childhood memories and their relation to nature and the environment. Lindahl (2005) described sense of place through her childhood upbringing in the Scandinavian lifestyle with its focus on outdoor life, gardening, and herbalism. Many researchers have found that children need wild places (natural ecosystems) for their development (through unstructured play) and happiness. Kirby (1989) confirmed that most preschool children have a predilection for playing in nestlike refuges whenever such microhabitats are available. Unlike the past when play and playgrounds included many such microhabitats, play has become too domesticated and regimented while playgrounds themselves have become more barren (Sutton-Smith 1990; Malone 2007). To counter historic trends toward the loss of wildness where children play, it is clear that we need to find ways to let children roam beyond the pavement, to gain access to vegetation and natural ecosystems that allows them to tunnel, climb, or even fall (Louv 2005, 2008). In short, nature matters to people whether that experience fosters creativity, restores spirit, restores physical condition, or simply creates leisure time.

Interactions of Ecosystem Services and Well-Being

Understanding the interactions among drivers that shape human well-being begs the question of just how much does each driver contribute to well-being. While that is a question for future assessment, it is important to understand what drivers affect well-being and what their relationships to ecosystem services might be. Understanding human well-being is a core task for both researchers and policy-makers. Human well-being, however, is an ambiguous concept. It has no universally acceptable definition and has numerous, and often competing, interpretations. As human well-being cannot be directly observed, it cannot be directly measured (McGillivray and Clarke 2006).

The multidimensional nature of well-being is now commonplace in discussion, yet it is only in recent times that human well-being has been considered analogous with income and consumption levels (Sen 1985; Nussbaum 1992). Subsequently, approaches to measuring human well-being have widened to incorporate non-economic aspects—gender, sustainability, and the environment. Given this evolution, it seems incongruous that the most used measure of human well-being is still income. With the advent of the Millennium Ecosystem Assessment (2005), the importance of ecosystem services as a driver for well-being was established.

The MEA built upon the World Economic Forum’s (2002) overall environmental sustainability index (ESI) which is intended to measure overall progress toward

environmental sustainability and Wackernagel et al.'s (2002) national estimates of the ecological footprint reported in the Living Planet Reports (e.g., WWF 2008). A review of well-being indices, examining the inclusion on aspects of basic human needs, economic needs, environmental needs, and subjective well-being shows no index is inclusive of all four of the driving elements of human well-being.

The New Economics Foundation has identified many of the cultural, social, political, and environmental factors that influence well-being (e.g., nef 2009). Much of the impetus to include ecological information in a measure of well-being emanates from earlier views of including man as a part of ecosystems rather than simply as a stressor upon them. Principal among these viewpoints is the philosophy of Arne Næss (1989). Næss is the founder of deep ecology and a personal ecological philosophy called ecosophy T. Although a very rich and complex philosophy, Næss's ecosophy can be summed up as having self-realization as its core. According to Næss, every being, whether human, animal, or vegetable has an equal right to live and to blossom (Næss 1989). Through this capitalized Self, Næss emphasized the realization of our selves as part of an ecospheric whole. It is in this whole that our true ecological Self can be realized. Practically, self-realization for Næss means that, if one does not know how the outcomes of one's actions will affect other beings (human and non-human), one should not act, similar to the liberal harm principle and, in essence, the basis of understanding unintended consequences before acting. It is not much of a leap to go from understanding unintended ecological consequences of actions to the inclusion and important role of ecosystem and environmental understanding (including ecosystem services) in human well-being.

Some "deep ecology" proponents would say ecosystem services are anthropocentric and as such are not really a part of deep ecology. We would argue that ecosystem services are a device or vehicle that can be used to help humans see the importance of all elements of nature and themselves as an integral part of the functioning of nature. One of the greatest problems inherent with today's decision making is the production of unintended consequences that often create a situation worse than originally existed. The use of ecosystem services and well-being are intended to minimize the uncertainty of unintended consequences and know how actions will affect other beings.

Our approach to well-being through the inclusion of ecosystem services addresses these needs but also requires a different evaluative approach than is often used. Causal relationships among ecosystem services and the elements of well-being, particularly those resulting in unintended consequences, are usually not direct, linear interactions. As a result, a reliance on Aristotelian rationality seldom

successfully untangles the intricate feedback relationships linking ecosystem services and well-being (Aristotle 1984). Aristotle's emphasis on reason and empirical demonstration is closely related to his assumption that nature is a composite of many independent substances, which are causally related. According to Aristotle, the universe is not fundamentally an inseparable whole. In contrast, Plato and other non-dualistic philosophers, such as Augustine and Spinoza, assume that nature is fundamentally an inseparable whole and that this universe is intelligible by intuition. A major consequence of Aristotle's dualism was his assumption of a mechanical model of causation—reductive determinism. In contrast, Plato's self-existing primal Unity (1956) and Spinoza's (1955) unity of being represent a holistic examination of nature and its internal and external relationships. Nature is seen holistically, as an integrated system, rather than as a collection of individual things. The "oneness" of nature, however, is not monistic, denying the reality of individuals and difference. Rather, the natural world consists of an organic wholeness, a dynamic field of interaction of diverse species and their habitats. In fact, that diversity is essential to the health of the natural world. Much of the basis of our understanding results from the creation of a sensuous, intuitive communion with the earth and it gives us needed insight into nature and our relationship to it. Scientific knowledge is necessary and useful, but we need a holistic science that recognizes the intrinsic value of the earth and our interdependence with it.

The same set of arguments of Aristotle's reductive determinism versus Plato's unity of one can be used to examine human well-being. Two basic errors have blocked the progress of a science of well-being—the fallacies of dualism and reductionism (Cloninger 2004). The first of these fallacies is the Cartesian error of separating the body and the mind (dualism) (Descartes 1650). Biomedical and psychosocial approaches to mental health are each merely steps in a path of development of self-awareness, which is ultimately non-dualistic. Any expansion of self-awareness involves an increase in intuitive understanding which is at least part free and creative (spontaneous). The second error blocking the progress of a science of well-being is the Aristotelian fallacy of reductive determinism—reducing thought to an algorithmic processing of physical sensations. Recent studies of learning in children, ordinary self-aware cognition in adults and human creativity show that intuition is actually the initial step in thought, not the final product of prior reasoning and analysis. Intuition is characterized by holistic preverbal recognition. The empirical findings of modern cognitive neuroscience confirm the importance of rational intuition as the initial foundation for self-awareness.

It is clear that unraveling the relationships among ecosystem services and human well-being will require a

different approach than has been used in the past. Piece-meal analytical techniques will likely undervalue the relationships. A holistic approach to the problem is necessary to ensure that not only direct effects but indirect effects (often multiple times removed) can be incorporated into the assessment of the role of ecosystem services in human well-being.

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