Conservation for a New Era

Jeffrey A. McNeely and Susan A. Mainka

International Union for Conservation of Nature

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Acronyms

ABS	Access and Benefit-Sharing
ADB	Asian Development Bank
BBOP	Business Biodiversity Offsets Programme
BIP	Biodiversity Indicators Partnership
BOD	Biological Oxygen Demand
CBD	Convention on Biological Diversity
CCAD	Comisión Centroamericana de Ambiente y Desarollo
CCS	Carbon Capture and Storage
CDM	Clean Development Mechanism
CEC	IUCN Commission on Education and Communication
CEESP	IUCN Commission on Environmental, Economic and Social Policy
CEFDHAC	Conférence sur les Ecosystèmes de Forêts Denses et Humides d'Afrique Centrale
CEL	IUCN Commission on Environmental Law
CEM	IUCN Commission on Ecosystem Management
CIFOR	Center for International Forestry Research
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS	Convention on Migratory Species
COP	Conference of Parties
CPF	Collaborative Partnership on Forests
CSD	Commission on Sustainable Development
CSR	Corporate Social Responsibility
DAC	Development Assistance Committee (of the OECD)
DALY	Disability Adjusted Life Years
EbA	Ecosystem-based Adaptation
EIA	Environmental Impact Assessment
ELC	Environmental Law Centre
ES	Ecosystem Services
FAO	Food and Agriculture Organization of the United Nations
FDI	Foreign Direct Investment
FLEG	Forest Law Enforcement and Governance
FLEGT	Forest Law Enforcement, Governance and Trade
FTAA	Free Trade Area for the Americas
GBO	Global Biodiversity Outlook
GDM	Green Development Mechanism
GDP	Gross Domestic Product
GEF	Global Environment Facility
GFP	Growing Forestry Partnerships
GHG	Greenhouse Gas
GISP	Global Invasive Species Programme
GWP	Global Water Partnership
GMO	Genetically Modified Organism(s)
GSTC	Global Sustainable Tourism Criteria Partnership
HDI	Human Development Index
ICT	Information and Communication Technology
ICCAT	International Commission for Conservation of Atlantic Tuna
ICMM	International Council on Mining and Metals
ICRAF	International Council for Research in Agroforestry
IEA	International Energy Agency
IIED	International Institute for Environment and Development
IISD	International Institute for Sustainable Development
IOSEA	Indian Ocean South East Asia Marine Turtle Memorandum of Understanding
IPCC	Intergovernmental Panel on Climate Change
ISSC-MAP	International Standard for Sustainable Wild Collection of Medicinal and Aromatic Plants
ISSG	Invasive Species Specialist Group
IT	Information Management Technology

ITTO	International Tropical Timber Organization
IUCN	International Union for Conservation of Nature
IUFRO	International Union of Forest Research Organizations
IUU	Illegal, Unregulated and Unreported
IWRM	Integrated Water Resources Management
IWSC	International Water Sanitation Centre
KBA	Key Biodiversity Area(s)
MDG	Millennium Development Goal(s)
MEA	Multilateral Environmental Agreement
MA	Millennium Ecosystem Assessment
MNC	Multinational Companies
MPA	Marine Protected Area
NBSAP	National Biodiversity Strategies and Action Plans
NEPAD	New Partnership for Africa's Development
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
PA	Protected Area
PALNet	Protected Areas Learning Network
PCR	Polymerase Chain Reaction
PES	Payments for Ecosystem Services
REDD	Reducing Emissions from Deforestation and forest Degradation
RTA	Regional Trade Agreements
RFP	Requests for Proposals
RSB	Roundtable on Sustainable Biofuels
SFM	Sustainable Forest Management
SME	Small to Medium-size Enterprises
SEI	Stockholm Environment Institute
SSC	IUCN Species Survival Commission
TEEB	The Economics of Ecosystems and Biodiversity
UNCCD	United Nations Convention to Combat Desertification
UNCLOS	United Nations Convention on the Law of the Sea
UNCTAD	United Nations Conference on Trade and Development
UN DESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNFF	United Nations Forum on Forests
UNWTO	United Nations World Tourism Organization
VPA	Voluntary Partnership Agreements
WB	World Bank
WBCSD	World Business Council for Sustainable Development
WCC	World Conservation Congress
WCED	World Commission on Environment and Development
WCPA	World Commission on Protected Areas
WDPA	World Database on Protected Areas
WGWAP	Western Grey Whale Advisory Panel
WHO	World Health Organization
WMO	World Meteorological Organization
WRI	World Resources Institute
WSSD	World Summit on Sustainable Development
WTO	World Trade Organization
WWF	World Wide Fund for Nature (World Wildlife Fund, in some countries)

Foreword

Conversation alone cannot deliver conservation on the ground. Not even good conversation.

Good conservation outcomes need hard work, mainly in the field. A conservationist's life is long hours of travelling to get there, longer hours of observation, even longer hours of analysis, deep thought and synthesis – and then more hours in the laboratory and the library, documenting and communicating. This does not mean that a life in conservation is tedious; on the contrary, its very nature is fun – but its primary fun is in nature.

Nevertheless, as for all professions, advancement of knowledge in conservation depends on sharing, critiquing, questioning, refining and honing ideas from research and for action through interaction with colleagues and peers from related and other disciplines. Modern communications have revolutionized the possibilities for such sharing but ultimately there is no substitute for physical encounters where researchers and practitioners can meet and exchange information on what they are doing.

The ultimate encounter is, of course, the periodic global congress that brings professionals together

in large enough numbers to demarcate the current frontiers of knowledge, create collective benchmarks and establish connections and networks for future work. And there is nothing like such a congress to focus the mind of a professional by providing a formal audience, venue and deadline for presenting recent progress and identifying opportunities for the next quantum jumps needed in our knowledge and understanding.

In other words, though conversation is not sufficient by itself, good conservation does need the occasional good conversation.

This is why, in 1996, IUCN decided to expand the Members' Assembly that it holds every four years into the World Conservation Congress (WCC), to bring together the top conservationists from all regions and nations to discuss and share their work and findings. WCC 2008, held in Barcelona in October and attended by more than 7,000 participants, was the largest civil society conference ever held in the domain of environment. It represented a valuable opportunity for IUCN Members, Commissions and partners, individuals, NGOs, governments and businesses to debate the many issues that concern the conservation community today.

This book, *Conservation for a New Era*, presents a synthesis of those wide-ranging discussions. It examines the state of our natural resources today, the stage at which conservation stands, and the current trends in these. It underlines the clear consensus that emerged from the Congress, that IUCN's heartland of species, protected areas and ecosystems work will now increasingly be a critical element for any societal strategy that can lead to a sustainable future. And it describes how the conservation community is responding to this challenge – and opportunity.

The richness of this book's content and the accessibility of its language, structure and presentation should make it many things to many people: a source book for school students; a supplementary text for undergraduates; a resource compendium for practitioners and civil society organizations; and a reference volume for decision makers in government, business and the design professions. And maybe even bed-time reading for those who love nature. In short, a fine record of what was evidently a very vibrant conversation. Which is what conservation surely deserves.

Ashok Khosla
President, IUCN

Preface

This book was inspired by the World Conservation Forum that took place in October 2008 in Barcelona, Spain, as part of the fourth World Conservation Congress (WCC)[1]. The Forum welcomed more than 7,000 committed conservationists who discussed and debated the urgent issues facing biodiversity today and to be expected in the future. More than 900 events took place during the four days of the Forum and this book attempts to capture the flavour, although certainly not the detail, of those discussions. We have freely incorporated many examples that were presented during the various WCC events, without seeking to specify what came out of which event. The chapters are often rather eclectic in their approach to the topic, reflecting the content of the various events and incorporating some of the current literature on the topic. The Forum Resource Centre (http://www.iucn.org/congress_08) provides access to all the information made available publicly by event organizers and speakers, including PowerPoint presentations, workshop reports, background documents and summary reports.

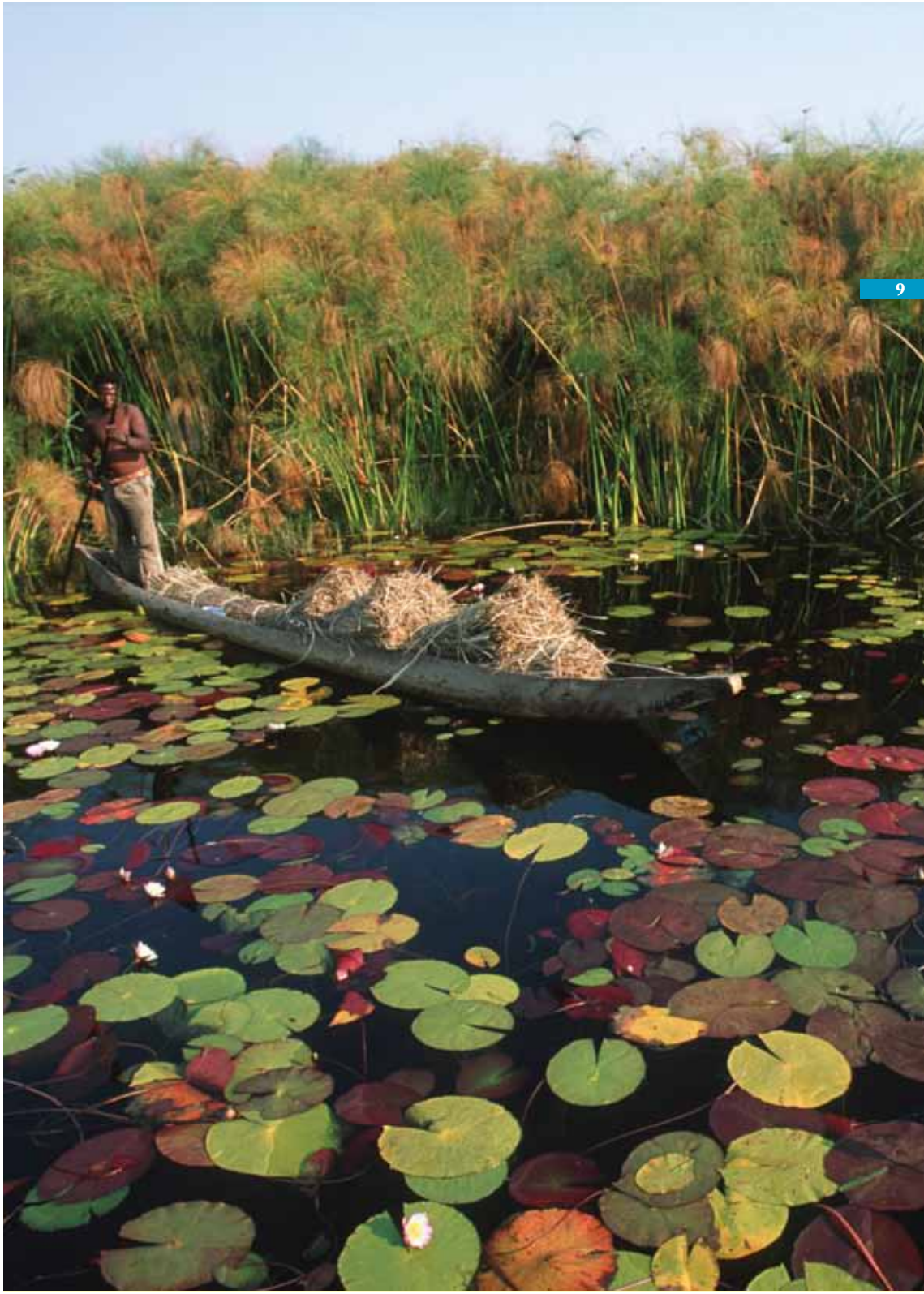
This volume seeks to put the Forum into a broader framework of global conservation concerns. While seeking to capture the key messages from the WCC in Barcelona, as editors and compilers we have sought to bring the various perspectives into a coherent synthesis that also draws on recent conservation literature. We start by reviewing the key issues involved; we then address the issues from the perspective of biodiversity.

Conservation for a New Era is intended as a milestone setting out current thinking for today's scientists, managers and politicians – all of whom face biodiversity-related challenges. None of these chapters are meant to be the final word on the subject. Quite the contrary, they are designed to help generate or sustain discussion and further research on the various topics being raised. We hope that the book also inspires everyone to act urgently to address the challenges to conservation. The breadth of topics covered in this volume also demonstrates that 21st century conservation permeates many parts of society.

We now have more compelling evidence than ever before that nature faces unprecedented threats, that these threats are caused by humans, and that the solutions are in our hands. The overview presented here points to some new directions for conservation, which will hopefully inspire an expanded constituency to engage with the challenges and compel action towards a more sustainable society. In the long run, collaborative and innovative action is our best hope to enable productive courses of action to be followed.

Editors: Jeffrey A. McNeely and Susan A. Mainka

1. Historically, IUCN separated its General Assemblies, which focussed on the statutory requirements of a meeting of Members, and Technical Conferences which focussed on the conservation issues of the day. Prior to the Montreal meeting in 1996, the IUCN Council decided that it would be more sensible to combine these into a single event, called the World Conservation Congress (WCC). The Barcelona meeting was the fourth in this new configuration. The three previous Congresses took place in Montreal, Canada, in 1996, Amman, Jordan, in 2000, and in Bangkok, Thailand, in 2004.



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Lorena Aguilar
David Allen
Neville Ash
Andrea Athanas
Tim Badman
Patrick Blandin
Josh Bishop
Intu Boedhihartono
Maria Ana Borges
Guido Broekhoven
Tom Brooks
Ximena Buitron
Giulia Carbone
Eric Chivian
Katherine Cross
Will Darwall
Jonathan Davies
Saskia de Koning
Joao de Queiroz
Nigel Dudley
Annelie Fincke
Kristina Gjerde
James Gordon
Sarah Gotheil
Marc Hockings
Geoffrey Howard
David Huberman
Ninni Ikkala
IUCN CEL Ethics Specialist Group
Alejandro Iza
Bill Jackson
Sally Jeanrenaud
Nik Lopoukhine
Nadine McCormick
Patti Moore
Roland Melisch
Russ Mittermeier
Teresa Mulliken
James Oliver
Samira Omar
Steve Osofsky
Gonzalo Oviedo
Georgina Peard
Sonia Pena Moreno
Jean-Yves Pirot
George Rabb
Pedro Rosabal Gonzales
Christina Sander
Adel Sasvari
Jeffrey Sayer
Sara Scherr
David Sheppard
Kevin Smith
Mark Smith
Jerker Tamerlander
Claire Warmenbol
Elizabeth Willetts
Jean-Christophe Vié
Xie Yan

1. The Barcelona Forum: A Diverse and Sustainable World

Life is resilient. It has persisted for more than two billion years, through five or more mass extinction crises, the most recent of which exterminated the great dinosaurs, leaving birds as their only descendants. Nature, in some form, will likely survive the rash actions of today's human societies that are based on ever-growing consumption of resources. But whether that pattern will enable modern societies to continue in their current form is not at all certain, even highly unlikely.

This book is a collection of challenges and strategies discussed at the World Conservation Congress (WCC) in Barcelona, Spain, in October 2008. The Congress theme was *A Diverse and Sustainable World* and discussions within the Conservation Forum focused around three broad themes (Box 1.1). The book is not meant to be comprehensive, which would have required working groups to spend months working on each chapter. Rather, we have sought to capture the essence of the issues, reflect the views of our membership, and bring in additional perspectives from the latest work in the field in an effort to catalyse conservation efforts in the coming decade.

The World Conservation Forum benefited from the active presence of participants drawn from across a wide spectrum of society including conservation organizations, indigenous and local communities, governments (local to national), and businesses. In keeping with this spirit of broad-based interest in conservation, we include actions that this expanded conservation community may consider pursuing in the future.

While the chapters of this book reflect the diversity of themes discussed, it will be helpful to highlight a few overarching issues from the start, including the 2010 Biodiversity Target, the link between biodiversity and sustainable development, and achieving the Millennium Development Goals (MDGs), and dealing with rapid demographic change.

Box 1.1 World Conservation Forum streams

Safeguarding the diversity of life

Our planet's rich variety of genes, species and ecosystems is the foundation which underpins social, economic and cultural diversity. For 60 years, IUCN has been the unifying force for biodiversity conservation and IUCN's Members continue to strongly support and pursue the importance of nature, both for its own sake as well as for humanity. But despite this long history, many issues remain unresolved, from the ethical (how should we decide whether people or nature take precedence when trade-offs are required?) to the practical (can we feed 9 billion people and also stop biodiversity loss?). While recognizing the fundamental importance of biodiversity to humanity's future, we still don't allocate the resources to effectively conserve it, so to whom and how do we reach out to make a difference?

A new climate for change

Evidence indicates that the environment is changing more quickly than at any time in human history. Over the next 40–50 years, the world's population is projected to reach 9 billion, up from 6.8 billion today. At the same time, changes in the global climate system are accelerating, and we now face the dual challenges of significantly and urgently reducing emissions to avoid dangerous climate change, and adapting to the impacts of climate changes already underway. In this changing world, people are becoming increasingly connected – through communications, transport and trade, but also through culture, politics and the environment. Such "globalization" brings tremendous opportunities but also brings risks. Finally, the drive for continued economic growth is fuelling rapidly increasing energy demands, requiring that we move away from an economy dependent on fossil fuels to energy mixes that are more sustainable.

Healthy environments – healthy people

Sustainable use and conservation of biodiversity can make meaningful contributions to poverty reduction and peoples' health and well-being; conversely, improved human well-being is a fundamental condition for sustainable conservation. Reconciling rural development, poverty reduction and biodiversity conservation is a key challenge facing societies today. Sustainably managing natural resources, such as fisheries, agricultural soils, and timber, provides another set of challenges. Promising steps forward include improved laws and regulations, long-term participatory planning, and new tools such as marine protected areas. One key question for the future is "What kind of potential can protected areas – established primarily to achieve conservation objectives – have for improving human well-being and reducing poverty?"

PROGRESS TOWARDS ACHIEVING THE 2010 BIODIVERSITY TARGET AND BEYOND

Many global environmental agreements and conventions have integrated targets into their strategies and planning. Among these, the most important from the biodiversity perspective is the 2010 Biodiversity Target. The general target of reducing biodiversity loss by 2010 has been adopted in international fora from the Convention on Biological Diversity (CBD) to the World Summit on Sustainable Development (WSSD), albeit in somewhat different forms (Box 1.2).

Box 1.2 The 2010 Biodiversity Target

The 2010 Biodiversity Target has been adopted in several forms as part of many international policy instruments:

- **June 2001** – The EU Summit in Gothenburg where EU Heads of State first adopted the target of "biodiversity decline should be halted [in the EU] with the aim of reaching this objective by 2010".
- **May 2002** – The Convention on Biological Diversity's (CBD) sixth Conference of the Parties (COP), included a 2010 target (this time "to achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on earth") in the Strategic Plan that they adopted.
- **September 2002** – The World Summit on Sustainable Development (WSSD) held in Johannesburg confirmed the 2010 Biodiversity Target and called for "the achievement by 2010 of a significant reduction in the current rate of loss of biological diversity".
- **May 2003** – Environment Ministers and Heads of delegation from 51 countries adopted the Kiev Resolution on Biodiversity at the fifth Ministerial Conference "Environment for Europe" and decided to "reinforce our objective to halt the loss of biological diversity at all levels by the year 2010".
- **September 2007** – The UN decided to adopt the 2010 target (in terms of rate of loss) as a sub-target of Millennium Development Goal (MDG) 7 – Environmental Sustainability.

The need to measure progress towards this target and beyond has stimulated the development of a framework of 17 "headline indicators" which were first reported upon in the *Global Biodiversity Outlook 2* (GBO2) (CBD, 2006) (Table 1.1). GBO2 summarized the situation by noting that:

- Deforestation, mainly through conversion of native forests to plantations or agricultural land, continues at an alarmingly high rate.
- Trends of some 3,000 wild populations of species show a consistent decline in average species abundance of about 40% between 1970 and 2000.
- More species are becoming threatened with extinction, including 12% of birds, 21% of mammals and 31% of amphibians, according to the 2008 *IUCN Red List of Threatened Species*.

In 2006, recognizing that the science underpinning many of these indicators still required considerable attention, 24 organizations working on indicators (including IUCN) established the 2010 Biodiversity Indicators Partnership (BIP) as a global initiative to further develop and promote indicators for the consistent monitoring and assessment of biodiversity (http://www.twentyten.net/Home/tabid/38/Default.aspx).

Drawing from the information in the report plus information from the Millennium Ecosystem Assessment (MA) (2005d), the GBO2 concludes that biodiversity loss "is likely to continue for the foreseeable future, and certainly beyond 2010". Nevertheless, GBO2 recognizes potential successes in biodiversity conservation, including:

1) at national, regional and global levels, with appropriate responses it is possible to achieve, by 2010, a reduction in the rate of biodiversity loss for certain components of biodiversity or for certain indicators, and in certain regions;
2) the majority of the targets that the Convention has established as part of its framework for assessing progress towards the 2010 target are

TABLE 1.1 Status and trends of biodiversity-related parameters according to the 2010 indicators

Based on the assessment in chapter 2 of *Global Biodiversity Outlook 2*. Arrows indicate the direction of trends (broad arrows indicate a high level of confidence about the trend; narrow arrows indicate low confidence; black arrows indicate a trend that is negative for biodiversity; white arrows indicate a trend that is positive for biodiversity). The quality of the data and indicators are shown by the stars at the right-hand side.

★★★ good indicator methodology with globally consistent time course data;
★★ good indicator, but no time course data;
★ indicator requires further development and/or limited data.

FOCAL AREA: Status and trends of the components of biological diversity		
↘	Trends in extent of selected biomes, ecosystems and habitats	★★★[1]
↘	Trends in abundance and distribution of selected species	★★★
↘	Change in status of threatened species	★★★
↘	Trends in genetic diversity of domesticated animals, cultivated plants, and fish species of major socio-economic importance	★
↗	Coverage of protected areas	★★★
FOCAL AREA: Ecosystem integrity and ecosystem goods and services		
↘	Marine Trophic Index	★★★
↘	Connectivity – fragmentation of ecosystems	★★
↑↓	Water quality of aquatic ecosystems	★★★
FOCAL AREA: Threats to biodiversity		
↗	Nitrogen deposition	★★★
↗	Trends in invasive alien species	★
FOCAL AREA: Sustainable use		
↘	Area of forest, agricultural and aquaculture ecosystems under sustainable management	★
↗	Ecological footprint and related concepts	★★★
FOCAL AREA: Status of traditional knowledge, innovations and practices		
↘	Status and trends of linguistic diversity and numbers of speakers of indigenous languages	★
FOCAL AREA: Status of access and benefit sharing		
?	Indicator of access and benefit sharing to be developed	
FOCAL AREA: Status of resources transfers		
↘	Official development assistance (ODA) provided in support of the Convention	★

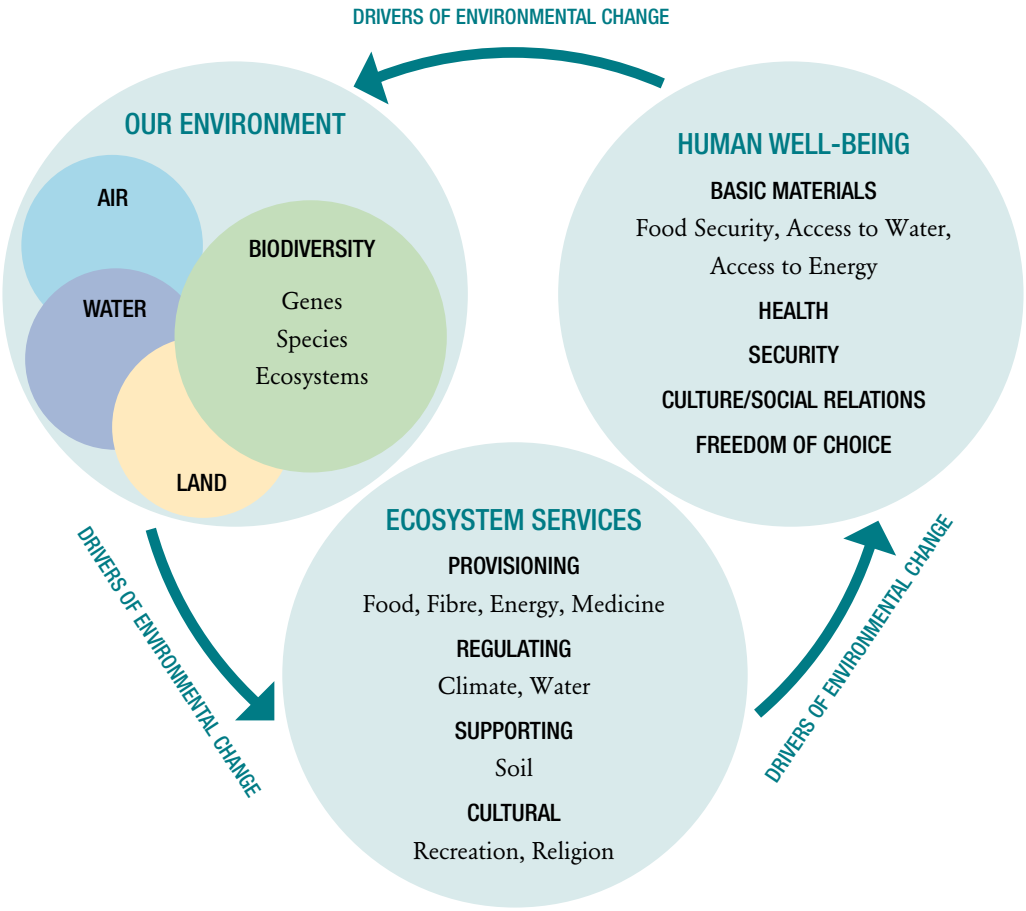
[1] for forests; data not available globally for all biomes, ecosystems and habitats.

achievable, provided that the necessary actions are taken; and

3) for the most part, the tools needed to achieve the 2010 target, including programmes of work, principles and guidelines, have already been developed.

Efforts to achieve the 2010 target have been important means to set in place awareness, capacity and political will towards biodiversity conservation. The global community should build on this progress through adoption of a post-2010 framework that is visionary, achievable and measurable.

FIGURE 1.1 DYNAMIC OF ENVIRONMENT, SERVICES AND HUMAN WELL-BEING



AGENTS OF CHANGE			
Demography	**Politics / Institutions**	**Economy**	**Socio-cultural**
Urbanization	Security and conflict	Markets and finance	New paradigms
Aging populations	Int'l environmental governance	Emerging economies	Ethics
Role of gender		Valuation of biodiversity	Spirituality

LINKING BIODIVERSITY, ECOSYSTEM SERVICES, POVERTY REDUCTION AND SUSTAINABLE DEVELOPMENT

Our environment, the services provided by ecosystems and human well-being are all the result of a complex web of interactions and responses. From a pragmatic perspective, whichever entry point into the system we use, be it species conservation or ecosystem management or supporting delivery of ecosystem services, we are ultimately talking about the same imperative: supporting the system within which we live (Figure 1.1).

In 2008, the World Bank estimated the number of people living in extreme poverty at 1.4 billion, with the majority in sub-Saharan Africa and

South Asia. While the percentage of those living in poverty has decreased in recent years in most parts of the world, it has remained stable in sub-Saharan Africa. The World Development Report 2008 notes that poverty reduction solutions vary from region to region (World Bank, 2008). For sub-Saharan Africa, increased agricultural productivity is the key to growth while in Asia reducing the ever increasing gap between urban and rural well-being will be the key to success.

Conservationists understand the importance of nature for nature's sake. But they also recognize that biodiversity can play an essential role in supporting and improving people's livelihoods. Conservation can contribute to poverty reduction, particularly through restoring ecosystems and by improving the access of the poor to ecosystem services, thus contributing to secure livelihoods for the people who depend on them (Fisher *et al.*, 2005). But articulating the link between biodiversity conservation and poverty reduction/development remains a challenge.

The popularization of the idea of ecosystem services (Chapter 4) by Gretchen Daly (1997) and the subsequent release of the Millennium Ecosystem Assessment just under a decade later in 2005, have helped to inspire a way of thinking that promotes collaboration and cooperation among conservation and development professionals. The concept of ecosystem services highlights the important role of species conservation and ecosystem management in our day-to-day lives. By speaking of ecosystem services we are, of course, also speaking of the genes, species and ecosystems that support and deliver these services.

LINKING POVERTY REDUCTION TO ECOSYSTEM SERVICES

The clearest links between poverty reduction and ecosystem services lie with the provisioning services that support delivery of food (Chapter 20), medicines (Chapter 10), forest products (Chapter 16), and, ultimately, income (Chapter 12).

In 2008, the Food and Agriculture Organization (FAO) (FAO, 2008c, d) reported that world hunger is increasing and that the distribution of those hungry people is focused largely on sub-Saharan Africa. The number of hungry people was estimated to be 950 million in 2008, an increase of more than 80 million since the 1990–1992 base period. Long-term estimates (available up to 2003–2005) show that some countries were well on track towards achieving MDG 1 of halving hunger by 2015 (Table 1.2). But the current period of high food prices is causing setbacks in progress, hitting the poorest, landless and female-headed households hardest.

Underlying this food insecurity, especially in Africa, are changing trends in precipitation leading to decreased productivity for small farmers who depend on rain-fed agriculture. This calls for new approaches to agriculture. Ecoagriculture is one example of an approach to land use that incorporates three main objectives – biodiversity conservation, increased agricultural productivity and sustainable rural livelihoods (McNeely and Scherr, 2003). Investing in ecosystem-based agricultural development along the lines of ecoagriculture approaches and adaptation to the impacts of climate change will be vital to solving the challenge of hunger in rural Africa (Ecoagriculture Partners, 2009). Similar approaches will be needed in other sectors; ecosystems and the technology and practice are already available to deliver forest, water, coastal and drylands conservation at landscape scales (see relevant chapters for more information).

Reliable delivery of natural resources is a source of employment (and income) for millions of people around the world. For example, globally more than 1.3 billion people were engaged in agriculture in 2002 and 34.5 million people were

employed in fishing and aquaculture in 2000 (www.earthtrends.org). At the micro-scale, local natural resources represent an important portion of household incomes beyond subsistence needs. At national level, natural resources also figure large; in Tanzania the use of the environment and natural resources accounts for 66% of gross domestic product (UNEP, 2008a).

Box 1.3 Five reasons to include environmental conservation in development and poverty reduction activities

1. Poor countries depend on fragile environmental resource assets. Such assets, privately owned or in the form of access to the commons, constitute the main source of income and survival for the poor.
2. While most manmade assets depreciate over time, some rather quickly, most natural resources can be sustained and even enhanced with rather modest efforts if properly managed.
3. 17% of all lost disability adjusted life years (DALYs) in developing countries are due to a poor state of the environment, against only 4% in OECD countries. Lack of safe water and adequate sanitation constitute by far the most important cause, accounting for 40% of the environmentally-induced loss of DALYs in developing countries; poor indoor air quality is the second worse cause.
4. There is currently severe underinvestment in agriculture, which results in loss of valuable nature-based income-generating assets (e.g. biodiversity, fertile soils due to water logging and salination, reefs and shorelines) of particular importance for reducing poverty and enhancing economic income growth.
5. Sound environmental management will reduce vulnerability to extreme natural events and the impacts of change.

Adapted from Hansen, 2007

The importance of natural resources in national economies, especially in the developing world, is an important motivation for ensuring that sound environmental management is integral to national development and growth strategies. Developing country governments and development assistance agencies are already recognizing the crucial role that sound environmental management will play in successful poverty reduction action (Hansen, 2007) (Box 1.3).

The current challenge for development support is how best to incorporate the environment in the process of improving human well-being. Environmental mainstreaming needs to happen both at the planning stage and when activities are being implemented. Bojo *et al.* (2004) reported that the degree of mainstreaming environment in 53 poverty-reduction strategy papers reviewed was highly variable but that the overall level was improving compared to earlier reviews. As with any environmental management programme, poverty reduction efforts must include an adaptive management approach to ensure timely response to environmental and social changes.

THE CONSERVATION VS. POVERTY REDUCTION DEBATE

The conservation community itself has actively debated whether and how much conservationists can really contribute to global development and poverty reduction efforts. Integrating the needs of increasingly vocal local communities into conservation projects is an additional challenge to those working in the field. Roe (2008) has summarized the evolution of the conservation/poverty reduction debate, noting that over the years the conservation and poverty reduction communities have converged and diverged. She found that some of the areas most in need of conservation actually have few people living in them, but these people are often very poor and suffer greatly if they are denied access to resources. Further, these people have often lived in the area

Table 1.2 Key links between Millennium Development Goals and the environment

Millennium Development Goals	Examples of links to the environment
Goal 1 Eradicate extreme poverty and hunger	• Livelihood strategies and food security of the poor often depend directly on functioning ecosystems and the diversity of services they provide. • Insecure rights of the poor to environmental resources, as well as inadequate access to environmental information, markets, and decision-making, limit their capacity to protect the environment and improve their livelihoods and well-being.
Goal 2 Achieve universal primary education	• Time that children, especially girls, spend collecting water and fuel wood can reduce study time. • Additional income generated from sustainable management of natural resources is available to be spent on education.
Goal 3 Promote gender equality and empower women	• Time that women spend collecting water and fuel wood reduces their opportunity for income-generating activities. • Poor rural women often depend heavily on natural resources, but inequity and lack of secure rights limit their access to decision-making and resources.
Goal 4 Reduce child mortality	• Improved management of local watersheds can reduce child mortality related to water-borne disease.
Goal 5 Improve maternal health	• Indoor air pollution and carrying heavy loads during late stages of pregnancy put women's health at risk before childbirth.
Goal 6 Combat HIV/AIDS, malaria and other diseases	• Environmental risk factors account for up to one-fifth of the total burden of disease in developing countries. • Preventive environmental health measures are as important, and at times more cost-effective, than health treatment.
Goal 7 Ensure environmental sustainability	• All of the other goals are linked to environmental sustainability, often in very direct ways (as described elsewhere in this book).
Goal 8 Develop a global partnership for development	• The complex interaction between human well-being, ecosystem services and biodiversity requires an integrated approach including partnerships between civil society, the private sector and government.

Sources: Taken from UN Millennium Project, 2005; DFID et al., 2002; UNDP, 2002

for many generations, and the fact that the area is valuable for conservation indicates that their activities are not contradictory to conservation. On the other hand, the pressures of modern development can overcome traditional conservation and resource management practices, leading to the loss of biodiversity and ecosystem services. The relationship between conservation and development in areas containing biodiversity of outstanding national or global value is highly complex, always requiring solutions specific to the site.

THE MILLENNIUM DEVELOPMENT GOALS AND THE ENVIRONMENT

In 2000, the Millennium Declaration recorded the commitment of the members of the United Nations to eradicate extreme poverty and hunger and to build a secure and peaceful world conducive to human development. Broad targets were set under the Millennium Development Goals (MDGs) and indicators were developed to assess progress. Listing the MDGs and accompanying targets may seem to imply that these are a sort of checklist of items that can be accomplished one by one. However, it is far better to consider them as an integrated set, with progress in achieving one MDG or target depending on also achieving others. While MDG 7 is the only goal explicitly targeting the environment, achieving each of the goals will require the support of a functioning ecosystem. In turn, achieving the other MDGs will support delivery of MDG 7 (Table 1.2). As the links between the environment and human well-being become more clearly articulated, so too do the threats to both. In particular, climate change, invasive alien species and unsustainable resource use are emerging as key issues that must be addressed in both conservation and poverty reduction planning.

A review of progress towards achieving the MDGs, essentially at the halfway point between the year the targets were established and the deadline for attaining the goals themselves, reported that while some successes had been achieved, much remained to be done (UN, 2008). The report identified many issues for which "greater effort" was required, including:

- The proportion of people in sub-Saharan Africa living on less than US$ 1 per day is unlikely to be reduced by the target of one-half;
- About one-quarter of all children in developing countries are considered to be underweight and are at risk of having a future blighted by the long-term effects of undernourishment;
- Of the 113 countries that failed to achieve gender parity in both primary and secondary school enrolment by the target date of 2005, only 18 are likely to achieve the goal by 2015;
- Almost two-thirds of employed women in the developing world are in vulnerable jobs as own-account or unpaid family workers;
- In one-third of developing countries, women account for less than 10% of parliamentarians;
- More than 500,000 prospective mothers in developing countries die annually in childbirth or of complications from pregnancy;
- Some 2.5 billion people, almost half the developing world's population, live without improved sanitation;
- More than one-third of the growing urban population in developing countries lives in slum conditions;
- Carbon dioxide emissions have continued to increase, despite the international timetable for addressing the problem;
- Developed countries' foreign aid expenditures declined for the second consecutive year in 2007 and risk falling short of the commitments made in 2005 and;

- International trade negotiations are years behind schedule and any outcome seems likely to fall far short of the initial high hopes for a development-oriented outcome.

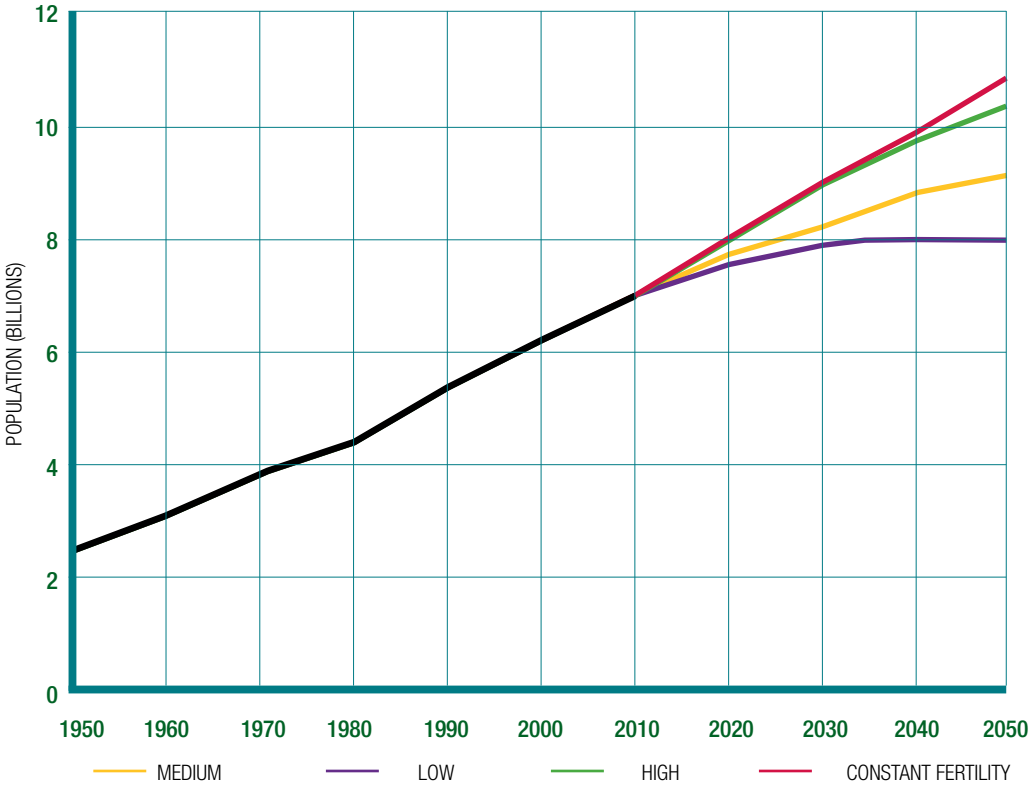
Given the important role of the environment in achieving all the MDGs, clearly greater attention to the environment is essential in efforts to achieve the MDGs.

DEALING WITH CHANGE: DEMOGRAPHICS AND CONSERVATION

In addition to the 2010 target and discussions about the link with sustainable development, change was a common thread linking many of the Barcelona discussions. Changes in climate, technology and human demography all affect what we do in biodiversity conservation. While climate (Chapter 5) and technology (Chapter 13) are the subjects of specific chapters, the issue of human demography is one worth exploring at the outset as it influences so many other issues.

The human population quadrupled during the 20th century, increasing from about 1.5 billion in 1900 to about 6.8 billion in 2009 (UN DESA, 2009 – Figure 1.2). This explosive population growth reached a peak of 2.1% growth rate in the late 1960s, the most significant demographic process since the beginning of the industrial revolution. Since that time, the population growth rate has fallen dramatically and, in contrast to

FIGURE 1.2 HUMAN POPULATION TRENDS



Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat (2009). World Population Prospects: The 2008 Revision, Highlights. New York: United Nations.

Box 1.4 Key global population projections

Total numbers

- Assuming that fertility levels continue to decline, the world population is expected to reach 9.1 billion in 2050 and to be increasing by about 33 million persons annually at that time.
- Future population growth is highly dependent on the path that future fertility takes but population growth until 2050 is inevitable even if the decline in fertility accelerates.
- The population growth of the 49 least developed countries is still the fastest growing in the world, at 2.3% per year.
- During 2010–2050, nine countries are expected to account for half of the world's projected population increase: India, Pakistan, Nigeria, Ethiopia, the United States, the Democratic Republic of Congo, the United Republic of Tanzania, China and Bangladesh, listed according to the size of their contribution to global population growth.

Demographics

- Globally, the number of persons aged 60 or over is expected almost to triple, increasing from 739 million in 2009 to 2 billion by 2050.
- Globally, life expectancy at birth is projected to rise from 68 years in 2005–2010 to 76 years in 2045–2050.
- In terms of annual averages, the major net receivers of international migrants during 2010–2050 are projected to be the United States, Canada, the United Kingdom, Spain, Italy, Germany, Australia and France. The major countries of net emigration are projected to be Mexico, China, India, the Philippines, Pakistan, Indonesia and Bangladesh.

Source: UN DESA, 2009

centuries past where populations were affected by major conflicts and epidemic diseases, in today's world the fall is related to voluntary choices to limit the number of children born (Cohen, 2005).

But population growth alone does not tell the whole story. As the UN DESA findings (Box 1.4) show, the proportion of elderly people in the population is increasing in some countries and from 2005 onwards they will have more people aged 60 years and older than children aged 4 years or under. That shift will be most evident in the developed world where, by 2050, one-third of the population is projected to be over 60 years old compared to only 20% in the developing world (Cohen, 2005); however, because the developing world has so many more people, this is still almost 80% of the total population of those aged 60 or older.

Other important shifts include that, as of 2007, more people lived in cities than in rural areas and as of early 2009, the majority of the world's people were classed as "middle income", denoting new spending power and the accompanying impact of increased consumption on natural resources. The number of cities of one million or larger was 76 in 1950, 522 in 1975, 1,122 in 2000, and is set to exceed 1,600 by 2015. Using current population projections to 2050, most of the forthcoming growth in population will be in cities, with poor countries having "to build the equivalent of a city of one million people each week for the next 45 years" (Cohen, 2005).

A new demographic challenge is the emergence of "environmental migrants", especially in response to climate change. Populations living in low-lying island nations, such as the Maldives or Tuvalu, or in vulnerable coastal areas, such as parts of Bangladesh and Florida, will pose environmental challenges as well as social, economic, and security ones.

One other perspective of population is related to number of households as opposed to number of people. Liu *et al.* (2003) reported that even when population numbers are stable or declining, if the number of households increases, the demands on natural resources will also increase. They report that the growth in population between 1985 and 2000 in countries with biodiversity hotspots was exceeded by the growth in the number of households, because average household size decreased (and decreased more rapidly than in non-hotspot countries), thereby posing serious challenges to natural resource management and biodiversity conservation.

Meeting the needs of these changing populations, increasing numbers of elderly people and extreme concentrations in urban areas, will inevitably have impacts on the environment. Increasingly cramped urban areas will need to expand – often into important nearby arable land, thereby limiting productivity of those lands. Demographic shifts will also mean increasing public-sector spending on healthcare and family support sectors with a potential trade-off of reducing investments in other public goods, including environmental management.

As this book explores the many challenges facing conservation today, it is helpful to keep in mind the underlying issues discussed above and how they will affect choices and actions in the coming decades.

2. The Ethics of 21st Century Conservation

Ethics are the general principles that guide human decision-making, influenced by cultural factors, religion, economics, knowledge, and science. Ethics are about collective values made up of individual and personal responses and they guide decisions about what we think we should do and how we think we should act. As in nature, ethics can be highly diverse. Drawing on the work of the Inter-Commissional Working Group on Conservation Ethics, IUCN seeks to provide some general principles that can be adapted to a wide range of specific applications in conservation.

Conservation, at its core, reflects the specific values individuals and societies hold about nature and human-nature relationships. The human condition is defined by individual and collective physical, biological, intellectual, and spiritual needs and responses. Alternative ethical frameworks can clarify the value systems that support decisions made about resource management.

Conservation ethics have been enshrined within religions for centuries and the link between nature and spirituality is well recognized. Conservation voices have also debated the links between religion and conservation, most notably in a series of articles in *Conservation Biology* in 2005 (Orr, 2005; Stuart *et al.*, 2005).

Ethics are necessary to inspire change, informing law, policies and research. IUCN has made critical contributions to enriching understanding of the foundational values and principles of nature conservation, including through *The World Conservation Strategy* (1980), *The World Charter for Nature* (1982), *Caring for the Earth* (1991) and *The Earth Charter* (1994).

In 1972 the Stockholm Declaration declared that "A point has been reached in history when we must shape our actions throughout the world with a more prudent care for their environmental consequences. Through ignorance or indifference we can do massive and irreversible harm to the earthly environment on which our life and well-being depend. Conversely, through fuller knowledge and wiser action, we can achieve for ourselves and our posterity a better life in an environment more in keeping with human needs and hopes."

Subsequently, the 1982 *World Charter for Nature* stated that every form of life is unique, warranting respect regardless of its worth to people, and, to accord other organisms such recognition, people must be guided by a moral code of action. People can alter nature and exhaust natural resources by their action or its consequences and, therefore, must fully recognize the urgency of maintaining the stability and quality of nature and of conserving natural resources.

“All the species and systems of nature deserve respect regardless of their usefulness to humanity.”

Caring for the Earth defined IUCN's ethical position as "respecting and caring for the community of life". Since that time, the world has faced increasingly significant collective action challenges of global proportions, addressing environmental concerns that can only be solved through international cooperation. The human responsibility for the continuity of life has become greater than ever.

How to use knowledge, and how to change behaviour as a result of that knowledge, remains a challenge for conservationists. Ecosystems and societies have both changed profoundly in recent years. Faced with global challenges such as climate change, invasive species, biodiversity loss, high seas governance, and others, ethics are being called upon to motivate the changes required to solve these issues, often confronting powerful pressures to accelerate consumption. *Caring for the Earth* emphasized ethical arguments alongside economic or social reasoning to promote conservation practices. Ethics was seen as providing the basis for mobilizing both collective action and individual responsibility.

COLLECTIVE ACTION

Ethics applied to conservation has evolved rapidly since the 1972 Stockholm Declaration. Nevertheless, it continues to be much more effective to make a social or economic case for the values of nature than an ethical one. Conservationists have found it difficult to convince the wider public to adopt a "conservation ethic" or a "bioethic" as a reason for significantly changing their behaviour. Part of this difficulty has been in defining the specific nature of that ethic, and specifically how to value the environment. Many conservationists accepted valuing conservation action for the ethical position of nature for nature's sake. Others used ethical arguments to advocate a more pragmatic approach, focusing on the benefits of conservation for people, through ecosystem services, recognizing that the poor often are the first to suffer from biodiversity loss. As Meffe (2005) writes, "biological conservation involves both ecological knowledge and value decisions".

The *Caring for the Earth* principle that "All the species and systems of nature deserve respect regardless of their usefulness to humanity" has been accepted by governments in the Convention on Biological Diversity (CBD), which recognizes in its preamble "the intrinsic value of biological diversity and of the ecological, genetic, social, economic, scientific, educational cultural, recreational and aesthetic values of biological diversity and its components".

In an age of ecosystem services and markets for these services, the frame of reference for ethics has grown to a global scale. *Caring for the Earth* calls for "codes of practical conduct that implement the world ethic within the cultural context of each society". When examining this evolution, the Montreal Protocol of 1987 concerning ozone stands out as a landmark as one of the first binding international treaties for global environmental concern, albeit of significant human self-interest. The issue of ozone depletion was a collective one, and was solved through a multilateral agreement. The Protocol showed that a global environmental movement could solve a collective problem. In Montreal, nations agreed to care for the earth by saving the ozone layer, and effectively their skin, from UV-B rays.

Four years after Montreal, *Caring for the Earth* called for conservation to make a leap, stating that nature "has to be cared for in its own right". The idea was radical because it moved from the anthropocentric view of humans at the centre to a more holistic perspective on the environment, placing humans within it. The Montreal Protocol showed that action can be taken to conserve the atmosphere for the health of the planet. *Caring for the Earth* asked

for people to expand the motivation for action to conserve nature more broadly.

A year later, the Convention on Biological Diversity was adopted at the Rio de Janeiro Earth Summit and entered into force in 1993. Its objectives take ethical positions in calling for "the conservation of biodiversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources".

Since *Caring for the Earth*, the movement toward a global compact between individuals and nature has grown. The idea of an Earth Charter was launched in 1992 at the Earth Summit. By 1995, the Earth Charter initiative had developed the principle that ethics are essential for a "just, sustainable, and peaceful global society in the 21st century," drawing upon "shared global values". The Earth Charter covers global issues that link all of humanity together, and to the environment. Its issues include global and development ethics, democracy, ecology and religion, climate change, biotechnology, public health, ecological integrity, environmental human rights, animals and ethics, and education.

To tackle issues such as biodiversity, sustainable development and climate change, conservation ethics has become essential for the mobilization of individuals. Over the past few decades, living sustainably has become an ethical imperative and is essential for managing global interdependence. This idea of personal responsibility, felt globally, is a revolutionary one, but essential if the global challenges to the environment are to be overcome.

> "By incorporating ethical principles into change processes and decision-making, individuals can help break the feedback loops which are driving the global environmental system toward collapse."

THE ROLE OF THE INDIVIDUAL

Personal ethics and the environment now span all of society. Ethics is helping to define a new social compact between human beings and the environment. The questions environmental ethics asks are: how do we want to live on this earth? What kind of world do we want? The future and the scope of change will depend on the answers to these questions, and how we convert those answers into action.

Turning the many answers to such questions into coherent and productive action is no simple matter. As Meadows *et al.* (1972) say, "it is not possible to assess the long-term future of any of these levels [population, capital, food, non-renewable resources, and pollution] without taking all the others into account. Yet even this relatively simple system has such a complicated structure that one cannot intuitively understand how it will behave in the future". Meadows suggests considering positive feedback loops, such as population and industrial growth, and negative feedback loops, such as pollution, which become stronger as growth approaches the carrying capacity of the system's environment. While it is impossible to predict what will happen as the carrying capacity of our planet is approached, the signs indicate that we are reaching these limits at least for people living a modern high-consumption lifestyle (Wackernagel *et al.*, 2002). Indeed, some indicators, such as WWF's Living Planet Index, report that we have already exceeded the planet's long-term carrying capacity (WWF, 2008).

Coupled with science and traditional knowledge, people need subjective, ethics-based assessment tools such as the framework of the Earth Charter to help apply ethical principles to current environmental challenges. In this way, biodiversity conservation ethics can be incorporated into policy and ethics can be more explicit in global to local biodiversity conservation efforts.

One such ethical tool is the Precautionary Principle, which was first elaborated at the 1992 Rio Earth Summit. As Principle 15 of the Rio Declaration, it stated that "Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation". Now widely accepted, the Precautionary Principle takes into account ethical concerns when making decisions which may affect the environment.

By incorporating ethical principles into change processes and decision-making, individuals can help break the feedback loops which are driving the global environmental system toward collapse. Ethics needs to become an effective tool for both collective action and individual action, and indeed the "greening" of many corporations indicates some progress in this direction (Chapter 15).

At the same time, different ethical frameworks can lead to misunderstandings and conflict. For example, issues relating to hunting, culling of wildlife populations, use of genetically-modified organisms (GMOs) and use of animals for human medical research have all sparked controversy and much media attention. As the ethical dimensions of conservation increase in the coming years, the conservation community will need to resolve this debate between the intrinsic values of species and ecosystems and their instrumental values to people. This can be supported by research into valuation of ecosystem services that is currently underway (Chapter 4), but efforts to ensure that all values are incorporated will be vital.

Building a stronger conservation ethic is a fundamental means to support biodiversity conservation in the long term. We will need to form partnerships with religious leaders who are increasingly emphasizing the environmental ethics that are inherent in all religions. As the future belongs to the young, we should focus on today's youth but include issues relevant for all people.

3. The Central Role of People

People can be consumers, builders, destroyers and much else besides. More than three-quarters of the Earth's ice-free land surface shows evidence of land alteration from human residence and land use. From the early years of the global conservation movement, habitat conversion was considered the leading threat to conservation of nature (and to a certain extent still is). People were excluded from protected areas (PAs), following the "Yellowstone Model", which removed Native Americans from their historical lands in the name of national conservation interests (enforced in the early years by the military).

Human development has now reached such a point that land use is being squeezed between protected areas, agricultural land, forests, and spreading urbanism. People who rely on ecosystems for their livelihoods are demonstrating that natural lands can include people, and that indeed people have long been part of nature. Many argue that local people have customary rights to these resources. Most conservation organizations now recognize how important it is to incorporate people in conservation efforts, though some argue that wilderness areas, where the human footprint is ephemeral, are essential to conserving at least some species (for example, large predators) and conserving "untouched" habitats is required for comparison with those modified by modern humanity.

In the past several decades many conservation organizations, including IUCN, have launched initiatives to harness and focus the institutional capacity of local communities in modern biodiversity conservation. These initiatives have been motivated by the principle that healthy ecosystems deliver essential services to all people. In spite of these efforts, increasing desertification, loss of soil fertility and water pollution have continued to reduce the capacity of ecosystems to meet human needs (Millennium Ecosystem Assessment, 2005). The 2005 report of the Millennium Ecosystem Assessment (MA) found that 60% of all ecosystem services are degraded. People are decreasingly able to depend on ecosystems, and people are relying on fewer and fewer sources of food. Only four plant species – wheat, maize, rice and potato – provide more than half of the plant-based calories in the human diet (Pirages and De Geest, 2003). Perhaps inadvertently, humans are increasing their exposure to the risks of ecosystem changes and how we manage these risks will have a profound impact on the outcomes.

The conservation community has generally accepted the premise that poverty is correlated with reduced status of biological resources and ecosystem services and the issues of conservation and poverty reduction are discussed in more detail in other chapters.

Conservationists are also recognizing that the impact of wealth on those resources and services is apparent as well. Consumption patterns, development choices, wealth distribution, government policies and technology can mitigate or exacerbate the environmental effects of demographic change. Today's industrial economies consume unsustainable quantities of energy and raw materials, and produce high volumes of wastes and polluting emissions. As the United Nations Environment Programme (UNEP) (2003) points out, the resulting pollution and disruption of ecosystems often occurs in countries far removed from the site of consumption. Consumer attitudes and preferences have a profound effect on the environment, due to differences in the environmental impacts of the production, use, and disposal of particular goods and services. Moreover, consumer preferences are not static. Consumption patterns are both rooted in and contribute to changing value systems. Cultures that were formerly distinctive and relatively isolated have become increasingly interconnected through market relations, fostering a new, homogenizing culture based on conspicuous consumption and possession of material goods. Traditional cultures that once practised low-intensity uses of natural resources are being rapidly displaced, or are radically transformed to acquire the perceived comparative advantages required to survive in a world driven by economic competition. Globalization has expanded the reach of the mass media and the advertising industry, reinforcing value systems based on ideals of consumption as synonymous with happiness and human well-being. Such value systems are of dubious sustainability and may even contribute to civil unrest.

The increasing integration of international markets – commonly called globalization – has enabled and stimulated the spread of modern "developed" country consumption patterns, with far-reaching implications for the environment and society. The potential of those same markets to contribute to conservation is discussed in Chapter 12.

While people and their needs and desires may be the reason that we are facing the urgent challenges before us, they are also the only means by which we can solve the problems. The development and adoption of the Ecosystem Approach by the Convention on Biological Diversity (CBD) was an explicit confirmation by the conservation world that considering people and their needs are fundamental to success (http://www.cbd.int/ecosystem/principles.shtml). IUCN has welcomed these 12 principles, but recognizes that many different ecosystem approaches can be consistent with them, for example forest landscape restoration, integrated water resource management and integrated coastal zone management.

Other issues that need to be incorporated include conservation of cultures and traditional knowledge, promotion of rights-based approaches to conservation, and engagement of local communities and indigenous peoples.

LINKING CULTURAL AND BIOLOGICAL DIVERSITY

Biodiversity and cultural diversity have a significant overlap, what some people call "cultural biodiversity" (Posey, 1999; Jianchu, 2000). This overlap is evident on maps where cultural diversity "hotspots", areas of high cultural diversity, overlap quite considerably with biodiversity rich areas (Maffi, 2005). This overlap illustrates that the concept of nature is not separate from people or culture, but rather is integrated with them.

People have always relied on social structures and norms, a reflection of culture, for protection against the risks of environmental change. These social means of adaptation can take the forms of local sharing of resources, dependence on families or lineages, adoption of new technology, migration, or

changing behaviour. By incorporating inventions and practices from many cultures, people are better equipping themselves to adapt to change. If such cultural resources are weakened, humans will have less capacity to adapt to changing conditions.

The importance of traditional environmental knowledge and the role of indigenous peoples and local communities in conservation work are recognized in the CBD which calls for the Parties to

> *respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilization of such knowledge innovations and practices.*

The CBD legitimizes traditional knowledge as part of a global legal framework. By creating a systematic approach to the relationship between people and environmental protection, it shows that people, biodiversity, and landscapes form a complex and integrated unit. This approach allows for innovative conservation strategies, such as exploring the relationship between indigenous women, resource management, and biodiversity.

The human capacity to change its behaviour enables people to be resilient to environmental change, to reduce their impact on natural systems, and to promote conservation, if they choose to do so. IUCN is actively integrating culture and livelihood concerns throughout its programme of work. Examples include the Programme on Forest Landscape Restoration and the World Commission on Protected Areas (WCPA), through its working groups on Protected Landscapes and on Cultural and Spiritual Values of Protected Areas. Increasingly, this integrated perspective is becoming part of virtually all conservation programmes.

One challenge with this shift in policy and in overall conservation thinking is that many local communities are now expected to manage conservation projects, often without the full range of skills and capacities needed to successfully deliver on what may be an unfamiliar approach to resource management. A solution would be to use conventional techniques to support and reinforce local capacities, technologies and traditional knowledge that are already in practice in local and indigenous communities. Many local cultures already manage their lands and resources well, but need help in adapting to the new pressures of a modern globalized society. The challenge will be in finding the appropriate ways to incorporate both local processes and conventional conservation practices into the new national and global resource governance structures.

RIGHTS-BASED APPROACHES TO CONSERVATION

Many large development projects, such as dam construction, urbanization, roads, timber concessions, and new approaches to agriculture, have given insufficient attention to the rights of affected local people. Similarly, the conservation community is recognizing that "conservation practices can affect human well-being and at times have undermined human rights, including local livelihoods, through human rights violations, forced resettlements and impacts on local livelihoods, especially of indigenous peoples and local communities" (IUCN, 2008e). With that in mind, IUCN's vision of "A just world that values and conserves nature" will require application of rights-based approaches to the Union's work. This will ensure full consideration of human rights, tenure and resource access rights, and customary rights of indigenous peoples and local communities.

The issue of rights-based approaches to conservation is particularly relevant for minority indigenous peoples who, as recently as 30 years ago, had few rights in most countries. This strongly

influenced conservation thinking prior to that time, with remnants in some of today's conservation practices. Until relatively recently, indigenous groups often had no legal standing or formal land rights, making it difficult for conservation organizations to work directly with them. With the promotion of human rights and the wider use of human rights-based approaches in development, indigenous peoples' rights are now being recognized and promoted through the explicit mention of the values of traditional knowledge and indigenous communities. The 2003 adoption of the Durban Accord by the Vth IUCN World Parks Congress and the 2007 United Nations Declaration of the Rights of Indigenous Peoples make it unthinkable for IUCN to carry out activities affecting local people without the free, prior and informed consent of the people directly involved.

This focus on rights and legal status is linked with the global democratization process. With an emphasis on transparency and public participation, resource management has shifted to become more community-based, presenting both challenges and opportunities for IUCN.

PEOPLE *AND* ECOSYSTEMS, OR PEOPLE *IN* ECOSYSTEMS

Local communities, and especially indigenous people, are often the most politically and economically marginalized peoples. At the same time, they are often the stewards of the most biologically-rich areas. According to Sobrevila (2008), traditional indigenous territories cover up to 22% of the world's land surface and support 80% of the planet's terrestrial species diversity.

Conventional modern conservation practices are often rejected by local communities, especially when they are not fully involved in decision-making. One result is continuing habitat degradation and loss of biodiversity. The Yellowstone model of national parks, for example, has been strongly resisted in West Asia, North Africa and elsewhere. This does not mean that these regions lack protected areas, but rather that local people have found their own means of protecting resources outside formal legal frameworks; some of these arrangements are being undermined because they are not recognized by international and national law. But traditional approaches to conservation, such as *hema* in West Asian grazing lands, can be adapted to provide viable approaches to conservation under modern conditions.

Most conservation programmes require long-term maintenance and management, which can also benefit from working with local communities. Conservation can be seen as a public good and therefore arguably should receive public funding, but this is seldom sufficient (especially in developing countries under IMF spending restrictions). Foundations, development agencies, non-governmental organizations (NGOs), and philanthropists have been extremely helpful, but conservation requires perpetual support, far longer than most donors are willing to fund. As a result, conservation projects have suffered systemic weakening as funding fades away. To overcome this difficulty, conservationists are building links to local social structures and turning to local communities for support. For many projects, local ownership of the project's maintenance and survival is both more cost-effective and has produced more successful outcomes, such as decentralized and locally-supported protected areas programmes.

One promising development which has recognized the importance of local communities in managing protected areas is the new approach by IUCN's World Commission on Protected Areas toward self-governance and management by indigenous communities. Some 86% of areas classified as National Parks in Latin America are either the permanent or temporary home of indigenous or local communities (Amend and Amend, 1995) so this approach capitalizes on the already-strong

presence of indigenous communities within and around protected areas. Self-governance of local resources can also help reduce poverty in local communities, including through opportunities such as integration of conservation and tourism.

Working with local communities must involve support for engaging with environment-related challenges such as climate change, invasive species, sustainable livelihoods and health. Each of these is discussed in more detail in other chapters. Traditional knowledge is an important basis for climate change adaptation and decreasing vulnerability to extreme events and its loss can increase local people's vulnerability to change (Ford, 2006).

Engaging all stakeholders in conservation will require tools and skills development including providing resource managers with manuals, technical assistance and other easily accessible practical guidance on how to balance natural resource management with economic development needs. Access to complementary skills necessary to achieve sustained poverty reduction and sustainable development should be facilitated.

Local communities must be empowered to conserve and manage the natural resources upon which they depend and enhance cooperation with neighbouring institutions when managing wide-ranging resources.

At the same time, governments must be encouraged to improve land tenure, give collective title legal status for indigenous peoples and empower civil society to manage renewable natural resources for sustainable use, through rights of access that are based on social and gender equity. Donors and governments should develop and implement policies that incorporate environmental and biodiversity conservation in the poverty-reduction activities they fund. Finally, a policy on conservation and human rights, including rights-based approaches to conservation, means of implementation, ways to promote sharing of experience, and responsibilities of governments, communities, the private sector and conservation organizations is urgently needed.

4. Ecosystem Services: The Benefits People Receive from Nature

Ecosystems support the processes that cleanse air and water, pollinate crops, decompose waste, control noxious pests and diseases, and regulate extreme natural events. Water, food, fibres, fuels, and medicines are all produced by the intricate web of life. Inspiration for arts, cultures and religions have come from nature, which also provides recreation and spiritual enrichment.

Life on Earth has persisted for more than two billion years, forming ecosystems that have provided the functions of nutrient flow, the predator-prey interactions that helped drive evolution, and even the current atmosphere that supports life on Earth. As humans evolved, our ancestors benefited from many of these basic functions that enabled our species to reach its current levels of cultural diversity. With the emergence of civilization through the establishment of irrigated agriculture, humanity began to realize the benefits of a much broader spectrum of ecosystem services and the hazards of undermining them. For example, Plato in 400 BC recognized that deforestation caused erosion and drying springs (Goldin, 1997). The Arabic medical treatises of the 9th century recorded sophisticated thinking concerning agricultural techniques including irrigation and crop rotation, as well as pollution control (Watson, 1983).

The civilizations of India, China, and Southeast Asia mobilized water and nitrogen-fixing algae to create irrigated rice-growing ecosystems that produced the world's richest cultures of those ancient times (McNeely and Wachtel, 1988).

More recently, the marriage of science and technology mobilized energy from fossil fuels and applied them to agriculture and manufacturing, producing sufficient food and other products to support a quadrupling of the world's human population during the 20th century. As human population growth accelerated, however, possible limits to growth became an increasing concern (Malthus, 1798; Meadows *et al.*, 1972). More recently, the Millennium Ecosystem Assessment (MA) brought together more than 1,300 scientists to report on the status of a wide range of the world's ecosystem services and the consequences of changes in ecosystems to people now and into the future (MA, 2005b). Its conclusion that 60% of the ecosystem services it assessed were being degraded or used unsustainably at global scales provided a sound scientific basis for the urgency of conserving biodiversity and ecosystems.

CLASSIFICATION OF ECOSYSTEM SERVICES

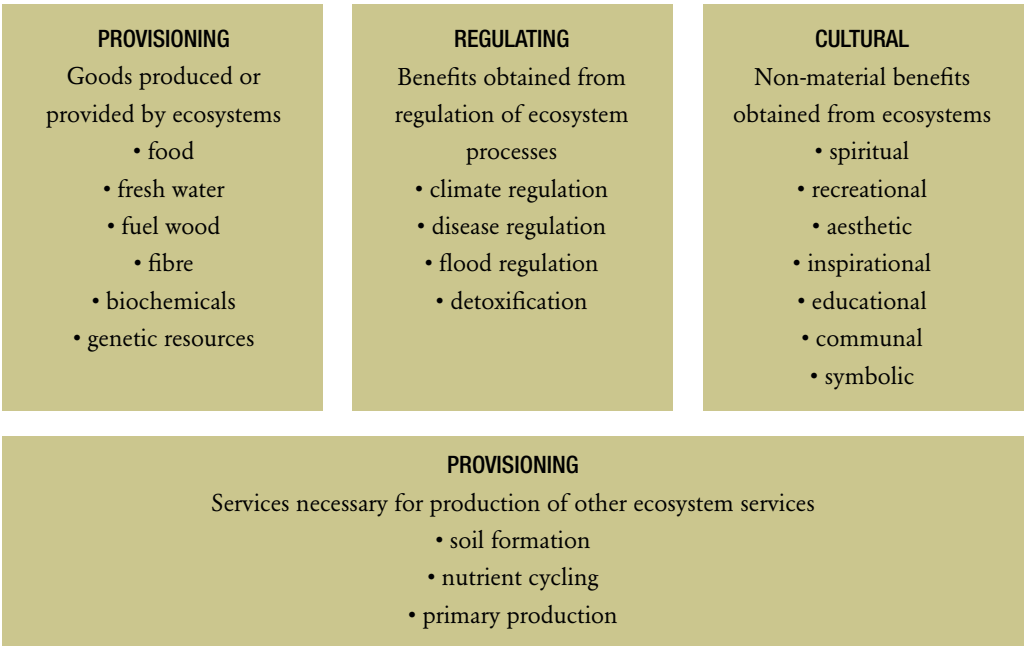
So what, exactly, are ecosystem services? Simply, they are the benefits that ecosystems provide to people. The concept of "ecosystem" highlights the interactions between components of biodiversity at a range of scales and interactions between living species and the abiotic environment. Indeed, those interactions support, regulate, and provide

the benefits that people derive from biodiversity. People do not derive services from a range of scales of biodiversity independently; rather, services are delivered from ecosystems and elements of them functioning as a whole. When the system is degraded, fewer services are delivered. This provides powerful justification for IUCN's focus on conserving ecosystems, the services they provide, and the biodiversity that supports them.

People often degrade ecosystems but we can restore them and we can intervene meaningfully in their management to change the balance and supply the multiplicity of services. Whether forest managers, wetland managers, farm managers, or backyard gardeners, people realize that they are managing an ecosystem. Even those who focus on species conservation in the wild recognize that no species is an island, independent unto itself; rather, its survival depends on its relations with the other components of the ecosystem of which it is part.

The Millennium Ecosystem Assessment (MA, 2003) classified ecosystem services into four groups: supporting services; regulating services; provisioning services; and cultural services (Figure 4.1).

FIGURE 4.1 FRAMEWORK FOR CLASSIFYING ECOSYSTEM SERVICES (MA, 2003)



SUPPORTING SERVICES

Supporting services include primary production, nutrient cycling, water cycling, pollination and the provision of habitats. Their benefits to people are indirect, and enable ecosystems to supply cultural, regulating and provisioning services. For example, the provisioning service of producing food depends on the supporting services of nutrient cycling, soil formation, water cycling, and pollination. From an economic perspective, it does not make sense to value supporting services directly, as the value of these services should be captured (but often is not) by the value of the direct benefits that we obtain from ecosystems (for example, food or water).

PROVISIONING SERVICES

Provisioning services are the goods produced by ecosystems. They are the most immediately recognizable of the ecosystem services to most people, and are the most tangible benefits derived from ecosystems (though, as mentioned above, they are totally dependent on the supporting services). From the genetic resources of wild species, to the domesticated plants and animals on which we depend for most of our food, provisioning services also provide a livelihood beyond their direct consumptive benefits, because they are readily valued and exchanged in markets. Although the process is rarely recognized as such, people engage in payments for ecosystem services schemes each time they buy food, firewood, or natural medicines. Provisioning services meet the global population's needs for food, natural fibres, medicines, and genetic resources, and meet the fuel needs for the one-third of the world's population who do not have access to fossil fuels.

REGULATING SERVICES

Regulating services are those benefits that arise from the ways ecosystems influence the environment in which we live. These include the regulation of air quality and climate, water quality and quantity, pests and disease, and storms and other natural hazards. Regulation services operate at a wide range of scales; for example the regulation of the climate system operates at global scales, the regulation of water flow at river basin-scales, and the regulation of wind and storm surges at very local scales. Regulating services are challenging to value in economic terms, and are rarely recognized in national accounting systems. Some regulating services can also be considered to be supporting services, depending on how changes in the service affect people. For example, while soil retention and formation directly regulate water quality, people also indirectly benefit from soil formation, for example again through the provisioning service of food production. Economists are now working on approaches to enable these services to be given value, leading to new forms of payment for ecosystem services (PES).

CULTURAL SERVICES

Cultural services are the non-material and sometimes intangible benefits that people derive from ecosystems. These include benefits people derive from aesthetics and inspiration, spiritual and religious aspects of ecosystems, education and science, and the cultural affinity and heritage values that many people associate with landscapes and species, especially in the areas in which they live. Cultural services are tightly linked to human values and behaviours, and can vary significantly across social, economic and political perspectives. Although cultural values and other intangible benefits from ecosystems are often difficult to value, they nonetheless provide fundamental benefits to individuals and societies across the world. Whatever the value we might put on the existence of individual species such as pandas and whales, the scientific insight we derive from observing nature, or the spiritual and cultural affinities that many people have with sacred groves or iconic species, the cultural services of ecosystems benefit our bodies, minds, and souls. The recreational and tourism benefits deriving from nature and biodiversity, in contrast to many of the other cultural services, are readily measurable and quantifiable in economic terms. They have become a major source of income at local, regional and national levels, and have contributed significantly to improved quality of life for local communities, though some trade-offs are involved.

POLICY AND PLANNING FOR ECOSYSTEM SERVICES

Growing understanding of the importance and value of ecosystem services over the past 20 years has stimulated a series of key events and, emerging from these, important policy initiatives. The most notable of these was the

United Nations Conference on Environment and Development, known as the Earth Summit, held in Rio de Janeiro, Brazil, in June 1992. One major outcome of the Earth Summit was the Convention on Biological Diversity (CBD), which now has 191 State Parties. The notion of ecosystem services is deeply embedded in the CBD through the concepts of "sustainable use" and "benefits" specified in its objectives.

Ecosystem services were also recognized when the United Nations General Assembly adopted the eight Millennium Development Goals (MDG) in 2000. The seventh of these, "Ensuring Environmental Sustainability", explicitly targets the maintenance of ecosystem services and the conservation of biodiversity (Melnick *et al.*, 2005). Two years later, the World Summit on Sustainable Development (WSSD), held in Johannesburg, South Africa, endorsed the Millennium Development Goals, consolidating the theme of progress towards these as a central component of intergovernmental policy.

> "The roots of appreciation of the intrinsic value of biodiversity run very deep in many cultural and religious worldviews."

At national levels, too, policies to maintain the supply of ecosystem services have been adopted. A search of the ECOLEX database (a joint effort by IUCN, FAO and UNEP) yields no less than 602 mentions of "ecosystem services" within national legislation. Provisioning services are the most common focus, perhaps because they are the most obvious, easiest to measure, and bring in the most tax revenue.

The other major policy response to the recognition of the values of ecosystem services has been the development of markets for them. Costa Rica is a good example of a country that has taken the first steps to develop markets for ecosystem services (Rojas and Aylward, 2003). The country has long been a global leader in the ecotourism industry – in effect selling recreational ecosystem services. During the 1990s it pioneered systems by which downstream communities and companies paid upland dwellers for the maintenance and restoration of forests for water provisioning. Most recently, Costa Rica has been active, alongside other tropical countries, in developing incentives and finance for Reducing Emissions from Deforestation and Degradation (REDD), as one approach to capture the economic benefits of carbon sequestration and storage in biomass, for climate regulation.

Given the emerging importance of ecosystem services in policies and markets, states, local governments, and non-governmental organizations (NGOs) are seeking approaches to best deliver ecosystem services. The key to effective planning is a clear statement of objectives. For example, the objective of a given agency might be to halve the proportion of people with no access to clean water (part of the Millennium Development Goal 7). Data can then be collected, and models constructed, to inform options that could help to achieve this goal, such as installation of infrastructure (for purification or desalination), improvements in sanitation, and maintenance of forest habitat within watersheds. Different combinations and spatial configurations of these options will have different costs and benefits. Costs will include not only straightforward construction and maintenance, monitoring and evaluation, but also opportunity costs (e.g. maintaining forest habitats may require foregoing some timber harvests). Benefits will be both direct, in contributing towards the stated goal, and indirect, where ecosystem services can be "bundled" or "unbundled" to attract others to invest in the plan (e.g. maintaining forest habitats will also deliver

REDD). With these data in hand, spatial cost-benefit analysis and/or reverse auction systems can then be used to derive a plan that will deliver the goal at minimum cost (or deliver as close to the goal as possible for a given budget).

VALUATION AND BEYOND

The concept of ecosystem services seeks to highlight the present imbalances in market forces, which give greater weight to traded goods and services but tend to neglect ecosystem values and other non-market benefits. By promoting awareness of the full value of ecosystem services, conservationists hope that policy makers will take action and markets can be reformed to better reflect the real relationship between human well-being and ecosystem health, and consequently support the conservation of nature. This often involves estimating the monetary value of well-defined ecosystem services, in order to make the economic case for change, followed by the introduction of mechanisms such as payments for ecosystem services, which can transform potential value into real cash-flow and behaviour change.

The first step is to value ecosystem services. The study of The Economics of Ecosystems and Biodiversity (TEEB) is poised to do just that. An interim report of the study (EC and BMU, 2008) states that human well-being is totally dependent on "ecosystem services". However, because these services are predominantly public goods, with no clear property rights, markets or prices, they are neither recognized nor adequately integrated into our economic policy and decisions. As a result, insufficient appreciation of the full costs and benefits of conservation leads to continuing biodiversity loss. TEEB, through the development and dissemination of economic tools to support the valuation of ecosystem services, hopes to rectify this situation.

At the same time, many people reject a purely utilitarian view of nature, emphasizing the moral or intrinsic values of biodiversity. While such values are notoriously difficult to measure, there are well-established approaches to reflect them in policy (e.g. through legislation relating to the protection of endangered species). The intrinsic value of nature may be considered in the same light as other moral or cultural values – of great works of art, perhaps, or of human rights.

The roots of appreciation of the intrinsic value of biodiversity run very deep in many cultural and religious worldviews. All of the world's religions have embraced notions of stewardship or caring for the natural world (Gardner, 2002), as have leading political philosophers, although such values are not equally distributed among components of the natural world (e.g. charismatic animal species are afforded considerably more intrinsic value than plants or micro-organisms in most cultures). Among contemporary thinkers, E.O. Wilson (1984) has most powerfully communicated intrinsic value, including detailed exploration of its evolutionary basis.

The place for the intrinsic value of nature in the world of economic development and ecosystem-service valuation can be identified through clarity of objectives. The objective of development is to improve human well-being. The objective of biodiversity conservation is to maintain and restore biodiversity and ecosystems, above all through ensuring that irreversible species extinction rates do not exceed natural levels. Valuing ecosystem services can help to deliver both human well-being and biodiversity conservation, a means to two ends, but is not an end in itself.

The concept of ecosystem services has drawn some criticisms (McCauley, 2006) but these can all be addressed (McNeely *et al.*, 2009):

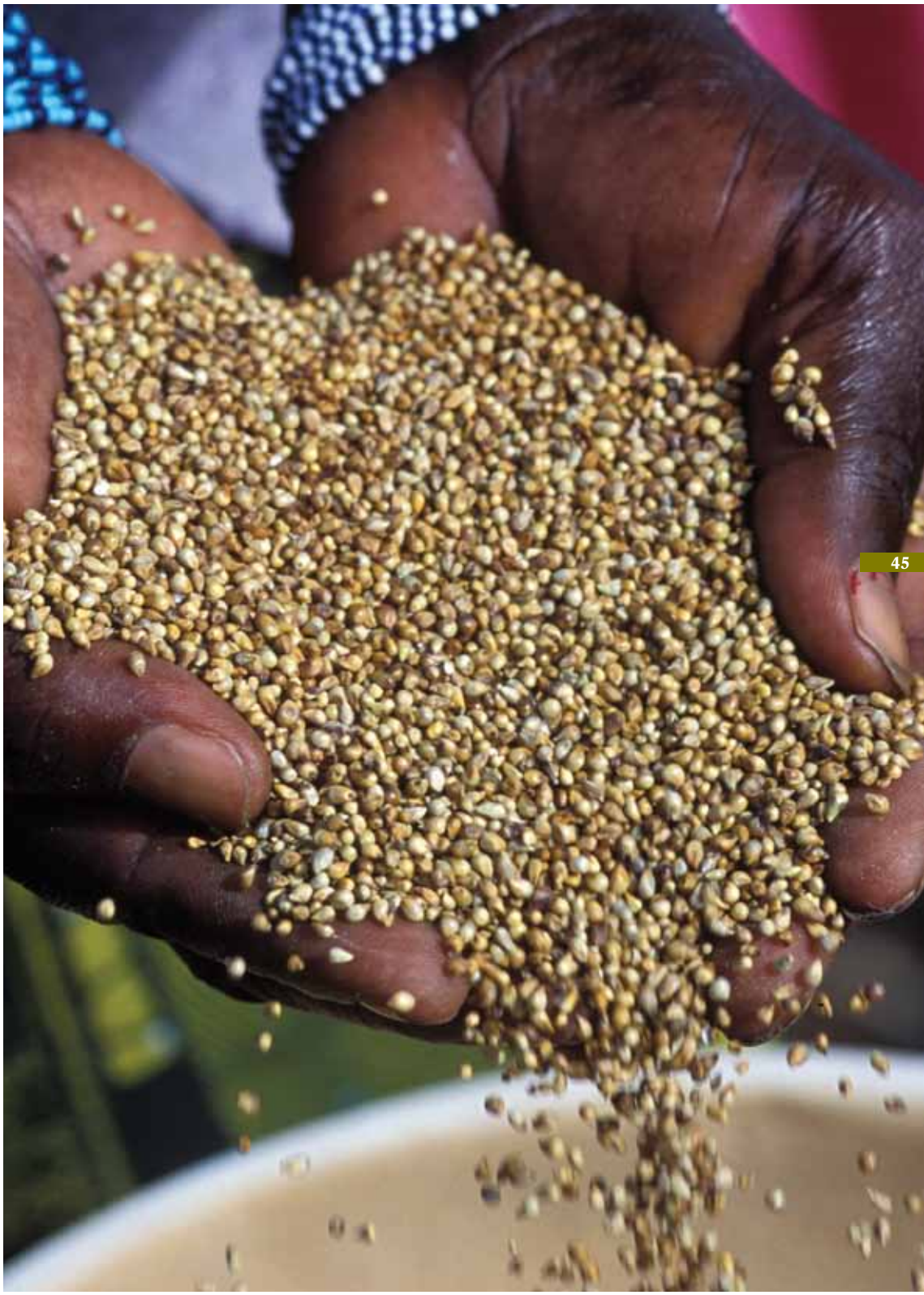
- Some components of nature may deliver few ecosystem services beyond cultural benefits, so the strategy may offer little support to the conservation of, for example, the nearly 2,000 endemic plants of South Africa's Succulent

Karoo. But this region may be especially important for its option values; and its cultural values to South Africans are substantial. Arguments based on ecosystem services are not cast only in financial terms.

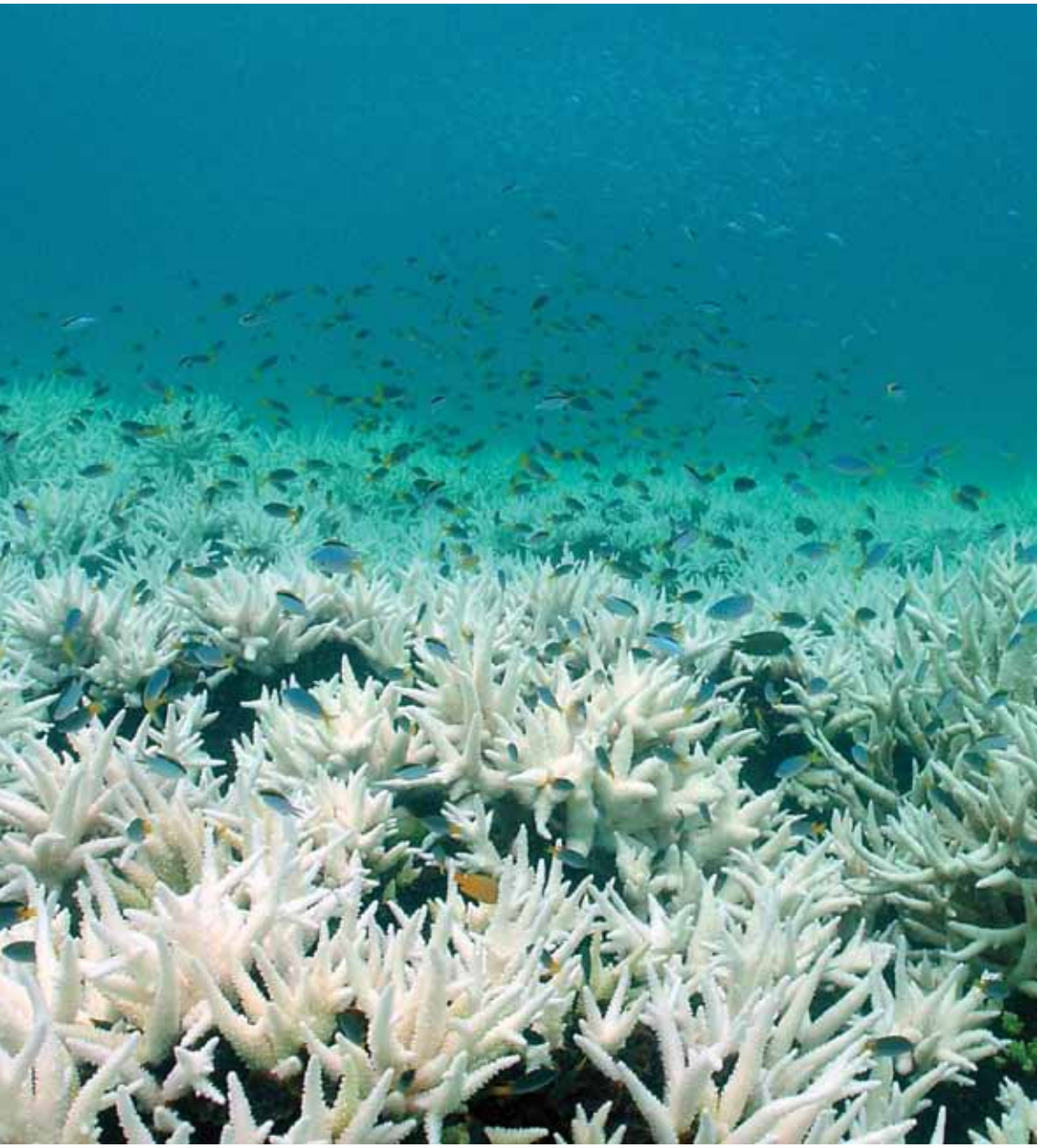
- Markets fluctuate widely (as 2008 demonstrated around the world), so should we liquidate our natural assets if a fickle market ascribes them a lower value tomorrow than they have today? Certainly not, because ecosystem services are not all amenable to assessment of economic values, and the concept encourages intrinsic, cultural, and economic values to all be considered in decision-making. The combination of intrinsic and economic values is more powerful than either alone.
- Reliance on ecosystem services as a basis for conservation may open the door to arguments that we can dispense with ecosystems if/when cheaper methods for delivering the same services can be manufactured. This concern may be less troubling when we recognize that ecosystems deliver multiple services, all of which need to be considered in decision-making.
- Situations will undoubtedly arise where more local economic benefit can be derived from destroying nature than global economic benefit can be derived from conserving it (for example, the introduction of the Nile Perch into Lake Victoria boosted local economies but devastated the lake's endemic fish species). Such trade-offs are common in resource management, but considering the full suite of ecosystem services better informs decisions about trade-offs that may need to be included. The Costa Rica experience demonstrates how the concept of ecosystem services can provide practical positive outcomes.

Oates (1998) adds a fifth fundamental concern: the "corrupting" influence of economics on the enterprise of conservation itself. But the concept of ecosystem services is useful for many resource management issues. Reid *et al.* (2006) point out that "our planet is a mosaic of systems providing people with different bundles of ecosystem services and disservices. We cannot manage these systems effectively if we do not actively seek to measure the flows of these services, examine who is benefiting from them, and consider a range of policies, incentives, technologies and regulations that could encourage better management and sharing of the benefits".

Any tool can be used improperly, but recent analyses indicate that proper use of valuation and payments for ecosystem services can greatly benefit conservation. In particular, new evidence suggests high (Turner *et al.*, 2007; Polasky *et al.*, 2008) or at least mixed (Chan *et al.*, 2006; Naidoo *et al.*, 2008) spatial correspondence between biodiversity-conservation priority and ecosystem-service value. This indicates that investment in conserving regions of high priority for biodiversity can often deliver at least some high ecosystem-service values as well. Given the concentration of priority areas for both biodiversity conservation and poverty alleviation needs in the tropics, conservation based on the concept ecosystem services provides a productive path for IUCN and other conservation organizations to follow into a sustainable future.



5. Climate Change and Biodiversity



The Intergovernmental Panel on Climate Change (IPCC) released its 4th Assessment Report in 2007, strengthening earlier findings that recent greenhouse gas (GHG) emissions have far exceeded pre-industrial values but adding that emissions had climbed even faster in the decade from 1995 to 2005 than ever before (IPCC, 2007a). Isotherms (lines connecting places with the same temperature) are shifting at a rate of 40km per decade in the northern hemisphere and at these rates, along with compounding factors such as habitat loss and pollution, some species will find it difficult to adapt (Hansen *et al.,* 2006).

Box 5.1 What's changing in climate change?

Increased greenhouse gas levels

↓

Leading to

↓

Increased temperatures

Rising sea levels

Shifting ocean currents

Changing air and ocean chemistry

Extreme climatic events

Key findings from the report from the biodiversity perspective include:

- Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow caps and glaciers and rising global average sea level.
- Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases.
- Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations.

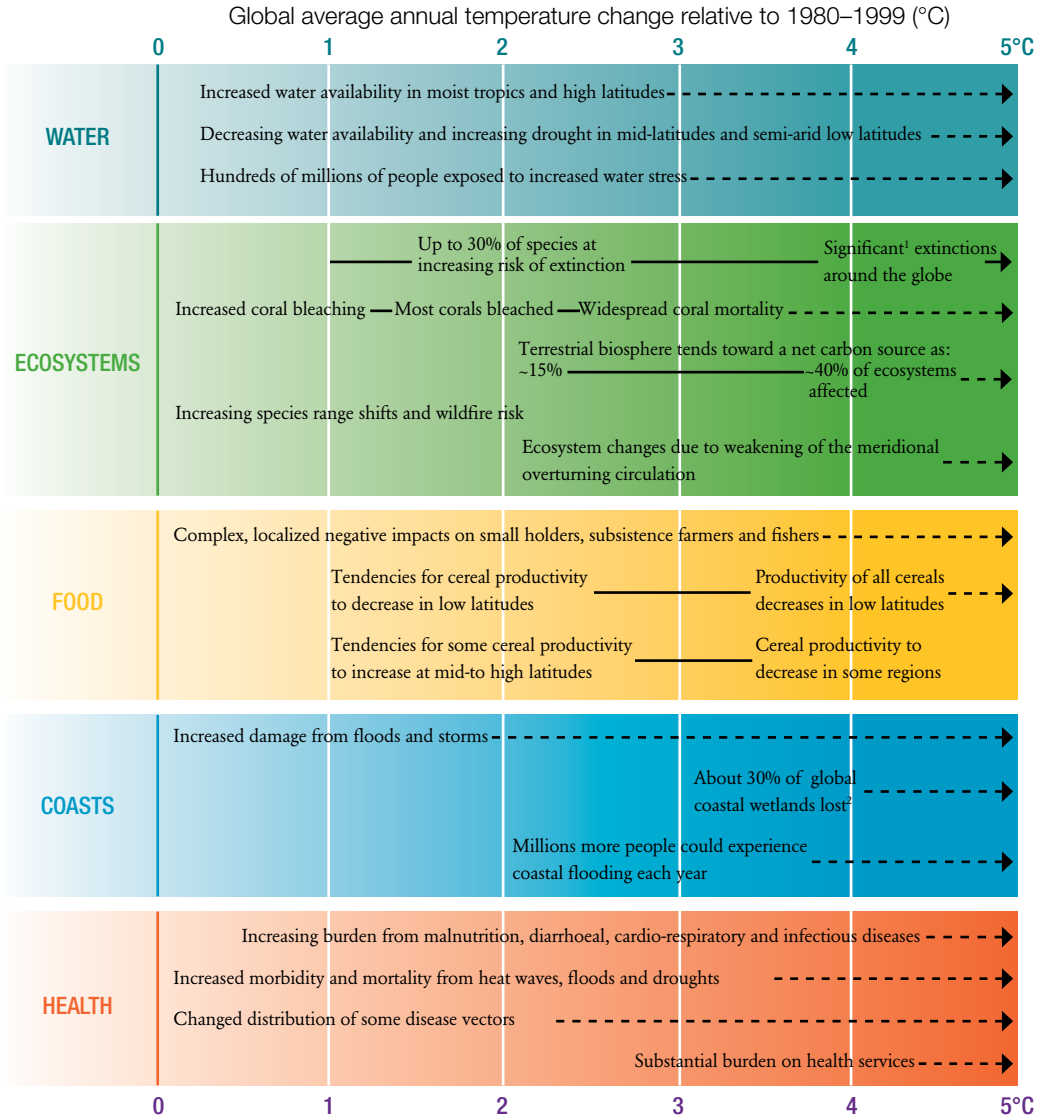
More recent evidence presented by IPCC scientists (March 2009) reported that even the dire evidence presented in the 4th Assessment Report was too optimistic. Warming between 2000 and 2007 was unprecedented, mainly due to rapid economic growth in China and India powered largely by coal.

Solomon *et al.* (2009) reported that the severity of the impacts resulting from climate change was related not only to the magnitude of the change but also to the potential for irreversibility. They concluded that the carbon dioxide emission-induced climate change will be largely irreversible

for as many as 1,000 years after emissions stop because of the length of time required for temperatures to decrease in response to decreased emissions.

As delegates met in April 2009 in Bonn, Germany, for a preparatory meeting for the United Nations Framework Convention on Climate Change (UNFCCC) COP 15 in Copenhagen in December 2009, the news of the collapse of the Wilkins Ice Shelf, an Antarctic ice plate the size of Manhattan, was on everyone's mind as a dramatic indicator of accelerating climate change and gave even greater urgency to the negotiations taking place.

The projected impacts of increasing temperatures are presented graphically in Figure 5.1.



[1]Significant is defined here as more than 40% [2]Based on average rate of sea level rise of 4.2 mm/year from 2000 to 2080.

Figure 5.1 Impacts of increased temperatures (IPCC, 2007a)

The impacts of climate change alone are causing significant changes to our environment. However, climate change is also a threat multiplier and a threat accelerator – amplifying the impacts of other biodiversity threats already stressing nature, including habitat degradation, pollution, invasive species, emerging infectious diseases and overexploitation. Ultimately, delivery of virtually all ecosystem services will be affected, some more than others. The human response to these changes will be a major preoccupation in the coming decades.

With the sense of urgency generated through media and scientific reports, climate is now widely recognized as everyone's issue – businesses, conservationists, local communities, municipal governments, private land owners, protected area managers and many others. Partnerships among these diverse sectors of society, generated by climate action, could also benefit biodiversity. Action is needed now, both to manage the avoidable impacts through mitigation and, increasingly, to cope with the unavoidable impacts through adaptation.

CLIMATE CHANGE AND BIODIVERSITY

For biodiversity, the impact of climate change is already evident. A review of 1,700 species showed that nature was following climate trends, with range shifts averaging 6.1km per decade towards the poles, and spring events advancing by 2.3 days per decade. This provides strong evidence that climate is already changing the natural world (Parmesan *et al.*, 2003).

The recently-released Climatic Atlas of European Breeding Birds reports that the potential breeding distribution of most of Europe's breeding birds will shift several hundred kilometres north (Huntley *et al.*, 2007). Many cold-blooded species such as reptiles are projected to fare poorly in a warming world (Kearney *et al.*, 2009). In addition, amphibian species extirpations and extinctions have been linked with climate change (Ron *et al.*, 2003; Burrowes *et al.* 2004; Pounds *et al.*, 2006). Marine fishes are predicted to be affected by rising water temperatures which will change oxygen levels in the world's oceans (Poertner and Knust, 2007), and increasing carbon dioxide is increasing the acidity of the oceans, with severe impacts on some marine communities (such as coral reefs). Climate change will affect species distribution, demography and life histories, with consequences for human livelihoods including changing patterns of human disease distribution (Box 5.2).

Box 5.2 Some examples of climate change impacts on species

Changes in species distribution

- Marine fish (Perry *et al.*, 2005)
- Southern California mountain plants (Kelly and Golden, 2008)
- Butterflies (Warren *et al.*, 2001)
- Tropical amphibians and birds (Pounds *et al.*, 1999)
- British birds (Thomas & Lennon, 1999)
- Polar bears (Derocher *et al.*, 2004)
- Tree distributions in British Colombia (Hamann and Wang, 2006)

Changes in population demography

- Potential changes in species with temperature-dependent sex determination (Schwanz and Janzen, 2008)

Changes in species behaviour

- Earlier flight times in insects (Ellis *et al.*, 1997; Woiwod, 1997)
- Earlier nesting in birds, earlier breeding in amphibians, and earlier flowering of trees (Walther, 2002)
- Skipped spawning seasons in herring (Engelhard and Heino, 2006)
- Ability of some shellfish to lay down calcium (Gazeau *et al.*, 2007)

Climate change impacts on species are not distributed equally across the spectrum of life either taxonomically or geographically. Groups of species that are more vulnerable include those that are already rare or threatened; migratory species; species with restricted ranges (narrow endemics); polar communities; peripheral populations; genetically impoverished species; and specialized species including alpine and island species. Those with the highest specializations in terms of lifestyle or location are typically most at risk. Using such characteristics, the Species Survival Commission (SSC) has completed an assessment of species vulnerable to climate change and therefore potentially at an increased risk of extinction (Vié *et al.*, 2009). They reported that:

- 35% of birds, 52% of amphibians and 71% of corals have traits that render them particularly susceptible to climate change impacts, and
- 70–80% of birds, amphibians and corals that are already threatened are also "climate-change-susceptible".

While climate change is having a negative impact on some species, it is creating more favourable conditions for others. The traits of species that make them invasive – ability to survive in adverse conditions, rapid growth rates, and wide dispersal – will often help them succeed under climate change. Acting together, climate change and invasive species can put many native species in situations beyond their ability to adapt. For example, *Mytilus galloprovincialis,* an invasive blue mussel species, has a higher tolerance for warm water temperatures and increased salinity levels than the native blue mussel, *Mytilus trossulus,* in California. Thus, *M. galloprovincialis* has replaced the native mussel along much of the southern and central California coastline (Braby and Somero, 2006).

Climate change is also having impacts at ecosystem levels and it is expected that polar ecosystems and the Mediterranean-type ecosystems of the Mediterranean basin, California, Chile, South Africa and Western Australia will be particularly strongly affected by climate change (Lavorel, 1998; Sala *et al.*, 2000). The 2008 update of the *Status of Coral Reefs of the World* included both good and bad news. Western Pacific and Indian Ocean reefs, which had earlier suffered severe bleaching as a result of increased ocean temperatures, were reported to be recovering but the overall impacts of climate change and of human activity remained significant threats to long-term survival of the world's reefs (Wilkinson, 2008). High altitude ecosystems and cloud forests are also at risk. Replacement of tropical forest by savannah is expected in eastern Amazonia along with vegetation changes in north-east Brazil as a result of synergistic effects of land use and climate change (Magrin *et al.*, 2007).

Climate change will certainly alter the way biodiversity is managed and conserved. Burns *et al.* (2003) reviewed the impact of climate change on mammalian diversity in US National Parks and reported that because of species losses of up to 20% and rapid influxes of new species, protected areas may not be able to fulfil their original mandates in terms of conservation. Management agencies will need to determine how protected areas can best be designed and managed today to enable them to adapt to possible future climate changes, and help mitigate the causes of climate change (for example, by storing carbon in vegetation, soils, and waters). UNESCO's World Heritage Committee has recognized that climate change is already affecting the world's protected areas and is likely to affect many more in the years to come. In response, they have adopted a strategy to assist countries as they address this threat (UNESCO, 2006).

With measurable impacts already evident at both species and ecosystem levels, the delivery

of ecosystem services inevitably will be affected. For example, scientists are projecting changes in rainfall for southern Africa as a result of changes in temperature in the Indian Ocean, with resulting decreases in agricultural output and increases in food insecurity in the region (Funk *et al.*, 2008). Conversely, ecosystems can play a role in mitigating those impacts. Sheil and Murdiyarso (2009) report on the potential role that forests play in hydrological cycles and maintaining rainfall. These and similar findings provide strong arguments in support of landscape approaches to climate change adaptation and mitigation.

THE PARTICULAR CHALLENGE FOR ISLANDS

Small island states are especially vulnerable to most of the impacts of climate change. Their land area decreases as sea level rises, their protecting reefs diminish as oceans acidify, and their vegetation cover has difficulty adapting to new climates because of their low levels of diversity. Many islands already suffer environmental degradation as a result of pollution, habitat destruction, invasive alien species, and overexploitation. With the addition of climate change impacts, only the most hardy of species can be expected to survive (often invasive species).

A landscape-scale approach is needed to help islands in their efforts to adapt to climate change impacts. Where inland forests and wetlands are linked to coastal ecosystems, they should be managed as an integrated entity. Different categories of protected areas can serve as an important part of the landscape mosaic that can help ecosystems adapt to the impacts of climate change.

Islands also provide excellent laboratories in which to study both impacts of climate change and responses to mitigation and adaptation action. IUCN, through the Mangroves for the Future Initiative, is working with other organizations to manage coastal ecosystems sustainably so as to enhance their adaptive capacity and enhance resilience of the communities that depend of them.

MITIGATION, ADAPTATION AND BIODIVERSITY

Climate change mitigation seeks to avoid the unmanageable; climate change adaptation seeks to manage the unavoidable. Responses, in terms of both mitigation and adaptation, must be developed on the basis of improved understanding of the dynamic context and cascade of impacts across all threats and the potential impacts across stakeholders. In late 2006, the UK Government issued a detailed report on the economics of climate change (Box 5.3) which concluded that action to stop climate change makes good economic sense. The report specifically highlighted forest conservation as a highly cost-effective way to slow climate change thereby making the case for avoiding deforestation for both climate and conservation reasons (Stern, 2006).

Box 5.3 Key messages of the Stern Report on Climate Change

Letting climate change proceed under a "business-as-usual" scenario would impose costs of between 5% and 20% of world GDP, whereas shifting to a low-carbon economy that stabilizes the climate would cost about 1% of world GDP. In short, the report finds that the benefits of stabilizing the climate far outweigh the costs.

Climate change impacts will vary widely among nations and, as in previous analyses, developing countries appear likely to be worst affected.

Source: Stern, 2006

IUCN's Members, through Resolution WCC 4.075 and others, have affirmed the strong links between conservation, biodiversity and climate action. That action recognizes the role of ecosystems including forests, peatlands, grasslands, watersheds and coastal ecosystems in supporting climate change mitigation and adaptation. In particular, in terms of international climate change policy under the UNFCCC, IUCN has focused on two key opportunities for biodiversity – Reducing Emissions from Deforestation and forest Degradation in developing countries (REDD) and Ecosystem-based Adaptation (EbA).

REDD

In terms of mitigation, REDD provides real opportunities to both mitigate climate impacts while also conserving global forest resources and the associated ecosystem services and dependent livelihoods. Deforestation and forest ecosystem degradation are significant causes of the global warming recorded in the past century, accounting for 17% of global GHG emissions, more than the entire transport sector. The UK Government's Eliasch Review (2008) contends that "without tackling forest loss, it is highly unlikely that we could achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that avoids the worst effects of climate change".

Another resource that the world can look to is the standing carbon stocks (forests) in the world's protected areas – calculated at 312 Gt of carbon or about 15% of the global total of sequestered carbon (CBD, 2008).

But a REDD mechanism under the UNFCCC that does not incorporate the considerations of those people most directly affected will inevitably fail. A successful REDD mechanism requires attention to governance issues if it is not to alienate or disenfranchise local forest-dependent communities, exacerbating conflict and thus undermining the prospect of securing permanent and additional reductions in emissions. Countries can draw on a substantial body of international agreements and best practice guidance to provide the necessary underpinning for national level REDD mechanisms. These include the United Nations Non-legally Binding Instrument on all types of forests; the Expanded Programme of Work on Forest Biodiversity of the Convention on Biological Diversity; and the United Nations Declaration on the Rights of Indigenous Peoples, among others.

ECOSYSTEM-BASED ADAPTATION (EbA)

Ecosystem services (Chapter 4) underpin human well-being and some of them are critical for regulating our climate and managing the impacts of climate change. On the other hand, the changes to climate patterns that are inevitable will undermine some of the services that ecosystems provide, thereby threatening human livelihoods. The increases in sea level, violent storms, melting glaciers, and droughts and floods influenced by global warming will result in millions of people losing their homes and livelihoods, and sometimes even their lives.

Evidence suggests that a diverse system will be more resilient when faced with environmental change and thus show greater ecosystem adaptability. In essence, a greater diversity of species and populations performing similar functions within an ecosystem is likely to result in a greater probability of ecosystem processes being maintained in the face of environmental change (McCann, 2000). EbA identifies and implements a range of strategies for the management, conservation and restoration of ecosystems to ensure that they continue to provide the services that enable people to adapt to the impacts of climate change[2]. EbA is a cost-effective, immediate and accessible

[2] *This definition draws from and is fully consistent with the draft report of the Convention on Biological Diversity's Ad-Hoc Technical Expert Group (AHTEG) on climate change and biodiversity.*

adaptation solution. Examples of EbA include the management of coastal ecosystems to reduce flooding during storm surges. Mangroves, salt marshes and other coastal vegetation types provide natural infrastructure which reduces the inland impacts of wave energy, acts as a barrier to debris, and reduces coastal erosion. Another example includes maintaining and enhancing the resilience of ecosystems at the landscape-scale, through systems of effectively managed protected areas and improvements in the management of surrounding lands and seas.

Climate change impacts on people will be differently distributed among different regions, generations, age classes, income groups, occupations, and gender. Rural communities, which are often most directly dependent on local natural resources, will be most affected, especially those in the most vulnerable ecosystems. The poor, primarily but by no means exclusively in developing countries, will be disproportionately affected due to their limited capacity to adapt to change and dependence on resources such as water and food that will be affected by climate change (IPCC, 2007b). Conversely, these groups can also be powerful agents of change by playing a key role in disaster reduction, deforestation and energy uses. Further, EbA is a means of adaptation that is often more accessible to the rural poor than technology or infrastructure solutions. EbA can be a means for supporting indigenous peoples by harnessing traditional knowledge in order to adapt to changing climatic conditions that also incorporates gender-specific needs in relation to natural resources.

The impacts of climate change could put poverty reduction strategies at risk and undermine efforts made to achieve the full range of Millennium Development Goals (MDGs). Therefore, poverty reduction strategies and development planning should incorporate EbA as an integral element of overall programmes to address both poverty reduction and climate change adaptation. Many tools are available to assist local communities in identifying their vulnerability to climate change impacts and also their options in adapting for the future. Among these, CRiSTAL (www.cristaltool.org), a climate risk screening tool developed by the International Institute for Sustainable Development (IISD), IUCN, Intercooperation and the Stockholm Environment Institute (SEI), helps development and conservation planners work with local communities to integrate climate change adaptation needs into their projects.

OTHER CONSIDERATIONS

In managing the impacts of climate change, we cannot ignore the impact of energy choices, both on mitigation and adaption planning and implementation. This will be discussed in more detail in Chapter 7. In addition, climate change issues should include aspects of rights-based approaches, synergies across international instruments considering climate change, and inclusion of disaster risk reduction as a complementary approach (Chapter 10).

The Stockholm Declaration (1972) stated that people have "the fundamental right to freedom, equality and adequate conditions of life, in an environment of a quality that permits a life of dignity and well-being". The impacts of climate change will put at risk many of the basic elements that support those "adequate conditions of life" and therefore can be considered to affect human rights. Therefore, any actions taken in terms of adaptation should include consideration of human rights as an essential element. In April 2009, the Office of the United Nations High Commissioner for Human Rights, by request of the United Nations Human Rights Council, released a report on the relationship between climate change and human rights (UN, 2009).

Governance of issues relating to climate change is not simply the purview of the UNFCCC and

government Parties. The linkages between climate change and biodiversity require action in many other relevant international agreements (McNeely, 2008). The Convention on Biological Diversity, for example, discusses the role of biodiversity for both sequestering carbon and adapting to climate change, while the conventions on wetlands (Ramsar) and desertification (UNCCD) deal with habitats whose effective management will contribute towards adapting to climate change in the coming decades. The United Nations Convention on the Law of the Sea (UNCLOS) deals specifically with marine ecosystems, and recent research is indicating how important marine environments are in addressing issues involving climate change. The Convention on Migratory Species (CMS) deals with wide-ranging species that are likely to be influenced by climate change and therefore could support the adaptation process. Given limited resources and time, a critical issue will be to focus on more effective coordination of action across these instruments as well as providing strong enforcement and implementation measures.

Climate change adaptation and disaster risk reduction are complementary approaches. Through the Hyogo Framework for Action 2005–2015, countries have committed to integrate climate change adaptation and disaster risk reduction through the identification of climate-related disaster risks, the design of specific risk reduction measures, and the improved and routine use of climate risk information by planners, engineers and other decision makers.

Climate change is the preeminent driver of change in today's world and an increasing threat to biodiversity and the ecosystem services it provides. As the world gathers in Copenhagen to discuss and agree on a post-2012 climate change framework, it is vital that States negotiating at the UNFCCC should:

- Incorporate biodiversity concerns into all efforts to mitigate climate change and adapt to inevitable changes, for example through Reducing Emissions from Deforestation and forest Degradation in developing countries (REDD) and ecosystem-based adaptation;
- Mainstream gender and rights-based approaches; and
- Consider the work carried out under the Hyogo Framework of Action when designing and implementing adaptation plans and strategies.

But the job does not belong to governments alone. In the wake of the financial crisis, initiatives to renew the global economy should also take advantage of the opportunity to de-carbonize that economy including development of innovative incentives, such as carbon markets, that will provide models for broader payments for ecosystem services. Prices paid for goods and services must include the "social cost of carbon" to reflect the impacts on climate change of the entire process of raw material supply, production, distribution and consumption. This needs to apply to all countries including for exported products. Some have suggested that countries should levy a "carbon tariff" on imports, to reflect any GHG emissions associated with their production. Carbon taxes on imports may be unpalatable to some, but it can be argued with equal conviction that they are essential to the survival of the planet.

Protected areas have already demonstrated their value for conserving biodiversity that otherwise might well be lost. When properly designed and managed, protected areas can also provide the capacity to mitigate and adapt to climate change. Conserving forest cover within protected areas could be a useful contribution towards REDD, provided the challenge of proving "additionality" can be overcome, while landscape-scale management of ecosystems that include protected areas will be an important aspect of climate adaptation planning.

Last, but certainly not least, efforts to mitigate climate change must ensure that alternative energy strategies, including the use of biofuels as an energy option, fully account for and guard against any associated negative impacts on climate, biodiversity and livelihoods.

6. Protected Areas: For Life's Sake

In 2003, the conservation world gathered in Durban for the Vth IUCN World Parks Congress and together adopted the Durban Accord as a new paradigm for the future (IUCN, 2003). The Accord recognized the critical role of protected areas (PAs) both in supporting biodiversity conservation as well as efforts to reduce poverty, support economic development, and promote peace. It celebrated the threefold increase in the number of protected areas in the previous 20 years.

However, the Accord also raised concerns. While 11.5% of the Earth was under some form of conservation, the existing network was still not representative of the full scope of biodiversity – especially for the marine realm. The costs and benefits of protected areas were not equitably allocated and finance for these valuable areas was woefully inadequate. As a result, management of many sites was compromised to the point that "many parks exist more on paper than in practice". The historic role of local communities, indigenous and mobile peoples in conserving biodiversity and the value of protected areas to these groups were seldom acknowledged or included in planning and implementation. Change, especially climate change, was compounding existing challenges to the world's protected areas.

The successes and concerns raised in the Durban Accord are certainly still valid. For example, 13 of the 199 natural World Heritage sites are listed as "in danger", including important biodiversity sites such as the Galapagos, Manas National Park in India and five national parks in the Democratic Republic of Congo. Causes include civil conflict and impacts of tourism and invasive species (UNESCO, 2009, figures as of May 2009). The number of World Heritage Sites that are critically threatened is also not fully represented by the In Danger List of UNESCO (Badman *et al.*, 2009).

Discussions at Barcelona explored progress on many of these issues and are included in several chapters throughout this volume. The role of local people and protected areas is included in Chapter 3, climate change and protected areas in Chapter 5, protected areas, conflict and peace parks in Chapter 9, and marine protected areas in Chapter 17. Here, the challenges of representativeness, management effectiveness, and finance, for protected areas are explored further.

A REPRESENTATIVE NETWORK OF PROTECTED AREAS

Even with 11.5% of the land designated as protected areas, significant gaps still remain. Rodrigues *et al.* (2004) pointed out the challenges of using global aggregate targets as a means to establish representative protected area networks

and identified several gaps in the existing network. They reported that of the species considered, at least 12% are not represented in any protected area, and that other taxa with high levels of endemism, such as plants and insects, are even less well represented, given the tendency for sets of species with smaller range sizes to have higher proportions of "gap species".

Tools are needed to help identify gaps in more detail and raise awareness of the issues. One important effort in that regard was the launch of the 2008 World Database of Protected Areas (the 2009 update is now available – www.wdpa.org), a significantly improved online tool which allows users to zoom in, fly over and explore over 100,000 national parks.

Another step in that direction has been the launch of Google Ocean, a joint effort of IUCN, Google, and other partners focusing on the existing marine protected area network (http://earth.google.com/ocean/). Other tools available include the development of guidelines to support identification, prioritization and gap analysis of Key Biodiversity Areas (KBAs), sites of global significance for biodiversity conservation, identified using globally standard criteria and thresholds (Eken *et al.*, 2004). Armed with the knowledge of KBAs, protected area managers can then undertake gap analyses and work towards more comprehensive networks of protected areas to conserve biodiversity (Langhammer *et al.*, 2007).

Each country should prepare its own review of its protected area system, to ensure that all key habitats and natural features are protected under the appropriate management category. Particular attention needs to be given to marine protected areas (MPAs) (Chapter 17). Today's 5,000 MPAs cover over 2.35 million square kilometres, but this is only 1.6% of the total marine area within Exclusive Economic Zones. IUCN's World Commission on Protected Areas (WCPA) and Marine Programme are working with many other partners to protect 10–30% of marine habitats by 2012 (Laffoley, 2008).

EFFECTIVE MANAGEMENT OF PROTECTED AREAS

Management effectiveness issues discussed in Barcelona included available tools and guidelines, engagement of local communities, invasive species, and the need for a landscape-scale approach to protected area management.

Since Durban, WCPA has invested considerable effort in developing tools and guidelines in support of improving management effectiveness of the existing network of protected areas. Hockings *et al.* (2006) produced a framework for evaluating effectiveness. In Barcelona, the IUCN Protected Areas Categories Guidelines (Dudley, 2008) were launched, emphasizing that while the priority objective for all protected areas is protecting nature, protected areas have other, important objectives aimed at enhancing the livelihoods of people.

The needs of people living in and around protected areas need to be given much more careful consideration. Redford and Fearn (2007) examine trade-offs, conflicts, flows of benefits and costs, legal issues, and the numerous other dimensions that need to be addressed as protected area management becomes more democratic. Coad *et al.* (2008), who also reviewed costs and benefits of protected areas to local communities, reported that livelihood impacts of protected areas vary with protected area status, management strategies, and community involvement in governance. Major costs to livelihoods were associated with protected areas with top-down management structures (generally associated with IUCN Management Categories I-II) or in protected areas where management and institutional capacity are lacking and issues

of governance and tenure are not resolved. On the other hand, community management schemes, and protected area management allowing sustainable use of resources (more often associated with IUCN Management Categories V-VI) can provide tangible benefits. Borrini-Feyerabend *et al.* (2004) discuss mechanisms to enhance conservation and equity of local and indigenous communities in protected areas.

The Convention on Biological Diversity (CBD), many governments and conservation organizations are recognizing the rights, skills, and knowledge of local and indigenous peoples, and giving special attention and respect to sacred natural sites. Such cultural dimensions of protected areas deserve greater attention in the coming years and inclusion in the consideration of representativeness for those protected areas. IUCN and UNESCO have developed Sacred Natural Sites Guidelines for Protected Area Managers, which recognize the importance of cultural and spiritual values in nature conservation and provide practical guidance on the management of these values in protected areas (Wild and McLeod, 2008). IUCN Members reinforced the importance of sacred sites in protected areas in Resolution WCC 4.038.

> "In virtually all parts of the world, a major biological threat to protected areas is invasion of non-native species."

In virtually all parts of the world, a major biological threat to protected areas is invasion of non-native species, ranging from goats on Galapagos to water hyacinth in the African Great Lakes. Some protected area managers have even intentionally introduced invasive alien species into their parks, such as trout into some of the mountain protected areas in the United States, in the belief that this would make the streams more attractive to visitors even if some native species were threatened. Much greater effort needs to be given to preventing non-native species from invading protected areas, eradicating them as soon as possible if they invade, and minimizing their impacts if they nonetheless become established (McNeely *et al.*, 2001). In addition, strategies to eradicate invasive species in protected areas should, as much as possible, include risk management for indirect side effects (Bergstrom *et al.*, 2009).

Under any realistic scenario of the future, protected areas by themselves will be insufficient for actually conserving the planet's biodiversity unless the land and waters outside the protected area system are managed in ways that are consistent with the conservation objectives of protected areas. Protected areas can no longer be islands of natural habitats in a sea of incompatible land uses, much less fortresses against local human interests. On the contrary, protected areas need to be seen as parts of regional landscapes, connected by habitat corridors that expand the effective territory of wide-ranging species and contribute ecosystem services to local people and support adaptation to changing conditions. To achieve this, successful conservation will require working at a larger scale, including at landscape and seascape levels, since the challenges facing protected areas are too complex and involve too many different interest groups to be solved at the level of individual sites.

IUCN Members have recognized the need for connectivity in Resolution 4.062, calling for increased attention to connectivity in large-scale conservation initiatives including linking protected areas into the broader landscape.

Examples of such a landscape approach include the Yellowstone to Yukon Corridor, the MesoAmerican Biological Corridor, Europe's Green Belt, and the Terai Arc in India and Nepal. Addressing such issues will be easier if public opinion is strongly supportive of protected areas, and because more people will live in cities, this will require innovative ways of reaching the urbanized population.

In support of management effectiveness, WCPA has now produced some 16 Best Practice Guidelines, including (in addition to those already mentioned) issues such as guidelines for management planning (Thomas and Middleton, 2003) and transboundary protected areas (Sandwith *et al.*, 2001). The full list is available at http://www.iucn.org/about/union/commissions/wcpa/wcpa_puball/wcpa_bpg/. Training is becoming accessible through internet tools such as Protected Areas Learning Network (PALNet) and activities supported by IUCN's Members and partners.

ADEQUATE FINANCE AND CAPACITY FOR PROTECTED AREAS

Although substantial funding is available for protected areas, it has not been enough to keep up with their expansion in recent years (Emerton *et al.*, 2006). Much protected area finance has been short term and focused on capital investment, with very limited support for sustaining protected areas structures and institutions over time. This has left many protected areas under-funded and likely to remain so under current conditions. Bruner *et al.* (2004) estimated that the shortfall in funding for managing existing protected areas in developing countries was approximately US$ 1.3 billion, wryly noting that this amount represents 2% of what Americans spend on soft drinks annually (Jacobsen, 2004). Other estimates of the protected areas funding gap are much higher (e.g. up to US$ 45 billion per year over 30 years to secure and expand both terrestrial and marine protected areas, estimated by Balmford *et al.*, 2002). Whatever the figure, it is clear that achieving sustainable finance will require building capacity within the protected areas community for financial and business planning as well as supportive policy and market conditions.

As already highlighted in the Durban Accord, if protected areas are to survive in the face of increasing demands, they will need significant financial support. This should not always be difficult, in view of the benefits protected areas generate. For example, in 2003, some 266 million people visited the US National Parks and spent an estimated US$ 10 billion during their visits. Tourism around the National Parks generated US$ 4.5 billion in wages, salaries, and benefits, and supported 267,000 jobs. Ensuring that protected areas receive a fair share of the benefits they generate is a challenge that deserves creative thinking, but it is likely to be most successful when based increasingly on the principle of user pays, including increased park entry fees or higher concession fees for tourism operators. In addition, governments may need to embrace the user pays concept more enthusiastically, enabling protected areas to retain more of the income they generate. For example, Serengeti National Park in Tanzania generates entrance fees amounting to about US$ 6 million per year, sufficient to support an appropriate level of management.

Nevertheless, some protected areas are unlikely to be able to generate sufficient income on their own, as they have limited attraction on their own. They will therefore continue to depend on public funding or other innovative ways of being compensated for the ecosystem services they provide to society at large. Protected areas need to see themselves as service providers to society, providing both income-generating (recreation, tourism, ecosystem functions) and non-income generating (biodiversity conservation, education, cultural values) services.

With respect to the cultural services, governments should view investments in protected areas in the same way as investment in education and the arts – a key means to support society and the creativity and values that underpin it.

BEYOND BARCELONA

The coming years will provide important opportunities for protected areas in terms of governance and engaging youth in protected areas work.

In terms of international environmental governance, the structure of international conventions – including the CBD, the World Heritage Convention, the Convention on Wetlands of International Importance (Ramsar), the United Nations Framework Convention on Climate Change (UNFCCC), the United Nations Convention on the Law of the Sea (UNCLOS) – in supporting conservation through protected areas is already proving its value, but clearly much more can be done, including support for governance of protected areas in the open seas, transboundary protected areas, and improved cooperation in information exchange and capacity building (IUCN, 2001). The role of the World Heritage Convention, while a highly successful conservation mechanism covering 8% by area of the global protected areas estate, could be enhanced by more recognition and support for its implementation, especially focused on increased action to tackle the conservation challenges facing the sites listed by UNESCO (IUCN, 2009b).

In 2010, Parties to the CBD will review the agreed programme of work for protected areas agreed in 2004 (CBD, 2004b) and should look to ensure greater synergy across the many instruments relevant to protected areas. CBD Parties will also be adopting a new Strategic Plan and, potentially, a post-2010 framework for biodiversity conservation into which the critical roles of protected areas should be integrated.

As pointed out in a very direct comment from the youth representative at the Vth World Parks Congress, the future of protected areas is in the hands of today's young people. WCPA is working hard to engage young people in protected areas and actions taken include establishing, jointly with the International Ranger Federation, the Young Conservationist Award, given annually to an outstanding young person for his/her work in protected areas/conservation and promoting membership of youth in the Commission through setting a 30% target for those under 35 by 2012.

In conclusion, conservation of biodiversity through protected areas can be a significant contribution to building a just, equitable and sustainable relationship between people and the rest of nature. However, this goal faces several challenges. To continue the strong tradition of protected areas' contributions to conservation, IUCN must continue to support efforts to ensure a fully representative system of protected areas is in place, effective management of those areas and adequate finance to implement that management. In addition, the opportunities provided by protected areas as mechanisms to support poverty reduction (Scherl *et al.*, 2004) and climate change mitigation and adaptation efforts should be promoted and implemented.

7. Species Conservation: Today's Challenges

The first attempts to catalogue life on Earth, begun by Linnaeus and his contemporaries in the mid-18th century, were at the level of species. Since then at least 1.7 million species have been formally described and estimates of undiscovered species on Earth range from 10 million to 100 million. As the best-understood and most widely described building blocks of nature, species are a natural focus for conservation action. The first IUCN Commission was focused on species, namely the Species Survival Service which was established in 1949 only one year after IUCN itself began. Some of the best known conservation programmes have been species based, such as "Project Tiger", launched in 1973 in India as a result of a tiger census reporting plummeting numbers of the big cats.

Since those early days of conservation, approaches to nature conservation have expanded to include landscape-scale and ecosystem services-based approaches. But species-based conservation remains a cornerstone of conservation today, offering a measurable basis that can be easily presented and understood by many audiences. Much of today's conservation theory is based on species; keystone species, flagship species, conservation hotspots and most biodiversity indicators are based on measures of species. At the World Conservation Forum, species were a popular focus for workshop presentations, and species issues are the subject of the greatest number of World Conservation Congress (WCC) Resolutions and Recommendations.

Nevertheless, many challenges remain for species-based conservation, including a still rudimentary understanding of the diversity and status of species in many taxa, especially invertebrates and marine species; an ongoing debate surrounding sustainable use of species; conflict between people and wildlife; and, ironically, the need to control some species (the invasive kind) so that other species can survive.

FILLING THE SPECIES KNOWLEDGE GAPS

Scientists may have only identified about 10% of existing species. Filling the gap between what we know about biodiversity and what we don't is a huge task complicated by numerous factors. Emerging technologies in genomics are making it "easier" to identify species through advanced techniques such as polymerase chain reactions while exponential advances in information management allow more rapid access to reference sources (McNeely, 2002).

Nonetheless, significant challenges remain including coming to agreement on species definitions, building capacities in taxonomy and supporting open access to all species-related knowledge.

Many species-based information initiatives are being developed and implemented at various levels, from the Global Biodiversity Information Facility (an inter-governmental initiative – http://www.gbif.org/) to the All Taxa Biodiversity Inventory (http://www.dlia.org/atbi). Most of these initiatives concentrate on cataloguing existing collections within museums, herbaria and academia. Some, such as IUCN's Species Information Service, are also attempting to identify and evaluate current *in situ* populations. However, the magnitude of the task is huge and a coordinated global effort will be required to build detailed understanding about the status and trends of a representative array of biodiversity at the species level.

Taxonomy, the means by which scientists catalogue species, faces many constraints that challenge our ability to manage species knowledge. Within described species, a significant proportion has been formally described more than once, leading to complicated issues of taxonomic synonymy. For example, one estimate suggests that approximately 13,000 new species are named each year, but the current rate of resolving synonymies reduces this number to around 10,000 distinct species for a synonymy rate of 20% in named species (May, 1999). The controversy about the status of Chinese freshwater turtles as true species or hybrids is a case in point (Dalton, 2003). The named species are not available in a single reference work or index, posing a challenge to those seeking an overview. Finally, taxonomists are becoming an endangered species themselves. There is a desperate need to encourage biology students to pursue taxonomy as a career, beginning with making the discipline more intellectually rewarding and challenging.

Several global initiatives are under way in support of taxonomy. The Global Taxonomy Initiative (http://www.cbd.int/gti/) is operating under a Convention on Biological Diversity (CBD) mandate while Species 2000 is the work of a "federation" of database organizations working closely with users, taxonomists and sponsoring agencies (http://www.species2000.org/). New technology is also assisting taxonomy and field biology more broadly. DNA assessment has doubled the number of known major divisions within Bacteria and Archaea (Boucher and Doolittle, 2002).

Knowledge of the status of species is embodied in the *IUCN Red List of Threatened Species*. The 2008 update of the *IUCN Red List* includes 44,838 species, of which 16,928 (38%) are threatened with extinction (Figure 7.1). Of the 223 species that experienced a genuine change in their Red List status between 2007 and 2008, 183 (82%) became more threatened, and 40 (18%) became less threatened (IUCN, 2008d).

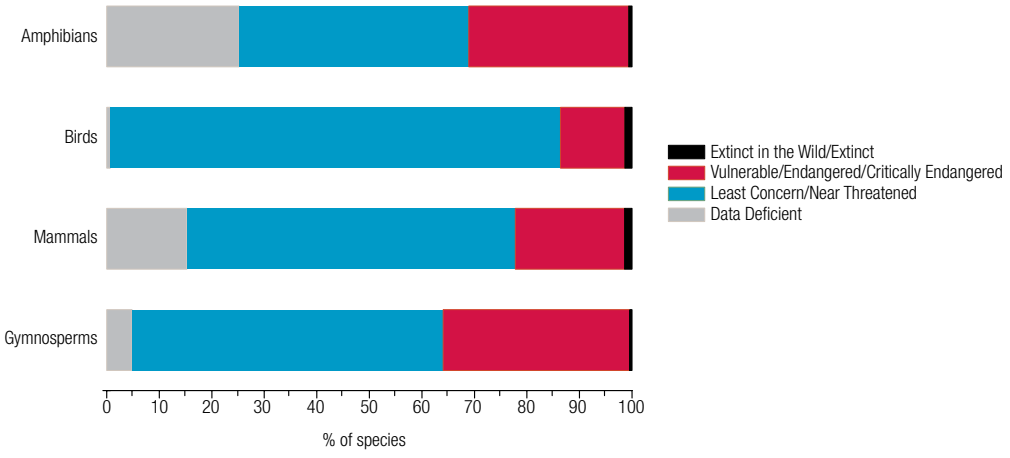


Figure 7.1 Red List assessments for comprehensively assessed taxa (IUCN, 2008d)

Using historical data from Red List compilations, IUCN and partners have developed the Red List Index that, for birds, shows a steady deterioration in threat status from 1988 to 2004. This deterioration is seen in all biomes (Figure 7.2).

SPECIES: TO USE OR NOT TO USE

At its simplest, the concept of "sustainable use" supposes that, with appropriate restraint and efficiency of harvesting, wild species can be used without becoming depleted (Mace and Hudson 1999). However, the term "sustainable use" is also used to describe the approach of actively promoting use as a conservation strategy. The argument is that promoting use, or allowing use to continue, will encourage people to value wild resources. And when wild species and their habitats have value, this encourages their conservation and discourages the conversion of natural habitat to other competitive land uses. The management of game animals such as deer and ducks in North America is often cited in support of the argument for consumptive use as a conservation tactic.

The value of international wildlife trade, an economically measurable form of use, has been increasing, growing from declared import values US$ 158.9 billion in the early 1990s to more than US$ 330 billion in 2005 (Engler, 2008). The vast majority (82%) of this value is in timber and fisheries, but trade is also significant in non-timber forest products (US$ 27.7 billion), ornamental plants (US$ 13.4 billion), medicinal plants (US$ 13 billion), and furs and fur products (US$ 4.9 billion).

In a review of expert opinions on the social and economic drivers of wildlife trade in four Southeast Asian countries, consumer income, the status of laws and regulations, availability/abundance of the species in question and price were all identified as drivers of change in wildlife trade levels (TRAFFIC, 2008). Other factors associated with wildlife trade

include increased communication and connectivity to markets, improved roads and infrastructure and illegal logging on-site. Wildlife trade management will need to plan for these non-conservation based issues if the tide of illegal and/or unsustainable trade of wild resources is to be stemmed.

The IUCN/SSC Sustainable Use Specialist Group has identified a set of considerations necessary to achieve successful sustainable use, based on global collective experience. To increase the likelihood that any use of a wild living resource will be sustainable requires consideration of the following principles (IUCN, 2000b):

- The supply of biological products and ecological services available for use is limited by intrinsic biological characteristics of both species and ecosystems, including productivity, resilience and stability, which themselves are subject to extrinsic environmental change.

> "Effective governance and guidance are needed to underpin sustainable use of resources."

- Institutional structures of management and control require positive incentives and negative sanctions, good governance, and implementation at an appropriate scale. Such structures should include participation of relevant stakeholders and take account of land tenure, access rights, regulatory systems, traditional knowledge, and customary law.
- Wild living species have many cultural, ethical, ecological, and economic values, which can provide incentives for conservation. Where an economic value can be attached to a wild living species, perverse incentives removed, and costs and benefits internalized, favourable conditions can be created for investment in conservation and sustainable use of the resources.
- Levels and fluctuations in demand for wild living resources are affected by a complex array of social, demographic, and economic factors, and are likely to increase in coming years. Thus attention to both demand and supply is necessary to promote sustainable use.

While the concept and principles underlying sustainable use are available, the reality is that many species are being used unsustainably and with impunity. For example, the Food and Agriculture Organization's (FAO) reports on the state of the world's fisheries tell an ongoing tale of overexploitation while the EU's discussions on a common fisheries policy are stymied by competing interests that are resulting in "real catch levels that are 'unknown'" (Economist, 2009). Brashares *et al.* (2004) have also reported that, in West Africa, decreased fish catches because of overexploited fisheries are resulting in increased pressure on other natural resources, specifically bush meat.

Unsustainable use is occurring in other sectors beyond fisheries. The use of meat from wild animals is causing local extinctions (Milner-Gulland *et al.*, 2003) and is of growing concern, especially as food security takes the attention of decision makers. In addition to the direct impacts on species being taken for meat, scientists are reporting broader changes to ecosystems as a result of removal of those species, including changes in plant diversity (Nuñez-Iturri and Howe, 2007).

Effective governance and guidance are needed to underpin sustainable use of resources. For example, ensuring conservation of tropical production forests is the objective of the recently adopted *Guidelines for the Conservation of Biodiversity in Tropical Production Forests*, which should be the framework for

sustainable use of forest products (timber and non-timber forest products including bush meat) outside of protected areas (ITTO Decision 6(XLIV) – www.itto.int/en/decisions).

Nevertheless, some mechanisms that have been put in place to manage use of resources have their limitations, not least of which is political pressure to either set quotas unsustainably high, as in the EU fishery policy noted above. Another example, in the case of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), is the danger that during the transition from one type of regulation of trade to another a marked increase in exploitation can occur (Rivalan *et al*., 2007).

New technologies are evolving, such as rhino horn fingerprinting, or molecular techniques in use for identifying birds, fish, and whale products in markets (Palsbøll *et al*., 2006; Baker *et al*., 2007) although Rubinoff (2006) warns that DNA barcodes provide only some of the information needed for identification and, especially with lesser known species, that this should be taken into account in decisions about their use. Water isotope analysis (Bowen *et al*., 2005) is also a potential means to manage trade in wildlife parts. Stable isotopes of precipitated water and snow vary widely and systematically on a geographic basis and their presence in animal tissue as a result of dietary ingestion means they are potentially tracers of geographic origin. However, calibration against samples of known origin is required.

Sustainable use of at least some natural resources is an integral part of any sustainable development programme yet remains a highly controversial subject within the conservation community (Hutton and Leader-Williams, 2003). Attention to all factors, beyond the biological and ecological characteristics of the resource involved, is a key to success as is increased collaboration in identifying those approaches most likely to be successful in reducing illegal and/or unsustainable use (TRAFFIC, 2008).

In particular, care in establishing positive incentives for conservation and sustainable use is critical. Fully resolving the controversies around use of particular species will continue to be a challenge as some groups may never accept any use of that species.

HUMAN-WILDLIFE CONFLICT

Large predators, such as big cats, bears, crocodiles and wolves, along with other species such as elephants, present a real threat to human life and livelihoods through destruction of assets such as crops and livestock. For example, a review of livestock losses by farmers living in Bhutan's Jigme Singye Wangchuk National Park reported per household losses of up to two-thirds of annual cash income (Wang and McDonald, 2006). Factors affecting predation rates included lax herding, inadequate guarding practices, overgrazing, lack of proper stables for corralling livestock at night and the distance between the household and the grazing pasture.

These conflicts are not new, with historical records back to the 1700s documenting man-eating wolves in Europe and man-eating tigers in Asia. But as truly wild spaces shrink and human populations expand, the probability of confrontation and conflict increases. In addition to direct causes of conflict, indirect impacts include loss of income due to time spent coping with these problem species.

Responses can be divided into protection, mitigation (compensation and incentive schemes) and prevention (through changing management practices or relocation) and successful approaches combine short-term biological approaches with long-term social approaches (Distefano, 2005; Thouless, 2008). First it is necessary to reduce conflict, then increase tolerance and finally implement profit-sharing and land-use planning to prevent future conflicts from occurring. Key steps include:

- Attention to land-use planning. Fragmentation of habitat and conflict are often directly related. In some cases buffer zones can be effective, and be created through land swaps.

- Community empowerment. A sense of ownership of wildlife often results in wildlife management by local people.
- Creating economic incentives to enhance tolerance.

Where conflict occurs across whole landscapes it is difficult to solve problems on a case-by-case basis and it is important to develop a framework for response involving the collaboration of all stakeholders. Although standardized methods for measuring conflict have been developed for elephants, there is an urgent need to do the same for other species, providing reliable ways to compare the intensity of conflict between sites for prioritization of response.

INVASIVE SPECIES

Invasive alien species pose an important threat to biodiversity and ecosystem services; they are considered one of the five major threats to ecosystem integrity by the Millennium Ecosystem Assessment (MA) (2005). Invasive species can cause biodiversity loss, changes in water chemistry, altered biogeochemical processes, hydrological modifications, and altered food webs (Dukes and Mooney, 2004; Ehrenfeld, 2003) as well as changes in availability of light, air, food, shelter and breeding sites. For birds, Butchart *et al.* (2008) note that invasives threaten birds in several ways, including predation on adults, reproductive stress through predation on eggs or chicks, and habitat degradation (particularly by invasive herbivores or plants). One-third of threatened bird species are threatened by invasive species, largely through predation by carnivores and rodents.

Baillie *et al.* (2004) reported that invasives are a major threat to 11% of threatened amphibian species and 8% of threatened mammals for which data are available. They also reported that island species were particularly susceptible, noting that 67% of oceanic islands' threatened birds are affected by invasives, compared to 8% of continental birds. Darwall *et al.* (2008) report that 85% of threatened fish in southern Africa, 55% of threatened freshwater fish in Europe, and just under 45% of threatened freshwater fish in Madagascar are affected by invasive species, the latter largely as a result of the implementation of a plan to re-establish local fisheries by introducing 24 non-native fish species (Benstead *et al.*, 2003).

Characteristics that define invasive potential include both factors intrinsic to the invading species as well as to the habitat to be invaded. Howard and Ziller (2008) list factors such as

- rapid growth rate;
- ability to grow well in dry or otherwise adverse conditions (broad environmental tolerance);
- production of many and well-protected fruits and seeds (high yielding species);
- production of fruit and seeds (or other propagules) early in growth and development phases;
- ability to disperse widely through wind or water or by animals that feed on them or carry their propagules; and
- effective competition with other plants.

SSC's Invasive Species Specialist Group (ISSG) provides a network of expertise on invasive species and a database on many of the most threatening invasives (www.issg.org). The Global Invasive Species Programme (GISP – www.gisp.org) is an international partnership (which includes IUCN) working to address the threat of invasive species through increasing knowledge and awareness of the issues and developing tools and methods needed to prevent and control invasions.

Predicting potential invasiveness of any individual species can be a challenging process because invasions, like human entrepreneurs, can

be confounded by issues of timing and change (Baskin, 2002). Although biological invasions are complex ecological, evolutionary and socio-economic problems, a better understanding is being achieved, especially in ecology both of invasiveness and habitat vulnerability to invasion. This knowledge is essential to determine how much effort needs to be invested in controlling an invasive species that has already become established or to clarify the trade-offs managers and land planners will have to consider.

Eradication and control of invasive species have used many different strategies and tactics (Wittenburg and Cock, 2001; Veitch and Clout, 2002). Chemical control of invasive plant species, sometimes combined with mechanical removal like cutting or pruning, has been useful for controlling at least some invasive plants, but has not proven particularly successful in eradication. Biological control of invasive species has also been attempted. The rationale behind this approach is to take advantage of ecological relationships like competition, predation, parasitism and herbivory, between an invader and another non-native organism introduced as a controlling agent (the control agent is often from the same original natural habitat as the invading species). Results are mixed. For example, the prickly pear moth (*Cactoblastis cactorum*), used to fight invading *Opuntia* species in Australia, has recently invaded the United States posing a serious threat to native *Opuntia* species (Stiling, 2002).

Successful eradication cases have three key factors in common: particular biological features of the species (for example, poor dispersal ability); sufficient economic resources devoted for a long time; and widespread support from the relevant agencies and the public (Mack *et al.*, 2000). When complete eradication is not possible, or is not desired, as in the case of native species invading through range expansion, some measures of "maintenance control" aimed at maintaining populations of the invading species at low acceptable levels may be attempted. However, the chemical and mechanical controls used pose many problems, including the high cost and low public acceptance of some practices (Mack *et al.*, 2000).

THE FUTURE OF SPECIES CONSERVATION

Paradigms of ecosystem services, pro-poor conservation and rights-based approaches to conservation are taking centre stage but these approaches all call for continued attention to the fundamental role that species play in underpinning those paradigms. In the brave new world of conservation, species approaches remain core business. We must continue to pursue all of the tools in the species conservation toolbox, from development and implementation of species action plans to re-introduction, *ex situ* management and more.

In the coming decade, no species should knowingly be allowed to become extinct. The conservation community should continue to contribute to monitoring and assessment of status and threat trends in species, including support for indicator development and reporting. Working towards a better understanding of the parameters defining "sustainable use" of species and encouraging managers of those species to make use of that knowledge will be vital. Similarly, the conservation world should promote all possible efforts to manage and control invasive species.

8. A Post-Petroleum Future: What Does it Mean for Conservation?

Energy use puts humans at a substantial advantage over all other species. From the time our ancestors first were able to convert carbon to energy through the use of fire, energy use has been a critically important part of our relations with the rest of the environment. Fire kept us warm in winter, enabled us to cook food, helped to clear undergrowth to facilitate hunting, and enabled us to become more active at night. Subsequent harnessing of water to run mills, wind to propel sail boats and turn wind mills for water pumps and grinding of grain, and so forth, helped to convert other forms of energy to enable humans to expand our ecological niche, as well as our population. Coal powered the industrial revolution, and remains the dominant source of energy in many countries (the United States, China and India, to mention just a few). The widespread use of oil in the 20th century led to numerous new applications of energy, including great mobility through automobiles and airplanes.

When oil prices reached US$ 147 per barrel in the summer of 2008, many conservationists were torn between jubilation and despair. On the jubilation side, this oil price spike clearly indicated how dependent our modern societies have become on petroleum, and emphasized the need to start thinking seriously about an alternative energy future. Many thought that this spike was a symptom of "peak oil", the time at which half of the available petroleum has been produced, meaning that oil supplies will decline from that point (Deffeyes, 2005). If demand for oil remains high, oil prices should remain high, hopefully driving investment in alternative energy sources which are far less damaging to the climate. In the event, oil demand fell, but the price spike served as a warning that alternatives need to be sought.

The concern over oil prices should be considered in the context of projections of energy demand. The World Energy Outlook 2008 predicts a 50% growth in demand for energy by 2030 with 70% of that increased demand to come from developing countries, 30% from China alone (OECD/IEA, 2008). While fossil fuels are expected to form the majority of the energy mix for the next few decades, now that oil is showing signs of depletion, it is timely to consider other energy options. These considerations are driven by concerns over climate change, energy security, and equitable distribution of benefits from energy.

All of the available energy choices have the potential for impacts on biodiversity. For example, fossil fuels are most associated with contributing to climate change and air pollution, with consequent impacts on nature. However, we should also consider the direct impact of oil spills on aquatic and marine ecosystems and the indirect impacts through the development of oil fields and their associated infrastructure and human activities in remote areas (such as Alaska's Arctic Wildlife Refuge) that are valuable for conserving biodiversity.

OPTIONS FOR A POST-PETROLEUM FUTURE

Energy efficiency

By far the quickest, cheapest and only option that does not have negative impacts on the environment is energy conservation – using less energy, both through simply reducing consumption and by making production processes more efficient. Japan, for example, uses only about 10% as much energy per unit of economic output as China. High oil prices clearly demonstrated that conservation is very feasible, covering everything from using public transport to using more energy-efficient appliances to providing better insulation for buildings. Individuals can also make significant energy savings. Energy efficiency and conservation should remain the first response to dealing with a post-petroleum future, with multiple benefits for everything from carbon emissions to energy security and biodiversity.

Alternative energy sources

Nuclear

Though nuclear power fell out of favour during the latter part of the last century, nuclear is back on the table now with high oil prices and climate change. Proponents argue that nuclear is very clean in terms of its impact on climate, has proven its effectiveness in the countries that use substantial amounts of nuclear energy (such as France and Switzerland), and could be greatly improved by drawing on new technologies. However, "clean" does not necessarily mean "green". Opponents raise the eternal concerns of waste disposal and risk of proliferation and consequences for global security, high capital costs, inherent dangers of a melt-down, high requirements for water for cooling, and the inescapable reality that the main feedstock, uranium, is a non-renewable resource (with associated mining impacts) and is in scarce supply. New advanced types of reactors such as breeder and pebble reactors may be a partial response to the latter concern, but have not yet proven their technical viability and any commercial use is far in the future. Furthermore, the true cost of nuclear energy is very difficult to determine because development costs are seldom considered, nor are the costs of decommissioning reactors and disposing of nuclear waste. In addition, nuclear power seems to require high levels of government support. For example, nuclear power in the United States is eligible for up to 32 different types of subsidies and is one of the most inefficient ways of abating greenhouse gas (GHG) emissions (Earthtrack, 2008).

Biomass

Biomass is an ancient energy form. Currently, more than 2.5 billion people worldwide depend on traditional forms of biomass such as wood, charcoal and animal dung for lighting, heating and cooking (OECD/IEA 2008), which can represent more than 90% of primary household energy demand in many developing countries. The use of traditional biomass for energy *per se* is not necessarily unsustainable; but the rate and method of use can cause environmental and health issues. The initial euphoria over industrial-scale biofuel production is being tempered by the realization that land used for producing biofuels may be diverted from other important uses,

including food production. Biofuel crops are typically grown as monocultures, a strategy that is inherently risky, as pests and diseases are far more likely to spread quickly in monocultures than in polycultures. IUCN and the Global Invasive Species Programme have cautioned about the risks of invasives in biofuel plantations. Further, the perceived climate benefits from biofuels are proving ephemeral and many may actually do more harm than good, depending on how and where the feedstock is grown (Howarth and Bringenzu, 2009).

The biodiversity impacts of biofuels can be significant. Interestingly, many characteristics of biofuel crops are shared by invasive species, such as fast growth, high productivity, adaptability to a range of soil and climatic conditions and resistance to pests and diseases. Nipa palm, for example, has invaded and colonized over 200 square kilometres of the Atlantic coast of Nigeria and can produce far greater biofuel per hectare than sugar cane, according to some experts. All introduced crops for biofuel production should therefore be treated as potentially invasive until proven otherwise. While simply harvesting existing problem invasive species such as water hyacinth, Lantana camara and nipa palm may present an interesting option for biofuel feedstocks, however it will not control them and may pose a perverse risk that markets are created for such invasive species, encouraging their spread and further damage to biodiversity.

> “By far the quickest, cheapest and only option that does not have negative impacts on the environment is energy conservation.”

In Resolution 4.082, IUCN called on governments who choose to develop large-scale or industrial bioenergy to implement and enforce criteria for the ecologically sustainable, socially appropriate and economically viable production and use of biomass, that:

a. Cause no net loss of biodiversity;

b. Cause no emissions from deforestation and forest degradation and degradation of other natural ecosystems;

c. Do not adversely affect food security;

d. Ensure that biomass energy reduces net emissions of greenhouse gases as compared to alternatives;

e. Provide benefits to feedstock producers, particularly vulnerable groups such as the rural poor, women and indigenous peoples;

f. Require production methods that use water efficiently and sustainably, favour the planting of native species, and avoid the planting of potentially invasive species; and

g. Discourage trade in unsustainably produced bioenergy, using non-protectionist measures.

The Roundtable on Sustainable Biofuels has developed 12 principles that frame guidance for more sustainable development of biofuels in the future (RSB, 2008), and the International Risk Governance Council (IRGC) has provided guidelines on how to govern the risks posed by biofuels (IRGC, 2008a).

Hydropower

Hydropower provides 2% of the world’s primary energy demand and is the dominant source of renewably produced electricity (World Energy Outlook, 2008). Most hydropower potential has been fully exploited in developed countries, with the remaining water systems often being protected. However, large growth is expected in developing countries. Some countries, such as Nepal, Lao PDR and Congo, have the potential to be the “batteries” of their respective regions,

due to steep mountains and vast water systems. However, many hydro dams are fiercely contested due to their restriction of water flows in river basins and the knock-on impacts for livelihoods such as fisheries, as well as the displacement of biodiversity and communities for the creation of reservoirs.

To find a way to balance the environmental and social risks with the creation of renewable energy, IUCN is engaging with the Hydropower Sustainability Assessment Forum, which aims to establish a broadly endorsed sustainability assessment tool to measure and guide performance in the hydropower sector, drawing from the World Commission on Dams (which IUCN helped establish). IUCN gives particular focus to encouraging the hydropower sector to sustainably manage upstream watersheds and to implement environmental flows that maintain downstream ecosystems and the services they provide to people.

IUCN works on projects throughout the world that demonstrate the importance of maintaining flows in all river systems including those with dams. For example, in the Huong Basin in Vietnam, a flow assessment made clear how changes in the river flow affected both economic returns and ecosystem health. Basin authorities were able to determine which options accommodated economic goals while protecting downstream ecosystems and their services. The application of environmental flows enables integrated decision-making about use of water within the limits of availability to meet priorities for economic growth, sustainable livelihoods and conservation, thereby increasing the sustainability of water infrastructure including hydropower.

Wind

According to the Global Wind Energy Council, the total installed wind power capacity for 2009 stood at almost 120,798 megawatts (MW) worldwide. Capacity has been growing at 25% annually for the past few years. The United States recently overtook Germany with the highest total installed capacity at 25,170 MW, equivalent to a fifth of world capacity. Germany has 23,903 MW, and Spain has 16,754 MW. China is also rapidly expanding its wind capacity with 12,210 MW, overtaking India with 9,045 MW. A critical factor in the successful development of wind energy is appropriate government support, often involving feed-in tariffs, subsidies or tax breaks to promote cleaner forms of energy.

Both birds and bats are victims of wind farms, usually through collision with turbine blades. Among birds, nocturnal migrating passerines were reported to be most susceptible and among bats, migrating tree-roosting species were more susceptible (NRC, 2007). Reasons for high mortality in bats range from tree-roosting species being attracted to the tall pylons of wind farms to potential increases in insect availability because of land-use changes associated with construction of wind farms to attractions to the sounds created by the turbines and collapsing of their lungs due to abrupt changes in air pressure (Kunz *et al.*, 2007b). To manage the potential impacts of wind farms on nocturnal birds and bats, Kunz *et al.* (2007a) have published guidelines to guide construction and operation of such sites.

On the positive side, the land associated with on-shore wind farm areas can continue to be used for farming or as a biodiversity reserve, depending on the wishes of the affected communities. Similarly, advocates of off-shore wind farms suggest that they will benefit fisheries by providing a "protected area" for fish breeding. However, some initial studies have indicated that the vibrations generated by wind turbines can disturb at least some species of fish and marine mammals. Therefore, the assumption that marine wind farms will benefit fisheries remains to be demonstrated in practice.

Solar

Though currently only meeting 0.1% of energy consumption worldwide, the potential for photovoltaic solar power is very large, especially in countries with lots of sunshine. The solar power sector is the fastest growing for power generation, ranging from new advances in small photovoltaics incorporated into buildings up to large-scale solar-concentrating thermal towers. While land use and access of local communities to large-scale solar developments is a current cause for concern, the main barrier to wider introduction of solar power is the high investment costs. Furthermore, the semi-conducting materials used to make new generation solar cells require mined minerals such as gallium and indium; both are extremely rare, and this suggests that for most efficient use, solar developments should be concentrated in countries with the most abundant sunshine. Elevated solar installations may nurture the growth of grass and herbs under their shelter, thereby providing habitat for at least some species.

> “Energy efficiency and conservation should remain the first response to dealing with a post-petroleum future.”

Geothermal

While Iceland is the leader in geothermal energy, providing 26% of total electricity demand, many countries have geothermal potential. New Zealand, Indonesia, Japan and Russia have notable potential. The Massachusetts Institute of Technology (MIT) (2007) reported that with a reasonable investment in research and development, geothermal energy could provide the United States with 100 gigawatts (GW) of power in the next 50 years. Interestingly from a development perspective, the Rift Valley in East Africa has a potential for 14,000 MW through geothermal yet only 200 MW is currently captured with Kenya leading in the region, currently providing 14% of its electricity (Economist, 2008). Environmental impacts are negligible.

Wave and tidal

The ocean has tremendous amounts of energy through the power in its waves and tides. Numerous ways of capturing this energy are being considered. The United Kingdom is the leading investor, with a strong policy to encourage ocean energy. For example, the 10-mile wide tidal barrage being proposed for the Severn estuary in south-west England would harness the second largest tide differential in the world to generate 5% of the United Kingdom’s electricity requirements, equivalent to eight typical coal-fired power stations. But it will also affect local wetlands and bird reserves. This example demonstrates that coastal ecosystems already have many and sometimes conflicting demands and, as a consequence, are some of the most degraded ecosystems.

ENERGY AND SUSTAINABLE DEVELOPMENT

Societies need energy in order to survive and prosper. Yet access to affordable and sustainable energy still eludes many parts of the world. Elsayed (2009) reports that for more than 30 countries, most of which are in sub-Saharan Africa, less than half the population has access to electricity (Figure 8.1). A map of countries relying on solid fuels (traditional fuels such as wood, dung, agricultural residues and coal) is almost the mirror image of Figure 8.1 with heavy dependence in sub-Saharan Africa and developing Asia (Elsayed, 2009).

of health hazards from cooking over poorly-ventilated indoor fires, including respiratory infections, cancers and eye diseases. Smoke from poorly ventilated indoor fires accounts for almost two million premature deaths per year. Replacing low quality fuels such as traditional biomass with more efficient fuels such as kerosene, natural gas, modern biofuels or electricity can do a lot reduce the health impacts from smoke and physical exertion that disproportionally affect women and girls (UNDP, 2004).

Energy options, therefore, need to be considered against the background of environmental and

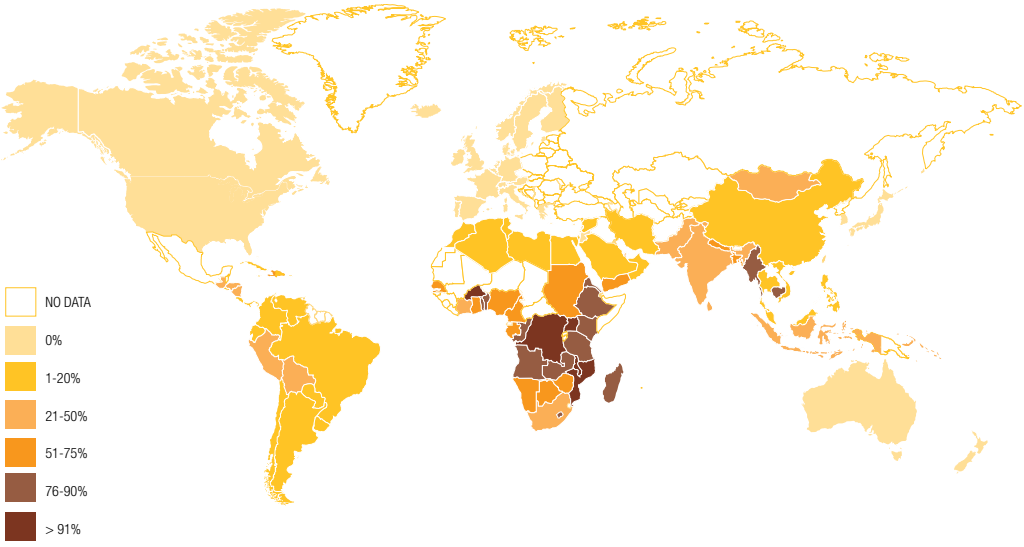


Figure 8.1 Percentage of population without access to electricity (Earthtrends 2009 (www.earthtrends.org) using data from Human Development Report 2007/2008)

Use of traditional forms of energy poses a particular threat to women and children. Traditional responsibilities for collecting fuel and water mean time and physical effort expended by women and girls in gathering fuel and carrying water rather than going to school or generating income. Many women and girls also suffer from health problems related to gathering and using biomass fuels. Women are exposed to a variety

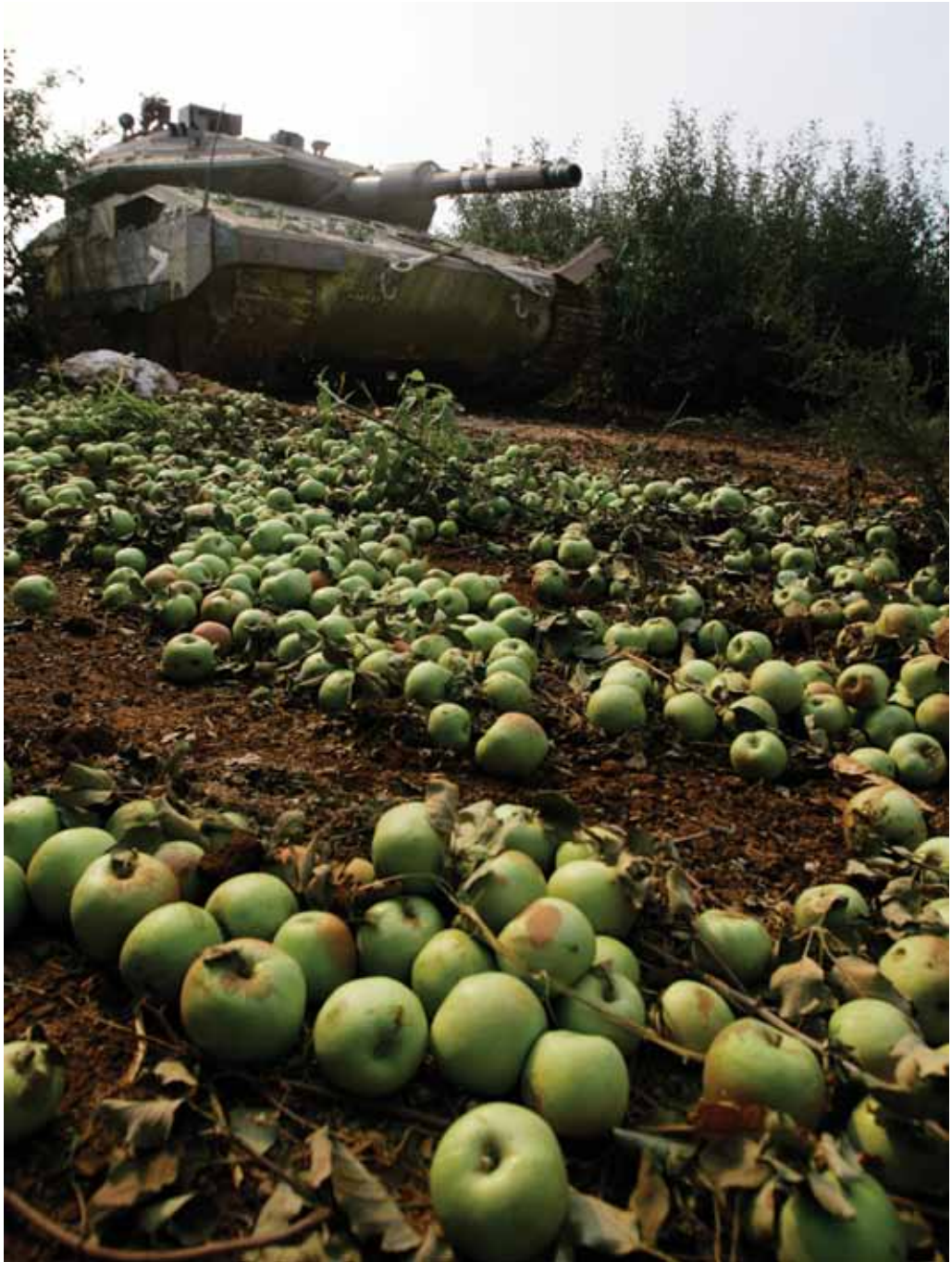
associated livelihood costs and benefits when setting the design criteria for new energy forms. Many options are being considered for a post-petroleum future, some more sustainable than others. Though all sources of energy have impacts on the environment it is important assess the full costs and benefits to promote the most equitable, efficient and sustainable options. However, only energy sources that depend on the sustainable

harnessing of environmental resources have the potential to be truly renewable, and efforts should be focused on enhancing the role that the environment can play, while recognizing the limits.

IUCN has called for all stakeholders and donors to provide the support necessary to enable development and implementation of ecologically sustainable, socially equitable and economically efficient energy systems in support of sustainable development (IUCN Resolution WCC 4.081).

Given the challenges faced by increasing energy demand at the same time as we are experiencing increasing climate change impacts we need to work urgently towards a transition in our energy future. First and foremost, we should promote energy conservation as part of any conservation plan and any new approach to energy. Each of us should take steps to conserve energy – avoiding unnecessary travel, turning off lights, air-conditioning, computers and other electrical items when not in use, etc. But, in addition to energy efficiency we will need to explore other options. We will need to invest in more comprehensive strategic environmental and social assessments of various energy options, including accurate cost/benefit analyses. As we are doing for biofuels and wind farms, we should promote development and implementation of guidelines for all energy options with respect to their environmental impact. Sustainable development will depend on it.

9. Conservation and Armed Conflict



Warfare – armed conflict between competing entities – has significant impacts on both the human societies involved and biodiversity more generally. While human suffering is quite properly of greatest concern, the ecological aspects of warfare and post-conflict reconstruction are also worthy of greater attention. IUCN is active in many conflict zones, gaining considerable experience in addressing conservation issues under difficult conditions in countries like Nepal, Pakistan, Somalia, Sudan, Sri Lanka, and the Democratic Republic of Congo.

Armed conflict today is particularly prevalent in areas important for biodiversity. Over 80% of the major armed conflicts in the second half of the 20th century happened in the biodiversity hotspots, areas that contain the entire populations of more than half of all species of plants and more than 42% of all vertebrates. Two-thirds of the world's 34 hotspots experienced warfare during that time (Hanson *et al.*, 2009). Hotspots are also characterized as being under particular threat because poverty in the poor countries where hotspots are mostly found puts great pressure on the resources found in natural environment. War in the hotspots makes conservation even more challenging, as refugees from the fighting often turn to the forests for food and building materials, putting additional pressure on biodiversity.

Wars in important habitats for wildlife have affected numerous countries since 1990. A partial list includes Angola, Bosnia, the Democratic Republic of Congo, Cambodia, Central African Republic, Colombia, Guatemala, India, Indonesia, Liberia, Mexico, Myanmar, Nepal, Pakistan, Peru, the Philippines, Sierra Leone, Senegal, Sri Lanka, the Solomon Islands, and Sudan – quite a depressing catalogue. These typically civil conflicts are often in areas distant from government control where few public services are available to the hundreds of millions of people who live in these remote areas.

CONFLICT AND BIODIVERSITY

Natural resources may be a significant factor in conflicts, especially civil conflict. An analysis of 47 civil wars found that the factor that best predicted civil war was the level of dependence on the export of commodities like timber, minerals or oil, what might be called "lootable" resources (Collier, 2003). These can provide sufficient finance to support an armed movement that will enable the victors to continue harvesting such resources. The conflict often is also related to political and ethnic factions that may already be in conflict over other issues, but the main motivation in at least some cases is the desire

Box 9.1 Case studies of civil conflict and wildlife

India's Naxalites and tigers

India is facing increasing insurgency problems, especially as disaffected tribes have turned against the government and have been supporting groups such as the Maoist guerrillas known as Naxalites. The Naxalites are a threat to the recovery of tigers in India, as they control vast areas of remote forest in central and eastern India – areas that serve as prime tiger habitat. While they may not be intentionally targeting tigers, they are preventing conservation activities in the regions they control, which may be as much as 30% of India's tiger range. And even if the tiger is not a target, excessive harvesting of tiger prey such as deer and wild pigs, is forcing tigers to prey on domestic animals (or even people) and come into conflict with rural communities.

Philippine rebels promoting conservation

In the Philippines, rebels in Mindanao have threatened to harm loggers unless the government puts a stop to the logging activities that threaten to denude forest cover on the island. In February 2005, a spokesman for the National Democratic Front claimed that the rebels were doing their part in protecting the environment by launching reforestation and education campaigns among the rural people to support the sustainable use of forest products and to minimize the damaging effects of shifting cultivation. They continue to contend that these activities are helping to maintain the wildlife habitat for the numerous endemic birds and mammals of Mindanao, and demonstrate that conservation is a people's issue, not just a government responsibility.

to gain the financial benefits of exploiting the resources. As just one example, the timber sold from rebel-held areas of Liberia enabled insurgents to purchase weapons and continue to earn income, perhaps discouraging them from seeking peace because of the benefits they earned by prolonging the fighting.

The impacts of conflict on biodiversity include changing distributions of both people and wild species, potential changes to patterns of exploitation and exacerbation of other concerns including poverty (Box 9.1).

Patterns of warfare have long influenced the distribution of species and ecosystems, and of biodiversity more generally. Some large mammals are especially vulnerable during times of conflict. For example, the white rhinoceros was exterminated from Sudan during its civil war (1955–1972), and the 1978–1980 war between Uganda and Tanzania virtually eradicated the black rhinoceros from those countries.

The civil war that began in the Democratic Republic of Congo in 1996 is tragic for its human costs, which include more than 3.8 million deaths and forcing settled farmers off their land to become roaming poachers or refugees, often settled around or inside national parks. Despite the 2003 Peace Agreement, Virunga National Park is still occupied by armed men who freely poach game for food and for sale. Under such conditions, the Democratic Republic of Congo's bush meat trade is closely linked to the wider informal community. Merode and Cowlishaw (2006) collected information on the sale of protected and unprotected species in urban and rural markets, and the bush meat commodity chains that supplied these markets, under conditions of political instability and armed conflict. During peacetime, meat from protected species from the Garamba National Park (mostly elephants and buffalo) rarely appeared in the rural markets, but they comprised more than half of all bush meat sales in the urban markets.

This pattern reflected differences in the rural and urban commodity chains. Automatic weapons were required to hunt large protected species and were supplied to hunters by the military officers who controlled the urban trade. The use of such weapons was discouraged by the traditional chiefs, who administered the village markets. During wartime, the sales of protected species in the urban markets increased fivefold because the military officers fled the scene, leaving behind an open-access system that led to a massive increase in the exploitation of protected species. In contrast, the rural markets remained relatively stable because of the continued authority of the village chiefs. These findings suggest that, even during times of violent conflict, traditional authorities can play an important role in conservation of biodiversity.

> Patterns of warfare have long influenced the distribution of species and ecosystems, and of biodiversity more generally.

The continuing series of wars in central Africa is having a profound negative impact on both people and wildlife species such as hippos. In Lake Edward, on the border between Uganda and the Democratic Republic of the Congo, for example, the hippo population has declined from 9,600 in the 1970s to about 680 in 2005, due to poaching from insurgent militiamen seeking meat. The ecological impact of this decline is profound, as the healthy population of hippos deposited nearly 100 million kilograms per year of nutrients into the lake through their droppings, which fed microscopic phytoplankton, which in turn fed water-borne worms and larvae, which then fed the lake's tilapia fish which were harvested by the several thousand fishermen who lived inside the Virunga National Park. The stress of declining fish is made worse by increasing demand for the tilapia, leading to rapidly increasing numbers of people using finer mesh nets. This means that younger and younger fish are being taken, and recruitment is falling fast, forcing people to turn to wildlife as a source of protein. While this is disastrous for the fishermen and the wildlife, it may not be so bad for Lake Edward, as the tilapia is a non-native species and its depletion may allow endemic native species of fish – many of which remain undocumented – to recover. The more serious problem faces the wildlife of Virunga National Park, which borders on Lake Edward and is threatened by both active conflict and the side effects of the settlement of refugees from the fighting.

One response of wildlife may be to move into less hazardous habitats. History suggests that in many parts of the world, buffer zones between ethnic groups that have been in conflict may be particularly rich in biodiversity, at least partly because these areas are subject to less hunting pressure out of fear of conflict with other ethnic groups. For example, a survey in southern Sudan carried out by the Wildlife Conservation Society in 2007 found what is possibly the largest remaining mammal migration in the world with over 1.3 million white-eared kob thriving in the region surrounding the Sudd, the largest freshwater wetland in Africa. The survey also identified an estimated 8,000 elephants, 13,000 reebok, 8,900 buffalo, and nearly 4,000 Nile lechwe (a species found only in that region) in the region. The Sudd has remained underdeveloped because of Sudan's civil war but many development interests have cast covetous eyes on the area, recognizing it as a potential breadbasket for West Asia, as well as China and West Africa.

POST-CONFLICT AND BIODIVERSITY

Post-conflict peace can actually be more of a problem for conservation than the conflict itself. When the combatants cease fighting, areas that once were off limits due to the conflict become prime sites for development, leading to deforestation, poaching of wildlife, and other forms of degradation. While some protected areas have been established, biodiversity may well be suffering more now than during the war (for example, in Angola and Mozambique). In addition, the weapons made available during the conflict are widespread and, judging from historical experience, peace will encourage at least some former combatants to become poachers who are anxious to convert wildlife into meat as a means of survival in times of great uncertainty.

Even more surprising, once war ends, field biologists may make new discoveries. For example when scientists returned to Vietnam's forests following the Indochina conflict, an amazing series of new species was discovered by field biologists from IUCN Member organizations such as the Wildlife Conservation Society. These discoveries included the Giant Muntjac, by far the largest of the barking deer; the Saola, a forest antelope so distinctive that it was assigned to a new genus; a new genus and species of forest goat known locally as *Linh duong*; evidence of at least two additional new species of deer; and a pig that was last seen 100 years earlier. IUCN activities in Lao PDR, Vietnam, and Cambodia are contributing to post-conflict conservation.

PREVENTING CONFLICT AND MITIGATING ITS IMPACT ON BIODIVERSITY

National security is an issue that will not go away and threats to governments are real, though they may take unexpected forms. One response aiming to pre-empt armed conflict is the establishment of international peace parks and transboundary protected areas with consequent needs for more cooperation with neighbouring countries. For example, Southern Africa has at least four transfrontier protected areas: the Kgalagadi between Botswana and South Africa; the Maloti-Drakensberg, between Lesotho and South Africa; the Great Limpopo, shared by Mozambique, South Africa and Zimbabwe; and the Nyika between Malawi and Zambia. Such areas will pose new challenges and opportunities.

Better understanding of the causes and consequences of conflict and the ecology of war can enable conservation organizations to continue functioning even during times of armed conflict, such as in the recent civil strife in Nepal. For example, some of the protected areas, such as the magnificent Kangchenjunga Conservation Area, were handed over to local communities for management, and local hunting of wild animals for meat was substantially reduced in at least some of the protected areas. Many IUCN projects in Nepal were able to continue during the strife, enabling them to flourish once peace had returned.

Many conflicts take place along border regions that often are remote from the central government. Such areas often are also rich in wildlife. The possibility of developing transboundary protected areas as a means of promoting peace has become increasingly popular. Peace parks are nothing new, serving as a sort of buffer zone between governments that are otherwise in conflict. The Global Transboundary Protected Areas Network has identified 227 transfrontier protected area complexes, involving nearly 3,043 individual protected areas or designated sites covering 4.6 million square kilometres (GTPAN, 2009). Such so-called "peace parks" can establish routine international cooperation, foster regional identities and interests, reduce the likelihood of conflict, expand the area of natural habitats for wildlife,

and provide a sense of hope that conservation can help bring peace to both people and nature.

Armies remain a dominant political, social, and economic force in most countries. Modern armies increasingly are recognizing that political, economic, and ecological viability are closely inter-related, and are contributing to conservation in many countries. They control large areas of land as training facilities or military reservations and often patrol remote border areas that are important for biodiversity. One might even argue that many threats to national security have their roots in inappropriate management of natural resources (Klare, 2001), so the military could legitimately be expected to support improved resource conservation. Several IUCN Members are working with the military toward this end.

Governments certainly are well aware of the hazards that conflicts pose to biodiversity. The Convention on Biological Diversity (CBD), in its Article 3, supports the Charter of the United Nations in recognizing the responsibility of States "to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction". This establishes a clear international legal basis for avoiding environmental damage in violent conflicts between governments. The Convention also stresses the value of peace for biodiversity, concluding that, "ultimately, the conservation and sustainable use of biological diversity will strengthen friendly relations among States and contribute to peace for humankind".

But some significant gaps remain in existing international law governing and protecting the environment during armed conflict, both normatively and administratively (not least of which is the issue of how to operationalize normative requirements); new measures are

necessary to address these gaps. Systems for liability and compensation for transgressions against the environment and natural resources during armed conflict could include a special international tribunal to investigate claims for environmental damages and case studies on the environmental impact of armed conflict.

So what are the implications of all of this for conservation organizations, including IUCN and its Members? If engaged in conservation in a conflict zone, conservationists should do everything possible to maintain a presence in these zones. This may involve working through local non-governmental organizations (NGOs) and avoiding being seen as a tool of the government, but rather as supporters of the legitimate interests of the people who are living in the conflict zone. IUCN experience in Central America, Nepal, India, and parts of Africa shows that insurgent groups will often permit non-governmental organizations to carry out conservation activities that benefit rural communities. In addition, the conservation community should continue to support local conservation agencies to the maximum extent possible. This may involve stepping in after government support has been withdrawn, and helping the local field staff to maintain good relations with the local people whose resource management is fundamental to conservation.

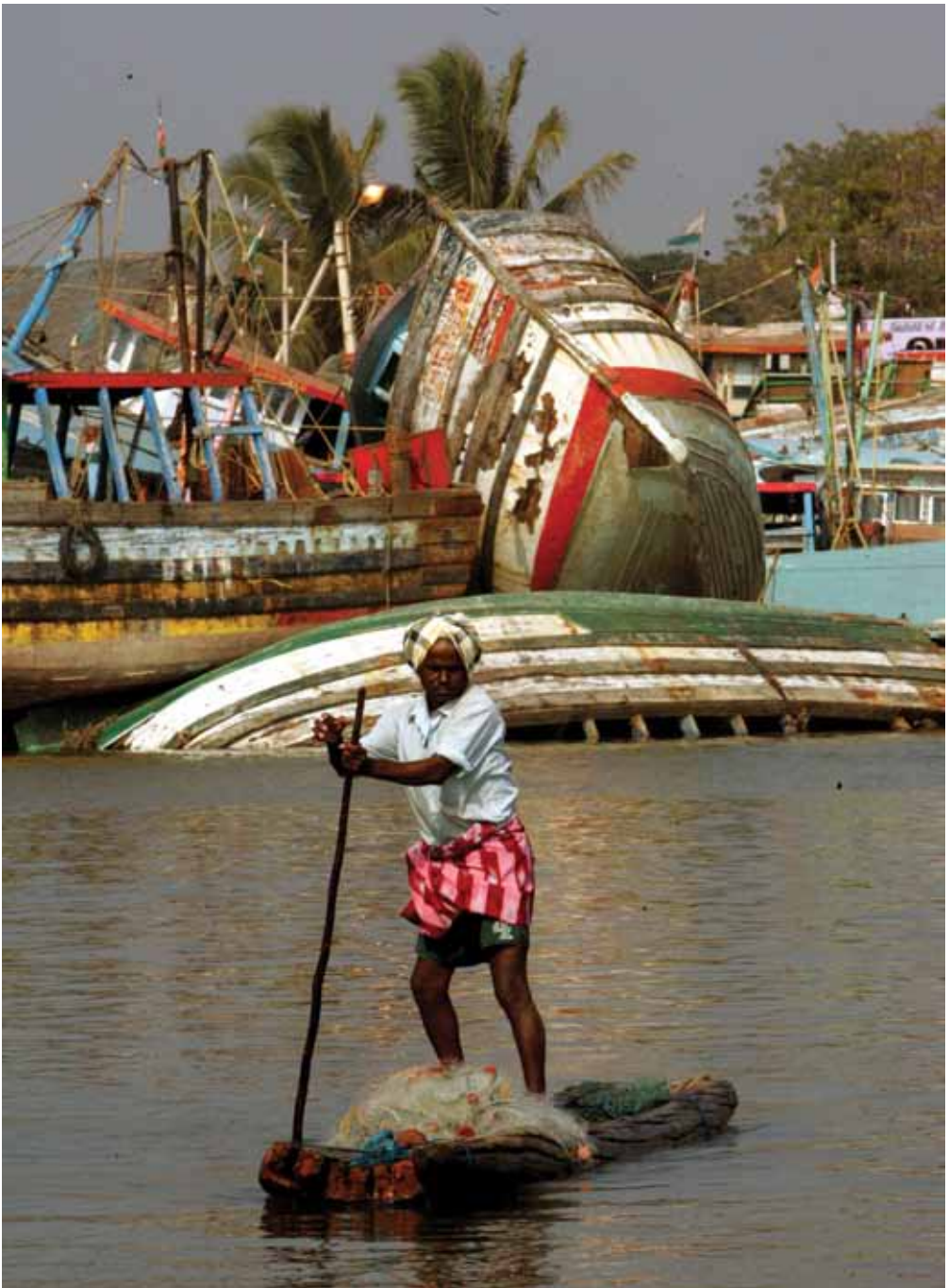
It is essential to seek objective understanding of any historical grievances of the communities living in remote areas where conflict is endemic, and use this understanding to design appropriate forms of support to conservation interests.

Experience over the past 30 years shows that effective management of natural resources can support post-conflict peace building and recovery; conversely, failure to address natural resources or to manage them effectively can undermine peace in post-conflict societies.

So while conflict and its consequences are indisputably a disaster for people, they do not necessarily have to be a disaster for wildlife (McNeely, in press).

To help communities in post-conflict situations, those working in the area of environment, conflict, and peace building should not raise expectations of local communities unrealistically, because the natural resource management in peace-building processes is very long term, slow going, and difficult. Conservationists should also collaborate with humanitarian agencies to encourage resettlement of refugees in suitable areas that will not damage conservation values.

10. Confronting Disaster: Ecosystem Considerations for Post-Disaster Recovery



In recent years, extreme natural events – from earthquakes to tsunamis to hurricanes – seem more common, becoming disasters when human interests are affected. The growing impact of such disasters may be due to increasing human population in vulnerable areas. As important and urgent as the human needs are following disasters, recovery efforts should also be taking into account how nature can contribute. Ecosystem services (Chapter 4) are both affected by these extreme events and can be part of the response to them. Reconstruction efforts following disasters often give opportunities to bring about more far-reaching and longer-term changes which will aid recovery of both people's livelihoods and security and the ecosystems on which many rely.

Addressing environmental concerns is an integral part of a successful recovery plan and will also reduce the vulnerability of local people should future disasters occur. History shows that earthquakes tend to recur in the same regions while events such as floods, cyclones, and droughts are increasing in frequency and intensity. Armed with this forewarning, planning should include all possible measures to both mitigate and adapt to this changing world. Those involved in the reconstruction now have that window of opportunity to change how they respond to the longer-term tasks of reconstruction and establishing sustainable livelihoods. But to make the most of this opportunity, they must be sure to draw from the lessons learned in coping with previous disasters and employ appropriate strategies as they develop their response.

The environment needs to be a central concern in all stages of a typical post-disaster response. Initially, of course, the rescue phase must focus on the immediate needs of people affected by the event. However, in the rescue and relief phases, the potential impact of actions taken to alleviate human suffering can also have unforeseen negative effects on the environment. For example, providing fuel wood instead of kerosene or natural gas can lead to deforestation in the surrounding region, increasing the threat of subsequent landslides. Decisions taken for short-term measures such as temporary resettlement can have long-lasting consequences, for example if disaster refugees are sheltered in a national park. Longer-term recovery will typically require concerted and directed action for both people and their environment.

SHORT-TERM RECOVERY PLANNING AND THE ENVIRONMENT

Two key activities in the relief phase – waste management and resettlement of affected people – can have profound influences on ecosystem function. In terms of the direct causes of environmental degradation, both can result in habitat loss or fragmentation, pollution, and spread of invasive species. Resettlement can also have the unintended consequence of overexploitation of natural resources as people living in new situations may likely need to scrounge for food, wood for heat and cooking, and natural products to consume or sell for income.

“Specific examples from which to derive important lessons for future planning come from experiences with previous responses to major disasters.”

Specific examples from which to derive important lessons for future planning come from experiences with previous responses to major disasters. For example, the Asian Development Bank (ADB), in a review of the recovery from the 2004 tsunami in the Andaman Sea in Hambantota, Sri Lanka, noted that accumulated debris in lagoons and other coastal ecosystems, plus salt intrusion inland, negatively affected local fisheries and agricultural productivity. The report also found that clean-up actions were affecting the environment, as municipalities dumped waste into wetlands with resulting impacts on drainage systems and flood retention areas, increasing the potential for water-borne diseases. Some of the proposed resettlement sites would threaten biodiversity-rich areas so the report recommended that resettlement sites should be located with an adequate buffer between them and the biologically sensitive sites and should ensure that the number of households relocated were within the carrying capacity of the area (ADB, 2005).

Invasive species present another important, but often overlooked threat. A post-tsunami environmental assessment carried out by the United Nations Environment Programme (UNEP) together with the Sri Lankan Ministry of Environment and Natural Resources found, among other things, that the giant waves carried invasive alien species such as prickly-pears (*Opuntia*) and salt-tolerant mesquite (*Prosopis*) further inland, reaching protected areas such as Yala National Park. These non-native species are replacing the native species that are more palatable to Sri Lanka’s livestock and wildlife (UNEP, 2005).

Invasive species were also a critical concern in the recovery plans for Hurricane Katrina, which hit New Orleans in 2006. The Formosan subterranean termite, *Coptotermes formosanus,* is native to China but was accidentally introduced into the United States, and has since invaded at least nine southern states. Prior to Hurricane Katrina, the Formosan termite was annually responsible for an estimated US$ 100 million in damage to homes and businesses in the New Orleans area (US EPA, 2005). Following Hurricane Katrina, the Louisiana Department of Agriculture and Forestry passed the Formosan Termite Initiative Act, effectively a quarantine on debris from the disaster (Louisiana Department of Agriculture, 2005). The act noted that “The hurricane has left millions of tons of wood debris, including debris infested with Formosan Termites,” and that “Imposition of this quarantine is required to prevent the spread of Formosan termites and infestation of areas, homes and structures that are

not currently infested, or which are to be built or reconstructed".

One of the short-term priorities is managing waste and rubble. In the case of the central China earthquake in 2008, the issues of waste are daunting. China's military is reported to have disposed of more than 8 million cubic metres of earthquake waste, enough to fill the inner space of the "Birds Nest" Olympic stadium in Beijing almost 16 times (WRI, 2008). In addition, dispensing treatment to the large numbers of injured people resulted in significant amounts of medical waste that required careful disposal. Finally, central China is an important producer of many chemicals for agriculture and several reports of damage assessment include release of chemicals such as phosphorus and ammonia into the environment (RSC, 2008).

Together, the medical waste and rubble plus potential leaks from the chemical sites are posing potential threats to the environment upon which people will be depending for food, water and shelter. Failure to address these threats to ecosystem services in the short term, will, in the longer term, delay restoration of people's livelihoods.

LONGER-TERM RECOVERY PLANNING

Longer-term recovery planning that addresses environmental concerns is a cost-effective approach. As initial planning for recovery begins, environmental considerations should be guided by three key elements – knowledge, capacity, and policy support.

Knowledge

Understanding the impacts on the environment, and subsequently on the ecosystem services provided, is an important step in planning and providing a baseline by which to measure the effectiveness of recovery action. Impacts of events are often felt well beyond the immediate zone of impact and the impact assessments should take this into account. For example, people's employment may depend on resources within an affected area even though they may live hundreds of kilometres away.

Effective action will need not only a sound baseline of knowledge of the state of the environment as action begins but also long-term monitoring of ecosystem changes in support of adaptive management.

Capacity

Capacity to respond to any disaster will be an important element of success. The sheer scope of most disasters means that all available people power will be needed. Ecosystem rehabilitation will require support from the people living in the area and, often, funding from government for aid agencies. Capacity also includes public support and engagement for all restoration actions taken. Public awareness campaigns on the importance of the environment's role in supporting recovery are also needed.

Policy support for action

From previous disasters, several lessons have already been learned about the need for supporting policies in aid of long-term environmental management. For example, policies on building construction codes may need to be established in terms of zoning for types of construction and types of building materials used. And, of course, mandating environmental impact assessment (EIA) requirements for both short and longer-term infrastructure is essential. In addition, as disasters may result in several areas of severely altered environments, rehabilitation may require establishment and enforcement of protected areas as buffer zones.

In developing longer-term plans, some of the policies that should be considered include:

- Ecosystem policies that foster spatial and biological heterogeneity when choosing sites and

also improve ecological resilience by re-establishing key ecological processes upon which agricultural and natural communities depend (e.g. hydrological cycles, nutrient cycles and flows); and

- Socio-economic policies that support infrastructure development that minimizes impact on ecosystems and creates new and potentially sustainable resources and adds to the diversity of economic resources available.

When the knowledge, capacity and policies are in place, effective action can follow. That action should be taken with a landscape-scale approach in mind. Landscape-scale management acts on a scale broad enough to recognize the role of all critical influencing factors and stakeholders that shape land-use decisions (McNeely and Scherr, 2003; Scherr and McNeely, 2007). Good landscape management will fulfil societal needs by equitably balancing trade-offs between the productive, social and environmental requirements of current land use.

Landscape approaches should include specific consideration of environmental flows of water. An environmental flow is the water provided within a river, wetland or coastal zone to maintain ecosystems and their benefits (Dyson *et al.*, 2003). Development of water resources upstream has consequences for the livelihoods of downstream users and ecosystems. Adequate environmental flows provide critical contributions to river health, economic development and poverty reduction. They ensure the continued availability of the many benefits that healthy river and groundwater systems bring to society. This is key to directly delivering on Millennium Development Goal (MDG) 7 (Environmental sustainability) and indirectly supporting achievement of the health-related and education-related MDGs.

In developing ecosystem recovery plans, various options need to be considered. Many different stakeholders are involved, from local villagers to city dwellers, depending on products from the region to international tourists who bring in valuable income. Each may want something different and the development choices made will need to balance the demands. Tools are available to help with this exercise, including developing scenarios, estimating flows, and conducting strategic environmental impact assessments. In the end, though, planners have to recognize that the ideal of a "win-win" result is unlikely and that they will need to find the best "win more-lose less" option.

Experience in ecosystem recovery from both natural hazards and manmade threats has yielded several key principles to be incorporated in planning the recovery from a disaster:

- Take the opportunity to do things better
- Don't simply plan to re-create what was there before
- Choose the most viable areas in which to work
- Not all areas affected by the disaster need active rehabilitation
- Create a plan with flexibility to adapt
- Assume that the plan will change as it is being implemented
- Don't assume a "one size fits all" strategy
- Avoid further damage to the environment through the actions taken.

THE INFLUENCE OF CLIMATE CHANGE ON RECOVERY PLANNING

Finally, in developing the response plan, it will be critical to include the potential impacts of future climate change, both in terms of adaptation and mitigation. Options for restoration should include efforts to mitigate greenhouse gas (GHG) emissions, should avoid measures that might result in increased emissions, and design

measures that will help affected communities adapt to expected changes in climate.

Given these lessons learned from managing responses to other disasters as well as current knowledge of complicating factors such as impacts of climate change, any actions taken as part of the disaster recovery plan should include consideration of ecosystems. This could include adapting to the future through carefully considering which species are used for reforestation and adjusting locations of villages to reduce vulnerability to future threats.

Full recovery from disasters takes an immense and coordinated effort and considerable investment of resources. But it is also an opportunity to unite people and create a better future that includes sustainable management of ecosystem services in support of development and an opportunity to take measures to mitigate and adapt to climate change in the process.

The incidence of extreme events and disasters, especially under the influence of climate change, is a growing concern for the environment. In the coming decade, the conservation community needs to learn from experiences in ecosystem-based adaptation for climate change and apply these to help reduce vulnerability of people to extreme events. We also need to promote improved management of the ecosystem services that will protect communities from extreme natural events and provide productive options for reconstruction and adaptation.

11. Human Health and Biodiversity: How Conservation Can Contribute

At one point in the 20th century it seemed that transmissible diseases had essentially been defeated, or at least controlled. But today the AIDS pandemic continues, more infectious agents are becoming resistant to antibiotics, increasing numbers of endemic diseases are flaring up in places where they were previously controlled, pathogens are spreading, and new diseases are emerging faster than societies can respond.

As the global health situation becomes more alarming, the relationship between health and biodiversity is receiving greater attention (Chivian and Bernstein, 2008). What are the links between health, climate change and biodiversity? Can we create more effective policy responses by investigating the links? Can alliances among the scientists and policy makers concerned with these respective sectors find common ground that will lead to more effective action?

Urban living and modern technology have diminished general public awareness of the fact that continued good human health depends on a healthy natural environment. Further, modern medical research has tended to focus on individual risk behaviours or unique disease-causing organisms. All too little attention is given to the influences on health that operate at the population level, such as water and soil quality, pollutants that may cause changes in the immune system, organic chemicals that disrupt the endocrine system and enhance the risk of certain kinds of cancer, or changes in climate that may influence the spread of vectors of certain diseases such as mosquitoes carrying malaria or dengue fever. These factors also need to be considered in more comprehensive approaches to human health.

Despite being part of the global economy, many people still think that health is primarily a personal issue, with both prevention and cure centred on the individual. But health is also a characteristic of populations, and looking at the issue from an holistic and larger perspective of society can lead in a very different direction. Of course, it is the individual who finally contracts any particular disease, but the risk of doing so is significantly influenced by the sociological and ecological context within which the population lives.

Emerging infectious diseases resulting from the destruction and fragmentation of tropical forests and other ecosystems (such as the Ebola virus), wildlife-human disease linkages (such as West Nile virus), the many known and yet-undiscovered pharmaceutical products found in nature, the contribution of ecosystems to human health, the increasing recognition of endocrine disrupters on both animal and human health,

and the effects of climate change on ecosystems, all confirm the importance of biodiversity in the complex of health-related issues.

Components of biodiversity can be both allies and enemies to our health. Bacteria and viruses can cause disease; large carnivores, poisonous creatures, and plants can kill us; conflict with small herbivores such as rats and large herbivores such as elephants can undermine our food production systems, thereby undermining our nutrition; and non-native species can include some that threaten our health.

Far outweighing the negative impacts of biodiversity on human health are the health benefits of biodiversity, such as medicine from plants and animals, and of ecosystem services that provide clean water and clean air. While many studies focus on health benefits from plant and animal species, other aspects of biodiversity are also important for human health. Nature can be a source of mental as well as physical health, especially for the young (Louv, 2005). Yet some of our actions today threaten our health tomorrow and far into the future. Environmental degradation from habitat loss, overexploitation and climate change can all have implications for human health and well-being.

BIODIVERSITY: HOW PLANT AND ANIMAL SPECIES CONTRIBUTE TO HEALTH

Our understanding of medicinal biodiversity is based on species. The role of species in support of human health ranges from direct sources for medicines to providing models for research. On the other hand, the way we manage biodiversity (including ourselves) can have implications for human health.

An ally for health

Some 50,000–70,000 plant species are used in medicines, of which 15,000 are threatened (Schippman *et al.*, 2006). The manufacture and production of pharmaceuticals derived from medicinal plants can help human health and conserve plant biodiversity. About 80% of the world's population use remedies and drugs containing natural plant agents, many from within their own countries. The world trade in medicinal plants has increased by 85% since 1991, though the vast majority of trade involves only about a dozen countries.

Medicinal species are part of both traditional medicine and "Western medicine" pharmacopoeias. Treatments for health problems such as obesity are now being addressed through medicinal plants from Africa such as *Hoodia sp.* A connection with the natural world is an integral part of much traditional indigenous knowledge. Many traditional health practices have been found to have measurable benefits and may continue to help lead to discoveries of medicinal plants or animals.

The traditional knowledge (TK) relating to health held by men and women is often different. An ethno-botanical survey conducted in the Jaú National Park in Brazil found that midwives were knowledgeable about certain plants, while traditional medicine men knew about others. In the Los Guatuzos community in Nicaragua, when asked about the type of medicinal plants found on their plots of land and in the forest, men called upon their spouses to answer the question (Azofeifa, 2003 as cited in Rodriguez, Blanco, & Azofeifa, 2004).

Many animals also provide important models for research into human health, such as the implications for osteoporosis of hibernating bears who lose no bone mass (Chivian and Bernstein, 2008). Animals also have unique physiologies that are providing valuable insights that could improve human health, such as gastric brooding frogs helping to understand peptic ulcers (though

these frogs may now be extinct). Numerous animals also provide medicines often from toxins used for offence (for example, by poisonous snakes and cone snails) or defence (amphibians).

A challenge to health

Our species hosts more micro-organisms in and on our bodies than we have human cells. Of this staggering number, over 1,400 species could be pathogenic to humans in at least some conditions. These include at least 217 viruses and prions, 538 bacteria and rickettsia, 307 fungi, 66 protozoa, and 287 helminths (Chivian and Bernstein, 2008). While most of the time our bodies rely on these micro-organisms for healthy functioning, this abundance and diversity also provides the capacity for new diseases to emerge. Humans host such a high diversity of organisms because we are excellent global distribution hosts, travelling far more broadly and occupying far more ecosystem types than any other species.

As more of these micro-organisms come in contact with each other, either through human travel or ecosystem change, new diseases emerge. For instance, nearly 190 new species of arboviruses and other viruses were identified in the Brazilian Amazon from 1954 to 1998 (Vasconcelos *et al.*, 2001). The Brazilian Amazon is very rich in arboviruses, reflecting its rich biodiversity in general. Very little is known about most of these viruses. The kinds of environmental changes that lead to the loss of biodiversity – namely, deforestation, mining, dam and highway construction, human colonization, and urbanization – have been the main environmental changes associated with the emergence and/or re-emergence of relevant arboviruses, including some known pathogens for humans. Other diseases also can be secondary effects of biodiversity loss.

Changing ecological relationships can increase epidemiological risks through the introduction of new pathogens to new populations. For instance, as humans spread into more nesting areas of wild birds, opportunities for genetic exchange may increase. A particularly worrisome mechanism is genetic exchange between viruses infecting people and wild or domestic animals, with the two viruses picking up genes from each other, enabling the virus to produce a new outer coat and so evade the human immune system. This is the main mechanism by which influenza pandemics arise, often involving an influenza virus that infects humans and one that is carried by ducks, including wild ducks, and other species of birds.

Some disease control programmes that target micro-organisms, even if successful, may undermine general health if they disrupt ecological systems. An example of this is the application of DDT, used to kill mosquito vectors for malaria. An unintended result was disrupted interactions among insect pollinators, reduced reproduction in some species of birds, and reduced food production. Agricultural development projects, designed to improve health through better nutrition, can also disrupt ecosystems by altering disease patterns. Promoting sustainable health must consider multiple scales, multiple perspectives, and high degrees of uncertainty, by taking an ecosystem approach to health issues.

The World Health Organization (WHO) (2002) reported that environmental hazards are responsible for an estimated 25% of the total burden of disease worldwide and up to 35% in sub-Saharan Africa. Improving environmental conditions could save up to 13 million lives per year. Better environmental management could prevent 40% of deaths from malaria, 41% of deaths from lower respiratory infections, and 94% of deaths from diarrheal disease – three of the world's biggest childhood killers. Ensuring the health of ecosystems can also help to decrease

people's vulnerability to the impacts of extreme natural events.

Biodiversity-related impacts on human health can be compounded by other threats. For example, globalization, with increasing numbers of travellers and globally traded items, is expanding the ranges of many viruses that are potentially dangerous to humans. And climate change has impacts on biodiversity – changing distributions and changing rain patterns have secondary effects on human health including changes in disease vector distribution as well as changes in food and water supply. Patz *et al.* (2004) report on the links between land-use change and the emergence of infectious disease, emphasizing the need for a broader perspective on land-use management because of the complex relationships among ecosystems in a landscape.

OPTIMIZING BIODIVERSITY-RELATED SUPPORT FOR HUMAN HEALTH

The full gamut of ecosystem services supports human health. This includes provisioning services in the form of medicines and food, supporting services in the form of soils for food and better nutrition, regulating services for suitable water and air quality, and cultural services in support of mental health. Research has shown that interaction with nature has a calming effect on people, and time outside can restore health, give stress relief, and offer life balance. These health values stemming from contact with nature are universal and not limited to "developed" countries. When people are asked to imagine a peaceful place, the vast majority cite a place in nature, such as the beach, a forest, or a lake.

Recognizing how the changes in today's world can affect biodiversity and health is crucial to recognizing where threats may originate, and how to respond to these threats. Conservationists can contribute through valuing medicinal plants and promoting research and sustainable use of native species that are relevant to the health industry, recognizing nature's impact on all aspects of health, and focusing on biodiversity-related policy.

The protection of medicinal plants involves many types of stakeholders. Those concerned with nature conservation are focused primarily on habitat protection, sustainable collection from the wild, appropriate controls on trade, and so forth. Those with social interests seek acknowledgement of traditional knowledge, and reliable and sufficient income to enable harvesters and farmers to make a viable income. Those with primarily commercial interests are concerned with quality standards, a prosperous trade, and a profitable processing industry leading to a lucrative trade.

The WHO, together with IUCN, WWF and TRAFFIC has developed guidelines for conservation of medicinal species (1993). In addition, the recently completed *International Standard for Sustainable Wild Collection of Medicinal and Aromatic Plants* (ISSC-MAP) (IUCN SSC Medicinal Plant Specialist Group, 2007), created by an industry-conservation-community-government partnership, building on the 1993 guidelines as well as the WHO Guidelines on Good Agricultural and Collection Practices (GACP) for Medicinal Plants (WHO, 2003), is a key vehicle for a future collaborative approach to the sustainable use and trade of medicinal and aromatic plants from the wild.

The linkages between human and animal health are also being explored by conservationists. A programme entitled Animal & Human Health for the Environment and Development (AHEAD) was launched by the Wildlife Conservation Society, IUCN and partners at the Vth IUCN World Parks Congress in 2003. Since then, AHEAD has brought together diverse

stakeholders across southern Africa to examine the landscape-level nexus represented by the triangle of wildlife health, domestic animal health, and human health and livelihoods as underpinned by environmental stewardship.

One particular focus has been the Great Limpopo Transfrontier Conservation Area (TFCA), where AHEAD has been supporting multidisciplinary dialogue and planning on the management of wildlife and livestock diseases (including zoonoses – those diseases transmissible between animals and people) within the developing transboundary landscape. Corridors in transboundary conservation areas serve not only to connect animals and people but also provide a "biological bridge" for vectors and the pathogens they carry. The need for a holistic approach to such large scale land-use planning activities could not be more urgent. In TFCAs like the Great Limpopo, fences are already coming down, allowing wildlife and livestock access to areas and to each other for the first time in decades. While this represents a potential milestone for conservation and the nature-based tourism (photographic, hunting, etc.) revenues it supports, it also demands a closer look at some of the implications. What effects might these transfrontier areas have on the health and sustainability of wildlife, domestic animals and human communities? AHEAD, a convening and facilitating mechanism, is actively working to create enabling environments that allow different and often competing sectors to literally come to the same table and find collaborative ways forward to address such challenges and look at health and disease not in isolation but within a given region's socio-economic and environmental context (Osofsky *et al.*, 2005).

> "When people are asked to imagine a peaceful place, the vast majority cite a place in nature."

Human population growth, globalization and international trade, and climate change are accelerating habitat loss, introducing new strains of diseases, and changing the way natural systems regulate themselves. A greater diversity of species performing similar functions within an ecosystem is likely to enhance the probability of ecosystem processes being maintained in the face of environmental change. From a human health perspective, the greater the diversity in an ecosystem, the more likely that the ecosystem services upon which our health depends will continue to be delivered.

Looking at biodiversity through the lens of human health can help provide new perspectives on policy and practice of biodiversity conservation with a view to supporting human health. Equally, conserving biodiversity for human health can help bring larger constituencies to conservation practices. Demonstrating biodiversity's links to human health puts conservation at the centre of humanitarian concerns.

Considering the obvious importance of all components of biodiversity to human health, in the coming decade, delivering biodiversity conservation that supports maintenance or improvement of human health will require improved knowledge sharing, expanding partnerships and management of biodiversity resources at a landscape-scale and implementing policies and guidelines, such as the ISSC-MAP, directed at conservation of medicinal biodiversity.

12. Developing a “Green” Economy

The financial crisis of 2008 and the subsequent responses of financial bailouts and austerity measures have had some potentially encouraging implications for conservationists: with a system ready for change, more room may be found for a green economy. But the concern over the collapsing economic system is diverting attention from another system that is on the verge of collapsing: the global ecosystem.

Climate change, failing fisheries, dwindling freshwater access, ecosystems degraded beyond repair; and the litany goes on, as recorded by the Millennium Ecosystem Assessment (MA). The same growth model that led to the financial crisis is leading to an ecological crisis of devastating proportions. A growth model that defies limits and externalizes costs is hardly sustainable. Mother Nature, unlike governments, does not do "bailouts".

The current operating system for the monetary economy is based upon unsustainable production of energy and material goods and consumption of the resulting goods, and the services that go along with them. People have been happy with consumption, and indeed many want more of it. However, the impacts of unsustainable consumption on the environment are becoming increasingly known and consumers are starting to react. *National Geographic*, in collaboration with Globescan, has developed a Greendex indicator to measure consumer choices and the environment. Their 2009 report provided information on 17 countries, of which India and Brazil were the most environmentally-conscious consumers while Canadians and Americans were at the bottom of the list (Figure 12.1).

How can the act of consumption be made net neutral with the environment on a global scale and not just in the higher rating countries in Greendex? This is the key challenge faced by a green economy. At an individual level, living sustainably is about managing our personal consumption so that it does not put undue stress on the Earth. At the other end of the scale, sustainability for a business is a question of giving back more to the Earth than it takes from it. The green economy recognizes that the environment, economy and society are all part of the same balance sheet. The health of the economy, based on consumption and production, lies in balance with the health of the environment.

MEASURING SUSTAINABILITY

A key to a more balanced and healthy Earth is to move away from natural resource use as the driver of economic growth. By bringing the environment and ecosystem services into the calculus of the world economy, economic instruments can be used to support the environment and environmental protection and

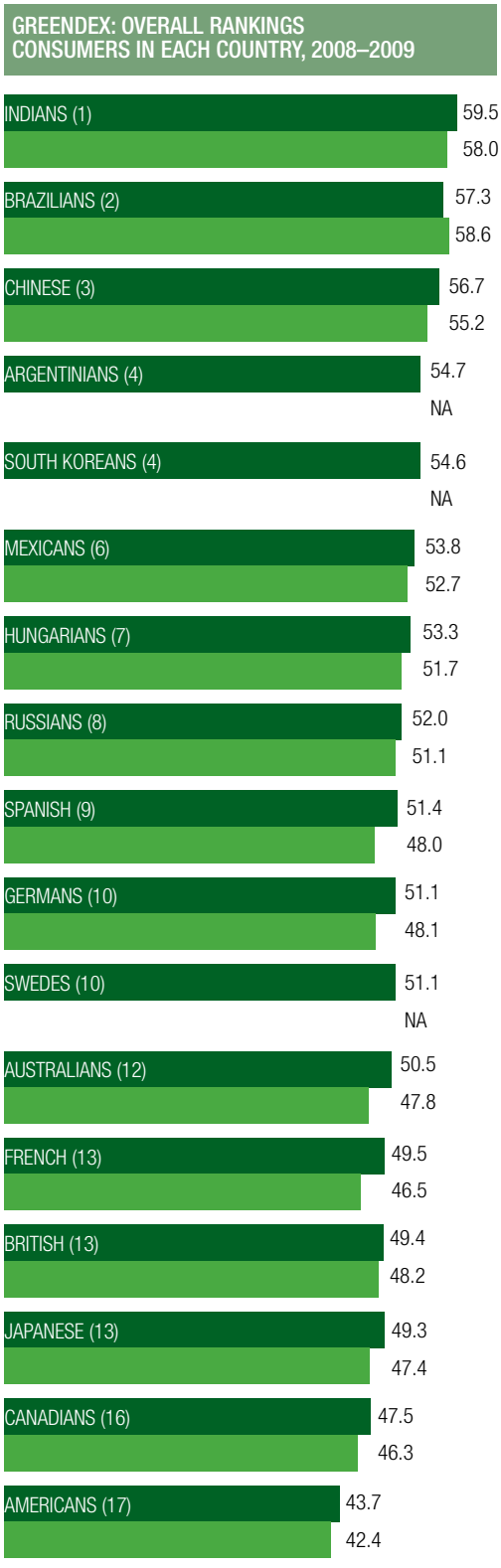


Figure 12.1 Greendex 2009 (National Geographic)

conservation. But the way we currently measure progress, through Gross Domestic Product (GDP), Human Development Index (HDI), and other similar indicators, does not adequately reflect the contribution of the environment.

The environmental impact of over-consumption in developed countries is magnified because the prices for natural goods and services do not correctly reflect the true costs to ecosystems and the environment more generally. Affluent people damage the environment through their buying practices, driving market forces which deplete natural resources both domestically and in the developing world, where environmental standards are often lacking or poorly enforced.

TOOLS FOR A TRANSITION TO A GREEN ECONOMY

Valuation of the environment

Understanding the value of the environment to our economy, as well as the costs of inaction or failing to conserve it, is increasingly the subject of economic study. Ten Brink (2008) has estimated that if we do not halt biodiversity loss today, the cumulative costs to human well-being by 2050, from the loss of forest goods and services alone, could amount to Euro 14 trillion (7% of global GDP).

The Economics of Ecosystems and Biodiversity (TEEB, Chapter 4) aims to improve understanding of the true costs of consumption, as well as the problems of externalities within modern supply chains and production systems (TEEB, 2008). Supply chains are the interlinked primary producers, manufacturers and distributors who buy and sell from each other in order to deliver finished products to consumers.

Supply chain managers looking for efficiencies sometimes find cost savings by refusing to pay the full costs of sustainable production. Examples include the money "saved" by not treating polluted water, or by not offsetting carbon sinks lost during land clearing. These are real costs which need to be reflected in supply chains, and ultimately passed on to buyers, so that consumers understand the value of the ecosystem services that went into producing the products they buy.

INCENTIVES – THE GOOD AND THE BAD

Market mechanisms used to support conservation are extremely varied and range from simple water-pricing schemes to sophisticated environmental hedge funds. Ideally, any such financial mechanism, rather than simply providing one-off funding, should operate as a sustained incentive for conservation. By accounting for the long-term role of ecosystems through such mechanisms, sustainability is incorporated into economic decisions. Of course, such schemes only function effectively if there are credible standards, verification and enforcement systems in place.

Offsets

An offset is a measure taken to counteract or compensate for the impact of other actions. For climate change, the best-known carbon offset programme is the 1997 Kyoto Protocol (and in particular the Clean Development Mechanism – CDM), which was devised to allow countries with emission control commitments under the Protocol to implement some of their required emission reductions in developing countries. While the CDM is designed to help meet intergovernmental commitments, under a binding legal framework, there are also voluntary carbon markets which, in 2008, nearly doubled in terms of both the volume of carbon traded and its value, as compared to 2007, with a total market value of US$ 705 million in 2008 (Hamilton *et al.*, 2009).

Offsets have also been applied to species and habitats, in some cases. The latter applications are relatively new but the Business and Biodiversity Offsets Programme (BBOP) is seeking to define principles and methodologies to support best practice in voluntary biodiversity offsets (BBOP, 2009).

Payments for ecosystem services (PES)

Payments for ecosystem services (PES) have been mentioned frequently in this volume as an important means of reflecting the value of the benefits people receive from nature (Wunder, 2005). One ecosystem service for which PES schemes are in place in several countries, especially in Latin America, is payments for watershed protection. As consumers become more aware of the many services provided by watersheds (water quality and quantity for industrial, domestic and recreational needs), motivation to pay for their conservation has grown (Smith *et al.*, 2006). Such payments may include payments by private water users to environmental agencies and non-governmental conservation organizations (NGOs), as well as direct payments by central government to private landowners. Experience suggests that payments for watershed protection are most appropriate when:

- buying the resource outright is too expensive (and unnecessary);
- payments are less expensive than alternative technical fixes (e.g. infrastructure);
- provision of the desired service is verifiable and enforceable;
- transaction costs are not prohibitive; and
- someone is willing to pay the price (Kousky, 2005).

Effective development and implementation of markets for ecosystem services are constrained by several factors including weak market institutions, especially poorly-defined property

rights, inadequate recognition of liability for environmental damages, no culture of rewarding positive contributions to ecosystem health, and weak regulatory capacity (Bishop *et al.*, 2009).

Certification

Biodiversity-relevant standards and certification schemes are increasingly seen as important tools for enhancing biodiversity performance of business. Certification schemes assume that consumers will prefer to buy or even pay more for certified goods and services. Certification is already an important part of several sectors including agriculture, forestry, tourism, and financial services (Bishop *et al.*, 2009). The value of certified products is substantial and growing, including the global market value of organic products of US$ 23 billion (2002) (Willer and Minou-Yussefi, 2006). Similarly, the volume of certified production is increasing; for example, certified forest area increased from 5.8 million hectares in 1998 (www.earthtrends.org) to over 300 million hectares worldwide by mid-2008, with most in the UNECE region, driven by green building systems and public procurement policies (UNECE and FAO, 2008).

Subsidies and tax incentives

Economic incentives for conserving biodiversity have been used for decades (McNeely, 1988) but this use has been relatively modest and needs to be significantly enhanced (as called for in the Convention on Biological Diversity's (CBD) Article II) (CBD, 2004a). In several countries incentives to encourage resource conservation have included subsidies and tax incentives, for example, in the form of income tax relief on charitable contributions. This mechanism has served as motivation for land donations in the United States and Europe, protecting millions of hectares (The Trust for Public Land, 2009; Bräuer *et al.*, 2006).

However, the potential for negative impacts from incentives such as subsidies is epitomized in the current situation with respect to global fisheries. In 2000, an estimated US$ 26 billion in subsidies were paid in the fisheries sector, of which US$ 16 billion was to increase fishing capacity in a world where the majority of fisheries are already overexploited (Chapter 17) (Sumaila and Pauly, 2006).

MAKING DEVELOPMENT INVESTMENT IN SUSTAINABLE NATURAL RESOURCE MANAGEMENT A DRIVER FOR GROWTH

Natural resources have long been the basis for economic growth. This growth, when poorly managed or unchecked, has caused long-term poverty, conflict and environmental degradation. Historically, much of colonialism was driven by the search for natural resources, largely for the benefit of the colonial powers. More recent examples include copper, coltan and cobalt production in the Democratic Republic of Congo, diamond mining in Sierra Leone, or oil-drilling in Nigeria.

Much of this degradation of natural resources stems from weak governance. Even countries with strong governance import resources for manufacturing and energy production, a sign that production is not locally-sustainable and a strong justification for global trade. Sustainable management of natural resources at both local and global levels has the potential to support long-term pro-poor economic growth and thus the achievement of broader development goals.

The use of natural resources can contribute to poverty reduction and peoples' health and well-being. Maintaining natural capital is essential for the preservation of human capital. The OECD (2008) calls this "critical natural capital" – the threshold of natural capital necessary for other capital, such as human capital, to exist. Subsistence farmers who are skilled in local agricultural processes are one example. Once

the soil fertility has collapsed, these farmers will be unable to farm, thus losing the human skills along with the natural capital in the soil. To ensure that natural resources support growth, sustain it, and contribute to lifting people out of poverty, developing countries are seeking efficient, equitable and sustainable use of natural resources (Box 12.1).

Box 12.1 Diamonds for development: the case of Botswana

Botswana has been using its natural resource wealth (diamonds) for poverty reduction, through the establishment of a Revenue Stabilization Fund and a Public Debt Service Fund. While diamonds are not a renewable resource, human capital is. By developing its diamond processing industry and enhancing economic diversification, and by channeling fiscal revenues from the minerals sector to the education and health sectors, Botswana has been able to reinvest gains made from the diamond industry into enhancing the country through the development of village institutions, local empowerment, village identity and culture, and reduced dependency on government support. All of this in turn has taken pressure off the environment, as people are not driven to exploit natural resources for subsistence.

Source: PEP, 2005

ANOTHER OPTION: DEVELOP A NEW ECONOMIC SYSTEM

The economic instruments detailed above work to incorporate environmental costs into macroeconomic policies. While many applaud these steps towards bringing the natural and monetary systems together, others worry that the current economy relies upon the model of perpetual growth and no matter how much we amend the model, we are inevitably continuing down an unsustainable path (e.g. Speth, 2008). The present day model will soon reach the point where the economy is outstripping the Earth's ability to sustain it. We are living beyond our carrying capacity (Box 12.2).

Box 12.2 Beyond carrying capacity

In November 2005, the European Environment Agency released its report, "The European Environment: State and Outlook 2005". It concluded that it takes 2.1 times the biological capacity of Europe to support Europe. With a population amounting to 7% of the world total, its demand on global ecological capacity is nearly 20% of global productivity. That biological capacity for Europe is coming from the rest of the world. What would be a fair price for this excess demand and how would it be paid?

Source: EEA, 2005

Many people (though not necessarily a majority of economists) believe that the world needs to invest in a new system, one that does not give perverse incentives for unsustainable growth. The world needs a system that shifts people's consumption habits, one that invests in green infrastructure (meaning both investments in the environment as fundamental infrastructure as well as physical infrastructure constructed in environmentally-friendly ways) and one that thinks strategically about how we are to live on this fragile planet. The world's collapsing systems make it painfully clear that it is time for fundamental change. Models proposed include a "circular economy" as articulated in China whereby economic and environmental goals are pursued in tandem and "one facility's waste is another facility's input" (Pinter, 2006). McDonough and Braungart espouse a similar philosophy in *Cradle to Cradle* (2002). Another approach is for conceptual reform towards a sustainable economy that promotes development

rather than growth, fully integrates nature's values in the system and applies a precautionary approach in public economic policy (WorldWatch Institute, 2008).

Yet another option is for a green economy to return closer to home for most of its inputs. The "buy locally" movement is one indicator of this. While its advocates recognize that some global trade is essential, they reject being totally subservient to the global economy and instead support the development of much greater local self-reliance, for everything from food to energy. This would involve greater collaboration within communities, which has been an age-old adaptation that has been neglected in modern times (McKibben, 2007).

No matter what the model chosen, personal choices about consumption and the values of nature will be important drivers towards a more sustainable economic system. Support for economic instruments such as carbon offsets can happen at the individual level every time an individual travels and buying products certified as sustainable is a means to ensure that the natural resources consumed are being effectively managed.

A "green economy" is an essential pre-condition for IUCN to achieve its mission. While the shape of this new economy is rapidly evolving through activities like TEEB, the United Nations Environment Programme's (UNEP) Green Economy Initiative, payments for ecosystem services and various national initiatives, the membership of IUCN is actively involved in ensuring that biodiversity and ecosystem services will be well reflected.

“The use of natural resources can contribute to poverty reduction and peoples’ health and well-being.”

13. Technology and Conservation

In October 1992, Julian Simon and Norman Myers had an historic debate at Columbia University on "Scarcity or Abundance" (Myers and Simon, 1994). While Myers, then identified by some as a "doom-sayer", argued that environmental indicators were all heading in the wrong direction and that ultimately people would pay the price, Simon applauded growth in human populations and asserted that more people provided more minds to develop technological solutions for dealing with coming challenges. This argument of the power of technology to overcome human impacts on our world is still raging (Ehrlich and Ehrlich, 2008) but evidence is accumulating to show that Myers may have got it right back in 1992. Still, it is worth asking whether technology can help us avoid the worst implications of the Malthusian prognosis of humanity outstripping Earth's carrying capacity.

Communities throughout the world have developed their own technologies over thousands of years. These traditional technologies have been overtaken by more modern forms, but the traditional technologies may still have much to offer (Klee, 1980; Gadgil and Berkes, 1991). Many of these traditional technologies are based on biomimicry, and can be improved through incorporation of some modern elements. IUCN's Commission on Environmental Economics and Social Policy (CEESP) has widely promoted such approaches. These are increasingly entering mainstream development thinking, and offer considerable potential as part of green economies.

Much modern technology has contributed to more comprehensive exploitation of natural resources and unanticipated side effects that have caused some of today's most intractable environmental challenges. However, as Simon would argue, new technologies may also be the basis for some of the solutions to those challenges.

WHICH TECHNOLOGIES AND WHAT IMPACT?

From an environmental perspective, some key technologies that have both helped and hindered environmental conservation include information management technology (IT), biotechnology and geo-engineering, and energy technology (Chapter 8).

Information technology

At the time of the 1992 Earth Summit in Rio de Janeiro, nobody had a mobile phone, the internet was not yet operational, and laptops were better considered portable desktop computers. In little

more than 15 years, IT has made remarkable advances, resulting in both costs and benefits to biodiversity.

The costs of IT advances can be calculated both in terms of the impacts of increased access to information as well as the impacts of developing and delivering technology to support that access. More accessible information has made it easier for those seeking to exploit nature to identify where valuable resources are and where potential markets might be. The raw materials to provide the computers and mobile phones with which we gather and share our knowledge, and how we dispose of them when a new model hits the market, can also have significant negative impacts on the environment. Exploration and extraction for raw materials such as coltan have already had devastating impacts on biodiversity in places such as the Democractic Republic of Congo. Making and operating computers and mobile phones is an energy and water-intensive exercise with resulting impacts on climate.

> “Communities throughout the world have developed their own technologies over thousands of years.”

Using IT products consumes huge amounts of energy, including both the electricity to run personal computers as well as the needs of server farms and other IT infrastructure that keeps the internet running. Annual energy consumption of computers varies from 52 to 482 kWh and for monitors ranges from 22 to 754 kWh (Bray, 2006), with differences depending on specifications and age of the computers and monitors being tested. By comparison, the average annual unit energy consumption for refrigerators in the United States was 1,239 kWh (http://www.eia.doe.gov/emeu/reps/enduse/er01_us.html#Electricity).

Finally, when obsolete computers are discarded, the lead, mercury and other toxic substances used in their manufacture can cause serious pollution problems. The scale of this waste is immense. In 2005, used electronic equipment amounted to about two million tonnes of waste, most of it disposed of in landfills. In the United Kingdom alone, 1,700 mobile phones are thrown away every hour, 15 million every year. Their heavy metals and other pollutants like mercury, lead, cadmium, and brominated flame retardants are left to pollute the soils. Much of the electronic hardware cast aside by industrialized countries goes to poor countries in Africa or Asia that have ineffective environmental policies. On the other hand, recycling mobile phones reduces greenhouse gas (GHG) emissions, keeps valuable material out of landfills and incinerators, and conserves natural resources. Recycling just one million mobile phones reduces GHG emissions equal to taking 1,368 cars off the road for a year.

While information and communications technology (ICT) is not especially environmentally-friendly, increasingly it is being mobilized to improve the management of ecosystem services and biodiversity. For example:

- Consolidation of information such as the World Database on Protected Areas (www.wdpa.org), an open-access and downloadable source of information on the world’s protected areas, is being used for ecological gap analysis, environmental impact assessment, private-sector decision-making, and the creation of new data products.
- Syntheses of information, such as electronic field guides to plants and animals, enable both scientists

and tourists to identify species they encounter in the wild.

- Remote sensing and tracking of elusive species such as snow leopards and tigers enables scientists to carry out censuses and even photograph elusive newly-discovered species such as the saola.
- Dynamic tracking of environmental change is assisting in responses to forest fires or climate change.
- Portable devices, especially mobile phones, enable farmers to greatly enhance their productivity and profitability through better and immediate access to prices that are being paid for their crops, weather forecasts, and improved irrigation regimes. By cutting out the middle-man, such ICT can help lift farmers out of poverty.
- Public access to information about the environment, for example through Google Earth or through the many websites with livecams on wildlife, has increased awareness and appreciation for the natural world and the changes occurring.
- IT has led to new forms of democracy in resource management, as rural people are using this technology to gain greater control over their natural resources.
- Remote sensing, often using satellites to help collect spatially-based temporal information from Earth, has become a mainstream environmental management technology being used in a wide variety of contexts.

IT advances are also being made in terms of the reduced size of the instruments. Many elusive species can now be studied through radio-tracking and tiny transmitters have already been applied to butterflies, indicating the degree of miniaturization that is now possible. Miniature video cameras have been attached to the critically endangered New Caledonian crow, enabling scientists, for the first time, to fully understand the complicated life these intelligent tool-using birds lead. At the other end of the scale, elephants have also been fitted with radio transmitters so that they can be followed by radio-tracking, both for scientific purposes and to help warn farmers when their fields might be raided by hungry pachyderms seeking a free meal.

Advances in IT, and the information that is now available as a result, enable policy makers and conservationists to better manage threatened species and ecosystems. IT is also supporting decision-making in other arenas, especially climate change, by helping to assess its real impacts by, for example, comparing the size of glaciers in remote areas, measuring the change in polar ice caps, and remotely taking the temperature of the Earth. IT will also be vital to understanding and monitoring the ecosystem response to measures taken.

The most sophisticated use of IT is being made by geneticists, who, without modern technology, would have little chance of understanding the genetic structure of the many species whose genomes have now been mapped. Dozens of knowledge-sharing genomic databases have now been established, covering everything from rice to rats to zebra fish to humans and even the duck-billed platypus. These model organism databases are providing a highly advanced research tool for scientists, enabling them to leap years ahead in the sophistication of the kind of research questions they are able to answer.

Despite the advances, though, the biggest challenge is in ensuring that more comprehensive knowledge of biodiversity is contributing to effective policy and decision-making. IT can and should help play a pivotal role in addressing this challenge. All indications are that these technological advances will continue to accelerate, providing quick and easy access to an increasingly broad range of important information, ranging from DNA analysis to

soil micro-organism richness to calculating the ecological footprint of humanity. All of this provides an opportunity to build a technological future that also helps to enhance significantly the management of biological resources, a marriage of technology and biology that can lead to a more sustainable future.

In addition to the hardware aspects of IT, the means by which we manage and manipulate information is also changing. As computers become more powerful, along the lines predicted by Moore's Law (the storage capacity of microchips will double every 18 months), our ability to explore areas that require extensive and complex computation has also expanded.

One of the limiting factors in projecting impacts on nature is the uncertainty involved – something that has plagued the climate community for many years. New methodologies for integrating uncertainty into calculations and modelling are emerging including the use of "fuzzy numbers" and Bayesian networks. All of these are also now being used in environmental research and management, including the assessments undertaken as part of the *IUCN Red List of Threatened Species.*

BIOTECHNOLOGY

Biotechnology is closely linked with emerging information management. Biotechnology can be defined as any application of technology to biological systems. It has a long history, stretching back to the use of yeast in baking bread and fermentation in making alcoholic beverages. These historical applications have been joined by more modern ones, including nanotechnology, biomimicry, and genetic modification. Some of these new applications of biotechnology are both powerful and novel, calling for the application of a precautionary approach.

Nanotechnology

Nanotechnology involves working at the atomic scale, roughly one-billionth of a metre in size. At this scale, materials behave in ways that are very different from when they are combined with others to form molecules, compounds, and so forth. Nanoparticles are so small that they can enter cells that are impermeable to larger particles. Hence their use in cosmetics, for example, could carry health implications. Further, nanoparticles have a large surface area relative to their volume, enhancing their chemical and electrical properties and increasing the risk that they could lead to damaging reactions within a cell they have invaded.

While nanoparticles can be produced naturally, for example by volcanoes, engineered nanoparticles are becoming big business. Global investment in nanotechnology in 2005 was US$ 10 billion and this is expected to increase to US$ 1 trillion by 2011–2015 (Navarro *et al.*, 2008). Benefits for people in medicines, electronics and the environment are expected. For example, the ability of nanoparticles to bind with polluting chemicals could reduce the bioavailability of those toxic substances. However, the potential for nanoparticles to have toxic effects, for example, lung irritation, has also been recognized. And the unknowns surrounding the use of nanoparticles are many (Navarro *et al.*, 2008).

The field of nanotechnology is virtually unregulated today, and few, if any, studies have been done about possible impacts on biodiversity. Like any new and powerful technology, nanotechnology should be approached with caution, and the application of the precautionary approach would seem appropriate. Sutherland *et al.* (2008) included nanotechnology among 25 novel threats facing biodiversity. They recommended that "if use becomes widespread or the structures are

incorporated into "near-living" systems, new approaches to risk will be needed". For its part, the European Commission (EC) has issued a "code of conduct" for nanotechnology (EC, 2008). Its section on sustainability states:

> *Nanosciences and nanotechnologies research activities should be safe, ethical and contribute to sustainable development serving the sustainability objectives of the Community as well as contributing to the United Nations' Millennium Development Goals. They should not harm or create a biological, physical or moral threat to people, animals, plants or the environment, at present or in the future.*

The International Risk Governance Council (IRGC) also notes that while nanotechnology presents great potential benefits it also poses serious risks with significant social, economic, political and ethical implications. The IRGC suggests that because issues raised by nanotechnology are more complex and far-reaching than many other innovations, decision makers need to manage for the uncertainties and risks associated (IRGC, 2007).

Biomimicry

"Biomimicry" is derived from combining the Greek words "bios", meaning life, with "mimesis", which means imitation. The word is applied to the applications of models and processes from nature to industrial or agricultural designs to solve human problems. As coined by Janine Benyus (1997), it is an approach that learns *from* nature, rather than just about nature.

Biomimicry is based on the principle that, through the process of evolution, nature has learned what works, what is appropriate and what is sustainable. Nature includes organisms that fly, occupy the entire globe, maintain appropriate living conditions, and build amazingly complex structures. Nature has developed biodegradable materials like glues produced by mussels that work underwater, silks from spider webs that are stronger than the toughest human-produced products, termite mounds that are able to maintain a constant internal temperature despite external temperatures that go from 40°C during the day to near freezing at night, and the feet of geckos that enable them to cling to a smooth ceiling.

We are already using biomimicry applications in our everyday life. Velcro was inspired by the common burr and the Wright Brothers, in designing the first powered aircraft, were inspired by the wings of birds. Solar panels that are used to power orbiting satellites are unfolded based on patterns learned from the unfolding of leaves from tiny buds, and low-energy modern buildings have been based on the model of a termite's nest. Work on biomimicry is highlighting the role of a new generation of well-adapted technologies, based on nature's design principles, for a sustainable future.

As the value of nature in supporting improved livelihoods through application of biomimicry becomes more common, the intrinsic value of all biodiversity as a living laboratory for future needs is more and more apparent. The rationale for conservation of all nature, as a key risk management strategy for capturing option value, is strongly supported by advances from biomimicry.

Genetically Modified Organisms (GMOs)

Genetically modified organisms are a particularly controversial aspect of modifying genetic diversity. They are becoming increasingly prevalent in many countries and are being used in many sectors, from agriculture to health to energy supplies. IUCN Members have acknowledged this growing trend and, while noting the potential of GMOs to improve livelihoods and promote development, have expressed concern regarding

the potential negative impacts of GMOs on food safety and the environment. The concern is reflected in IUCN Resolution WCC 3.007 in which the Union calls for "a moratorium on further environmental releases of GMOs until these can be demonstrated to be safe for biodiversity, and for human and animal health, beyond reasonable doubt". IUCN Members have also recognized the rapid developments in the fields of genetic technology and have requested ongoing updates on this issue.

Potential negative impacts of GMOs include a reduction in biodiversity, threats to human health, unexpected consequences of gene transfer between plants, and creating pests or weeds that are resistant to controls. The Parties to the Convention on Biological Diversity (CBD) have recognized both the potential benefits and costs of GMOs through the Cartagena Protocol, which promotes informed and cautious use of this technology and works to build capacity in all countries to support the decision-making processes involved. IUCN Members have called for governments to ratify the Cartagena Protocol.

The United Nations organizations responsible for human health and food production have found no evidence to date of negative impacts of GMOs on biodiversity or human health. A 2003 review of research undertaken to assess the environmental impact of transgenic crops concluded that insufficient monitoring and testing had been carried out to make any determination in that regard (Ervin *et al.*, 2003). Though scientists have found little conclusive evidence of direct negative impacts of GMOs on biodiversity or human health, other ethical issues need to be considered. Some organizations share views with those of Via Campesina, a worldwide movement of peasant farmers, who believe that GMO technology poses a serious and immediate threat to the security and livelihoods of peasant farmers (www.viacampesina.org). On the other hand, some farmers in developing countries such as China, India, Argentina and Brazil, welcome GMO crops, especially cotton, soybeans and maize.

Geo-engineering

Geo-engineering is the deliberate modification of the environment to achieve specific outcomes relating to human needs. With respect to climate change, two aspects of geo-engineering are considered: managing solar radiation, for example through creation of solar sulphur aerosols; and managing GHG emissions, for example through carbon capture and storage techniques or employing biochar as a carbon sink (Victor *et al.*, 2009). The side effects of these technologies remain largely unknown. At least one geo-engineering technology, ocean fertilization by iron to promote the growth of carbon-sequestering phytoplankton, has been tested, leading to considerable debate in global environmental policy arenas; governments have agreed a moratorium on further testing of this technology.

Mathews and Caldera (2007), looking specifically at the question of managing solar radiation, reported that while geo-engineering solutions may provide some mitigation, these technologies also masked increases in GHG emissions. Should geo-engineering solutions fail or be stopped abruptly, the result could be very rapid climate change, with warming rates up to 20 times greater than present-day rates. They conclude that simply relying on geo-engineering without complementary efforts to reduce carbon emissions presents high risks for the global climate system.

Synthetic biology

While some consider that synthetic biology is simply an extension of genetic engineering, it is in fact much more complex, involving the engineering of new biological systems, parts, or devices that do not exist in nature, and the

re-design or re-engineering of existing biological elements for useful purposes (IRGC, 2008b). While genetic engineering typically involves only one or a few genes at a time, synthetic biology creates entire new organisms or metabolic units. While this technology is still in its infancy, it has been shown to be possible to create viral genomes such as the polio virus (Cello *et al.*, 2002) and to reconstruct the virus that was responsible for the 1918 influenza pandemic (Tumpey *et al.*, 2005).

As an emerging branch of biology, most of the work in this field is far from having any commercial applications. But its advocates see potential in bioremediation (for example, degrading pesticides and removing pollutants), developing bio-sensors that can detect toxic chemicals, developing bacteria or viruses that could identify cancer cells and deliver therapeutic agents where they are required, developing pharmaceuticals more effectively, engineering micro-organisms that can produce new sources of energy, and other applications that are beyond current imagination.

On the other hand, synthetic biology could pose substantial risks, such as the unintended detrimental effects on the environment of the accidental release of synthetic organisms, such as those designed originally for bioremediation. Using synthetic biology to create micro-organisms could lead to highly unpredictable effects; in a worst-case scenario, harmful organisms could be deliberately created (though it currently is much easier to obtain pathogens in other ways). At a philosophical level, it is feasible that synthetic biology will lead to most evolution taking place in the laboratory rather than in nature, potentially posing significant risks to the very concept of nature, and to biodiversity.

In 2003, J. Craig Venter and his team of researchers successfully built a fully synthetic chromosome in two weeks. Since that time, the Venter Institute has continued to be at the forefront of synthetic genomic technology to examine and replicate the genetics of life (Smith *et al.*, 2003). In 2008, scientists at the J. Craig Venter Research Institute announced the first completely synthetic bacterial genome (*Mycoplasma genitalium*), thereby taking a significant step towards artificial life.

The tools for synthetic biology are easily available online in an open-access library, the Registry of Standard Biological Parts (http://parts.mit.edu). Undergraduates are already holding competitions for using "BioBricks" to develop their own synthetic biological devices, though no regulatory measures have yet been put in place to ensure that such experimentation does not threaten the environment (IRGC, 2008). Synthetic biology is a field that certainly calls for the precautionary approach and deserves greater attention from the conservation field than it is currently receiving.

MAKING THE MOST OF TODAY'S TECHNOLOGY WHILE SUPPORTING THE ENVIRONMENT

To meet today's conservation challenges, new technology will be particularly important to provide the means by which to deal with some of the main threats to biodiversity and ecosystem services, such as climate change, pollution, and invasive alien species. In all cases, making the most of technology that is compatible with environmental conservation means that in the coming decade, we will need to support development of tools and information technology that are needed to effectively manage vulnerable ecosystems and to ensure sustainable livelihoods for people living in these areas. In addition, we will need to apply a precautionary approach to manage the many uncertainties about the longer-term impacts of some of these technologies and adopt some fundamental behavioural changes to manage the impacts of consuming these technologies, including paying attention to the 3R's – reduce, recycle, and reuse.

14. International Cooperation

Today's international political agenda is largely focused on economic and security issues, including the threats of financial collapse, terrorism, arms proliferation, and climate change. The environmental dimensions of these issues are starting to get some air time but still lag behind attention to the direct impacts on people around the world. However, accepting responsibility for impacts on global public goods, including biodiversity and the ecosystem services provided, is now beginning to be discussed in sectors from fisheries management to climate change.

In terms of the international biodiversity agenda, most multilateral environmental agreements (MEAs) and processes are focusing on implementation of existing commitments and work programmes. New challenges include the discussions on the need for a post-2010 biodiversity target and framework, the ongoing negotiation of an international regime on access and benefit-sharing (ABS) under the Convention on Biological Diversity (CBD), and measures to address high seas governance beyond national jurisdiction in the context of the United Nations General Assembly. The year 2010 has been declared by the latter as the International Year of Biodiversity shining a spotlight on the discussions leading up to the 2010 milestones, the United Nations General Assembly and its high level session on biodiversity and the 10th Conference of the Parties of the Convention on Biological Diversity (CBD COP 10) that will take place in Japan in October 2010. The Commission on Sustainable Development (CSD) will also focus on biodiversity in 2010.

Climate change, in particular, is providing an opening for environmental issues to become a significant aspect of these negotiations. However, many constraints exist to full integration of the environment in current deliberations. These include agreeing the need for harmonization across instruments and discussions, packaging biodiversity and climate change convincingly (Chapter 5), building capacity (technical and financial) to implement the resulting decisions, and mobilizing political will to act for the global good.

HARMONIZATION AND SYNERGY ACROSS INTERNATIONAL AGREEMENTS

During the latter half of the 20th century, and in particular following the Stockholm Conference on the Human Environment in 1972 and the release of the Brundtland Commission Report in 1987, hundreds of environmental agreements were drafted and ratified. Most notable from biodiversity's perspective include the Convention

on Biological Diversity, the Convention on Migratory Species (CMS), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the World Heritage Convention and the Convention on Wetlands of International Importance (Ramsar).

This web of instruments has created, in some cases, a very tangled and difficult to implement framework for conservation. For example, for hawksbill turtles in the Wider Caribbean Region this single species is subject to the jurisdiction of more than 12 global instruments (from CITES to Ramsar to the United Nations Convention on the Law of the Sea – UNCLOS), more than seven regional agreements, and three Atlantic agreements (CITES, 2001). Unfortunately, the obligations and requirements of all these legal instruments do not always agree, leaving countries in the Caribbean struggling to identify an appropriate management scheme for hawksbills.

Similarly, while the United Nations Framework Convention on Climate Change (UNFCCC) is the pre-eminent instrument for global cooperation on climate change, many other global and regional agreements also include climate within their work. From a biodiversity perspective, these include the CBD, the United Nations Convention to Combat Desertification (UNCCD), UNCLOS, CMS, and Ramsar at the international level (McNeely, 2008). But the particular agendas and requirements across these instruments also vary, leaving Parties with a dizzying array of actions to implement. In some cases, even the definition of the issue or scope of action is different, for example the definition of drylands in the UNCCD and the CBD (Box 14.1).

More than 700 international agreements relate to the environment and no effective international architecture has been established to coordinate this host of official commitments, resulting in fragmentation and duplication as well as serious capacity issues for many countries – the so-called "treaty congestion" problem. As the number of agreements grows, and along with them the number of decisions and actions to be implemented, Parties are calling for more harmonization and synergy. Attempts to support efficiency, harmonization and synergy have included Tematea (www.tematea.org), an online tool that provides rapid information on decisions and resolutions across a number of treaties and conventions according to issues; and ECOLEX (www.ecolex.org), a platform created by IUCN's Environmental Law Centre (ELC) in collaboration with the United Nations Environment Programme (UNEP) and the Food and Agriculture Organization (FAO), that provides access to over 600 multilateral treaties and 45,000 national laws and regulations, encompassing both the conservation and use of natural resources as well as environmental contamination through pollution and wastes. The potential for conflicting advice, as noted above for hawksbills, grows with each additional instrument drafted and attention should be paid to ensuring synergy with those that already exist as well as the means to effectively implement them.

Box 14.1 Defining drylands in policy terms

UNCCD definition of arid and semi-arid regions:

Areas, other than Polar and sub-Polar regions, in which the ratio of annual precipitation to potential evapotranspiration falls within the range from 0.05 to 0.65.

CBD definition of drylands and sub-humid lands:

Dry and sub-humid lands, including arid and semi-arid regions, grasslands, savannahs, and Mediterranean landscapes.

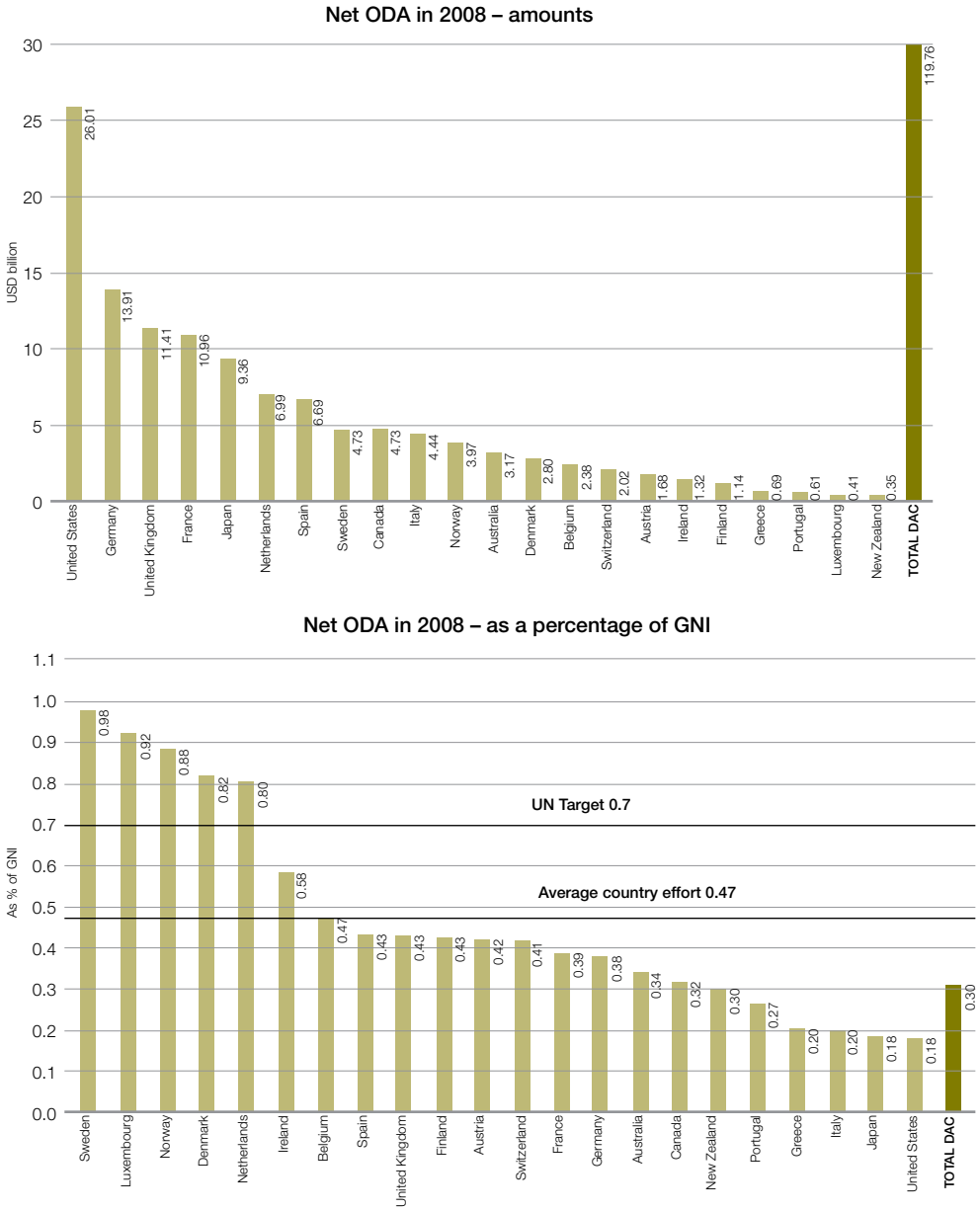


Figure 14.1 ODA trends (OECD, 2009)

CAPACITY TO IMPLEMENT

While harmonization will certainly be part of the answer, another aspect of international cooperation that must be addressed is capacity, both technical and financial, to implement existing commitments. This is a particular concern for developing countries which are expected to be full partners in coming to agreement during discussions at inter-governmental meetings but lack the underlying support and systems to participate fully in the negotiations or to implement the resulting decisions.

The Global Environment Facility (GEF) was created as the primary financial mechanism in support of the CBD. Between 1991 and 2006, the GEF provided about US$ 2.2 billion in

grants and leveraged about US$ 5.17 billion in co-financing in support of more than 750 biodiversity projects in 155 countries. These amounts are trifling in terms of overall needs for conservation. Effective global conservation has been estimated to require an investment of US$ 20–25 billion/year (James *et al.*, 2001) – a goal well within the means of today's financial systems that are spending billions to bail out banks.

In terms of financial capacity, given biodiversity's role in supporting human well-being, another avenue for support should be Official Development Assistance (ODA) to developing countries. In 2008, ODA was US$ 119.8 billion, representing only 0.3% of the combined Gross National Income (GNI) of the OECD Development Assistance Committee (OECD DAC) member countries, falling far short of the agreed 0.7% (OECD, 2009 – Figure 14.1). ODA is usually targeted at human development concerns (for example education or health) not conservation but the OECD DAC, in light of our increasing awareness of the dependence of vulnerable populations on the ecosystem services from their environment, has highlighted the role of sustainable natural resource management in "pro-poor growth" and recommended "providing development cooperation support for improved natural resource management" (OECD, 2008).

Five countries exceeded the United Nations target of 0.7% of GNI: Denmark, Luxembourg, the Netherlands, Norway and Sweden. The largest volume increases came from the United States, the United Kingdom, Spain, Germany, Japan and Canada. However, given the sudden change in the global financial climate during 2008, this level of investment may be difficult to maintain. On the other hand, as the environmental damage caused by the wealthy countries becomes more apparent, the developing countries who are disproportionately suffering from these damages have a stronger case to argue for support in maintaining (or regaining) healthy ecosystems (Srinivasan *et al.*, 2008). International payments for ecosystem services (PES) may be one important means for greening the world's economy and engendering international collaboration for conservation.

But any focus on ODA support for developing countries or GEF support for biodiversity conservation misses the reality that the most significant financial input into these countries comes from bilateral sources of investment. In 2007, almost US$ 2 trillion of Foreign Direct Investment (FDI) was reported by the United Nations Conference on Trade and Development (UNCTAD) of which US$ 500 billion was invested in developing country economies. The amount from FDI sources has grown to many times ODA although the amounts from year to year can be highly volatile and change rapidly, as happened during the fall of the Asian "tiger" economies in the late 1990s and is likely to continue in the coming few years as the financial fallout from credit failures around the world begins to take effect.

This foreign direct investment also reflects the significant number of bilateral agreements in existence. Crawford and Fiorentino (2005) report that Regional Trade Agreements (RTAs) are "a major and perhaps irreversible feature of today's multilateral trading system (MTS)". They suggest that the limited progress in multilateral trade negotiations under the Doha Development Round appears to have accelerated development of RTAs around the world and particularly in the Western Hemisphere and Asia-Pacific region (Figure 14.2).

POLITICAL WILL AND PUBLIC OPINION

Ultimately, the limiting factor for all international cooperation is political will, both to come to agreements on decisions as well as to support full implementation of those decisions.

Since 1992, the Asahi Glass Foundation has conducted a survey on environmental problems and the survival of mankind. The survey results for 2008 (Figure 14.3), including responses from 732 individuals in 81 countries, noted that 70% of respondents cited global warming as the main environmental concern followed by water shortages (50%) and loss of biodiversity (43%). The survey includes a measure of the awareness of the impact of the environmental problems facing humanity by an Environmental Doomsday Clock (moving towards midnight). In 2008, respondents in all regions with the exception of the Middle East and Asia, in choosing a time on that Doomsday Clock that corresponded to their level of concern about the deterioration of the environment, averaged a time of 21:33 which was an advance of 2 minutes towards midnight, the greatest year-to-year increase since the start of the survey (Asahi Glass Foundation, 2008).

To the extent that political will reflects public opinion, this limiting factor also involves effectively communicating environmental issues to the public. The time, effort and investment required to put climate on the political agenda need to be replicated for biodiversity.

For the environmental community, ensuring recognition of the role of conservation in non-environmental discussions is an important means to engage decision makers and engender that political will and strong public support. New ways of thinking about development and development aid mean that attention must be paid to poverty-reduction plans to ensure that the environment is routinely considered part of the mainstream of development. Clarifying the governance needs for achieving effective and equitable conservation and natural resource management, particularly at the community level, will be required. Donor interest in these aspects of governance was highlighted for example by the launching of the High-Level Commission on the Legal Empowerment of the Poor on the margins of the 2005 World Summit (UNDP, 2005).

Commitments made outside the biodiversity-related multilateral environmental agreements, including the World Summit on Sustainable Development (WSSD) commitment to the 2010 Biodiversity Target and beyond, may be critical to achieving both conservation and development in the future. Nevertheless, progress towards the implementation of the 2010 target, and the Millennium Development Goals (MDGs) in

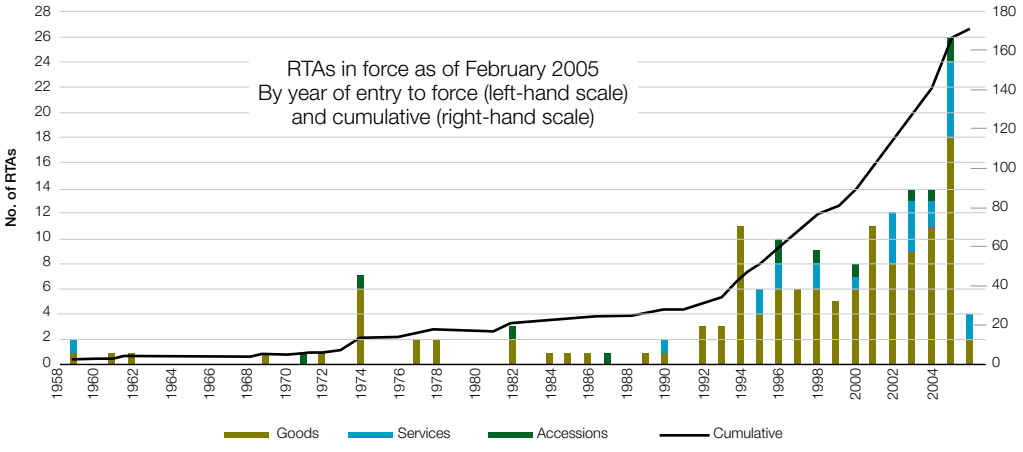


Figure 14.2 Regional Trade Agreements (Crawford and Fiorentino, 2005)

general, has been slow (Chapter 1). Achieving these targets requires unprecedented efforts from the international community.

In some cases, political will may be more easily achieved at regional or cross-border level. Already a considerable number of regional processes and institutions form an important part of the environment and sustainable development agenda. Examples of these include the Africa Convention, the Barcelona Convention, the Comisión Centroamericana de Ambiente y Desarrollo (CCAD), the Conférence sur les Ecosystèmes de Forêts Denses et Humides d'Afrique Centrale (CEFDHAC), the Pan-European Biological and Landscape Diversity Strategy, the New Partnership for Africa's Development (NEPAD), the Indian Ocean South East Asia (IOSEA) Marine Turtle Memorandum of Understanding, the Caribbean Environment Programme, the Amazon Treaty Cooperation Organization, and the Free Trade Area for the Americas (FTAA). The importance of these processes has been widely recognized by global-level diplomatic initiatives (e.g. WSSD, CSD, and the UN Forum on Forests) though governments are still struggling to find effective models of coordination and collaboration between global and regional levels. The general public is largely oblivious to these processes, suggesting that public support is often assumed rather than carefully built.

Mechanisms to create political and public will at more local levels include transfrontier conservation areas, such as the Greater Limpopo Transfrontier Conservation Area, and managing ecosystems at landscape scales (e.g. river basins), which often also means multinational cooperation and collaboration.

THE FUTURE OF INTERNATIONAL COOPERATION

The ongoing challenges of achieving synergy across legal instruments and capacity to implement them suggest that a more effective future of international cooperation requires a fresh look at current mechanisms and consideration of new approaches to achieving agreed goals.

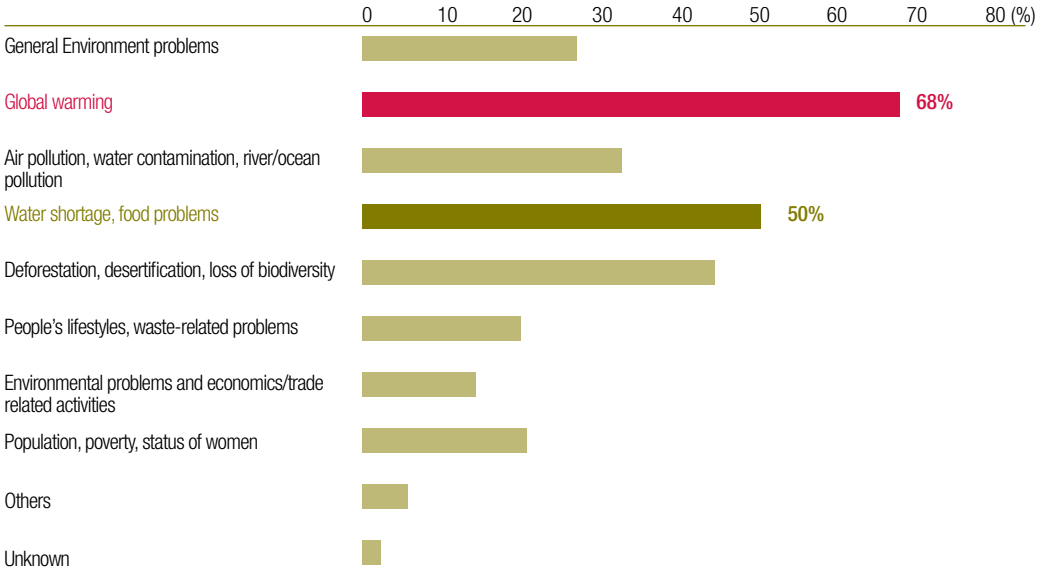


Figure 14.3 Respondents identifying important environmental issues in 2008 (Asahi Foundation, 2008)

One potential "quick win" would be to coordinate the objectives and outputs of the many major meetings in the coming decade relating to environment and development. From 2009 to 2015, numerous environment-related international gatherings of politicians (UNFCCC Conferences of Parties (COPs) 15 and beyond, CBD COPs 10, 11 and 12, Rio +20, MDG 2015) will be held in addition to the regular schedule for G8 and the World Trade Organization (WTO) (which should also address environmental issues). If the capacity invested in all these events separately could be focused on common objectives, there would be a stronger chance that integrated solutions addressing environmental, social and economic challenges could result.

The challenges of implementation and enforcement of environmental law (and international commitments in general) suggests re-considering the reliance on legal measures. It is not only the implementation and enforcement constraints, but also the legislative techniques which have been traditionally the source of environmental regulations which might need to be questioned. While remaining a central tool, legislation is increasingly being supplemented by softer measures, primarily economic instruments providing incentives to reach desirable goals. This includes concepts such as payments for ecosystem services (PES), which permit trade-offs through statutory or contractual arrangements between buyers and sellers of ecosystem services (Chapter 4). This trend also includes the use of rights-based approaches, which are expected to provide better leverage for enforcement of traditional approaches based on the responsibility of States to meet their commitments to their citizens and the health of the ecosystems upon which they depend.

New responsibilities and rights in environmental governance derive from a recognition that, increasingly, governments are not the dominant drivers of change. At the global level, the role of business (as evidenced through growing FDI) has important repercussions for both the environment and human well-being. Integrating the "softer" economic instruments supporting international conservation, such as payments for ecosystem services (Chapter 12), along with rights-based approaches and corporate social responsibility (CSR) will help bring the private sector on to the international conservation scene.

Many of the environmental problems facing humanity are global issues that require concerted international efforts for successful solutions. In the coming decade, the conservation community will need to promote synergies across the multilateral agreements and with any new instruments that might be developed. Supporting full implementation of the existing agreements through capacity building and engagement of all stakeholders, especially business, should be high on everyone's agenda. Finally, expanding the available tools from binding agreements and restrictive legislation to voluntary options and positive incentives should help to promote active engagement in conservation.

15. Working with the Private Sector

As banks fail, money markets freeze, and politicians bicker over the terms of a bailout (or buy out), more and more people are focusing on financial outcomes and economic stability for their own futures and less on perspectives such as the role of markets and business in biodiversity conservation. Yet it is becoming increasingly clear that markets and companies, once perceived as a conservation "problem" by environmentalists, will need to be an important part of the solution.

Businesses that are especially likely to have impacts on biodiversity fall within the following four categories:

- Large "footprint" industries (mining, oil and gas, construction, automotive and energy suppliers)
- Biodiversity-dependent industries (agriculture, forestry, fishing, hunting and wildlife trade)
- Financial services (banking, insurance investment and other financial intermediaries)
- "Green" enterprises (organic farming, low-impact logging, renewable energy, nature-based tourism, ethical traders).

Today, several approaches are being adopted by various parties, both business and non-business, in an attempt to transform business practices, commodity markets, and company and producer-association relationships, as part of efforts to achieve greater environmental sustainability.

During the Barcelona Forum, several business sectors provided a focus for discussion including fisheries (Chapter 17), energy (Chapter 7), agriculture (Chapter 20), extractive industries and tourism.

The nexus between extractive industries and conservation is highly emotive and has been the subject of intense concern on the part of IUCN Members over the years, especially with respect to the impacts on indigenous and local communities. The International Council on Mining and Minerals (ICMM) (2006) has developed Good Practice Guidance for Mining and Biodiversity which provides information across all operational stages and includes specific guidance on stakeholder consultations. Several Resolutions (WCC 4.084, 4.087, 4.088, 4.089 and 4.090) were adopted in Barcelona targeted at mining impacts on biodiversity at regional and global levels and specifically impacts on protected areas and on local and indigenous communities.

The United Nations World Tourism Organization (UNWTO) reported 924 million tourists travelled internationally in 2008 and forecast 1.6 billion international tourist arrivals by 2020 (UNWTO, 2009). The Global Sustainable Tourism Criteria (GSTC) Partnership, a coalition of 32 organizations including IUCN, has reached out

to close to 100,000 tourism stakeholders, analysed more than 4,500 criteria from more than 60 existing certification and other voluntary sets of criteria, and received comments from over 1,500 individuals to develop the Global Sustainable Tourism Criteria (GSTC Partnership, 2008). These represent the minimum standards that any tourism business should aspire to reach in order to protect and sustain the world's natural and cultural resources while ensuring tourism meets its potential as a tool for poverty alleviation (http://www.sustainabletourismcriteria.org). IUCN, in cooperation with Accor Hotels and the International Hotel & Restaurant Association, has also launched *Biodiversity: My Hotel in Action* guidelines for the sustainable use of biological resources in this sector (IUCN, 2008a).

In addition, an emerging sector of "biodiversity businesses" – commercial enterprises that generate profits via activities which conserve biodiversity, use biological resources sustainably, and share the benefits arising from this use equitably – is also gaining attention. Bishop *et al.*, (2008) argue that the current biodiversity challenge is to re-orient the economic incentives that drive private investment, production and consumption, and to make biodiversity conservation a viable business proposition in its own right.

The challenges that environmental degradation presents to all of these include water scarcity, climate change, habitat change, invasive species, overexploitation of oceans and nutrient overloading. The current market turmoil, alongside the urgent environmental challenges, makes it more relevant than ever to promote collaboration across the public and private sector and governments in protecting biodiversity and ecosystem services which are an integral part of many business operations (Box 15.1). Conservation organizations can help to put biodiversity action/management plans in place for large-footprint businesses, such as ongoing rehabilitation of mines. This approach not only minimizes impacts of mining on biodiversity, but also helps the company to attain a license to operate for its next development.

Box 15.1 WWF and Coca Cola – a water conservation partnership

In 2006, the Coca-Cola Company and its franchised bottlers used approximately 290 billion litres of water for beverage production, of which approximately 114 billion litres were contained in the beverages sold around the world, and another 176 billion litres were used in beverage manufacturing processes such as rinsing, cleaning, heating and cooling.

Coca Cola and WWF established a partnership in 2007 that works on both improving water efficiency and reducing the carbon emissions from the company's system-wide operations, and helps the corporation promote sustainable agricultural practices. In addition, Coca Cola and WWF will collaborate on projects to conserve freshwater basins.

Source: WWF, 2007

The primary objective of business is to make profit, but the private sector is increasingly recognizing the detrimental impacts on the environment of some of its activities and the fact that these impacts pose a risk factor to its own longer-term success. Businesses are finding that greater focus on "being green" can also enhance efficiency while smart business practices can make their operations greener and more likely to be successful. Indeed, sustainability-focused companies were found to have fared better during the recent financial crisis (AT Kearney, 2009). The potential benefits of business with a sustainable

development philosophy is one of the issues being explored by the World Business Council for Sustainable Development (WBCSD – www.wbcsd.org), a CEO-led, global association of some 200 companies that is examining the role of business in sustainable development.

Both demand and supply-side rationales exist for business to develop and implement Corporate Social Responsibility (CSR) programmes. As Lyon and Maxwell (2008) note, from the demand side, environment friendly products are a growth business, investors are driving companies to adopt "green practices" and employees prefer working for companies that "make the world a better place". From the supply side, environmental efforts often can be more cost effective than other options and also enhance longer-term access to resources needed for production. For example, convincing hotel guests to use less water as a benefit to conservation also saves on the hotel's water bill. Nevertheless, Margolis *et al.* (2007) reviewed the link between corporate social performance and corporate financial performance and found only a very small but still positive association.

Another measure businesses can take is engaging in voluntary environmental programmes, Depending on whether these programmes are self-monitored or externally evaluated, their impact on business is highly variable (Darnall and Sides, 2008).

Larger multinational corporations may have stronger incentives for "going green" because of the influence of the public spotlight on their activities and associated reputational risks but also because they have the capacity to make changes. A large company with poor environmental practices may be publicly criticized. Multinational companies have global standards to which they have to adhere. It is in this capacity as sector leaders that large companies have a positive role to play. They can offer procedures and guidelines, training and awareness.

A challenge for conservation organizations is how to get small and medium-sized enterprises (SMEs) involved. Often SMEs do not have the resources or capacity to undertake conservation efforts, or lack the international, or even national, reputation to make it worthwhile or politically necessary to do so.

New tools and mechanisms to help business engage constructively in conservation include both engagement in mitigation actions as well as proactive support for conservation. More discussion on tools for a green economy including offsets, payments for ecosystem services (PES), incentives and subsidies can be found in Chapter 12.

BUILDING RELATIONSHIPS WITH BUSINESS

IUCN has developed operational guidelines for working with the private sector (IUCN, 2009a) and has a history of such engagement. Conservation organizations cannot ignore or forget the private sector and its huge impact on biodiversity and ecosystem services. While advocacy has a role for awareness-raising and creating pressure for change, constructive engagement is another, complementary strategy. IUCN and other conservation organizations can influence, encourage and assist in improving business practices, with the objective of improving the policies and practices of entire industries. IUCN and many of its Members do this by working with industry players to improve environmental standards, and eventually government regulations. By engaging with one company, IUCN can create an entry point into an entire sector.

When contemplating whether to engage with corporations, conservationists must first

understand that businesses operate differently from non-governmental organizations (NGOs) and from governments. To build a relationship requires understanding of how it will create mutual benefit for both parties. The questions businesses face when considering working with a conservation organization are *what* are green partnerships, *why* be greener and *how* to be greener.

As with any other conservation organization that enters into a relationship with a business, IUCN must be a critical friend and not a rubber stamp. IUCN as a membership organization is governed by its membership, which is comprised of governments and NGOs. Many Members have voiced concern over such partnerships because of a perceived lack of transparency. Such relationships can also risk an NGO deviating from its mission and purpose. The main apprehension conservationists feel toward such arrangements is that they will be part of "green washing", where a company uses the conservation organization to imply positive conservation actions by the company that do not reflect reality. To avoid this from happening, it is essential that the "green" partner be professional, objective, and transparent in its dealings with private sector partners. Seen from the private sector viewpoint, this is vital as well, as it ensures the credibility of its partner; if the "green" partner is not credible then the relationship loses its value.

> "A "green" partner needs to be professional, objective and transparent in its dealings with private sector partners."

Working with the private sector can be controversial and caution is needed, but many of IUCN's NGO Members have already entered into productive relationships with the private sector, in all parts of the world. IUCN's government Members typically are supportive of NGO-business collaboration because they believe both parties can benefit, thereby delivering better conservation and better business practices. The initial benefit NGOs feel when engaging in these types of agreements is the power businesses have to influence stakeholders and thus contribute to conservation on a vast scale. This power and influence can be seductive and the relationship can easily devolve if both the NGO and the business do not maintain rigorous guidelines. If they do not do so, the long-term benefits of the engagement will be lost, devaluing the reputations of both parties.

The easiest type of relationships that conservation organizations can undertake with businesses are often related to sponsorship arrangements, including logos, but engaging in such relationships leaves organizations vulnerable to "green washing". Similarly, conservation organization support for CSR programmes of businesses (meaning self-generated actions above and beyond legal requirements for social and environmental safeguards), has been criticized as those organizations aiding in "green washing" the corporation because CSR is a voluntary programme focused on sustainable practices and does not necessarily mean integrating conservation into the business, nor is it necessarily integrated into overall business practices or business decisions.

More involved relationships can range from joint venture conservation projects to technical support and reviews of companies' activities. For example, since 2004 IUCN has worked with Sakhalin Energy of Russia, a consortium of Gazprom, Shell, Mitsui and Mitsubishi, to

provide advice and recommendations on how to minimize risk with oil and gas development to whales and at least part of their habitat. A major part of this work has been the creation in 2006 of the Western Gray Whale Advisory Panel (WGWAP), a panel of independent scientists that provide scientific advice on the company's operational plans. The panel was a successful partnership, convincing the company to re-route underwater pipelines to avoid whale feeding areas based on IUCN advice. More recently, the recommendations of the WGWAP regarding seismic activity disturbing whale populations have resulted in the seismic surveys in the area being stopped (IUCN Press release 24 April 2009 – http://www.iucn.org/about/work/programmes/marine/marine_news/?3069/Stop-all-oil-and-gas-activities-that-could-harm-Western-Gray-Whales-says-panel).

BENEFITS OF A CONSERVATION/BUSINESS COLLABORATION

Collaboration between the private sector and conservation organizations can promote design innovation and technical solutions for both business and conservation. Conservation

“Collaboration between the private sector and conservation organizations can promote design innovation and technical solutions for both business and conservation.”

organizations can help corporations improve their operational performance from an environmental perspective. This could be through biomimicry design of products or buildings, advice on emissions reductions, operational efficiency, or alternate energy sources and technologies. Creating a greener (and more efficient) supply chain can have numerous positive side benefits, especially for large corporations. A sustainable supply chain passes environmental standards and environmental criteria from the company down to suppliers, as part of criteria in their requests for proposals and standards from suppliers of raw materials. Environmental standards enable corporations to create stronger relationships with suppliers, along with health, safety, and quality. Integrating conservation considerations early in project or site design will pay off in the long term.

On the other hand, conservation organizations can benefit from advice from the private sector on project management, public relations, financial management, and design of complex operations. For conservation organizations, the challenge, in terms of supply chains, is determining where its advice can be most helpful in bringing about conservation and how far down the chain can conservation standards be passed from subcontractor to subcontractor, and to what level in the supply chain is a corporation responsible.

FUTURE CHALLENGES

Once a corporation has determined to make its operations greener, what operational changes are needed and how can a conservation organization best contribute? How can private interests best be reconciled with the public good?

The need for stronger corporate social and environmental responsibility and government regulations to guide the private sector is broadly accepted in the environmental sphere as in the world's financial markets. The real question is what kind of voluntary initiatives or regulations will ensure outcomes that meet the dual requirements of conservation and profitability.

Many corporations are interested in partnering with conservation organizations to realize better environmental impacts, or cost savings. Few, however, are interested in making fundamental and potentially disruptive changes in their business practices. Companies are willing to enter into partnerships with environmental organizations to improve their practices, but most discussions are more about improved practices rather than new practices.

Partnerships between conservation organizations and the private sector can help make business greener. But until green business becomes the norm and competition between businesses based on green criteria forces corporations to make deep and fundamental changes, the number of businesses that are truly "green" will remain modest. To support the transition to "green business", conservation organizations and the private sector will need to develop a common language for valuation of the many roles that biodiversity may play in business. In the long term there will be a need for growing recognition on the part of business of the issues; and leadership will be required from within the business community. Concurrently, there will be a need for increased dialogue between companies, civil society and regulators.

16. Forest Systems: Seeing the Forests and the Trees

Forests contain the most species of any terrestrial ecosystem and 75% of Centres of Plant Diversity are found in forests. While according to the Food and Agriculture Organization (FAO), global forest cover is increasing very slightly (3.95 billion hectares in 2005 compared to 3.86 billion hectares in 2000), the figures include plantations and regeneration of temperate forests. If plantations are excluded, the deforestation rate has continued at about 13 million hectares per year during the period 1990–2005, with few signs of a significant decrease over time (FAO, 2005). Meanwhile, at the individual species level, the 2008 *Red List of Threatened Species* reports that 172 of 620 species (28%) of conifers are threatened with extinction (IUCN, 2008d).

The *State of the World's Forests 2009* (FAO, 2009a) paints a diverse picture of issues for forests globally. While forest area is projected to stabilize in developed Asia, North America, and some parts of West and Central Asia, forest loss is expected in much of Africa, and South America, although for the latter planted forests are expected to increase. Increasing awareness of the wide variety of services provided by forests, especially those relating to climate change mitigation and adaptation, is bringing new audiences and potentially new investment to sustainable forest management. The report notes continuing innovation in the forest sector but a developed/developing country gap in access to those innovations. Finally the report questions what impacts the economic crisis of 2008/2009 will have on forests globally and whether or not a "green path" to development will be taken that supports sustainable forest management for the future.

This decline in forests globally is a problem for everyone, especially the rural poor. In 2004 Vedeld *et al.* reported that forests provided 22% of income for rural families in 17 countries across three continents. The majority of the income came from wild foods and fuel wood with fodder, timber, thatch and wild medicines also occupying an important place. Forests, and the many services they provide, are truly an important part of the wealth of the poor.

Forest conservation today is focused on managing at landscape scales, supporting improved law enforcement and governance of forests, applying ecosystem approaches and promoting dialogues and partnerships that enhance the role of forests in underpinning livelihoods for local communities. Each of these themes has figured high on the forest agenda and received due attention at the Barcelona WCC.

FUNCTIONAL FORESTS THROUGH FOREST LANDSCAPE RESTORATION

Forests, with their rich array of biodiversity, provide a vast number of goods and services in support of human well-being. However, maintaining those services requires an approach that looks beyond the trees to a broader vision of land use that supports environmental, social, cultural and economic benefits for people. Within the conservation world, sustainable forest management (SFM) has been broadly adopted. Sayer and Maginnis (2005) have proposed ten tenets of good practice for SFM (Box 16.1).

Ecosystem approaches, SFM and forest landscape restoration have evolved to go beyond biophysical characteristics and include social, political and other components of the system (Sayer *et al.*, 2007). Forest landscape restoration operates at a scale that incorporates all surrounding land types, creating a mosaic of forests, woodland, agricultural land, protected areas, and settlements within which planning and implementation occur and that incorporates participation of all relevant stakeholders based on the multiple uses of that landscape to support livelihoods (Fisher *et al.*, 2008).

The unifying concept in these approaches is the idea of integrating conservation and development. Often a large task for conservationists is convincing local communities that the long-term benefits of conservation will

Box 16.1 Ten tenets of good practice for sustainable forest management

1. There is no single ecosystem approach, but multiple ecosystem approaches that need to be adapted and applied pragmatically in each situation.
2. People are part of ecosystems – jobs, livelihoods and wealth-generation are as important as the birds and the monkeys.
3. All environmental management must be adaptable: we manage, learn, adapt and manage again.
4. Ecosystem approaches require tools that measure the performance of the whole system, including both environmental gains and people's livelihood improvements.
5. Clear and defendable land rights, democratic institutions and the rule of law are important elements of an enabling environment for ecosystem approaches.
6. Forestry professionals must be eclectic, have excellent inter-personal skills, and earn the respect of all stakeholder groups.
7. Science does not provide the answers but it helps us to learn from mistakes, adapt and explore innovative options.
8. The soft side of ecosystem approaches is more important than the hard side. These approaches are not just another formula – they entail new attitudes, approaches, sets of competencies and a broadened range of skills.
9. Many elements of ecosystem approaches are not directly under the control of forest departments, so these agencies have to learn to exert influence and broker deals with other stakeholders.
10. Ecosystem approaches will not make conflicts disappear; they can make trade-offs more explicit but there will always be winners and losers. Ecosystem approaches can help reduce the power differentials between stakeholders and lead to more equitable outcomes, ensuring that society in general and specific stakeholder groups in particular are winning more and losing less.

Source: Sayer and Maginnis, 2005

outweigh the short-term benefits of harvesting forests. Sayer *et al.* (2007) propose planning projects that include indicators based on the five capital assets (financial, social, physical, human, and natural capital) as a means to ensure the perspectives of local people as well as conservation are linked together.

Integrating traditional knowledge into the design and implementation of projects is crucial for maintaining interest in projects in the short and medium term. Conservationists need to consider very carefully the social and environmental implications of projects, such as land tenure rights, good governance needs, indigenous people's rights, and corruption. Ignoring root causes of deforestation, which are usually social causes, was one of the largest reasons for the failures of early forest conservation plans.

So what are the future directions for conservation action in forest landscape development? One is new opportunities and threats driven by agricultural and agro-industrial expansion and economic uncertainty. Numerous recent studies have sought to identify the threshold by which it becomes more profitable for forest dwellers to clear land for agriculture than to maintain forest on their land (Box 16.2). Conditions promoting such deforestation include rising global prices for food like soybeans and beef as well as the increasing accessibility of forests as transport infrastructure improves. In addition to assessing cost/benefits over long enough time frames other techniques that can support SFM include certification systems, reduced impact logging, and financial instruments such as payments for ecosystem services (PES).

Box 16.2 Forest versus agriculture – the case of the Mabira forest reserve

The Mabira forest reserve, on the shores of Lake Victoria in Uganda, hosts valuable wildlife, serves as a timber resource, provides ecosystem services for the water balance, and the rainforests represent a tourist destination. Following a proposed plan for clearing one-third of the reserve for agricultural use, the values of the forest were calculated by local researchers. This economic evaluation of the forest shows that, from a short-term perspective, growing sugar cane would lead to more economic benefits than maintaining the forest reserve, with a return of US$ 3.6 million per year in contrast to US$ 1.1 million per year for conservation. However, sugar cane production is only optimal during a short time span of five years. When comparing both land-use alternatives over the lifetime of the timber stock, 60 years, the benefits from the forest, and the ecosystem services it provides, exceed those of the sugar cane planting.

Source: Environment Times #5, http://www.grida.no/publications/et/ep5/page/2351.aspx

FOREST LAW ENFORCEMENT AND GOVERNANCE

Failure of governance mechanisms for forest resources is at the heart of problems relating to SFM. The World Bank (2006) estimates that losses to governments from illegal logging amount to US$ 10 billion per year, many times the amount of Overseas Development Assistance (ODA) invested in SFM. In addition, an estimated US$ 5 billion is lost annually from uncollected royalties and taxes from legally sanctioned harvests due to corruption. The millions of people who depend on forest resources for their livelihoods are the ultimate losers.

At the World Conservation Congress (WCC) held in Amman in 2000, IUCN Members recognized the impact of corruption in the forest sector and the need to support better governance

(Resolution WCC 2.039) (IUCN, 2000a). Many countries and regions are now trying to address the issue of forest crimes and its consequences through engagement in Forest Law Enforcement and Governance (FLEG) processes.

The G8 Action Programme on Forests (1998) identified illegal logging as a key obstacle to sustainable forest management. The Programme provided an important incentive to increase actions against illegal logging. As a result, three regional Forest Law Enforcement and Governance (FLEG) ministerial conferences have been organized, namely, the East Asia FLEG (EA FLEG) in September 2001 in Bali, Indonesia; the Africa FLEG in Yaoundé, Cameroon in October 2003; and the Europe and North Asia FLEG in St. Petersburg, Russian Federation in November 2005. All three FLEG conferences brought together governments, industry, non-governmental organizations (NGOs) and researchers from countries both inside and outside the region to improve governance and foster international dialogue on illegal activities in the forest sector, as well as to establish frameworks that enable producer-country governments to work with one another to improve linkages and harmonize regulations, and with governments of consumer countries to tackle illegal logging and trade practices. The conferences resulted in higher political attention for illegal logging and in a range of national and international initiatives by governments, private sector and NGOs to tackle the problem.

An important initiative came from the European Commission (EC) when it approved an Action Plan on Forest Law Enforcement, Governance and Trade (FLEGT) in 2003. The plan was approved by the member countries in the same year. This Action Plan aims to exclude illegal timber from entering the European Union (EU) market through strategies including the implementation of voluntary partnership agreements (VPAs) with producer countries. These agreements will put in place in each country a licensing system for legal timber that would be allowed to be imported by EU member countries thus keeping unlicensed and possibly illegal timber products from entering the EU market. As of May 2009, a VPA has been initialled with Ghana and negotiations are near complete with Congo (Brazzaville) and Cameroon. Negotiations are ongoing with Malaysia and Indonesia and will start with Gabon later in 2009. The EC is also engaged with China, Vietnam and other countries to address illegal logging in other ways.

Other strategies employed or under discussion include procurement policies and additional legislation to prevent illegal timber from entering consumer markets.

Lessons emerging from these initiatives include:

- Illegal logging is both a result and a symptom of poor forest governance, and actions to promote improved law enforcement will need to be accompanied by more fundamental forest governance reform to address the underlying causes of illegal logging.
- "Legal" logging is not necessarily part of "sustainable and equitable" forest management. IUCN's aim is to put in place forest governance arrangements that promote sustainable and equitable forest management.
- Actions to address illegal logging and broader forest governance reform need to be based on effective multi-stakeholder processes to increase the quality of the decisions and to enhance societal support for their implementation.
- Effective multi-stakeholder processes that accompany initiatives to address illegal logging, such as the VPAs, have the potential to become a springboard to address broader forest governance reform.

- Recent experiences with forest governance reform in the context of FLEG(T) and associated multi-stakeholder processes are providing valuable inputs to the discussions about the forest governance arrangements to underpin Reducing Emissions from Deforestation and Degradation (REDD) schemes.

FOREST-BASED PARTNERSHIPS IN SUPPORT OF LIVELIHOODS

Forests provide multiple goods and services to multiple stakeholders. This has to be reflected in the way forested landscapes are managed and conserved, but can only be done equitably when all relevant voices are heard. Partnerships are therefore crucial for needs and perspectives to be shared, and for synergies to be found. In this context, an approach to the governance and management of forests from a single issue perspective is counterproductive – if those with a legitimate interest in forests do not have a say in the future of forest landscapes, they are likely to undermine attempts to make progress. An assumption that forests are "for carbon sequestration" or "for biodiversity conservation" cannot be allowed to deflect attention from the goods and services they provide to rural people, a disproportionate number of whom count on such resources for basic livelihood support. Neither is it enough to assume that simplistic conservation and development "win-win" scenarios can be attained in such a setting. Satisfying multiple competing voices means negotiating trade-offs, which is best done in a spirit of collaboration and partnership.

The Tropical Forest Dialogue, whose secretariat is at Yale University, has been fostering dialogue processes since its inception in 1998. It takes as its premise that it should build trust among the different groups participating in dialogues, and provide them with tools, ideas and an environment in which they can form their own partnerships. Such partnerships need not necessarily result in toothless compromise; creating consensus in itself can be radical. IUCN has contributed to Intensively Managed Planted Forests: towards best practice and beyond REDD – the role of forests in climate change, a consensus-based statement on forests and climate change.

The Collaborative Partnership on Forests (CPF) is a voluntary arrangement among 14 international organizations and secretariats with substantial programmes on forests (CIFOR, FAO, ITTO, IUFRO, CBD, GEF, UNCCD, UNFF, UNFCCC, UNDP, UNEP, ICRAF, WB, IUCN)[3]. The CPF's mission is to promote the management, conservation and sustainable development of all types of forest and strengthen long-term political commitment to this end. Increasingly, CPF members work together in projects and mobilize resources supporting countries to achieve their forest-related goals and supporting implementation of sustainable forest management (FAO, 2009b).

In 2007 the World Bank proposed creating a Growing Forestry Partnership (GFP) Initiative that links local and global processes and promotes decision-making on the international stage to reflect the views and needs of forest dwellers. The World Bank then asked the International Institute for Environment and Development (IIED) to conduct an independent assessment of its proposal with a broad range of stakeholders. More than 600 forest experts responded to IIED's assessment, or participated in focus groups in Brazil, China, Ghana, Guyana, India, Russia and Mozambique, as well as international meetings.

[3] Long forms of these organizations are the following: CIFOR – Center for International Forestry Research; FAO – Food and Agriculture Organization; ITTO – International Tropical Timber Organization; IUFRO – Global Network for Forest Science Cooperation; CBD – Convention on Biological Diversity; GEF – Global Environment Facility; UNCCD – United Nations Convention to Combat Desertification; UNFF – United Nations Forum on Forests; UNFCCC – United Nations Framework Convention on Climate Change; UNDP – United Nations Development Programme; ICRAF – World Agroforestry Centre; WB – World Bank.

IUCN has also taken a leading role in the GFP. This initiative, supported by FAO and the World Bank, aims to make forestry truly sustainable by building and strengthening new partnerships that reflect local needs and protect global public goods. In its specific focus on being led from the ground up, it differs from and complements CPF. IUCN's immediate GFP focus is on developing partnerships in Mozambique, Ghana and Guatemala.

An interesting advance taken by certain NGOs is helping local communities build capacity in business development. Forest Trends, an IUCN Member, has developed a Business Development Facility to provide technical assistance to forest operators in assessing, identifying and developing opportunities for non-timber revenue streams to maximize the value of the forest, including carbon sequestration, watershed conservation, and biodiversity conservation. Conservationists can support forest dwellers in shifting from a "single asset approach" where cut timber is seen as the only real value of forests, to a "multiple asset approach" that diversifies livelihood improvement opportunities by capitalizing on non-timber products and services and supporting access to markets.

FORESTS AND CLIMATE CHANGE

Chapter 5 highlights the role of forests in mitigating climate change through REDD. In addition to REDD, forests present another climate change opportunity. Degraded forest lands currently cover an estimated 800 million hectares. Although their carbon stocks are significantly depleted, these lands often retain sufficient forest cover to exclude them from being classified as deforested and therefore available for reforestation funding under the Kyoto mechanisms. The Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report estimates that the restoration of these lands could account for approximately 117 million tonnes of carbon dioxide equivalent (calibrating other greenhouse gases to carbon dioxide) until 2030. This is equivalent to one-and-a-half times the estimated potential available from avoiding deforestation until 2030. The restoration of degraded forest lands offers a triple climate benefit: avoided emissions from halting ongoing degradation; significant additional sequestered carbon through restoration; and landscape-wide climate adaptation benefits with respect to the provision of restored ecosystem services, such as improved hydrological cycle regulation.

17. Marine Systems: Directing Conservation to the Sea

After many years of being largely overlooked, despite representing the vast majority of the planet's surface, the marine realm is now commanding attention. As terrestrial resources become increasingly scarce, the world looks to the seas for solutions. As terrestrial solutions to climate change mitigation become more challenging, policy makers ask how the oceans can help.

Among the most urgent of the many issues to address from the marine perspective are the impacts of increasing concentrations of CO_2 and other greenhouse gases (GHG) and overfishing. As we struggle to address these, two key tools that must be refined and adapted to oceans include governance of marine resources in areas beyond national jurisdiction and spatial planning, including marine protected areas (MPAs).

OCEANS AND CLIMATE CHANGE

The oceans play a crucial role in regulating the world's climate, as well as providing food and income for billions of people across the globe. As the world's climate changes at an unprecedented rate due largely to anthropogenic GHG emissions, evidence of impacts on marine and coastal environments can no longer be ignored. Effects such as warming oceans, increasing water acidity, coral bleaching and rising sea levels are already being observed, and are having serious consequences on marine biodiversity and human societies. Improved understanding of climate change as well as how it interacts with and exacerbates many direct stresses, such as pollution and overfishing, and applying this knowledge to climate change mitigation and adaptation have thus become priorities for the international community.

Oceans will be both the victim of and potential solution to climate change impacts. Coral reefs are one of the world's most vulnerable ecosystems to climate change, and can be considered the "canaries in the climate change coalmine". The 2008 report on the status of the world's coral reefs found that 19% of coral reefs had been lost with a consequent impact on 500 million people who depend on those reefs for their livelihoods (Wilkinson, 2008). But it isn't just reefs that are showing signs of the impacts of climate change. Mangroves and other coastal ecosystems are particularly vulnerable to rising sea levels. Higher sea temperatures and changes in acidity are affecting sea grasses which are used for traditional medicines, furnishings and roofing for houses, as well as providing essential habitats for numerous species, ranging from fish to dugongs.

Fisheries, and communities dependent on them, will also certainly feel the impacts of climate change. Alison *et al.* (2009) compared

the vulnerability of 132 national economies to potential climate change impacts on their capture fisheries and determined that Malawi, Guinea, Senegal, Peru, Colombia, Bangladesh, Cambodia, Pakistan, and Yemen were the most vulnerable. This vulnerability was due to the combined effect of predicted warming, the relative importance of fisheries to national economies and diets, and limited societal capacity to adapt to potential impacts and opportunities.

In terms of watery solutions to the threats posed by climate change, one attracting much attention is that of geo-engineering the oceans. Phytoplankton play a key role in making the oceans the world's largest carbon dioxide sink, and proposals to "geo-engineer" the oceans and increase carbon absorption include stimulating algal blooms through the addition of iron and other nutrients to capture CO_2 or by directly "injecting" CO_2 into the geological structures under the seabed, a process known as carbon capture and storage (CCS) (Victor *et al.*, 2009). Many heated discussions about the potential of the oceans to help with climate change mitigation cannot overcome the fact that we still know very little about oceanic biochemical processes and capacity to absorb CO_2. While some studies show that ocean fertilization does stimulate plankton blooms it is unclear whether the transport of carbon to ocean sediment is effective, and impacts of such activities on the marine environment, plankton feeders such as whales, and the global climate remain unknown and unpredictable. Before considering the sale of carbon offsets for fertilization projects, further research is needed to assess the risks to our oceans, and large-scale fertilization activities require extreme caution. Similarly, the energy and cost-efficiency of CCS are not proven, and the potential implications of leaking are severe. Lastly, regulatory frameworks for neither ocean fertilization nor CCS are presently sufficient, and neither activity actually contributes to reducing manmade CO_2 production.

OVERFISHING

The Food and Agriculture Organization's (FAO) *State of World Fisheries* report (FAO, 2008a) repeated the findings of its 2007 report but, while a stable situation over the past two years is a positive sign, the fact remains that the majority of the world's fisheries are already fully exploited and an additional 28% are overexploited. The report confirms that, in 2006, capture fisheries and aquaculture provided more food fish than ever before, with a growing proportion of those fish coming from aquaculture. Progress has been minimal on tackling the main factors resulting in overfishing; including managing by-catch, over-capitalization of the world's fishing fleets, control of illegal fishing, and mitigating the damage done through some fishing methods such as bottom trawling and cyanide fishing.

The FAO report does not mention some of the other serious findings coming to light in recent years. Some 26% of northeast Atlantic sharks and rays are threatened with extinction due to excessive fishing of these slow-growing species (Gibson, *et al.*, 2008). Many seabirds, in particular albatrosses, are threatened by fishing activity as they can be part of the by-catch, although changes in the Hawaiian longline tuna fishery methods have resulted in a 67% decrease in seabird by-catch (Gilman *et al.*, 2008). Another disturbing consequence of years of overfishing, especially for fish such as cod, is the finding that some fish populations, within a decade of a population crash due to overfishing, are now maturing at smaller sizes and earlier ages (Fudge and Rose, 2008). Modern fishing practices are resulting in evolutionary-scale change much more quickly than we might have imagined.

Political will to manage fisheries seems to be in short supply. One of the more

disappointing events recently was the decision taken in November 2008 by the International Commission for the Conservation of Atlantic Tunas (ICCAT) to endorse a quota for North Atlantic tuna that exceeds the recommended fishing level, proposed by its own scientific advisors, by almost 50% (IUCN, 2008c). The population of Bluefin Tuna has reached a critically low level, with all scientific advice agreeing on the need for a drastic reduction of fishing levels and a fishing closure during the spawning season to allow the stock to recover. Short-term economic and employment objectives are trumping the longer-term needs of ecosystems that underpin those objectives. It puts into question the role of regional fisheries management organizations and their ability to manage the resources on the high seas for a sustainable yield. On a smaller scale, however, some successes in fisheries management are being documented through the use of "catch shares" allocations to private fisherman, essentially a rights-based approach to resource management (Costello *et al.*, 2008).

As if dealing with the impacts of short-sighted management decisions were not enough, new findings on climate change-induced shifts in the distribution and abundance of fish and invertebrates of commercial interest are now available and suggest that warmer-water species are shifting to higher latitudes and fish productivity is likely to decline in lower latitudes (i.e. most tropical and subtropical oceans, seas and lakes) (FAO, 2008b). While such ecological changes may have positive impacts in northern countries, they will obviously reduce fishing catch potential in tropical nations. In addition, tropical and polar oceans, as well as semi-enclosed seas, are predicted to be the most vulnerable to invasion by non-native species and shifts in species distribution. Due to their high dependence on fisheries for livelihoods and their limited capacity to adapt to climate change, poor coastal nations in the tropics, particularly in Africa, Asia and north-western South America, will be most affected by climate change impacts on fisheries. Management responses are needed, but these need to be carefully considered to balance trade-offs between fisheries management, biodiversity conservation and management of other human activities at sea for the long-term benefit of all.

GOVERNING WHERE NO GOVERNMENT GOVERNS

The world's ocean needs to be considered as a whole and building bridges among the multiple stakeholders of the ocean and ocean resources – while representing a significant challenge – is also the only reasonable path forward. Uncoordinated, sectorally-focused governance and management regimes are not suited to appropriately address the multiple threats to the marine environment, or to assess cumulative impacts of activities or the impact of one activity on the other. And they are not suited to addressing the particularly thorny issue of governance beyond national jurisdiction – namely the high seas.

Nevertheless, marine issues are receiving significant political attention each year in the United Nations and present a tangible, near-term opportunity for conservation policy results. The United Nations General Assembly is addressing illegal, unregulated and unreported (IUU) fishing, bottom trawling, sea mount and other vulnerable marine ecosystem conservation, deep seabed genetic resources, and area-based management measures beyond national jurisdiction, while the Convention on Biological Diversity (CBD) is dealing with marine conservation issues within national jurisdiction including MPAs and providing scientific and technical advice with respect to MPAs beyond national jurisdiction,

including the identification of ecologically and biologically significant areas and the design of representative networks of MPAs.

The World trade Organization (WTO) is also negotiating reform of fisheries subsidies, mainly in response to concerns about unsustainable exploitation and environmental impacts (e.g. by-catch). These issues will remain politically and technically important for the foreseeable future. The London Convention (LC) has developed regulations with respect to sub-seabed sequestration of CO_2 and is developing an assessment framework for scientific research activities involving ocean fertilization. The parties to the LC have called on States to refrain from ocean fertilization activities and have meanwhile issued a resolution stating that ocean fertilization activities other than "legitimate scientific research" are contrary to the aims of the London Convention or its Protocol, do not currently qualify for any exemptions, and should not be allowed.

To spur international discussion about reform, at the World Conservation Congress in Barcelona, 10 Principles for modern high seas governance were launched that reflect fundamental principles that nations have adopted in various treaties and declarations but have largely failed to implement on the nearly 50% of the planet that lies beyond any individual nation's jurisdiction (Box 17.1). These approaches are designed to stimulate progress by identifying common guidelines for action.

Box 17.1 Ten principles for high seas governance

1. Conditional freedom of activity on the high seas
2. Protection and preservation of the marine environment
3. International cooperation
4. Science-based approach to management
5. Public availability of information
6. Transparent and open decision-making processes
7. Precautionary approach
8. Ecosystem approaches
9. Sustainable and equitable use
10. Responsibility of States as stewards of the global marine environment

Source: http://cmsdata.iucn.org/downloads/10_principles_for_high_seas_governance___final.pdf

MARINE PROTECTED AREAS (MPAS)

Although the global coverage for terrestrial protected areas is at ~12%, for the marine realm coverage is at less than 1% – a paltry measure considering that 71% of the planet is ocean. MPAs, when effectively designed, managed and enforced, can deliver many ecological and socio-economic benefits as well as build resilience of marine ecosystems in the face of increasing global pressures, especially climate change. Yet, at the current pace, the globally agreed goal of protecting 10% of the world's oceans by 2010 will not be met before 2060 – a time when many marine species, especially of high commercial value – might have already disappeared. The IUCN World Commission on Protected Areas (WCPA) will include a focus on improving tentative lists for marine World Heritage sites as well as developing approaches to improve the effectiveness of management for existing marine sites.

Several global assessments have concluded that well-managed MPAs, grounded in in-depth knowledge of the local context, can be highly beneficial to local communities in addition to achieving conservation goals. Effective MPAs have been demonstrated to help improve productivity of neighbouring fisheries, increase

and diversify economic opportunities for local people, support recognition of traditional fishing rights and other users' rights, and resolve local conflicts. MPA networks also serve an important role in increasing ecosystem resilience and can promote adaptation to climate change.

To be effective, networks of marine protected areas must be ecologically coherent and should be embedded in integrated ocean management frameworks that address the range of human activities and impacts both within and beyond the protected areas. An effective and representative MPA network requires current spatial and temporal information about the marine realm. The launch of the MPA layer on Google Earth, accessible to hundreds of millions of users, as well as a user-friendly global MPA web portal at www.protectplanetocean.org should be able to draw interest and support sharing of information amongst governments, conservationists, practitioners and the public alike to achieve that increased knowledge. Decisions about where to establish new MPAs need to be supported by relevant information on species, habitats and livelihoods across the oceans. Initial efforts have already been made to pull together species information and habitat data for optimized MPA planning, marking an innovative new partnership of experts for conservation.

THE FUTURE OF OUR OCEANS AND SEAS

It is evident that increasing concentrations of CO_2 and other greenhouse gases (GHG) and related changes in the Earth's climate as well as ocean chemistry pose a significant threat to ocean and coastal ecosystems. This threat needs to be addressed in the context of the many direct drivers of change, including overexploitation and pollution, most of which are exacerbated by climate change.

While the threats facing the marine environment in some respects are similar to those facing terrestrial habitats, the solutions must be rooted in an understanding of and carefully address the differences marine work faces. In addition, there is an urgent need for global agreement on management strategies in areas beyond national jurisdiction as well as the need to apply rights-based approaches to fisheries management and to meet internationally agreed targets on effectively-managed and ecologically coherent networks of MPAs.

18. Dryland Systems: It's about Water

IUCN considers drylands as tropical and temperate landscapes and regions with an aridity index value of less than 0.65, which includes the following dryland sub-types: dry sub-humid, semi-arid, arid, and hyper-arid (deserts) (IUCN, 2008b). Such drylands constitute approximately 40% of the terrestrial surface of the planet, and can be found in both developing and developed countries. At least 30% of the world's cultivated plants originated in drylands, and drylands are home to 47% of endemic bird areas and 26% of protected areas worldwide.

IUCN has an inclusive approach to mosaic dryland landscapes, and so includes urban and wetland areas within dryland regions and landscapes. However, for the purposes of IUCN's programmes of work on drylands, Arctic and Antarctic dry areas are excluded, as these are areas where temperature rather than water availability limits biological productivity. In addition, IUCN also includes seasonal drylands in the scope of its drylands work, specifically grasslands where their range and species composition are determined by water scarcity.

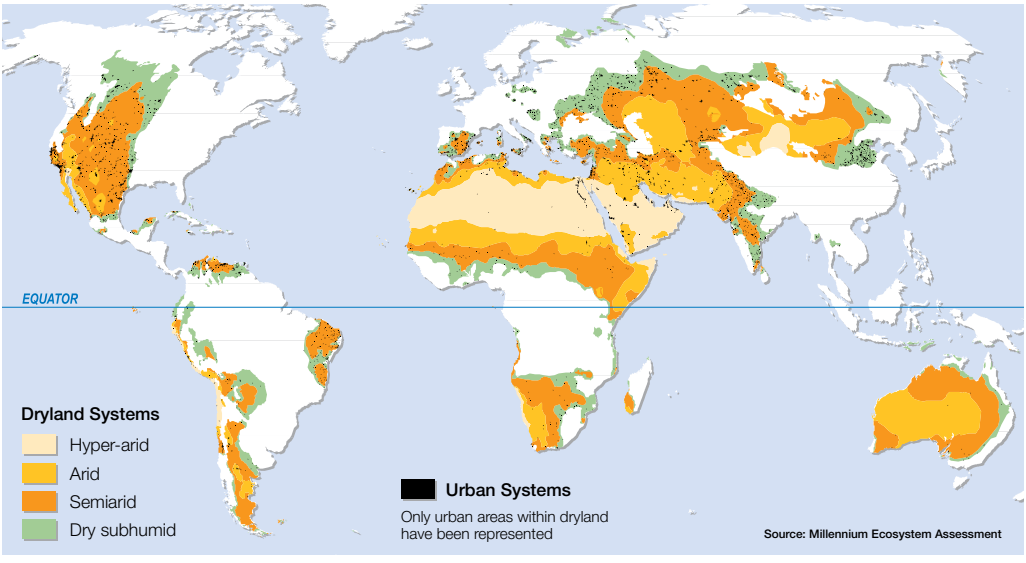


Figure 18.1 Distribution of the world's drylands (MA, 2005a)

Biodiversity in drylands is well adapted to harsh conditions and drylands are significant locations for endemism around the world. Species' adaptive strategies range from the architectural wonder of termite mounds which insulate the colonies from extreme temperatures to the desert amphibians which burrow into the sand and remain dormant until rains come. Indeed, some of these strategies have been the source of important discoveries in support of improving human livelihoods. Nevertheless, with changing climate and increasing human demands on these dryland systems, the special biodiversity living here is under increasing threat.

Drylands are home to some of the most charismatic species, support high species endemism and comprise many unique ecosystems and biomes, including Mediterranean-type ecosystems, grasslands, savannahs, dry forest, coastal areas, deserts, fynbos and the succulent Karoo (the latter two being highly distinctive vegetation types unique to southern Africa) (Zeidler and Mulongoy, 2003; White *et al.*, 2000; Bonkoungou and Niamir-Fuller, 2001). Furthermore, many other ecosystems, such as riparian or forest ecosystems are located within the drylands landscapes and are at risk from drylands degradation.

Functioning dryland ecosystems provide many ecosystem services including crops for food and medicines, forage for animals, genetic resources, water for both people and animals, and materials for housing and clothing. In addition, they can be important sources of income (e.g. tourism) or cultural and spiritual support. The potential value of some of these services can be expressed in terms of percentage of agricultural output in countries that are largely dryland. For example, agriculture accounts for more than 30% of GDP in Afghanistan, Kenya and Sudan. The dryland portions of India contribute 45% of the country's agricultural output. Chinese drylands are home to 78 million cashmere goats that supply 65–75% of the global market, and Mongolia generates 30% of GDP from dryland pastoralism.

Pastoralism, which is usually most profitable on lands marginal for crops, is an important source of livelihoods in drylands. Mobile herding allows better use of grazing land that is subject to variations in rainfall and temperature. Crop farming or sedentary herds of livestock do not have the flexibility to move when conditions are no longer suitable. However, some traditional practices support crop farming through tree planting and other mechanisms to support natural regeneration.

Dryland-adapted species tend to be ecologically resilient and able to cope with extremes of environment. Nevertheless, according to the Millennium Ecosystem Assessment (MA), 10–20% of drylands are being degraded, threatening billions of hectares of rangelands and croplands with subsequent impacts on the more than 2 billion people living in these ecosystems (2000 data).

DRYLANDS AND DESERTIFICATION

Desertification is increasingly a topic of discussion beyond its "homeland" venue of the United Nations Convention to Combat Desertification (UNCCD). While desertification is an important issue for drylands, most drylands are not desertified. Desertification has been defined, through the UNCCD, as "land degradation in arid, semi-arid, and dry sub-humid lands". In turn, that degradation is expressed as a persistent reduction of biolog¬ical and economic productivity and can be measured by monitoring outputs of ecosystem services including crops and water supplies.

The causes of desertification include:

- Social and economic policies
- Forcing nomadic pastoralists to pursue sedentary cultivation lifestyles

- Promoting or imposing land tenure practices that result in overexploitation of resources
- Unsustainable land management practices, often resulting from the three previous points.

Desertification occurs on all continents except Antarctica and has particular impacts on the poor in drylands where they depend heavily on the ecosystem services that these systems provide.

While many impacts of desertification on drylands are local, there are also regional and global consequences. From an environmental perspective, loss of vegetation leads to soil loss, erosion, and downstream flooding. From the social perspective, people living in degraded drylands may be forced to migrate to other areas that are already crowded and unable to cope with increasing demands.

Other impacts of dryland degradation on associated lifestyles include:

- Loss of indigenous (native) knowledge and traditional know-how;
- Increased vulnerability of communities unable to adapt to variations and changes in conditions;
- Marginalization of indigenous (native) peoples;
- Conflicts in arid and semi-arid lands; and
- Disappearance of traditional management institutions that have proven effective over many generations.

BIODIVERSITY LOSS

The loss of biodiversity, critically important in these challenging environments, is felt particularly keenly by dryland inhabitants. Dryland biodiversity, though, provides support not only for local inhabitants but is also the source of many services for wealthier parts of the world. Consider medicinal plants such as *Harpagophytum* sp., or *Hoodia sp.* used to treat common "Western" ailments such as arthritis and obesity. Without sound dryland management, solutions to today's and tomorrow's health problems could disappear before we discover them (Box 18.1).

URGENT ISSUES

Desertification is being driven by a suite of factors including water scarcity, intensive use of ecosystem services, and climate change. These factors are strongly linked as climate change will likely result in increasing water scarcity in many drylands with resulting decreases in services in spite of increasing demand. Such changes also tend to increase the risks of conflict.

Intensive use of ecosystem services, especially water

Continuing population growth and the consequent increase in food demand is likely to increase pressure to make land available for cultivation and could result in further degradation and conflict among ethnic groups. Dryland regions undergo cyclical episodes of water scarcity during which local people are more vulnerable to its effects, namely food shortages and health crises from lack of water.

Climate change

Climate change impacts present a complex picture of possibilities for drylands. For some, more intense and extended drought could eliminate any productivity from a dryland landscape. For others, significant increases in precipitation (and in intensity in volume and temporal distribution) could transform drylands into more humid systems. This could potentially be beneficial but may also lead to conflicts between farmers and pastoralists.

Desertification contributes to climate change through soil and vegetation loss which decrease the land's carbon storage capacity. An estimated 300 million tonnes of carbon are lost to

Box 18.1 Gum Arabic – a case study in drylands ecosystem services

Gum Arabic in Sudan drylands

The most important forest type in the Sudan may be the gum Arabic belt, which lies within the low-rain savannah zone. Ecosystem services provided by the hashab trees (Acacia Senegal) in this belt include:

- Acting as a natural barrier to protect more than 40% of the total area of Sudan from desert encroachment.
- Supporting family economies through provision of gum Arabic from hashab trees, a multipurpose tree that has an important role in generating income, and meeting household wood energy and fodder demands.
- Enriching the soil fertility, possibly also through biological nitrogen fixation.

In pharaonic times, gum Arabic was also used for body mummification and making watercolours, dyes and paint.

Typically, land use in Sudan included a bush-fallow system that supported both crop cultivation and harvest of gum Arabic, The bush fallow cycle starts with the clearing of an old gum garden (15–20 years old) for the cultivation of agricultural crops. Trees are cut at 10cm from ground level, and stumps are left to initiate vigorous coppice re-growth while the cleared area is cultivated for a period of 4–6 years. When soil fertility declines, crop growing ceases and the area is left fallow save for the remaining trees which are tapped for gum Arabic until the age of 15–20 years. The cycle can then be repeated. This approach was recognized and considered one of the most successful forms of natural forest management in the tropical drylands and regarded as sustainable in terms of its environmental, social and economic benefits.

Today's challenges to gum Arabic production in Sudan's drylands

The importance of gum Arabic in the livelihoods of the people inhabiting the gum belt is well known. More than four million people in the gum belt of Sudan are involved in gum tapping, harvesting, cleaning and trading of gum. Sudan commands 70–80% of the world gum Arabic market. Its annual exports range from 20,000–50,000 metric tonnes with an annual average for the past decade of 25,000 metric tonnes.

In recent decades, the bush fallow system has been disrupted and the traditional rotational bush-fallow cultivation cycle has been dramatically shortened or completely abandoned with consequent impacts on both crop and gum Arabic production. Sustainable management of the gum gardens is threatened because of severe droughts and indiscriminate clearing of A. senegal stands for firewood and charcoal production. In addition to these threats, gum production communities suffer from the lack of regulatory infrastructure as well as lack of market information upon which to plan distribution and sales of any gum produced. Other challenges include lack of finance and transportation facilities. As a result, one report has noted that the actual return to gum producers does not exceed 40% of the production cost. To try to address these issues, Gum Producers' Associations (GPAs) were formed in several provinces as a test case and then expanded. Today 1,650 GPAs have two million members of which 30% are women.

Source: A.G. Mohammed, 2008

the atmosphere from drylands as a result of desertification each year (about 4% of the total global emissions from all sources combined) (MA, 2005a).

DRYLAND MANAGEMENT AND PREVENTION OF DESERTIFICATION

Increased knowledge

One of the most important efforts needed is increased understanding of drylands, factors involved and resulting vulnerability of local people. Decision makers and technicians charged with conservation and devising livelihood alternatives need appropriate knowledge on the potentials, limitations and ecological opportunities presented by arid and semi-arid lands and a better understanding of urban and external impacts on arid and semi-arid lands. In response, the Food and Agriculture Organization (FAO), along with many partners, has developed the Land Degradation Assessment of Drylands that includes mapping, indicators and country-level pilot studies to help increase our knowledge of drylands. The UNCCD and the World Meteorological Organization (WMO) are collaborating on a project to help with prevention, warning and monitoring of drought.

The value of drylands and dryland services also needs to be better understood. To date, drylands have been characterized by under-investment as potential opportunities are overlooked in favour of agricultural lands, tropical forests or marine ecosystems.

INTEGRATED DRYLAND MANAGEMENT

Water resource management

Integrated water resource management is a key means by which to prevent desertification by ensuring that land management policies are adapted to local traditions and needs. Such policies should support existing pastoralist lifestyles and maintenance of the traditional knowledge, avoiding unnecessary transition to more water-intensive cultivation. Dryland management involves water management and requires inter-sectoral cooperation to be effective. Reducing stress on dryland areas may sometimes require development and promotion of alternative livelihoods, including livelihoods in nearby non-dryland areas.

Restoration of degraded drylands

As with other degraded ecosystems, dryland restoration should be undertaken at a landscape scale, utilizing the principles of ecosystem approaches.

Drylands policy and governance

Dogmatic definitions of what a dryland is are not helpful in policy terms. In fact, the definition of drylands in the UNCCD differs from that in the Convention on Biological Diversity (CBD) with the former being more precise in terms of precipitation levels and the latter including a larger area through inclusion of specific vegetation types (Box14.1). The result is a potential challenge for parties trying to implement drylands programmes of work in both conventions and this is a typical issue that underpins the need for harmonization across multilateral environmental agreements (MEAs).

However, no matter what the definition, the governance issues facing drylands management remain the same, namely:

- Correcting the disenfranchisement of drylands people, including securing local land rights as well as related issues of self-determination, education, and health;
- Decentralizing natural resource management including establishment of "local conventions" (community-based agreements) and enabling local people to be compensated for the nationally and

globally-enjoyed benefits (through payments for ecosystem services provided by drylands); and

- Strengthening the resilience of dryland residents, including pastoralists in drylands, through relevant policy frameworks and action.

As highlighted in earlier chapters, these governance issues will also need to bring in concerns relating to climate change (Chapter 5) and poverty reduction (Chapter 1).

Drylands are productive ecosystems supporting large numbers of people but these people are vulnerable to changing climates, markets and rights (Mortimore *et al.*, 2008). Effectively managing drylands – and thereby preventing desertification – will be a major step towards poverty reduction and biodiversity conservation in a significant portion of our world.

19. Freshwater Systems: Managing Flows for People and Nature

Freshwater systems cover less than 1% of the Earth's surface yet they are essential to support life. Water quality supports the health of people and ecosystems. Rivers and groundwater need a holistic landscape-scale approach to address pressures on upstream and downstream resources, giving recognition to the importance of the aesthetic, religious, historical, and archaeological values water contributes to a nation's heritage.

Freshwater habitats provide a home for 126,000 species, or 7%, of the estimated 1.8 million described species including a quarter of the estimated 60,000 vertebrates (Balian *et al.*, 2008). They also have economic value. According to one estimate, the value of the goods and services provided by the world's wetlands is US$ 70 billion per year (Schuyt and Brander, 2004).

Both biodiversity and human well-being are affected by changes to freshwater. On average freshwater species populations were reduced by half between 1970 and 2005, a sharper decline than for other biomes (World Water Assessment Programme, 2009). The Red List Index for birds living in freshwater habitats shows one of the most serious declines for all habitats, second only to marine habitats (Butchart *et al.*, 2004). A global Red List assessment for freshwater crabs reported that, of species for which enough data were available to carry out an assessment, 32% were threatened (Cumberlidge *et al.*, 2009). Reviews of the status of freshwater fishes across particular regions report figures ranging from 11% threatened in southern Africa (Darwall *et al.*, 2008) to 56% of endemic Mediterranean freshwater fishes being threatened (Smith and Darwall, 2006).

More than 60% of the largest 227 rivers are fragmented by dams, diversions or canals (Revenga *et al.*, 2000) leading to widespread degradation of freshwater ecosystems. Overfishing and destructive fishing practices, pollution, invasive species and climate change are additional major concerns for most freshwater systems. Darwall *et al.*, (2008) report that 85% of threatened fish in southern Africa, 55% of threatened freshwater fish in Europe, and just under 45% of threatened freshwater fish in Madagascar are affected by invasive species. In the latter case, this is largely the result of implementation of a plan to re-establish local fisheries through the introduction of 24 non-native fish species (Benstead *et al.*, 2003). Climate change will cause further vulnerability and result in further impacts on freshwater systems. Finally, in many countries water policies and laws are undergoing reform and need to be implemented effectively to conserve water resources.

In a world with diminishing access to water, solving conservation challenges requires solutions that combine the needs of both people and nature. The Vision for Water and Nature (2000) promotes an ecosystem approach to applying integrated water resources management (IWRM), including through improving water governance, empowering stakeholders, building knowledge and valuing water resources.

IUCN has prepared a series of toolkits to support the implementation of sound water resource management to strengthen water security, including Change, Flow, Value, Pay, Share and Rule. They are all accessible online, and are available in several languages, at: http://www.iucn.org/about/work/programmes/water/wp_resources/wp_resources_toolkits/.

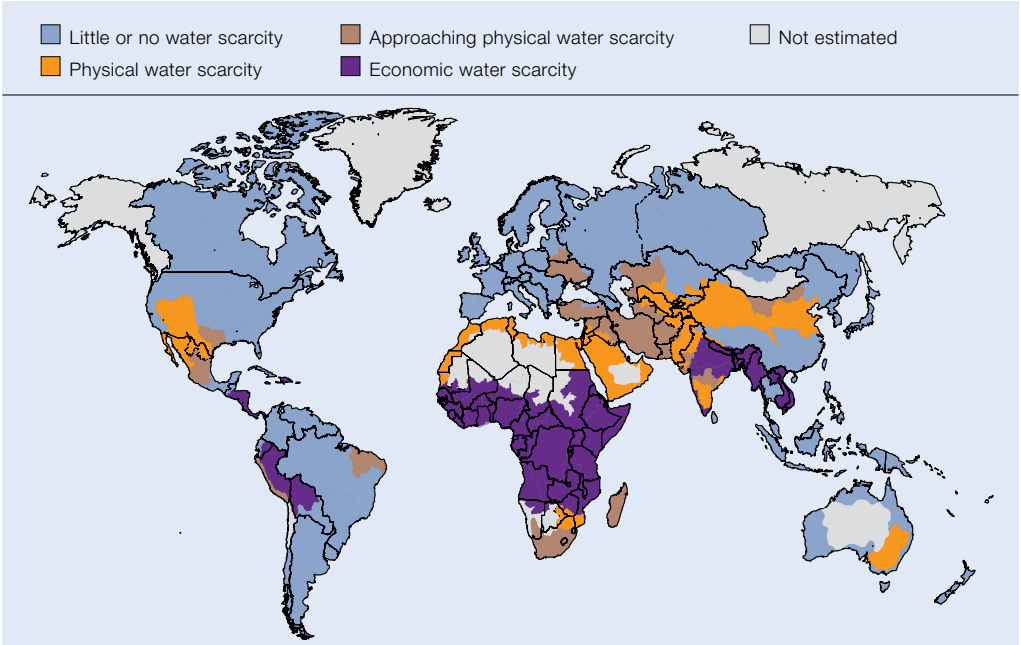
ECOSYSTEM SERVICES AND WATER SECURITY

People need a minimum of 20 litres of water a day to drink, bathe, and maintain basic hygiene (UN Water, 2007). Imagine what it is like to survive on one-quarter of that amount, 5 litres a day – the amount people were living on during the East African drought (2005–2006). The UN states that by 2025 two-thirds of us will experience water shortages, with a severe lack of water afflicting the lives and livelihoods of 1.8 billion people (UN Water, 2007).

The challenges we face relate both to quantity and quality of water. The 2006 Global International Waters Assessment confirmed that shortages of freshwater were a problem in most parts of the world but especially in sub-Saharan Africa where freshwater shortages affect nine of 19 freshwater systems assessed by the Global International Waters Assessment and pollution (including transboundary pollution) affects five systems. By 2025, many southern regions of the world are projected to face water scarcity (see Figure 19.1). However, water scarcity is not consistent across time and space. Physical water scarcity occurs when physical access is limited, and thus water resources' development is approaching or has exceeded sustainable limits. Economic water scarcity exists when the population does not have the human, institutional and economic capital to access water even though water in nature is available locally to meet human demands. Economic water scarcity resulting from unequal distribution of resources has many causes including political and ethnic conflict. Much of sub-Saharan Africa suffers from the effects of this type of water scarcity (Comprehensive Assessment of Water in Agriculture, 2007).

The water crisis stems from rising demand, falling quality and therefore dwindling per capita availability. Distribution and management are also issues. The difference in water reliability between Japan and Cambodia – which have annually about the same average rainfall of 160cm a year – is that Japan has been able to create infrastructure to harness and store water. In countries with heavy rainfall, such as Bangladesh and Myanmar, much of the monsoon precipitation is not captured for productive use and runs off into the ocean.

While the minimum water needed may be 20 litres per day, the average daily use in the USA and European countries is 200–600 litres per day (UN Water, 2007). Managing your own water consumption might be as easy as turning off the tap while brushing your teeth. One tool that can be used to determine water consumption is the water footprint tool (Box 19.1).The water footprint of an individual, community or business is defined as the total volume of freshwater that is used to produce the goods and services consumed by the individual or community or produced by the business. The water footprint tool and other approaches can be used as tools to implement IWRM.



Definitions and indicators

- Little or no water scarcity. Abundant water resources relative to use, with less than 25% of water from rivers withdrawn for human purposes.
- Physical water scarcity (water resources development is approaching or has exceeded sustainable limits). More than 75% of river flows are withdrawn for agriculture, industry, and domestic purposes (accounting for recycling of return flows). This definition—relating water availability to water demand—implies that dry areas are not necessarily water scarce.
- Approaching physical water scarcity. More than 60% of river flows are withdrawn. These basins will experience physical water scarcity in the near future.
- Economic water scarcity (human, institutional, and financial capital limit access to water even though water in nature is available locally to meet human demands). Water resources are abundant relative to water use, with less than 25% of water from rivers withdrawn for human purposes, but malnutrition exists.

Source: International Water Management Institute analysis done for the Comprehensive Assessment of Water Management in Agriculture using the Watersim model.

Figure 19.1 Projected water scarcity in 2025 (IWMI, 2009)

WATER MANAGEMENT AND ENVIRONMENTAL FLOWS

IWRM is "a process which promotes the coordinated development and management of water, land and related resources in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems" (GWP, 2009). It integrates landscape-scale management that acts on a scale broad enough to recognize the role of all critical influencing factors and stakeholders that shape land-use decisions. IWRM is based on the Dublin Principles (GWP, 2000), namely:

> Principle I: Water as a finite and vulnerable resource
>
> Principle II: Participatory approach
>
> Principle III: The important role of women
>
> Principle IV: Water as an economic good

IUCN's Members, in Resolution 4.063 (*The new Water Culture – integrated water resources management)* have urged governments to adopt IWRM and support frameworks for its implementation.

The key question when managing water allocations is "How can we ensure there is enough water for nature?" This can be answered by applying environmental flows. Environmental flows describe the quantity, timing, and quality of

Box 19.1 Walking on water: how big is your water footprint?

While many of us have heard of our carbon footprint, few are aware that we also leave a water footprint. You can calculate how much water your daily habits require – be it showering, cooking, how much water went into your food, or the type of electricity you use. Visit the website of the Water Footprint network to learn more:

http://www.waterfootprint.org/?page=files/home

water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems (Brisbane Declaration, 2007). Assessments are undertaken to determine the amount of flow needed to maintain a healthy river and support vital ecosystem services. This information is used to make informed decisions about allocation of water to all sectors including the environment.

To increase integration of environmental flows into policy and practice for water management, communication, learning and demonstration of the benefits of flows for people and nature are needed. The Environmental Flows Network (www.eflownet.org) is a central reference point for information on flows and also is a tool to share experiences, develop the concept and link to a broad, cross-sectoral audience.

IUCN supports application of environmental flows to mitigate the effects of infrastructure development on rivers, including dams and large-scale irrigation. Environmental flows are implemented by changing the operation of infrastructure in ways that restore the quantity, quality and seasonal rhythm of river flows in order to sustain downstream ecosystems and the services they provide to people. Application of environmental flows is through negotiation of water allocations by stakeholders, which encourages the integration of the needs of both people and nature in decisions about water resources management. Strengthening support for application of environmental flows in policy and law drives development of the knowledge, capacities and institutions needed to implement IWRM.

WATER GOVERNANCE AND STAKEHOLDER PARTICIPATION

Effective water management must be supported by policies and laws that enable transparent definition of rights, roles and responsibilities, including sufficient allocation of water to sustain healthy ecosystems. Successful implementation of well-structured water policies and laws also requires the necessary institutions for that implementation as well as an enabling environment that is characterized by transparency, certainty, accountability and lack of corruption.

At an international level this was recognized at the UN 2000 Millennium Assembly, which agreed "to stop the unsustainable exploitation of water resources, by developing water management strategies at the regional, national and local levels, which promote both equitable access and adequate supplies". At the World Summit on Sustainable Development (WSSD) in 2002 Heads of State agreed a specific target to prepare Integrated Water Resource Management (IWRM) and water efficiency plans by 2005 – a target that was not met.

Water governance continues to be a major challenge in many countries, for example because of lack of coherence among sectors and conflicting policies and laws made at different times by different administrations and interest groups. Reforming national policies and laws into a cohesive package is a difficult and

resource-consuming task, but countries that have tackled it have found that their downstream implementation plans go more smoothly. For example Brazil has undertaken a lengthy reform of its water governance structure which, as a result of the systematic reorganization of policy, law and institutions, led to a substantial improvement of its water management scheme. In addition, Iza and Stein (2009) suggest that water governance reforms that reduce poverty and make economies more resilient should be based on principles of equity and sustainability. For example, South Africa has implemented ambitious water reforms over the last decade. The National Water Act guarantees a "water reserve" to secure a basic water supply and the health of aquatic ecosystems.

IUCN Members, in WCC Resolution 3.006 (*Protecting the Earth's waters for public and ecological benefit)* urged support for achieving the WSSD target as well as full participation in decision-making about conservation, protection, distribution and use of water. The international community is also promoting rights-based approaches to water management based on the fundamental need for clean and drinkable water. At the national level, the State has to translate these obligations and commitments acquired in the international context into actual practice.

Transformation of water policy and management comes from consensus building in multi-stakeholder platforms. These platforms empower stakeholders at local, basin or transboundary levels to agree on rights, roles and responsibilities and to negotiate on water law reforms.

Furthermore, a good governance system should "think basin-wide, but act local". When grassroots water user associations are involved in the process of planning, execution and maintenance of traditional water harvesting systems, they are more resilient and enable communities to adapt to climate change. Involving civil society at all levels encourages awareness and responsibility towards water and facilitates the acceptance of the legal system. This in turn presents a useful platform for solving possible conflicts between traditional and customary rights, by facilitating the implementation of water law through an active participation of the users at the final stage of water distribution. Finally, they can play a very important role in monitoring their share of the water system.

Successful water governance and management depends on including women. A 1988 study by the International Water and Sanitation Centre of community water supply and sanitation projects in 88 communities in 15 countries found that projects designed and run with the full participation of women are more sustainable and effective than those that do not involve women as full partners (IWSC, 1988).

Governance of transboundary waters is a complex issue with several challenges to delivering its environmental objectives. There are more than 260 international rivers in the world, covering 45% of the land surface of the Earth, and accounting for about 80% of global river flows. About 90% of the world's population currently lives in the countries sharing these rivers (World Bank, 2009). These essential resources are coming under increasing pressure as populations grow and economies develop. It is important to identify mechanisms and instruments to support the use of water as a catalyst for regional cooperation rather than a source of potential conflict. Cooperatively managing and developing these rivers requires great skill, robust institutions, significant investment, and strong cross-border cooperation. Examples of initiatives to do just that include the Nile Basin Dialogue, the Mekong River Commission, and the newly formed Volta Basin Authority.

Finding a common approach to the governance of transboundary waters is further complicated by the differing legislation, water management practices, institutional structures, languages and cultures of the bordering countries. Nevertheless, cooperation in managing the quality and quantity of transboundary water bodies also presents an opportunity from which all of the parties involved can benefit (Aguilar and Iza, 2006). Negotiations, consensus and agreements reached between two or more parts of a shared river basin become part of the system of water governance, but it is the political will of sovereign States that determines whether those will successfully support sustainable water management.

PAYMENTS FOR WATERSHED SERVICES

Water resources underpin the economy and dividends from investing in watershed services must account for the benefits and water security for livelihoods, business and economic development. Within the business sector there are diverse water interests; water services interest (people making money out of water); companies which sell products that need water; hydropower companies; companies that make biofuels; energy companies that use water for cooling; industries that require water for processing, etc. Before engaging businesses, however, it is important that users have a full understanding of all potential losses of ecosystem services that may be caused by development. Market-based incentives, including payments for ecosystem services (PES), are part of sustainable financing for IWRM. In Ecuador, the Quito Water Fund (FONAG) has built an investment prospectus to attract contributions from the public and private sectors to a long-term trust fund that aims to secure quantity and quality of water supplied to Quito from the Guayllabamna River Basin.

Water is a vital resource for the global agriculture and energy sectors. Agriculture is by far the main user of water. Irrigation and livestock account for 70% of water withdrawals, which can rise to more than 80% in some regions, so conservationists need to connect more with the agricultural sector to strengthen knowledge on water issues (MA, 2005c; World Water Assessment Programme, 2009). Without reliable access to water of the right quantity and quality, hydropower generation fails, especially where flows or cooling of power stations is reduced. These sectors, including the expanding numbers of biofuel producers, need to make sustainable water futures a priority, including investment in sustainable watershed management. Water and energy policy needs to be coordinated in both strategy and operation.

Returns on investment in water management and in ecosystems services are too often unaccounted for or underestimated. Ecosystem services-based management can provide a framework within which to support decision-making for services provided by natural systems and identify the trade-offs that may be needed in decisions (Farber *et al.*, 2006). Investments in river basin sustainability stimulate "green growth" and economic resilience. Water and the services provided by watersheds, including water storage, purification, flood regulation and food security, have benefits across the economy, from local to national levels. Investments which ensure continuing or renewed water security and watershed services sustain local livelihoods, create opportunities for enterprise development and underpin national economic growth. Investments in river basin sustainability can thus stimulate growth that is pro-poor and environmentally robust while strengthening the resilience of communities and national economies.

WATER AND CLIMATE CHANGE

Climate change is projected to cause significant impacts on water resources and widespread

vulnerabilities. These impacts will be felt first and foremost through water – through drought, floods, storms, ice melting and sea-level rise. The rapid shrinking of the Himalayan glaciers, which may lose four-fifths of their area by 2030, means a huge natural reservoir storing water for more than a billion people may be lost.

Coping with such impacts means the need for climate change adaptation strategies. While water is at the centre of climate change impacts, it is also at the centre of adaptation policies, planning and action. River basins and coasts, and their ecosystems, are natural infrastructure for coping with these impacts. They provide water storage, flood control and coastal defence, all vital for reducing the vulnerabilities of communities and economies to climate change. Investment in IWRM, as "critical national natural infrastructure", should be integral to climate change adaptation portfolios (Smith and Barchiesi, 2008).

20. Agricultural Systems: Biodiversity in Domesticated Landscapes

As the global population expands, seemingly inexorably, toward 9 billion, it is widely accepted that global food production will need to increase by at least 50% to feed the growing population and improve the living standards for billions of people. Even more challenging, this must be done in the face of climate change, which makes agricultural productivity highly unpredictable. Food demand may grow even faster than human population, as a result of growing urbanization, rising incomes, and greater efforts to reduce hunger among the estimated 950 million people currently under-nourished (FAO, 2008c). Global consumption of livestock products is predicted to exceed 650 million tonnes by 2020. More land will surely be required to grow crops and graze livestock, even more so as biofuels are expected to become a greater contributor to meeting energy needs. In Africa alone, land devoted to cereal production is expected to increase from over 100 million hectares in 1997 to about 135.3 million hectares in 2025, inevitably involving trade-offs among land devoted to crops, livestock, and other purposes.

Feeding a human population of 9 billion using current methods could require converting another one billion hectares of natural habitat to agricultural production, primarily in the developing world, together with a doubling or tripling of nitrogen and phosphorous inputs, a two-fold increase in water consumption and a three-fold increase in pesticide use. A serious limiting factor is expected to be water, as 70% of the freshwater used by people is already devoted to agriculture. Scenarios prepared by the Millennium Ecosystem Assessment (MA) thus suggest that agricultural production in the future will need to focus more explicitly on ecologically-sensitive management systems that give greater attention to biodiversity (Carpenter *et al.*, 2005).

Whether increased agricultural production is accomplished through more intensive use of existing agricultural land or more extensive use of lands that are currently being used for other purposes, biodiversity inevitably will come under increased pressure.

Agriculture can be defined as the art, science and business of raising livestock and cultivating soil to produce crops. It is totally dependent on genes, species and ecosystems and the variability they contain. This biodiversity also provides

agriculture with the capacity to adapt to changing conditions.

The conservation movement is now considering how it wishes to relate to agriculture in the most productive manner. After all, farmers, pastoralists, and hunter-gatherers are the occupiers of the rural landscapes where most of the world's biodiversity survives. If we hope to maintain global biodiversity and a reasonable balance between people and the rest of nature, then agriculture needs to be part of the conversation.

On the other hand, conservation has much to contribute to sustainable agriculture. Such agriculture should be highly diverse, requiring supporting ecosystems that comprise a wealth of wild species of benefit to agriculture. These include wild relatives of domesticated plants, pollinators, species useful for pest control, soil micro-organisms, and many others.

Nearly one-third of our planet's land is dominated by agricultural crops or planted pastures, thus having a profound ecological effect on the whole landscape. Another 10–20% of land is under extensive livestock grazing, and around 1–5% of food is produced in natural forests (Cassman and Wood, 2005). The biodiversity and ecosystem services involving agriculture are therefore critical to ensuring a sustainable future for our farmers.

HOW BIODIVERSITY SUPPORTS THE GROWING DEMAND FOR AGRICULTURAL PRODUCTION

Virtually all domesticated species of plants and animals still have wild relatives whose genetic diversity can be valuable in enabling the domesticated species to adapt to changing conditions. While national and international seed banks contain much valuable genetic material, the wild relatives are especially important because they are living and adapting to changing climate conditions, in competition with other species, predators, and new diseases. Efforts to conserve wild relatives of domesticated plants and animals have greatly increased over the past few decades, international agreements now recognize their value, numerous projects have been launched in various countries, and institutional collaboration is expanding (Meilleur and Hodgkin, 2004). Within IUCN, the Species Survival Commission (SSC) now has a Specialist Group working on wild relatives of domesticated plants, and several of its other Specialist Groups deal with wild relatives of domesticated animals (e.g. Wild Cattle, Camelids, Pigs and Peccaries, Pheasants).

An especially important supporting service provided to agriculture by biodiversity is plant protection. Plants respond to insects feeding on their leaves by synthesizing and releasing complex blends of volatile compounds, which attract insects that are natural enemies of the insects who are feeding on the leaves, thereby helping defend the plant. If the biodiversity-based natural defences of plants could be more effectively mobilized, safe and effective crop protection strategies could be designed that would significantly minimize the negative side-effects of the current generation of chemical fertilizers.

Many of the world's most important watersheds are densely populated and under predominantly agricultural use, and most of the rest are in agricultural land-use mosaics where crop, livestock and forest production influence hydrological systems. In such regions, agriculture can be managed to maintain critical watershed functions, such as maintaining water quality, regulating water flow, recharging underground aquifers, mitigating flood risks, moderating sediment flows, and sustaining freshwater species and ecosystems. Effective water management encompasses the choice of water-conserving crop mixtures, soil and water management (including irrigation), vegetation barriers to

slow movement of water down slopes, year-round soil vegetative cover, and maintenance of natural vegetation in riparian areas, wetlands and other strategic areas of the watershed. Well-managed biodiversity-rich agricultural landscapes can also provide protection against extreme natural events. With water scarcity and extreme weather events predicted to increase in the coming decades in many parts of the world, the contribution of biodiversity to enhancing the capacity of agricultural systems to sustain watershed functions is likely to be one of the most important considerations in agricultural investment and management.

Agricultural landscapes can conserve a broad range of native terrestrial species, especially those that adapt well to habitat fragmentation and agricultural land use. The prospects for conserving biodiversity in agricultural landscapes depends on the degree of fragmentation and functional connectivity of natural areas, the habitat quality of those areas, the habitat quality of the productive matrix, and the extent to which farmers manage their land to conserve biodiversity. Forms of agriculture that successfully balance productivity, improved livelihoods, and biodiversity conservation at a landscape scale have been termed "ecoagriculture" (McNeely and Scherr, 2003).

Efforts to maintain natural habitats in farming areas are longstanding, principally through agricultural set-aside schemes, crop rotation, leaving some land fallow, and including trees in the farmstead. Land withdrawn from conventional production of crops has been shown unequivocally to enhance biodiversity in North America and Europe (van Buskirk and Willi, 2004). For many commercial crop monocultures, leaving field margins uncultivated for habitat protection does not reduce total yields, as inputs are applied more economically on the rest (Clay, 2004).

However, landscape-scale interventions specifically designed to protect habitats for biodiversity are much more effective than a farm-by-farm approach. A recent review of evidence from North America on how much wildlife habitat is "enough" in agricultural landscapes (Blann, 2006) concluded that habitat needs must be considered within the landscape history and context. Habitat patches must be large enough and connected to other patches, for example along rivers and streams or steep, hilly lands that are covered in native vegetation. Smaller patches of natural habitat may be sufficient if adjacent agricultural patches are ecologically managed. A growing body of research shows that landscape connectivity between large patches of forest can be effectively maintained through retention of tree cover on the farm, such as live fences, windbreaks, and hedges in grazing lands and agricultural fields (Harvey *et al.*, 2004). Biodiversity conservation efforts designed to adapt to changes in agricultural landscapes should therefore focus on protecting (or restoring) large areas of native habitat within the agricultural matrix, and retaining elements (such as hedgerows, isolated trees, riparian forests and other non-cropped areas) that enhance landscape connectivity. Such measures will ensure heterogeneity at both field and landscape levels, thereby enhancing the adaptability of agricultural ecosystems in the face of climate change, new demands for new crops, demographics, and other dynamic factors.

THE FUTURE OF BIODIVERSITY AND AGRICULTURE

From a wild biodiversity conservation perspective, the ideal agricultural production systems mimic the structure and function of natural ecosystems (Blann, 2006; Jackson and Jackson, 2002). In humid and sub-humid forest ecosystems, farms would resemble forests, with productive tree crops, shade-loving understorey

crops, and agroforestry mixtures; in grassland ecosystems, production systems would rely more on perennial grains and grasses, along with economically useful shrubs and dryland tree species. Annual crops could be cultivated in such systems, but as intercrops, or monoculture plots interspersed in mosaics of perennial production and natural habitat areas. Domesticated crop and livestock species' diversity would be encouraged at a landscape scale, and genetic diversity within species would be conserved *in situ* at a large ecosystem scale, to ensure system resilience and the ecological diversity required to adapt to changing conditions.

Box 20.1 Cabrucas: conserving bats while producing cacao

In Bahia State, Brazil, traditional shade plantations of cacao (known locally as "cabrucas") also provide habitat for many forest-dwelling species, including a rich and abundant bat community that feeds on many species of insects and helps pollinate night-blooming species of plants. But when the cabrucas are located more than one kilometre from native forests, the bat communities are less diverse than those found in forests. Therefore, the entire landscape should be considered for management, taking into account that maintenance of cabrucas together with the preservation and restoration of forest patches is essential to the conservation of bat diversity.

Source: Schroth and Harvey, 2007

Multi-storey agroforestry systems, tree fallows and complex home gardens are especially rich in wild biodiversity. For example, canopy height, tree, epiphyte, liana and bird species diversity, vegetation structural complexity, percentage ground cover by leaf litter, and soil calcium, nitrate nitrogen and organic matter levels in topsoils are all significantly greater in shaded than in sun-grown farms, while air and soil temperatures, weed diversity and percentage ground cover by weeds are significantly greater in farms without trees. In Central America, complex polyculture combinations and management systems enhance the productivity of coffee, cocoa, banana, timber and other commercial tree products.

While coffee grown in monoculture plantations with full exposure to the sun has higher yields, coffee grown in the shade is far more beneficial for sustainable agriculture and conserving biodiversity (often supporting more than twice as many species of birds). Systems with many species of trees providing shade also help support beneficial insects, orchids, mammals, and other species, as well as protecting fragile tropical soils from erosion, providing nutrients, and suppressing weeds, thereby reducing or eliminating the need for chemical herbicides and fertilizers and thus reducing farming costs. Farmers also are able to harvest various species of fruits, firewood, lumber, and medicines from the shade trees.

To replace crops that must be replanted each year (usually as monocultures, where a single species is planted over an extensive area), new and improved perennial crops, such as fruits, leafy vegetables, spices, and vegetable oils, are becoming more popular. Perennial crops can be more resilient and involve less soil and ecosystem disturbance than annual crops, and provide much greater habitat value, especially if grown in mixtures and mosaics (Jackson and Jackson, 2002).

Strategic planning for agricultural development has begun to focus on adaptation of systems to climate change, anticipating rising temperatures

and more extreme weather events. With each one degree Celsius increase in temperature during the growing season, the yields of rice, wheat and maize drop by about 10% (Brown, 2004). Cash crops such as coffee and tea, requiring cooler environments, will also be affected, forcing farmers of these crops to move higher up the hills, clearing new lands as they climb. Montane forests important for biodiversity are likely to come under increasing threat as a result. Effective responses to climate change will require changing varieties, modifying management of soils and water, and developing new strategies for pest management as species of wild pests, their natural predators, and their life-cycles alter in response to changing climates. Increasing landscape and farm-scale diversity are likely to be an important response for reducing risks and adapting to change.

> "An especially important supporting service provided to agriculture by biodiversity is plant protection."

Since the 1960s both industrial agriculture in developed countries and the original Green Revolution in developing countries have depended on improved seeds, chemical fertilizers and pesticides, and irrigation. This production model involved a small number of crops, generally in monoculture stands (to increase efficiency in use of external inputs and mechanization). Wild flora and fauna were considered direct competitors for resources or harvested products, while water was diverted from wetlands and natural habitats for irrigation. But over the past two decades, research has demonstrated the value of agricultural biodiversity in all its forms, including crop and livestock genetic diversity, associated species important for production (for example, pollinators, soil micro-organisms, beneficial insects, and predators on pests) and wild species who find their home in agricultural landscapes (Uphoff *et al.*, 2006).

A variety of modern approaches that encourage biodiversity have arisen from various disciplines, philosophies, or geographical conditions. Biodiversity-friendly alternatives to industrial agriculture include agroecology (Altieri, 1995), conservation agriculture (FAO, 2001a), organic agriculture (IFOAM, 2000) and sustainable agriculture (Pretty, 2005). They have tended to focus on maintaining the resource base for production, through managing nutrient cycles, protecting pollinators and beneficial micro-organisms, maintaining healthy soils and conserving water. They seek to reduce the ecological "footprint" of farmed areas and the damage to wild biodiversity from toxic chemicals, soil disturbance and water pollution. In many ways, they resemble pre-industrial forms of farming, but benefit from modern approaches that enhance yields and labour productivity while still maintaining biodiversity.

Organic farming aids biodiversity by using fewer pesticides and inorganic fertilizers, and by adopting wildlife-friendly management of habitats where crops are not being grown, including strategies such as not weeding close to hedges and by mixing arable and livestock farming. Mixed farming particularly benefits some bird species, including those that nest in crops. Some farms that adopt selected organic practices, such as replacing chemical weeding with mechanical methods, may encourage biodiversity as much as completely organic farms.

The future of agriculture will depend heavily on contributions from women. Women are the main producers of the world's staple crops (rice, wheat, maize) that provide up to 90% of the rural poor's food intake and produce 60–80% of food in most developing countries. In India, women provide 75% of the labour for transplanting and weeding rice, 60% for harvesting, and 33% for threshing. (Press releases from the United Nations Information Centre in Sydney for Australia, New Zealand, and the South Pacific 1995 as cited in Mata & Sasvari, 2009).

According to the Food and Agriculture Organization (FAO), women produce, select and save up to 90% of seeds and germplasm that are used as planting material in smallholder agricultures. In Rwanda, women produce more than 600 varieties of beans, and Peruvian Aguaruna women cultivate more than 60 varieties of manioc (FAO, 2001b).

According to the Yemen National Biodiversity Strategy and Action Plan (NBSAP) women also have a key role in growing and preserving underutilized species, which do not satisfy a large proportion of the world's food needs, but are used by specific communities to complement their diets. In Yemen, women grow different crops from men, identified as "women's crops", such as groundnuts, pumpkins, leafy vegetables, cowpeas, cucumbers and sweet potatoes, which has the effect of raising farm biodiversity and food security (NBSAP Yemen, 2005). NBSAP Bhutan recognized that underused species contribute substantially to household food and livelihood security; they are often managed or harvested by women. Knowledge of the uses and management of these species is likewise localized and specialized (NBSAP Bhutan, 2002).

In the coming decade, the conservation community, working in closer cooperation with agricultural organizations, should seek sustainable and adaptable forms of land use that give high priority to conserving wild relatives of domestic plants and animals (noting that many of these are threatened species). Incorporating compatible forms of agriculture in landscape-level biodiversity conservation strategies and action plans will require building the expertise of farmers as ecosystem managers and publicizing the multiple values of biodiversity in supporting agriculture, thereby helping to build support for conservation.

Biodiversity and ecosystem services should be incorporated into agricultural research and development to ensure that new agricultural technologies support conservation of biodiversity rather than threatening it. Finally, developing new approaches to paying farmers for their contributions to conserving biodiversity and maintaining ecosystem services will help provide the necessary incentives for consolidating conservation and agriculture pursuits.

21. Urban Systems: Conservation in the City

In 1900, about 160 million people lived in cities, the equivalent of about 10% of the world's population of 1.6 billion at that time. By 2000, around half of the world's 6 billion people lived in urban areas, and the percentage has continued to grow (Chapter 1). If conservation is to be a universal phenomenon, new ways must be found to enable people who live in cities to be active participants in conservation.

The conservation of nature in cities can be approached from many directions. Benton-Short and Short (2007) provided a social perspective, while Shiro (2004) took a planning approach based on considering cities rather like gigantic organisms, and Isenberg (2006) provided a more historical perspective, with examples from the United States, Europe, and Africa.

While the conversion of forests or farmlands into cities inevitably causes a loss of biodiversity, urban-dwellers actually use less of some resources per person than do those living in the countryside. Apartments in tall buildings are more energy-efficient than individual houses, and cities tend to have more efficient means of providing water, energy and transport than do rural areas. In London, per capita carbon dioxide emissions are only a little more than half of the average for the entire country, while New York City's inhabitants produced less than a third of the average per capita emissions for the United States as a whole. São Paulo and Rio de Janeiro also have substantially lower per capita emissions of carbon dioxide, but cities like Beijing and Shanghai, which contain many factories that produce high emissions, score well above the national average. But at a global level, cities emit 50–60% of greenhouse gases (GHG), rising to around 80% if indirect emissions are included, according to figures by UN-Habitat.

Of course, cities pose problems for ecosystems as well. Cities occupy 2% of the land surface, yet consume 75% of its natural resources. With more people packed into smaller areas of land, infectious diseases may be more easily transmitted. Biodiversity in cities, especially at ecosystem and species levels, is particularly threatened by invasive alien species. This is to be expected, because cities tend to be the focus of international trade which carries invasive species with it (Schwarz *et al.*, 2006). This effect extends also to birds, and the avifauna of urban areas tends to become increasingly homogenized, with rare species tending to drop out and cosmopolitan species such as pigeons and sparrows dominating (Clergeau *et al.*, 2006). And people living in cities need to draw on the surrounding countryside for many of their essential resources, especially food, water and energy.

They also need protected areas, which provide significant benefits to cities, including water supplies, recreation, and various economic and

other values. Many people living in cities seek protected areas to provide significant psychological well-being, finding a week in the wilderness of a national park to be an invigorating and life-sustaining respite from the pressures of living in crowded and impersonal cities. Protected areas also depend on cities, for political support, as a source of visitors, and for ensuring a cultural link between urban people and their environment.

Many conservation organizations have recognized the importance of incorporating natural spaces as part of the urban infrastructure. This extends far beyond simple neighbourhood parks, though of course these play an important role. Some cities have been quite ambitious in integrating biodiversity into urban planning. London, for example, has adopted a formal Biodiversity Strategy, with five main elements: enable those who live or work in London to have greater contact with nature in their own locality; protect London's important wildlife habitats and identify over 1,500 such sites; enhance the habitats of public parks and open spaces or create new wildlife habitats for public enjoyment and environmental education; encourage provision of facilities for environmental education and opportunities for all sectors of society to be actively involved in environment projects; and engage a wide range of organizations and individuals in a supporting partnership for the Biodiversity Strategy (Goode, 2005). Many cities have national parks within their borders, or immediately adjacent to them, including large metropolises such as Los Angeles, Rio de Janeiro and Sydney. Protected areas within cities can help protect water resources, provide recreational opportunities, help promote environmental education, and create local jobs.

IUCN has sought to coordinate conservation action within cities, led by the World Commission on Protected Areas (WCPA) Task Force on Cities and Protected Areas, which in turn has contributed to the Global Partnership on Cities and Biodiversity, which began in 2006. And more than 300 local governments have joined in a network to support IUCN's Countdown 2010, which seeks to reverse the rate of loss of biodiversity by that date.

THE VALUES OF NATURE IN CITIES

Urban areas can be expected to provide more support to protected areas when people living in cities recognize the benefits such areas provide. For example, Dudley and Stolton (2005) found that around a third (33 of 105) of the world's largest cities obtain a significant proportion of their drinking water directly from protected areas, including Barcelona, Bogota, Brasilia, Caracas, Jakarta, Johannesburg, Karachi, Los Angeles, Madrid, Melbourne, Mumbai, Nairobi, New York, Perth, Rio de Janeiro, São Paulo, Singapore, Sydney, Tokyo and Vienna.

Many other cities manage forests specifically for watershed protection, including Seoul, Tokyo, Beijing, Rangoon, Santiago, New York, Stockholm, Munich and Minsk. Some 90% of the Melbourne (Australia) water supply comes from the uninhabited forested mountainous catchments to the north and east of the city. The majority of these catchments are outside protected areas, but are managed to protect these forested catchments by the government-owned company Melbourne Water. Linking a very practical contribution of protected areas or other biodiversity-rich areas to cities helps to build stronger support for them.

Access to green spaces within cities provides many benefits to people, especially in regards to health, safety and well-being (Kuo *et al.*, 1998). Fuller and Gaston (2009) have sought to assess the green space within 386 cities in 31 European countries, containing over 170 million people (over a third of Europe's population). They found wide variation in green space from 1.9% in Reggio di Calabria, Italy, to 46% in Ferrol, Spain, with cities in northern Europe tending to have greater proportions of

green space compared to those in the south. Not surprisingly, they found that the proportion of green space per person generally diminishes as population density increases. Growing population density in cities certainly is a threat to the remaining green areas. For example, Mexico City is losing as much as 500 hectares of park and forest land annually to squatters and development, taking nearly half of the remaining protected open area in the capital over the past decade.

Some experts consider that fossil fuel is essential to the modern approach to urban life (Girardet, 1999). Until very recently, most cities had what might be considered a linear metabolism, with resources flowing into the system without consumers being concerned about either the origin of the resources or the disposal of their wastes. A more appropriate model for cities would be to mimic the circular metabolism of nature, where every output is also an input that helps to sustain and renew the whole system – the essence of ecosystem services. Recycling is already becoming standard behaviour in many cities, and the current financial crisis has demonstrated that it is quite possible to live a decent urban life without high levels of resource consumption. A sustainable city will be able to meet its own needs without threatening the natural world or the living conditions of its citizens.

A NEW VISION OF CITIES AND NATURE

Many metropolises are already relatively green, with Beijing, for example, producing almost all of its vegetables within its metropolitan region. Others are seeking to become greener.

Despite some significant efforts at greening cities, most of the world's cities are concentrated in neighbourhoods of impoverished biodiversity (Turner *et al.*, 2004). Billions of people may lose the opportunity to develop an appreciation of nature, and lose the benefits that can be gained from such an appreciation. This suggests that a significant

Box 21.1 Birds in cities

Birds in urban landscapes primarily occupy parks (which may be seen as forest fragments), wooded streets (linear strips connecting fragments), or the urban matrix; pigeons, for example, treat buildings as their ancestors treated cliffs, and falcons have found a home in Manhattan, where pigeons offer plentiful prey. Fernandez-Juricic (2000) studied the effects of street location in the landscape, vegetation structure, and human disturbance (pedestrian and automobile load) within wooded streets on bird species richness, temporal persistence, and density of feeding and nesting guilds, and on the probability of street occupation by individual species in Madrid, Spain. The number of species recorded increased from the least suitable (streets without vegetation) to the most suitable habitats (urban parks), with wooded streets being intermediate landscape elements. Tree-lined streets that connected urban parks positively influenced the number of species within wooded streets, species persistence, guild density and probability of occupation of streets by individual species. Human disturbance exerted a negative influence on the same variables. Wooded streets potentially could function as corridors, allowing certain species to prosper by supporting habitat for feeding, nesting, and resting (for migratory species). Local improvements in corridor quality, through increased vegetation complexity and reduced human disturbance, could positively influence the regional connectivity of the system and thus suitability as habitat for birds.

Source: Fernandez-Juricic and Jokimaki, 2001

Box 21.2 Chicago Wilderness

Conceived with IUCN as a model, Chicago Wilderness is a collaborative, regional alliance that is broadly engaged in biodiversity conservation in the Chicago metropolitan region, connecting people with nature. More than 240 diverse member organizations work together on programmes and scientific studies to protect and restore natural areas within an urban region that spans four states. The alliance seeks to increase awareness and knowledge of native biodiversity and the values of nature in the region, increase and diversify public participation in environmental stewardship, build collaborative relationships among diverse constituencies throughout the region to foster a sustainable relationship with nature, facilitate the application of natural and social science research in restoration and maintenance of the diverse environments in the area, foster development of best management practices and information sharing, and generate broad-based public and private support for the goal of having native biodiversity – wilderness – maintained in the Chicago metropolitan region, and, in the process, to reconnect many people with the region's nature and remaining wild places.

The name Chicago Wilderness is also applied to the regional mosaic of natural areas in more than 145,000 hectares of protected lands and waters. The natural communities in Chicago Wilderness include tall grass prairies, hardwood forests, oak savannahs, sedge meadows, marshes, bogs, and fens. Less than one-tenth of 1% of the original tall grass prairies of Illinois remains, but Chicago Wilderness has some of the best examples, with several species therein that are regionally threatened.

The Chicago Wilderness alliance was formed in 1996 to enhance management of the many protected areas in and around Chicago, stretching from south-western Michigan through north-western Indiana and north-eastern Illinois into south-eastern Wisconsin. The alliance first produced an Atlas of Biodiversity, then a Biodiversity Recovery Plan, and subsequently a Report Card on the status of the biota and the ecosystems in the region. It also produces a quarterly magazine and has published a family guide to promote youth activities in nature. The magazine features articles on particular native species, celebrates professional and lay people active in conservation, and describes a variety of protected places in the region. It has also published special

effort to provide opportunities for linking people to biodiversity within cities is both necessary and worthwhile.

Some cities have recognized this imperative. Jinan, capital of eastern China's Shandong Province, will plant up to 7,100 hectares of new forests in the next three years. The city is planning to have everyone over the age of 11 responsible for planting three to five trees a year, as part of the city's Blue Sky Project which is intended to create a clean and green environment in this rather polluted city within five years.

One innovative programme for linking urban youth to nature in the countryside is the programme known as "Kids for Tigers", which was launched in India in 2001, with the objective of encouraging urban children from throughout South Asia to visit nature. While tigers were the draw card, many of the most important issues focused on water (Sahgal, 2005). Over one million children have participated in the programme, from 700 schools in 12 Indian cities.

In recent years, "urban ecology" has evolved as an initiative to integrate natural and social sciences to study the environments of cities and their regional and global effects, based on the principle that cities present both the problems and solutions to sustainability challenges of an increasingly urbanized world (Grimm *et al.*, 2008). The Chicago Wilderness Area (Box 21.2) is one outstanding example.

issues on major concerns such as water resources and road building. As for the members of the Chicago Wilderness alliance, there are federal, state and local government agencies; municipalities, and park districts; large non-governmental conservation organizations, small volunteer groups, education and research organizations; and cultural institutions. A Corporate Council has been established with some 35 companies having pledged their support to and participation in the efforts of the alliance. Financial support now comes from the member organizations and Corporate Council, philanthropic sources, and magazine subscribers, but much of programmatic funding has come through two federal agencies, the US Fish and Wildlife Service and the US Forest Service, used as matching challenges to other member organizations.

The agenda of the Chicago Wilderness alliance now has four foci: a task force on climate change effects on regional biodiversity; a visionary landscape plan to quintuple protected areas for the continued existence of the diverse native biota; the Leave No Child Inside programme that aims at developing children's interest in nature and at building environmental stewardship capacities; and a long-term initiative to gain more knowledge in restoration ecology and apply it in management.

Chicago Wilderness is succeeding because it was built on a century-long history of local conservation, had a diverse founding group of organizational leaders already dedicated to the mission of biodiversity conservation, had important early public notice through its publications, and enabled the members of the alliance to better achieve their individual organizational missions. Even where such conditions do not exist, Chicago Wilderness provides a powerful model showing how a collaborative approach to biodiversity conservation can be implemented in an urban setting, and it has been taken up already in Curitiba, Brazil and Houston, Texas.

Source: http://www.Chicagowilderness.org

While invasive species of plants often increase in urban areas, this may increase species richness in cities relative to rural areas, even protected areas. Cities are characterized by a highly heterogeneous patchwork of habitats, and people introduce non-native species of plants with relatively few individuals of each of these species in urban gardens.

Many cities have zoos and botanical gardens that serve as valuable repositories of wild native species, as well as providing an opportunity for urban people to have closer contact with species of plants and animals from all over the world.

Urban ecosystems often bear little resemblance to rural ecosystems, and bird communities often shift to grain-eating species at the expense of those feeding on insects; and many insect communities may lose their specialists while gaining more generalists. Many cities tend to have rather similar urban-adapted species, leading to homogenization as opposed to diversity (Grimm *et al.*, 2008). And with cities being characterized by generally warmer temperatures and far more light at night, many nocturnal species are comparatively disadvantaged. Grimm and her colleagues advocate "reconciliation ecology", where habitats that are greatly altered for human use are designed, spatially arranged and managed to maximize biodiversity while providing economic benefits and ecosystem services. They suggest that reconciliation ecology offers significant

opportunities for ecologists to contribute to designing and managing new cities and helping to reconstruct older ones.

Since the biological communities in cities are the ones that half the human population normally experience, it is increasingly important to ensure that full advantage is taken of the last remnants of "nature" found in urban areas to build support for conservation more broadly.

City-dwellers should promote and vote for city-based strategies that are more resource-efficient, advocate education programmes about nature for urban centres and foster a culture of urban sustainability and conservation.

Urban decision-makers should be encouraged to engage more in biodiversity and protected area issues and to include these in relevant meetings, both national and international. One important opportunity could be the Mayors' Conference in 2010 in Nagoya, Japan, in parallel with the Conference of Parties of the Convention on Biological Diversity (COP CBD). They should also establish and recognize Municipal Conservation Areas as a significant contribution to the global network of protected areas and the international effort to conserve biodiversity and seek to incorporate biodiversity and protected area components in the planning of major urban-based sporting events, such as the Olympic Games (both summer and winter) and the World Cup. Finally, linking with the United Nations Centre for Human Settlement and other relevant parties could improve information flow among urban administrators and business leaders on environmental issues relevant to cities.

22. A MAP for Conservation in a New Era

This book, and the World Conservation Forum that inspired it, has highlighted many issues and concerns as well as opportunities. We applaud the arrival of ethical and inclusive approaches to biodiversity conservation in general. We recognize the primacy of climate change as a threat but also note that "older" issues such as habitat degradation, overexploitation and invasive species have not gone away and indeed are entwined with climate change. We see the potential opportunities for biodiversity to help solve many of humanity's most pressing problems. This book has confirmed that not only is nature important for its own sake but it is important for human well-being as well.

As potential approaches to conservation were discussed throughout this volume, several commonalities emerged. Conservation today will need to address the specifics of the various issues but a few key points apply across the board – a MAP for the future of conservation.
These include:

1) **M**ainstreaming biodiversity and ecosystem services in all sectors

2) **A**dapting to change through diversity, creativity and respect for nature

3) **P**romoting policies that support equity and rights as integral to conservation.

MAINSTREAMING BIODIVERSITY IN ALL SECTORS

The paradigm of ecosystem services crystallizes the interdependency of our lives and our environment. It also provides means by which we can measure and monitor the impact of our actions and more easily establish costs and benefits of those actions. Ecosystem services also provide an entry point into many seemingly non-environmental areas, perhaps the most visible of which have been efforts to incorporate environment as an essential part of development.

An important step to take in mainstreaming is to harmonize language across disciplines. IUCN's World Commission on Protected Areas (WCPA) recognizes the need to "speak a common language" in order to reach a broad spectrum of audiences and help those audiences understand IUCN's classification system for protected areas (Bishop *et al.*, 2004). Use of medical jargon has been identified as a factor interfering with patient health because they simply don't understand what their doctor is telling them (Zeng and Tse, 2006). If conservationists really want to see a world changed for the better in the coming decades, we will need to reach out to new audiences and speak to them in language that makes sense to them. The chapters on

energy (Chapter 8), armed conflict (Chapter 9), disasters (Chapter 10), human health (Chapter 11), technology (Chapter 13), the private sector (Chapter 15), agriculture (Chapter 20) and cities (Chapter 21) are all attempts in this direction. Speaking of ecosystem services instead of biodiversity is another step in that direction and The Economics of Ecosystems and Biodiversity (TEEB) study is building on this to bring the economic and biodiversity communities together. We will also need to make use of the many new communications and awareness tools at our disposal. Gone are the days when knowledge could be passed only through personal interaction or books. Wikis, blogs, e-courses online instead of in the classroom, and who knows what else will be in the future of sharing conservation science.

With growing appreciation of the role that nature can play in supporting poverty reduction and development, governments have the evidence they need to support investments in nature as a fundamental means to support sustainable development across all sectors. In addition, many donor agencies are now taking steps to "mainstream" environment as a cross-cutting issue. By mainstreaming is meant "The process(es) by which environmental considerations are brought to the attention of organizations and individuals involved in decision-making on the economic, social and physical development of a country (at national, sub-national and/or local levels), and the process(es) by which environment is considered in taking those decisions" (IIED, 2009). Mainstreaming environment in development requires ensuring that recipient countries include environment in their requests and that donor countries ensure that environment is included in their projects. Governments seeking a better future are now looking at the role of environment in their national planning and deciding that it counts (Box 22.1). As biodiversity's role in those processes is fundamental, mainstreaming therefore is about biodiversity.

But mainstreaming, considered as sustainability, also influences the private sector. Environmental issues, once regarded as irrelevant to economic activity, today are dramatically rewriting the rules for business, investors and consumers. Companies that are taking sustainability seriously

Box 22.1 Updating Tanzania's PRSP: national-level environmental mainstreaming for poverty reduction

Tanzania's new National Strategy for Growth and Reduction of Poverty (NSGRP) or *Mkukuta* represents a new, more comprehensive approach to poverty reduction. In particular it pays greater attention to across-the-board issues such as environmental sustainability that contribute to both poverty reduction and growth. This follows the realization by the government of Tanzania, national stakeholders and development partners that the first PRSP failed to properly address the environment and other important major issues, essential to achieving sustainable poverty reduction and growth. Fifteen of the NSGRP's 108 targets in the Mkukuta are directly related to the environment and natural resources, and interventions on the environment are expected to contribute to other targets. Action on the environment is expected to help achieve governance and accountability goals. A key feature of the review leading to the NSGRP was national ownership. It was coordinated out of the Vice President's office, and the implementation of extensive consultation with a wide range of stakeholders on content and focus.

Source: UNEP 2008b, The Environment Times, http://www.grida.no/publications/et/ep4/page/2641.aspx

have fared better than others in the recent economic crisis (AT Kearney, 2009).

Longer term sustainability, though, will need the environment to be mainstreamed everywhere – especially in individual lifestyles. The choices we make – from the food we eat to the cars we drive to the way we relax – all affect nature. As we become aware of the nature of those impacts, it is incumbent on us to take responsibility for our own actions and to join governments and business in a global effort in support of a healthier and more productive environment.

Mainstreaming conservation efforts at an institutional level and managing individual behaviour are both necessary for a sustainable future. This book has included many examples of actions anyone can take to mainstream the environment in their own life. For example:

1. Pursue a carbon neutral lifestyle through conscious energy choices.
2. Check water footprints and manage water consumption at home.
3. Consume in an ecologically-friendly manner – support certification programmes, follow the 3R's – reduce, recycle and reuse.
4. Support and vote for government policies that support conservation of the environment.

ADAPTING TO CHANGE

As we have described throughout this book, human society is currently developing faster than at any other time in its history and is constantly being challenged by the scale and consequences of social, economic and environmental change. In terms of addressing conservation challenges in the coming decades, one constant must be integrated into our thinking and planning – the need to cope with constant change

As human population continues to grow, and concentrates in urban areas, the impacts on natural resources' ability to provide food, fibre and fuel are increasingly evident. Global fisheries are collapsing, forests are disappearing, and agricultural choices are now influenced by global energy needs as well as food requirements. Rapidly growing urban areas are driving a sustained, but perhaps unsustainable, increase in the timber trade, agriculture, stock raising and mining, resulting, in turn, in deforestation and changes in land use. And as migration may be one major strategy in climate change adaptation planning, especially for those living in coastal areas, managing that population shift and its impact will be critical.

But it's not just provisioning services that are affected. Supporting and regulating services that ensure optimal conditions for human health are also at risk. Overwhelming evidence points to human demographic changes as the major direct and indirect factor contributing to the increase in infectious disease (Chapter 11).

Our rapidly changing world is also having a profound effect on the cultural services associated with nature. Human culture is inextricably linked to the environment in which we live and the challenges facing our environment are also threatening cultures around the world. Scholars have estimated that 60–90% of today's 6,900 languages may disappear within the next century (Romaine, 2007), a projected extinction rate even higher than that cited by IUCN's Red List for Threatened Species for any of the major taxa. Losing languages means also losing associated knowledge and practices, some of which may be vital for our future in adapting to changing climate. Conversely, losing biodiversity means loss of the foundation for many cultural beliefs and practices.

All services are also being affected by environmental changes resulting from climate change, especially. As just one example mentioned frequently throughout this book,

invasive alien species, already recognized as a major source of biotic and economic losses, are inherently species that adapt well to change and will likely demonstrate increased spread and impacts.

Managing the impacts of change will require a two pronged approach – mitigation and adaptation – and this approach is equally applicable across the other aspects of change that we are experiencing.

Wherever possible, we must mitigate the magnitude of impacts of the change on the environment – be it decreasing greenhouse gas (GHG) emissions or managing population migration or shifting energy mixes. But we must also recognize that impacts of change are already being felt, and because of lag times in impacts being observed, it is likely that more intense impacts will be seen before any mitigation would have an effect. Therefore, adaptation is as necessary as mitigation. And adaptation must be dynamic as we are living in a constantly adapting environment, not a static one.

Ideally, all planning should be based on processes and not on state so planning based on delivery of ecosystem services provides a useful model that promotes adaptive management. Adaptive management and monitoring are essential elements of such an approach. Adaptive management is an approach to management that integrates regular monitoring and updating of plans and strategies based on the results of that monitoring. It is a means by which to ensure that any use of resources is sustainable and is also an important mechanism to deal with any uncertainties inherent in natural resource management planning. Plans should focus on addressing changes, threats and responses. Technologies such as computer modelling tools are available to help (Pressey *et al.*, 2007).

Underpinning action to mitigate and adapt to change is the need for improved understanding

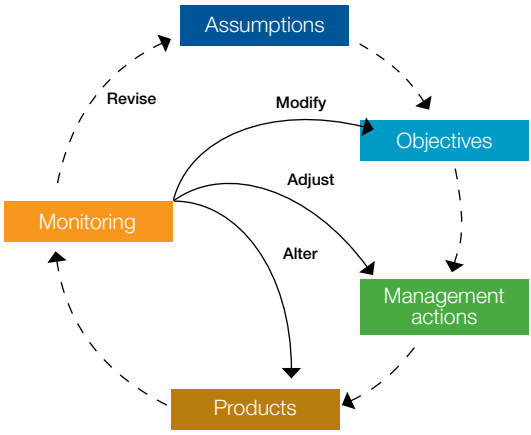


Figure 22.1 Feedback loops associated with adaptive management (CBD, 2003)

of the processes by which these influences are creating change in the environment. What supports ecological resilience and robustness and where are the tipping points to extinction? In addition, while recognizing that the environment has an intrinsic existence value, enhancing understanding of the many economic values of nature will help in making the economic case for investing in environment. As the global community is now focusing on the Millennium Development Goals (MDG) and, potentially, a post-2015 framework for action, a better understanding of the role of the environment, especially for poverty reduction and development, will certainly help in assuring adequate investment in conservation. The Economics of Ecosystems and Biodiversity (TEEB), a review of the value of nature that will be launched at Conference of the Parties to the Convention on Biological Diversity (CBD COP 10) in 2010 will be a major step forward in this regard. In addition, applying economic theory to ecosystem management may provide new insights into resource management and better understanding of trade-offs being made when decisions are taken about using or not using those resources (Perrings, 2006).

In addition to improved understanding of impacts and options for action, implementing effective decisions also requires establishing partnerships across sectors and philosophies. Business, government programmes, development aid and local communities will need to join together towards common objectives. Institutional structures evolve, perceptions change and emerging technology opens up new opportunities. The development of an increasingly global society produces both problems and opportunities. Addressing these in a way that ensures quality of life for both present and future generations will require new visions and new approaches.

Innovation is central to today's world and a key ingredient in responding to and adapting to changes that result from an ever more complex world characterized by increasing human population and declining resources base. Thus innovation will continue to be the imperative and hope for a sustainable world that many envision for the future.

How can conservation spur innovation? What are the most innovative ideas emerging from the WCC? Who are the new partners? This book points the way to some of the answers.

Pragmatism may be the key to it all, recognizing that win-win solutions may not be possible and agreeing to trade-offs to allow a "win more, lose less" option.

PROMOTING EFFECTIVE GOVERNANCE

Governance is the interactions among structures, processes and traditions that determine how power and responsibilities are exercised, how decisions are taken, and how citizens or other stakeholders have their say in the management of natural resources. Governance is a means to a result and not the result in itself. Governance happens at multiple levels (local to global) in multiple sectors (public and private) and in multiple cultures. Ideally all this activity should be mutually reinforcing so that decisions taken at international levels should enable action at local levels. If governance fails, the consequences can mean more than loss of natural resources. As Milledge *et al.* (2007) point out, "governance shortfalls [in the forestry sector] can ultimately affect the prospects for achieving national economic growth and poverty reduction objectives".

Definitions of what "good governance" is have been the subject of many reviews (Bosselman *et al.*, 2008). The Convention on Biological Diversity has recognized, through Decision VII/11, that good governance is essential for application of its Ecosystem Approach.

Through several resolutions (WCC 3.012 and WCC 4.037) and the IUCN Programme, IUCN has recognized the importance of effective governance and defined the principles underpinning good governance as:

- Transparency – openness in decision-making
- Access to information and justice – accurate, effective and open communication
- Public participation – genuine involvement in decision-making
- Coherence – a consistent approach
- Subsidiarity – decisions taken at the lowest level appropriate
- Respect for human rights – interwoven with "good" environmental governance
- Accountability – for economic, social and environmental performance
- Rule of law – fair, transparent and consistent enforcement of legal provisions at all levels.

IUCN's vision, "a just world that values and conserves nature" will simply not be possible if these principles are not the foundation of the

conservation work that we do. Not only is it an ethical imperative but it also makes sense: effective conservation is achieved when these fundamental principles are integrated into our work.

EQUITY, ESPECIALLY GENDER EQUALITY

IUCN is committed to equity both through its vision and mission as well as through numerous policy statements, including the Gender Policy and policies on rights-based approaches. The work carried out within IUCN to promote gender equality is based on two principles:

(1) gender equity is a prerequisite for conservation since women make up approximately half of biological resource users and without their support no conservation policy can be efficient and/or sustainable;

(2) conservation of biological diversity is an opportunity to promote gender equality as it promotes the revision of both existing and the introduction of new practices that offer the possibility of empowering women.

As acknowledged throughout this volume, women are among the most vulnerable to changing circumstances (climate, disasters, poverty). On the other hand, IUCN promotes an approach that goes beyond considering women merely as a marginalized group by highlighting the significant role played by women in natural resources management and acknowledges women as resources of essential knowledge and skills for conservation.

Research shows that environmental management projects that include women's participation (and thereby their experience and traditional knowledge in resource management) are more effective (IWSC, 1988). A World Bank review of 121 rural water supply projects found that women's participation was among the variables strongly associated with project effectiveness. Furthermore, it was found that the failure to take gender differences and inequalities into account could result in failed projects (Narayan, 1995).

Throughout this volume, we have seen that equity and gender equality are of concern across many of the issues discussed from poverty reduction to climate change to energy to water management. Engaging women into governance as main actors and integrating their knowledge can significantly enhance the efficiency and sustainability of conservation initiatives. The issue of equity and its importance is often expressed in terms of costs if it is not incorporated as opposed to benefits if it is. Take the case of gender equality. In no region do women and men have equal social, economic, and legal rights and the result of that inequality is explored in a report from the World Bank (2001). The findings show that the costs of gender inequality can include higher incidence of AIDS, poor nutrition, higher fertility and higher child mortality. All of these can have subsequent impacts on the environment.

Agarwal (2002) reporting on community forest management in India noted that several basic inequalities (for example, unequal division of labour across men and women, unequal access to resources, social norms and perceptions of the role of women) resulted in decreased women's participation in management of resources upon which they depend as well as decreased benefits to women since these are often distributed on a household basis where men are given the benefit on behalf of the household. As noted below, full participation is an important factor in effective conservation and sustainable resource-use management decisions.

RIGHTS-BASED APPROACHES

A rights-based approach to conservation, for IUCN, means conservation that incorporates

consideration and respect for human rights, tenure and resource access rights and/or customary rights of indigenous people and local communities (IUCN, 2008e). IUCN has adopted this policy in recognition of the fact that some conservation practices, such as forced resettlement or sedentarization, may have detrimental effects on human well-being and IUCN, through its Environmental Law Centre (ELC), has prepared a set of principles concerning human rights in conservation (Box 22.2)

Scherr (1999) reports that recognizing property rights in respect of resources such as land, water and trees, as important household assets for local people, has been found to play a fundamental role in the poverty-environment nexus. Gbetibouo (2009) in reviewing southern African farmers reported that tenure rights were one of the factors affecting ability to adapt to climate change. Fisher and Oviedo (2008) note that "environmental rights can sometimes be interpreted in ways that undermine human rights", and urge that discussion about rights-based approaches to conservation move beyond property/access rights to resources to include a broader set of issues including human rights and justice.

Devolving authority to local people has been successful in forest conservation in Tanzania (Barrow *et al.*, 2003), Ethiopia (IIRR, 2000), and China (Oviedo, 2006). Rights-based approaches have been vital in supporting indigenous people's livelihoods and culture as well. Examples include providing title and rights of the southern forests in Guyana to the Wai Wai with which they created Guyana's first and only Amerindian protected area (Janki and Sose, 2008) and co-management in Waza Logone, Cameroon. In the early 1990s, IUCN initiated development of co-management organizations including recognizing and expanding local community land-use rights within the park, and devolving management authority to communities within

Box 22.2 Principles concerning human rights in conservation prepared by the Environmental Law Centre:

1. Promote the obligation of all State and non-State actors planning or engaged in policies, projects, programmes or activities with implications for nature conservation, to secure for all potentially affected persons and peoples, the substantive and procedural rights that are guaranteed by national and international law;
2. Ensure prior evaluation of the scope of conservation policies, projects, programmes or activities, so that all links between human rights and the environment are identified, and all potentially affected persons are informed and consulted;
3. Ensure that planning and implementation of conservation policies and actions reflect such prior evaluation, are based on reasoned decisions and therefore do not harm the vulnerable, but support as much as possible the fulfilment of their rights in the context of nature and natural resource use;
4. Incorporate guidelines and tools in project and programme planning to ensure monitoring and evaluation of all interventions and their implications for human rights of the people involved or potentially affected which will support better accountability and start a feedback loop; and
5. Support improvement of governance frameworks on matters regarding the legal and policy frameworks, institutions and procedures that can secure the rights of local people in the context of conservation and sustainable resource use.

Source: WCC 4.056

the park "periphery zone resulted in improved ecosystem health, and members of participating communities reporting positive outcomes in terms of resource access and reduced conflict" (Scholte *et al.*, 2006).

PARTICIPATION, TRANSPARENCY AND ACCOUNTABILITY

Rio Principle 10 states that "Environmental issues are best handled with participation of all concerned citizens, at the relevant level". Participatory conservation as part of natural resource management has been shown to result in improved status of that resource – for example forests in Tanzania (Blomley *et al.*, 2008).

Inclusive approaches also support integration of many separate but relevant elements into sustainable resource management. For example, the Newfoundland and Labrador Government wanted to strengthen management of the Davis Strait sub-species of polar bear and created an inclusive document that combined local, indigenous, and scientific knowledge into a Management Plan that is a "living document" that will continue to be updated as new information is available. The Newfoundland and Labrador Management Plan goes further than most species management plans by including not only scientific and local knowledge, but also the traditional knowledge of Nain elders about the polar bear's habitat, climate change, human encounters, and traditional hunting (MacLeod, 2008).

THE LAST WORD

Shaping a sustainable future will require the concerted efforts of all of society. In *Transition to Sustainability: Towards a Humane and Diverse World,* Adams and Jeanrenaud (2008) outline the need for a "one planet economy", a "rejuvenated global environmental movement", and "institutional architecture that supports change". Failure to act now will incur high costs, not just monetary, for the future. Conserving genes, species and ecosystems will save substantial long-term costs but requires significant investments today. What will it take to convince people to make these investments?

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Rue Mauverney 28
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