3 The Millennium Ecosystem Assessment: Securing Interactions between Ecosystems, Ecosystem Services and Human Well-being

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3.1 Introduction

During the past millennia the human impact on natural systems has only gradually increased. In the 20th century the impacts have accelerated and increased exponentially. For example, humans now appropriate about 20 per cent of global Net Primary Production (NPP). In Western Europe and south Central Asia, humans consume even more than 70 per cent of their regional NPP (Imhoff/Bounoua/Ricketts/Loucks/Harris/Lawrence 2004). Up to 50 per cent of the land surface is in some way modified by humans. This fragmented the habitats of many species. For an even larger area, humans are altering the functioning of ecosystems through emissions and deposition of nitrogen and other substances (Vitousek/Aber/Howarth/Likens/Matson/Schindler/Schlesinger/Tilman 1997). Additionally, through emissions of greenhouse gases due to the burning of fossil fuels, cement production and land-use change, humans are altering the composition of the atmosphere and changing the climate (IPCC 2001). The consequent climate change is illustrated by the observed rise in the global-mean surface-air temperature by 0.8 °C since the late 19th century (e.g. Moberg/Sonechkin/Holmgren/Datsenko/Karlén 2005).

Ecologists have shown that all these environmental changes together (depicted by the term 'global change') have a noticeable impact on present-day ecosystems in widely dispersed ecological zones (e.g. Parmesan/Yohe 2003, Root/Price/Hall/Schneider/Rosenzweig/Pounds 2003, van Vliet/Leemans 2006). Species extinction levels are estimated to be a magnitude larger than natural background levels (e.g. Jablonski 2004), coral bleaching by the increased pollution and frequency of high-temperature events in surface waters are abundant (Knowlton 2001), and glaciers and permafrost disappear rapidly all over the world (Arctic Climate Impact Assessment 2004).

These increasing human pressures on the Earth’s functioning have been studied intensively over the last few decades (e.g. Steffen/Sanderson/Tyson/Jäger/Matson/Moore/Oldfield/Richardson/Schellnhuber/ Turner/Wasson 2004). Many now recognize that we live in an era that for the first time in the Earth’s history is dominated by one single species: homo sapiens. Crutzen (2002) therefore named the current era the ‘Anthropocene’. All these studies indicate one important feature. The biosphere and the ecosystems, landscapes and species (including humans) that are part of it, play an important role in the functioning of the Earth. This role involves the cycling of water, energy and nutrients, it involves the provision of many different ecosystems, goods, and services to humanity, and it ultimately regulates many parts of the earth system (Lovelock 1992). The diversity of life or biodiversity (e.g. Wilson 1989, e.g. Wilson/Peter 1988) strongly supports this role and emphasizes that ecosystems thus are capital assets. Threats to ecosystems and biodiversity are thus direct threats to the functioning of ecosystems and (indirectly) human well-being.

Although the changes that have been made to ecosystems have contributed to large gains in human well-being and economic development, the corresponding degradation of ecosystems and their services limit the benefits that future generations obtain from ecosystems. This can cause significant harm to human well-being and represents a loss of a natural asset or wealth of a country. Global environmental change has therefore become a major issue in discussions on environmental security (O’Brien 2006). I use the term ‘environmental security’ in the broadest possible sense, similar to the pragmatic definitions promoted elsewhere (e.g. the Copenhagen School: Buzan/Wæver/De Wilde 1997; Wæver/Buzan/De Wilde 2008; De Wilde 2008 and Dalby 2002, 2008).

Global environmental change, together with the concerns about the socio-economic consequences of these changes and the costs associated with the pro-
posed measures to cope with them, have attracted the attention of the general public, decision-makers, the press, and interest groups from industry and NGOs (non-governmental organizations). Concerns about global change have already led to national and international actions. Several international treaties and conventions deal with ecosystems, biodiversity, and species. The *Convention on Biological Diversity* (CBD) that originated at the second UN *Conference on Environment and Development* (UNCED) in Rio de Janeiro in 1992, for example, directly targets biodiversity. Its objective is to “conserve biodiversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising out of its utilization”. This objective does clearly recognize that humans are dependent on the sustainable use of biodiversity. It therefore does not solely focus on conservation. Additionally, the equitable or fair sharing of benefits is a strong political statement targeting (sustainable) development. Much scientific and policy attention has already focused at the conservation of biodiversity (Heywood/Watson 1995), but little on how to manage the use of biodiversity.

This chapter reports on the background and findings of an international assessment, the *Millennium Ecosystem Assessment* (MA)\(^1\), which was concluded in 2005 (Box 3.1). This MA explicitly linked ecosystems and biodiversity through ecosystem services to human well-being. The MA also evaluated the biodiversity target “to significantly reduce the decline of biodiversity by 2010”, and the *Millennium Development Goals* (MDGs) to eradicate extreme poverty and hunger, to achieve universal primary education; to promote gender equality and empower women; to reduce child mortality; to improve maternal health; to combat HIV/AIDS, malaria and other diseases; to ensure environmental sustainability; and to develop a global partnership for development. These were agreed upon by the world’s leaders at the *World Summit on Sustainable Development* (WSSD) in Johannesburg in 2002.

### 3.2 Defining Important Concepts

#### 3.2.1 Ecosystems and Biodiversity

Central in the discussion on biodiversity is the *ecosystem* concept. An ecosystem is a complex of communities, consisting of plants, animals and microorganisms and their non-living environment. Ecosystems exhibit different kinds of dynamics: the species involved are important in the cycling of energy (e.g. CO\(_2\) and carbohydrates), water, and nutrients. Through time species can replace each other as a response to changes in the environment or succession. All these

\(^1\) Reports and additional information can be found at: <http://www.maweb.org>.