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Biodiversity

Global overview

Biodiversity resources

Biodiversity refers to the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part. This includes diversity within species (genetic diversity), between species and of ecosystems.

There is no universally accepted classification of ecosystems at the global scale (UNEP 1995) but Olson (1994) defined 94 ecosystem classes based on land cover, vegetation and climate. This framework provides a mechanism for summarizing data at the global level, while recognizing the distinctiveness of ecosystems within each individual region.

Tropical forest ecosystems are the most species-rich environments. Although they cover less than 10 per cent of the world's surface, they may contain 90 per cent of the world's species. Coral reefs and Mediterranean heathland are also highly species-rich. Around 1.75 million species have been named by taxonomists to date (UNEP-WCMC 2000). The total number of species has recently been estimated as 14 million (see table), although this is highly uncertain, due to a lack of information about the number of insect, nematode, bacteria and fungus species.

Living organisms contribute to a wide variety of environmental services, such as regulation of the gaseous composition of the atmosphere, protection of coastal zones, regulation of the hydrological cycle and climate, generation and conservation of fertile soils, dispersal and breakdown of wastes, pollination of

Estimated number of described species

Kingdom	*Described species*
Bacteria	4 000
Protoctists (algae, protozoa, etc.)	80 000
Animals: vertebrates	52 000
Animals: invertebrates	1 272 000
Fungi	72 000
Plants	270 000
Total described species	**1 750 000**
Possible total including unknown species	**14 000 000**

Source: UNEP-WCMC 2000

many crops, and absorption of pollutants (UNEP 1995). Many of these services are neither widely recognized nor properly valued in economic terms; however, the combined economic value of 17 ecosystem services has recently been estimated in the range US$16–54 trillion per year (Costanza and others 1997).

Human health and well-being are directly dependent on biodiversity. For example, 10 of the world's 25 top-selling drugs in 1997 were derived from natural sources. The global market value of pharmaceuticals derived from genetic resources is estimated at US$75 000–150 000 million annually. Some 75 per cent of the world's population rely for health care on traditional medicines, which are derived directly from natural sources (UNDP, UNEP, World Bank and WRI 2000).

Biodiversity also provides genetic resources for food and agriculture, and therefore constitutes the biological basis for world food security and support for human livelihoods. A number of wild crop relatives are of great importance to national and global economies. For example, Ethiopian varieties have provided protection from viral pathogens to California's barley crop, worth US$160 million per year. Genetic resistance to disease obtained from wild wheat varieties in Turkey has been valued at US$50 million per year (UNEP 1995).

Decline and loss of species

Global biodiversity is changing at an unprecedented rate (Pimm and others 1995), the most important drivers of this change being land conversion, climate change, pollution, unsustainable harvesting of natural resources and the introduction of exotic species (Sala and others 2000). The relative importance of these drivers differs between ecosystems. For example, land conversion is most intensive in tropical forests and less intensive in temperate, boreal and Arctic regions; atmospheric nitrogen deposition is largest in northern temperate areas close to cities; introduction of exotic species is related to patterns of human activity — those areas remote from human intervention generally receive fewer introduced species. The ultimate causes of biodiversity loss are human population growth together with unsustainable patterns of consumption, increasing production of waste and pollutants, urban development, international conflict, and continuing inequities in the distribution of wealth and resources.

Over the past three decades, decline and extinction of species have emerged as major environmental issues. The current rate of extinction is many times higher than the 'background' rate — that which has prevailed over long periods of geological time. Estimates based on the fossil record suggest that the background extinction rate in mammals and birds has been one species lost every 500-1 000 years (May, Lawton and Stork 1995).

Information on the conservation status of species is provided by the World Conservation Union (IUCN) which regularly publishes 'Red Lists' of species considered to be threatened with extinction. The latest IUCN Red List (Hilton-Taylor 2000) indicates that about 24 per cent (1 130) of mammals and 12 per cent (1 183) of bird species are currently regarded as globally threatened (see table). Since the Red List assessment in 1996, the number of critically endangered species has increased from 169 to 180 mammals and from 168 to 182 birds (Hilton-Taylor 2000). Analyses suggest that over the next 100 years the extinction rate of vertebrate groups could be as high as 15-20 per cent (Mace 1995). However, species trends derived from Red List data should be interpreted with caution because the criteria for listing have changed over time and some of the changes in status reflect taxonomic revisions (May, Lawton and Stork 1995).

Insufficient information is available to determine precisely how many species have become extinct in

Globally threatened vertebrate species by region

	Mammals	*Birds*	*Reptiles*	*Amphibians*	*Fishes*	*Total*
Africa	294	217	47	17	148	723
Asia and the Pacific	526	523	106	67	247	1 469
Europe	82	54	31	10	83	260
Latin America and Caribbean	275	361	77	28	132	873
North America	51	50	27	24	117	269
West Asia	0	24	30	8	9	71
Polar	0	6	7	0	1	14

Note: 'Threatened species' include those categorized by IUCN in 2000 as Critically Endangered, Endangered and Vulnerable (Hilton-Taylor 2000); adding totals for each region does not give a global total because a species may be threatened in more than one region

Source: compiled from the IUCN Red List database (Hilton-Taylor 2000) and the UNEP-WCMC species database (UNEP-WCMC 2001a)

the past three decades. However, the database maintained by the Committee on Recently Extinct Organisms (CREO 2001) lists 58 fish species and 1 mammal species recorded as extinct since 1970; assessments by BirdLife International indicate that 9 bird species have become extinct during this period (BirdLife International 2000).

Much of the relevant information on the status of species is qualitative or anecdotal, and it is therefore difficult to develop a quantitative overview of global trends. To assess trends in species loss or decline, indicators are required that provide quantitative estimates of change over time, using consistent methodologies for sampling and analysis. Ideally, such indicators should be based on data sampled explicitly for this purpose. Few such monitoring programmes have yet been established.

One approach is the Living Planet Index created by UNEP-WCMC in cooperation with WWF (see box). The index is derived from trends in the size of wild populations of species in three habitats — forest, freshwater and marine ecosystems. The prevailing trend of all three indices is downward.

The impact of decline or loss of species on the provision of environmental services is difficult to evaluate because the relationship between species diversity and ecosystem function is still unclear. Some species are known to play more significant roles than others; these have been termed 'keystone' species — loss of one of these species has a particularly disruptive effect (Vitousek and Hooper 1993). Reductions in the number of species affect the provision of all ecosystem services because resource capture (of energy, water and nutrients) is greater in more diverse systems. Some ecosystems, such as arid and arctic areas, appear to be particularly vulnerable to human impacts. In these systems, relatively few organisms share common ecological roles (UNEP 1995). Species diversity may also play a role in buffering ecosystems against the effects of human activity (UNEP 1995).

The past three decades have been marked by the emergence of a concerted response to the biodiversity crisis. Civil society, particularly in the form of a hugely diverse and increasingly sophisticated NGO network, has been a major driving force behind this. A trend towards increased stakeholder participation relating to conservation action is evident as illustrated by the emergence of partnerships between NGOs, governments and the private sector.

A number of international conventions have been developed that deal specifically with conservation of

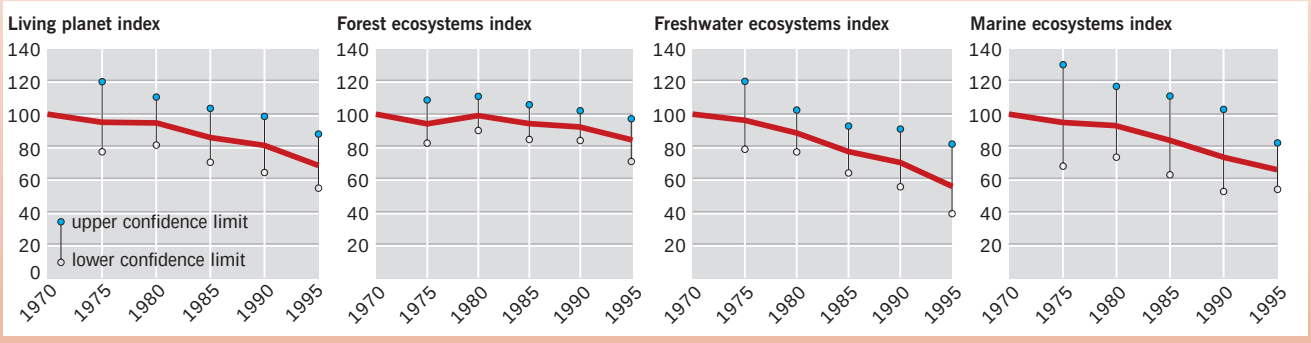
The Living Planet Index: a global biodiversity indicator

The Living Planet Index system is based on estimates of population size of individual wild species available in the scientific literature. The index is calculated as a percentage of the population size estimated at 1970; the mean value of the index is calculated as an average of all the species included in the assessment at each time interval (Groombridge and Jenkins 2000, Loh 2000, UNEP-WCMC 2000). The index has been calculated for the forest, marine and freshwater ecosystems (see graphs).

The forest index, based on 319 populations of temperate and tropical species (mostly birds), shows a decline of about 12 per cent during 1970–99. The index for temperate species only shows little change over the period (most deforestation here having taken place before the 20th century). The tropical sample shows a downward trend, consistent with the continuing deforestation in many tropical areas.

The marine index, based on populations of 217 species of marine animals, shows a decline of about 35 per cent in the same period.

Inland water and wetland species, represented by a sample of 194 populations, have declined by 50 per cent. This suggests that inland water ecosystems are more severely degraded than other ecosystem types, a finding consistent with other evidence.



Source: Loh 2000

threatened species. Among the most notable are the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and the 1979 Convention on the Conservation of Migratory Species of Wild Animals (CMS) — or the Bonn Convention — which was developed to conserve terrestrial, marine and migratory bird species throughout their range. Inter-governmental agreements such as the African-Eurasian Waterbird Agreement — which aims to develop transboundary strategic measures necessary to conserve the network of critical wetland areas on which migratory waterbirds depend — are the primary tools for the implementation of the CMS.

Habitat degradation and loss

The focus of conservation action has recently shifted from protecting individual species to conserving habitats and ecosystems. An illustration of how conservation plans are now conceived at broader scales is provided by WWF International which recently developed priorities for action at the scale of ecoregions (large areas of relatively uniform climate that harbour a characteristic set of species and ecological communities). Ecoregions of particular conservation importance include Lake Baikal in Russia, the Australian Great Barrier Reef and the Atlantic forests of Argentina, Brazil and Paraguay.

Loss and degradation of habitat is the most important factor causing loss of species. For example, conversion of forests or grasslands into croplands results in the local extinction of plant and animal species (Sala and others 2000). Worldwide about 1.2 million km^2 of land have been converted to cropland in the past 30 years. In a recent global survey, habitat loss was found to be the principal factor affecting 83 per cent of threatened mammals and 85 per cent of threatened birds (Hilton-Taylor 2000, BirdLife International 2000). Habitat modification arises from many different types of land use change including agricultural development, logging, dam construction, mining and urban development.

Over the past three decades, major losses of virtually every kind of natural habitat have occurred. For example, FAO assessments show that between 1980 and 1995 forest cover in developing countries declined by an estimated 2 million km^2 — an average annual loss of 130 000 km^2 (FAO 1999a). The most important causes of forest loss included conversion to agriculture and development schemes involving resettlement. As a result, habitats such as the tropical dry forests of Central America have virtually disappeared (UNDP, UNEP, World Bank and WRI 2000). In terms of loss of species, freshwater habitats are the most degraded, with some 20 per cent of freshwater species having become extinct or threatened with extinction in recent decades (UNDP, UNEP, World Bank and WRI 2000). The main causes of extinctions among freshwater fishes are declines in habitat quality (Harrison and Stiassny 1999).

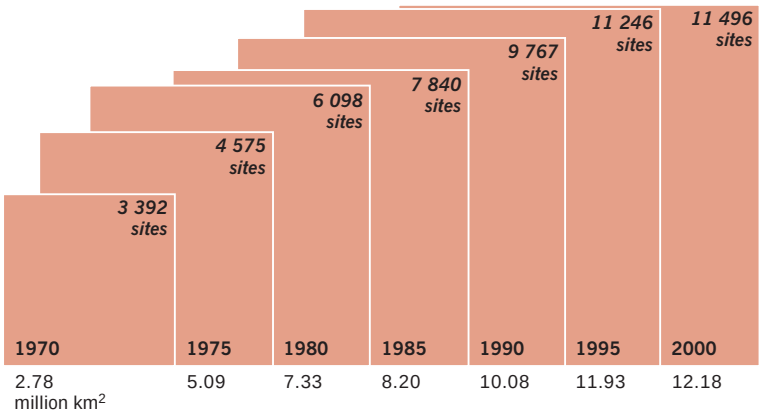
Dryland ecosystems, which cover more than one-third of the world's land area, are particularly vulnerable to degradation. Statistics indicate that more than 250 million people are directly affected by desertification (UNCCD 2001). In 1977, 57 million people failed to produce enough food to sustain themselves as a result of land degradation and by 1984 this number had risen to 135 million (UNEP 1992). Impacts of degradation on dryland biodiversity have not been comprehensively documented but substantial changes have resulted from grazing of livestock, deforestation, introduction of non-native species and conversion to croplands (UNEP 1995). In response, the 1977 United Nations Conference on Desertification adopted a Plan of Action to Combat Desertification. Despite this, assessments by UNEP (1992) indicated that land degradation in many dryland areas had continued to intensify. As a result the United Nations Convention to Combat Desertification was developed, entering into force in 1996. This convention aims to promote effective action through local programmes and international partnerships.

Wetlands are areas where the water table is at or near the surface of the land, or where the land is covered by shallow water, and include areas of marsh, fen and peatland. Wetlands play an important role in regulating water flow and are of exceptional importance as habitats for large numbers of species. Wetland habitats are also of high economic importance for provision of water and fisheries (more than two-thirds of the world's fish harvest is linked to coastal and inland wetland areas). Concern about degradation and loss of wetland habitats led to the development of the Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar) in 1971. The Ramsar Convention provides a framework for national action and international cooperation for the conservation and wise use of wetlands and their

resources (see Chapter 1 for more information).

The designation of protected areas, such as national parks, is one of the most widely used approaches for conserving habitats. In addition to national parks, a total of 167 sites have now been designated as natural heritage sites under the World Heritage Convention. The total area of protected sites has increased continuously during the past three decades from less than 3 million km^2 in 1970 to more than 12 million km^2 by the late 1990s (Green and Paine 1997), indicating that there are continuing efforts by governments to establish protected areas. Although the effectiveness of protected areas for conserving biodiversity has been questioned, a recent analysis of 93 protected areas around the world indicated that most parks are successful at stopping land clearing and to a lesser extent at mitigating logging, hunting, fire and grazing (Bruner and others 2001).

Global number and area of protected sites by year



Total area of protected areas has increased from some 2.78 million km^2 in 1970 to more than 12 million km^2 by 2000

Note: areas of more than 1 000 ha, IUCN categories I-VI
Source: compiled from Green and Paine 1997 and UNEP-WCMC 2001b

The most significant response to the biodiversity crisis during the past 30 years has been the Convention on Biological Diversity (CBD) which entered into force in December 1993 and had been signed by 182 Parties by December 2001. The convention has three main goals: the conservation of biodiversity; sustainable use of the components of biodiversity; and sharing the benefits arising from the use of genetic resources in a fair and equitable way (see Chapter 1).

The CBD has resulted in major activity at both national and international levels, and in the increased coordination of cross-sectoral action within and between countries. However, major challenges remain in increasing capacity to assess biodiversity and its value to people, securing adequate financial resources for conservation actions, and building political support for the changes necessary to ensure biodiversity conservation and sustainable use.

It is clear from national reports that the implementation of the convention is making progress in most countries, as illustrated by preparation of national biodiversity strategies and action plans, increasing efforts to reform institutional and legislative arrangements, integration of biodiversity into sectoral activities and increased recognition by governments of the importance of the identification and monitoring of biological diversity.

It is not yet possible to assess accurately the impacts of the CBD on biodiversity, partly because the CBD has been in force for only a short time. In addition, the parties to the convention have yet to develop any globally applicable criteria and indicators by which overall changes in biodiversity can be measured. It is clear that the convention has had some impact at the policy level in many countries. What remains difficult to assess is the depth of commitment to implementation and how any such policy changes may result in changes in the state of biodiversity. This issue is addressed in the strategic plan for the convention, currently under discussion.

Climate change and global warming

During the 1990s climate change emerged as one of the major potential threats to biodiversity. The IPCC concluded that climate change could lead to severe adverse impacts on ecosystems, and on the goods and services they provide (IPCC 2001). Some ecosystems might disappear, while others could experience dramatic changes in species composition. Desertification may increase in some areas and some species could also become more vulnerable to extinction (WRI and IUCN 1998).

The impact of climate change on biodiversity to date is unclear. The increasing incidence of coral reef bleaching may be a consequence of recent rises in global ocean temperature (Goreau and others 2000). Reports of coral bleaching have increased greatly since 1989, with all records of mass bleaching occurring after this date. The most significant mass bleaching was associated with the 1997-98 ENSO event, when all ten reef provinces of the world were affected. In some areas, most notably the Indian

Ocean, this event was followed by mass mortality, where up to 90 per cent of all the corals died over thousands of square kilometres (Goreau and others 2000). Climate change has also been implicated in the decline of amphibians in tropical montane forests (Pounds, Fogden and Campbell 1999).

Nitrogen deposition

Nitrogen deposition has become a major cause of biodiversity loss. It has increased substantially in recent decades, primarily as a result of an increase in the use of fertilizer and the burning of fossil fuels. Increased nitrogen in soil and water can lead to loss of species and shifts in the species composition of plant communities (Wedin and Tilman 1996); for example, the conversion of heathlands to species-poor grasslands in the Netherlands (Vitousek and others 1997). Aquatic ecosystems are the most vulnerable; nitrogen deposition can lead to eutrophication, currently one of the most serious threats to aquatic environments, particularly in inshore waters where many commercial fish and shellfish species breed (Diaz and Rosenberg 1995). Nitrogen deposition has also been associated with the recent increase in toxic algal blooms (Anderson 1994).

Oil spills

Oil spills have also had a major impact on biodiversity in recent decades. In 1998 alone, a total of 108 000 tonnes of oil were spilled worldwide into marine and inland environments as a result of 215 incidents (Etkin 1999).

Consumption and international trade

During the past 30 years, consumption of natural resources has increased substantially — for example, the global consumption of forest products such as paper increased threefold (Matthews and others 2000). For many biological resources, such patterns of increasing consumption are unsustainable. The most striking example is marine fisheries. Consumption of fish has increased 240 per cent since 1960. However, the marine catch has now levelled off and shows signs of declining as a result of overexploitation. More than 70 per cent of the world's commercially important fish stocks are described by FAO as either fully fished, overexploited, depleted or slowly recovering (FAO 1999b). Numerous fisheries collapsed during the latter part of the 20th century, including Canada's Grand Banks cod fishery which closed in 1992 with the loss of 40 000 jobs (Milner-Gulland and Mace 1998).

Products derived from wildlife form the basis of an international trade valued at approximately US$10 000 million annually. Additionally, there is an extensive illegal trade in such products (Mahony 1996). In addition to the CITES secretariat, the establishment in 1976 of the Trade Records Analysis for Flora and Fauna in International Commerce (now simply known as TRAFFIC) by IUCN and WWF has strengthened the international community's efforts to monitor illegal wildlife trade and implement CITES' provisions and decisions. The CITES secretariat, Interpol and the World Customs Organization, as well as a number of NGOs, have been establishing networks and organizing training of customs, borders, police, wildlife and other enforcement authorities.

The impact of CITES on biodiversity is difficult to assess, as it is often not possible to ascribe unequivocally any changes in the conservation status of species to the impacts of actions taken under the convention. The continual upgrading of many species to increasingly higher levels of protection suggests ineffectiveness, although some species (such as vicuña) have been downgraded because of successful sustainable use schemes (Milner-Gulland and Mace 1998). In the case of the African elephant, although upgrading from Appendix II to Appendix I in 1989 was highly controversial, it appears to have contributed to a decline in poaching. In contrast, rhinos have been listed on CITES Appendix I since 1973 and yet poaching continues to be a major threat to this species (Milner-Gulland and Mace 1998).

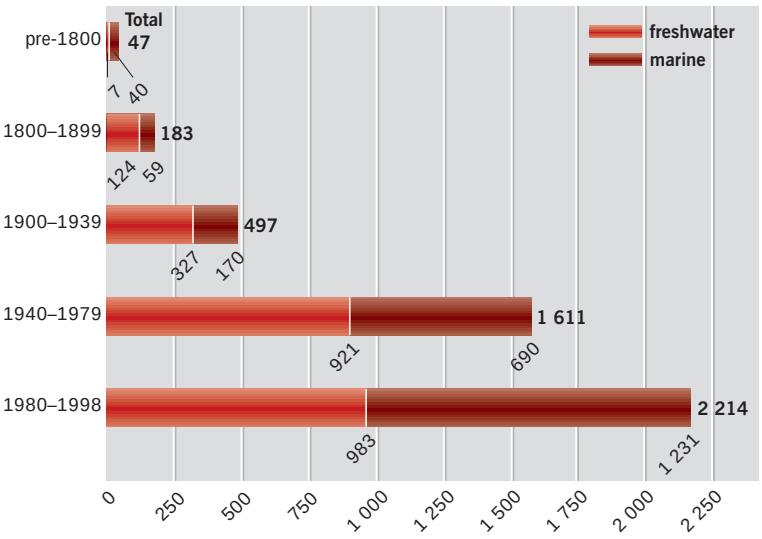
Invasive species

Invasive species are organisms (usually transported by humans) that successfully colonize native ecosystems. Such species have been a major threat to native species through the effects of predation, alteration of habitat or disruption of ecosystem processes. Notable terrestrial examples include the loss of many endemic land snail species of French Polynesia following the introduction of the predatory snail *Euglandina rosea,* and the decline in New Zealand's native birds due to the introduction of Australian brushtail possum. Aquatic examples include the introduction of the predatory Nile perch *Lates niloticus* to Lake Victoria around 30 years ago, which contributed to the apparent extinction of 250 endemic species of cichlid

fishes (Harrison and Stiassny 1999). The number of aquatic introductions rose rapidly during the second half of the 20th century (see graph).

The CBD recognizes the importance of invasive species as a global problem and calls upon contracting parties to prevent the introduction of, control or eradicate those alien species that threaten ecosystems, habitats and species. In response to a recommendation from the CBD in 1996, the Global Invasive Species Programme (GISP) was developed, which is coordinated by the Scientific Committee on Problems of the Environment (SCOPE), in collaboration with IUCN, Centre for Agriculture and Biosciences International and UNEP. The programme will review current knowledge on invasive species and develop new tools and approaches to deal with the problem both locally and globally.

Cumulative number of aquatic introductions



Cumulative number of aquatic introductions rose fast in the second half of the 20th century

Source: FAO 1998 and Wellcome 1988

Biotechnology

Biotechnology is increasingly being used for the genetic improvement of crops but concerns have been raised about potential risks to biodiversity. The organisms produced are referred to as genetically modified organisms (GMOs) or living modified organisms (LMOs) and efforts have focused on such crops as tomatoes, grains, cassava, maize and soybeans. In response to this concern, a subsidiary agreement to the CBD was negotiated to address the potential risks posed by cross-border trade and accidental releases of GMOs. Adopted in January 2000, the Cartagena Protocol on Biosafety was developed to ensure that recipient countries have both the opportunity and the capacity to assess risks relating to GMOs, and to ensure their safe transfer, handling and use.

Conclusion

Assessing the impact of the various multilateral environmental agreements on biodiversity is problematic. This is because there is an absence of baseline data from which to measure changes and the agreements generally do not refer to explicit biodiversity-related targets (either in their texts or in subsequent elaboration) against which to measure impacts. It is also extremely difficult to separate the impacts of one agreement from a host of confounding factors. One exception is the moratorium on commercial whaling imposed by the International Whaling Commission since 1985-86. In this case, there were appropriate baseline data on whale stocks and it is reasonable to assume that subsequent increases in populations, where these have been observed, are a result of the moratorium.

Assessment of the impact of policy responses to pressures on biodiversity is limited by the lack of a comprehensive system for monitoring, for collating relevant data and for presenting information in a consistent manner. The Global Biodiversity Information Facility (GBIF) was recently developed to help address this need by improving collection and presentation of information on biodiversity. GBIF developed from the work of the OECD Megascience Forum Working Group on Biological Informatics that was established in January 1996.

In general, the available data suggest that despite a variety of initiatives, biodiversity continues to decline. Most examples of successful conservation action are those where particular attention, and considerable financial resources, have been focused on individual species or localized areas. Many threats to biodiversity such as habitat loss and invasion by introduced species continue to intensify. In addition, new threats may be emerging, such as climate change and the introduction of LMOs. Overall, it appears that the drivers of biodiversity loss are so pervasive that conservation efforts have at best only slowed the rate of change at the global level.

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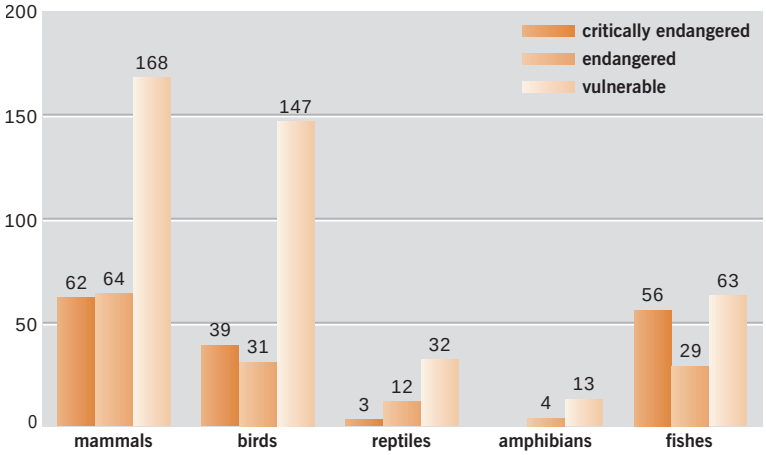
Biodiversity: Africa

Five internationally recognized 'biodiversity hot spots' (areas of particularly high species richness and endemism, and under particular threat) are found in the African region (Mittermeier and others 2000). These are the Western Indian Ocean islands, the Cape floristic region, the Succulent Karoo (the most species-rich desert in the world), the Upper Guinea forest and the Eastern Arc mountain forests of Eastern Africa.

Numbers of threatened vertebrates: Africa



Note: critically endangered (extremely high risk of extinction in immediate future); endangered (very high risk of extinction in near future); vulnerable (high risk of extinction in medium-term future)

The data include all globally threatened vertebrate species with country records in the UNEP-WCMC database (UNEP-WCMC 2001a). Marine species recorded by ocean area are not included

Part of the Mediterranean Basin hot spot, home to 25 000 plant species and 14 endemic genera, is also found in Africa (Quézel and others 1999). The continent possesses several other areas of great importance for biodiversity. These include the highlands of Ethiopia; the forests of the Albertine Rift in Burundi, eastern Congo, Rwanda, and adjacent parts of Kenya and Uganda; the western escarpment of Angola; and the miombo woodlands of interior Southern Africa (Mittermeier and others 2000).

In the past three decades, habitat loss and degradation has been a major issue throughout Africa, particularly in dryland areas. In humid areas, the bushmeat trade has also had a significant impact on biodiversity. Biodiversity resources are extensively used for subsistence and commercial purposes. For example, approximately 70 per cent of the wild plant species in Northern Africa are used as sources of traditional food, forage, medicine and agroforestry, and half have more than one use (Ucko and Dimbleby 1969, UNESCO and UCO 1998, WWF and IUCN 1994). The richness and diversity of ecosystems in Africa underpins a flourishing tourism industry, which is an important source of foreign exchange for many countries. For instance, Southern Africa's wildlife attracted more than 9 million visitors in 1997 bringing in a total of US$4.1 billion (SADC 2000).

Habitat degradation and loss

Loss and degradation of habitat have been widespread over the past three decades. FAO's Global Forest Resources Assessment (FAO 2000) estimated the rate of deforestation in Africa during the period 1990–2000 as 0.78 per cent of total forest area a year, representing a yearly loss of some 5.2 million ha. The cause is primarily clearance for agriculture but extraction of timber and fuelwood, fire and overgrazing have also been important factors. Deliberate burning of grasslands is widely practised in many African countries, with 25-50 per cent of land cover in the arid Sudan zone and 60-80 per cent in the humid Guinea zone burned annually (Menaut and others 1991).

Impacts of habitat loss and degradation on biodiversity are difficult to evaluate. However, dramatic contractions in the range of many species have been recorded. For example, in Africa as a whole, elephants declined from about 1 300 000 to 500 000 during the 1980s. Declines were most pronounced in areas characterized by poaching, civil war, high rates of land use change and increases in human population densities (Happold 1995). Central Africa had lost about half of its wildlife habitats by 1986 (McNeely and others 1990). Draining of wetlands for agricultural and urban development, degradation through overgrazing and collection of fuelwood, and pollution through effluent discharge have caused the loss of up to 50 per cent of wetlands in Southern Africa (DEAT 1999) and Western Africa (Armah and Nyarko 1998, Oteng-Yeboah 1998), while some 80 per cent of the Upper Guinea forest has now been cleared (Conservation International 1999).

During 1980–95, the number of recorded extinct plants in Southern Africa increased from 39 to 58, and the number of threatened plants more than doubled (Hilton-Taylor 1996). Recent estimates indicate that more than 700 vertebrate species (see bar chart), around 1 000 species of trees (Hilton-Taylor 2000) and several hundred other plant species (IUCN 1997) are threatened with extinction.

Protected areas

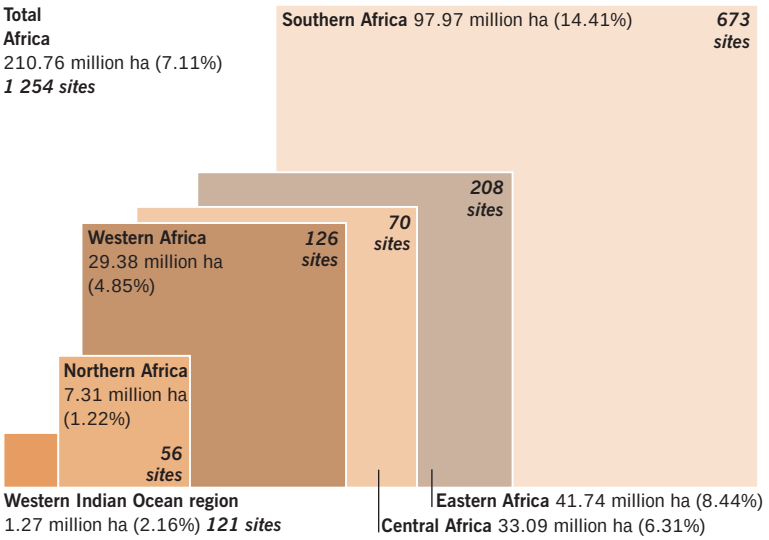
The main response to loss of natural habitat has been the establishment and extension of protected areas. Overall, approximately 7 per cent of the land area of Africa has been designated as protected. In total, Africa contains 1 254 protected areas (UNEP-WCMC 2001b), including 198 marine protected areas, 50 biosphere reserves, 80 Wetlands of International Importance and 34 World Heritage sites (UNDP, UNEP, World Bank and WRI 2000).

Protected area coverage differs markedly within Africa; for example, a substantially higher proportion of the land area is designated as protected in Southern Africa than in other sub-regions (see graphic). Lack of financial support and weak law enforcement are common problems in African protected areas, resulting in encroachment by human activities and settlements. However, sub-Saharan Africa accounts for 18 per cent of the global mean investment in protected areas (James 1996). Protected areas are being increasingly managed for multiple uses, including tourism and sport hunting.

Some 52 African countries are party to the Convention on Biological Diversity, 48 countries are party to CITES, and 22 are party to CMS. This is reflected at the national level in the development of national action plans and strategies for the environment, biodiversity and conservation. Financial assistance from a range of bilateral and multilateral donors offers opportunities to address the key issues relating to biodiversity and to promote sub-regional cooperation in conservation. Several transfrontier reserves are being established in Southern and Eastern Africa.

During the colonial era, conservation policies were often based on protectionism that ignored the needs of African people, by imposing hunting restrictions and excluding people from reserves. Protected areas fell under this category and have been described as 'fortress conservation' (Adams and Hulme 2001). Policies on wildlife conservation have since changed with communities living adjacent to national parks being considered as partners; a key trend during the past three decades has been the increasing involvement of local people in conservation initiatives. Community-based conservation (CBC) programmes seek to achieve this by allowing people living near protected areas to participate in land management decisions, giving people rights to wildlife resources and ensuring that local people derive economic benefit from wildlife conservation (Hackel 1999). Some, however, argue that community conservation is no panacea (Adams and Hulme 2001). It has been argued that CBC projects are not primarily established to achieve biodiversity conservation goals but are usually based on the sustainable harvest of living organisms.

Protected areas: Africa



Note: number of protected areas includes those in IUCN categories I-VI

Source: compiled from UNEP-WCMC 2001b

Impacts of wild harvest

In much of sub-Saharan Africa, the harvest of wildlife for food has a major impact on the populations of many species. Wild food may play an important role in food security for rural people and is also, increasingly, a commercial commodity that is traded nationally and regionally. In many urban areas, meat from wild animals commands a significantly higher price than that from domestic animals, helping to stimulate large-scale harvest. Large quantities of meat are involved: in the Central Africa moist forests alone as much as 1 million tonnes of wildlife (primarily antelope, wild pigs and primates) are killed for food each year. A great deal of the wildlife harvest in Africa is believed to be currently unsustainable and has been implicated in the declines and local extinctions of a range of animal species (Barnett 2000, Oates 1999, Wilkie and Carpenter 1999).

A number of wild plant species are affected by harvest for medicinal purposes. Rural and urban populations all over Africa depend largely on medicinal plants, often collected in the wild, for their health

needs. Some species, such as the montane tree *Prunus africana* and the southern African devil's claw Harpagophytum species, are also exported in significant quantities. Overharvesting, together with agricultural encroachment and unregulated burning, are believed to be contributing to the decline of many species in the wild. In a survey of medicinal plant use in 17 countries in East and Southern Africa, more than 100 indigenous plant species were identified as conservation or management priorities on a national basis (Marshall 1998).

Over the past 30 years, trade regulation and prohibitions or suspension, mainly through CITES, have been used to control international trade in threatened species with varying degrees of success. For example, the black rhino, listed in Appendix I of CITES and thereby banned from commercial international trade, is still threatened by illegal hunting, and populations have not recovered to pre-1960s levels. On the other hand, there has been significant recent growth in elephant numbers in Botswana, Namibia and Zimbabwe.

Species re-introduction and plant propagation are also helping. In the Western Indian Ocean islands, successful conservation measures resulted in the Mauritian kestrel population increasing from just four individuals in 1974 to more than 500 in 2000. Similarly, the pink pigeon population now exceeds 350 from a mere 10 wild individuals in 1990 (BirdLife International 2000).

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Biodiversity: Asia and the Pacific

Species diversity in the region is extremely high. Indonesia is thought to support more species, with more endemic species, than any other country in the world, closely followed by several others, including Australia and China (Groombridge 2000). The tropical waters around the Indo-Australasian archipelago are the world's centre of diversity for a wide range of marine groups, including corals, coral reef fishes and mangroves (Groombridge 2000). Rangelands in western parts of the region, the Tibet plateau and Australia are particularly rich in lizards and snakes adapted to arid conditions (Anderson 1963, Cogger 1992, Zhao and Adler 1993). Many of the rivers and freshwater lakes hold endemic species of fish and aquatic invertebrates (Kottelat and Whitten 1996).

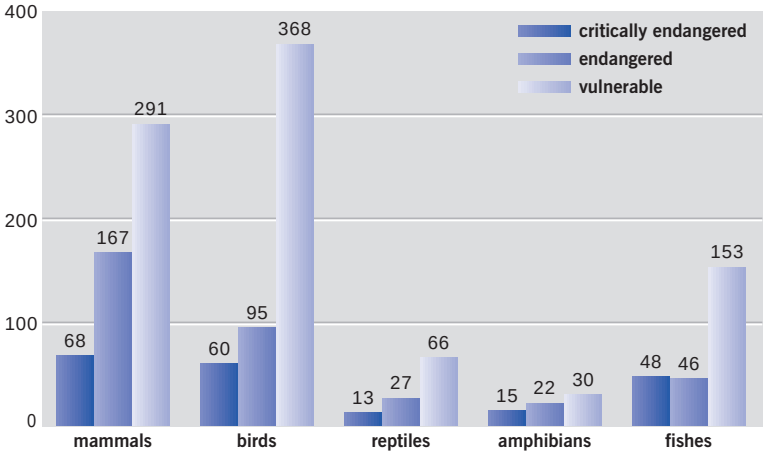
The larger islands are home to a wide range of endemic species while the continental areas often have high species richness together with high rates of endemism. Such 'hot spots' can be identified at a range of scales, from individual mountains to extensive hill ranges. The entire Hindu Kush-Himalayan belt has as many as 25 000 plant species, comprising 10 per cent of the world's flora (Shengji 1998). A few such areas remain relatively unknown: remarkably, even new large mammal species have recently been described in Viet Nam and Laos (see box).

Biological resources have long been of subsistence importance, and have been increasingly exploited for trade. At the global level, around three-quarters of known or suspected species extinctions have occurred on isolated islands (WCMC 1992), many of which were molluscs and birds from the Asia-Pacific region. Some 1 469 vertebrate species in the region are currently considered to be threatened with extinction (see bar chart above). Habitat loss is the principal factor that fragments natural populations and increases their risk of extinction but this often acts in synergy with other pressures such as alien species and unsustainable harvesting (Eder 1996, NBSAP 2000, NIES 1997).

Alien species

Introduced species have long been recognized as a threat to indigenous species, particularly species endemic to single countries or small islands. For example, native plants on the main islands of New Zealand compete with a range of introduced plants and

Numbers of threatened vertebrates: Asia and the Pacific



are heavily affected by introduced terrestrial mammals, among which brush-tailed possums (from Australia) are a particular threat. Tens of millions of New Zealand dollars were spent annually on possum control in the 1990s to reduce habitat loss and control bovine tuberculosis which can be passed from possums to domestic cattle (MFE 1997). New Zealand birds, reptiles and amphibians are also under pressure from introduced predators such as stoats, rats and cats but much emphasis is now given to invasive species control programmes on small islands, where long-term control may be feasible. The robin *Petroica traversi* was formerly widespread in the Chatham Islands but had been much reduced by the late 19th century. By the 1970s, the species was restricted to Little Mangere Island, where the remaining patch of forest was being destroyed by invasive plants. A conservation programme has now resulted in a population of some 200 birds, all descended from a single pair (MFE 1997).

The brown tree snake *Boiga irregularis* spread widely through Guam, from the 1950s onward, after

Note: critically endangered (extremely high risk of extinction in immediate future); endangered (very high risk of extinction in near future); vulnerable (high risk of extinction in medium-term future)

The data include all globally threatened vertebrate species with country records in the UNEP-WCMC database (UNEP-WCMC 2001a). Marine species recorded by ocean area are not included

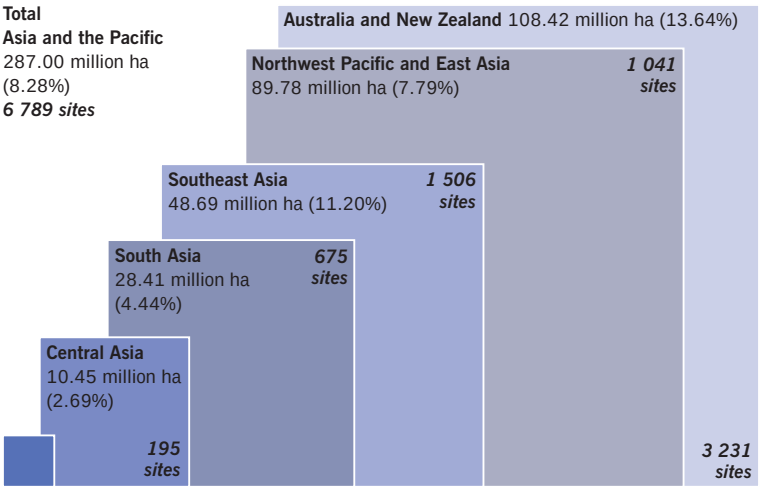
New species in Viet Nam

Two large mammals previously unknown to science have been discovered in one small area, the Vu Quang Nature Reserve in Truong Son, Viet Nam. The Vu Quang ox (*Pseudoryx nghetinensis*) was first described in 1993, followed a couple of years later by a giant muntjac deer (*Megamuntiacus vuquangensis*) from the same area. The ox is of particular interest because it does not appear to fit neatly in any of the main bovid groups as currently recognized. It is now known to occur in adjacent parts of Laos. Other new species have also been found, including the world's smallest muntjac deer, the Truong Son muntjac (*Muntiacus truongsonensis*).

Source: Dung and others 1993

being accidentally introduced in military aircraft. It has had a severe impact on the native bird fauna, one species of which is believed to be extinct, one is extinct in the wild and one has been assessed as critically endangered. Molluscs in Moorea (Society Islands, French Polynesia) provide a striking example of the potential impacts of introduced species. A carnivorous snail from Florida, *Euglandina rosea*, was introduced to control numbers of the giant African land snail *Achatina fulica* that had become an agricultural pest after itself being introduced to the island. The introduced carnivore subsequently preyed heavily on the endemic native snails in the genus *Partula*, all seven species of which are now extinct in the wild — although they survive in captivity (Wells 1995).

Protected areas: Asia and the Pacific



Note: number of protected areas includes those in IUCN categories I-VI
Source: compiled from UNEP-WCMC 2001b

Forest loss and degradation

The natural vegetation over much of the region is forest, with grassland, scrub and semi-desert occurring in the more arid regions. Much of the forest cover has been recently cleared by humans so that temperate forests are reduced in China, Japan and New Zealand, while tropical forests are similarly reduced in South Asia and Southeast Asia. More extensive forest cover persists in Borneo, Myanmar and New Guinea (FAO 2000, Groombridge 2000).

Timber and non-timber forest products (rattan, bamboo, resins, waxes, nuts, honey, spices and medicinal plants) provide a livelihood for indigenous people. Timber extraction and clearance for commercial plantation have caused much of the forest loss, reinforced by increasing human numbers and development pressures.

National policies and plans for management of forest resources exist and there is an increasing amount of plantation forest but serious decline in natural forest cover has occurred in many countries. Indonesia recorded an average annual decrease between 1990 and 2000 of 1.3 million ha (equivalent to a 1.2 per cent annual loss), one of the highest rates of deforestation recorded globally. Malaysia, Myanmar and Thailand all also show major decreases of 237 000, 517 000 and 112 000 ha respectively, with equivalent percentage losses of 1.2, 1.4 and 0.7 (FAO 2000).

This trend is of major concern. If current trends continue, Indonesia's lowland forests will be destroyed by 2005 on Sumatra and by 2010 on Kalimantan (Jepson and others 2001).

Dams and biodiversity

Although the benefits of dams can be substantial, their negative impacts, including significant biodiversity loss, are common. Analysis by the World Commission on Dams (WCD 2000) has shown that the environmental, hydrological and economic arguments used to support dam construction are often flawed.

Impacts on biodiversity are not well documented but major river systems are drying, groundwater is increasingly overexploited and pollution is a major concern (Fuggle and Smith 2000); as a result biodiversity impacts are likely to be substantial. The Yangtze dolphin *Lipotes vexillifer* and the Chinese alligator *Alligator sinensis* are two large species restricted to the Yangtze basin that are already regarded as globally threatened and are likely to be affected by recent closure of the Three Gorges dam.

A case study of the Pak Mun dam in northeast Thailand reports failures in the decision-making process (Amornsakchai and others 2000). The fish yield from the reservoir was far below the level predicted in the 1981 impact assessment and yields from the original free-flowing river were underestimated. Some 50 fish species dependent on rapids have disappeared and migratory fishes have declined; these biodiversity losses have had serious impacts on households that depend on fishing. The lack of evaluation of the likely impacts on fishes and fisheries is identified as a critical omission from the original impact study (Amornsakchai and others 2000).

More comprehensive impact assessment, better evaluation of biodiversity impacts and greater emphasis on mitigation and remedial measures will be needed for future dams. The work by the World Commission on Dams may provide an opportunity for better-informed debate.

Response measures

In response to deteriorating biodiversity, many countries are party to international agreements. All except Afghanistan, Brunei Darussalam and Thailand are party to the Convention on Biological Diversity (CBD). The CBD specifies a framework of measures at the national level for the conservation of biodiversity and many countries have prepared National Biodiversity Strategy and Action Plans and submitted National Reports. Most countries are party to CITES and the Ramsar Convention on Wetlands.

National responses aimed at conserving biodiversity have been variable in effectiveness, with many initiatives suffering from a lack of data and common understanding of ecological systems. Protected areas have been set up in different countries but they tend to be geographically limited and disconnected. The proportion of protected area to total area in most countries is lower than the 10 per cent norm recommended by IUCN.

Conservation in Nepal

The National Parks and Wildlife Conservation Act was implemented in Nepal in 1973, and its amendment in 1993 has provided for the involvement of local people in species conservation. Buffer zone management was introduced in 1996 with the Buffer Zone Management Rules which allow local people to access ecosystem resources in protected zones. Under the Forest Act 1992, 13 plant species have been protected. The government has also given legal protection status to 26 species of mammals, 9 species of birds and 3 species of reptiles. A total of 17 protected areas (eight national parks, four wildlife reserves, one hunting reserve and four conservation areas) constitute about 17 per cent of the total area in the country (MOPE 2000).

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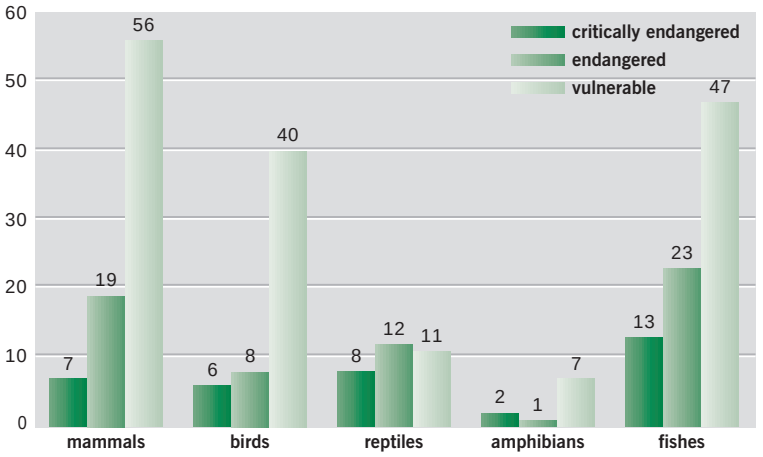
Biodiversity: Europe

Europe is home to a wide variety of ecosystems, ranging from the Atlantic coast to the Russian steppes, and from the boreal forest and tundra of Scandinavia to Mediterranean forests and shrubland (EEA 2001). Europe is also an important crossroads for large populations of migratory species shared with Africa, West Asia and North America.

Agricultural land covers some 45 per cent of Europe and most natural habitats are therefore restricted in extent. The impact of agriculture on biodiversity is thus a key issue (Hoffmann 2000). The genetic modification of organisms for agriculture has also emerged as an important issue relating to biodiversity.

Numbers of threatened vertebrates: Europe



Note: critically endangered (extremely high risk of extinction in immediate future); endangered (very high risk of extinction in near future); vulnerable (high risk of extinction in medium-term future)

The data include all globally threatened vertebrate species with country records in the UNEP-WCMC database (UNEP-WCMC 2001a). Marine species recorded by ocean area are not included

The landscape has been significantly modified by human activities, including deforestation, agriculture, drainage of wetlands, modifications to coastlines and river courses, mining, road construction and urban development (EEA 2001). As a result, natural habitats have been reduced in size and fragmented, and are therefore less able to support wildlife. Habitats such as lowland forests and wetlands have undergone particularly large declines. Relatively pristine areas remain in some Nordic and Eastern European countries (EEA 2001).

Many large mammals such as the polar bear (*Ursus arctos*), wolf (*Canis lupus*), lynx (*Lynx lynx*) and bison (*Bison bison bonasus*) are now restricted to small remnants of their original habitat while others such as the tarpan (*Equus caballus*) and the saiga (*Saiga tatarica*) have become extinct (EEA 2001). Some 260 vertebrate species are now considered to be threatened with extinction in Europe (see bar chart). Other species, such as the lark (*Alauda arvensis*) and the hare (*Lepus europaeus*) are directly associated with agricultural landscapes, and have therefore benefited from human activities. Similarly, species such as the seagull (*Larus* spp.) and black kite (*Milvus migrans*) have increased in abundance due to growth in urban waste sites (EEA 2001).

Agricultural intensification

The direct impacts of agriculture include effects on water quality, land drainage, soil erosion, toxic effects of fertilizers and biocides, and the destruction, degradation and fragmentation of habitat (Hoffmann 2000). This has had a substantial negative impact on biodiversity, and population declines and range contractions have been found to be significantly greater in countries with more intensive agriculture (Donald, Green and Heath 2001). In the United Kingdom, 26 species of farmland birds declined significantly during 1968–95, primarily as a result of agricultural intensification (Siriwardena and others 1998).

Intensive agriculture also often leads to the eutrophication of freshwater habitats, resulting in deoxygenation of water, production of toxins and a general decline in wildlife conservation value (EEA 2001). Some 46 per cent of Ramsar lake sites in Europe have suffered a decline in water quality, largely as a result of eutrophication (EEA 2001). Wetland habitats have also been affected by land reclamation for agriculture. In Spain alone, more than 60 per cent of all inland freshwater wetlands disappeared during a 25-year period (Casado and others 1992).

Nutrient enrichment also has a significant impact on marine ecosystems, particularly in areas such as the Caspian Sea. Such pollution has increased the frequency of algal blooms in the Adriatic, where they foul fishing gear and beaches, and in the North Sea where in 1988 they caused massive mortalities of farmed salmonid fish (EEA 2001).

Key trends over the past three decades include the agricultural 'improvement' of low-intensity farmland, which has led to substantial and mostly irreversible loss of habitats through drainage, fertilization and increased stocking densities (Hoffmann 2000). In addition, hedgerows, field verges and grass tracks have been lost as a result of increased field sizes and

mechanization. During the 1970s and 1980s, some 27 200 km of hedgerows were lost annually in England and Wales (Barr and others 1993).

As a result of agricultural mechanization, much of the remaining area of scrub and grassland habitat is now restricted to ground of low agricultural value, such as steep slopes and poor soils (EEA 2001). Agricultural intensification has also resulted in the loss of fallow land and stubble, important habitats for wildlife, particularly birds.

The importance of agriculture to biodiversity has been recognized in several policy responses. A European Commission Biodiversity Action Plan for Agriculture has been developed as part of EC commitments to the Convention for Biological Diversity (CBD) through the 1998 Biodiversity Strategy (Hoffmann 2000). The plan is designed to help integrate biodiversity targets into relevant policy sectors. Strategic questions relating to agricultural policy are mainly addressed within the Common Agricultural Policy (CAP) and a key element of the Biodiversity Strategy is therefore to incorporate biodiversity objectives into CAP (Hoffmann 2000).

In Western Europe, more than 22 million ha of agricultural land are covered by some form of agreement to maintain biodiversity and landscapes (EEA 2000). This exceeds the target set in the EU's fifth environmental action programme. However, the extent varies — from more than 60 per cent of farms in Austria, Finland and Sweden, to 7 per cent or less in Belgium, Greece, Italy and Spain (EEA 2000). The environmental performance of these schemes is open to doubt since many lack precise objectives and have no monitoring provisions (BirdLife International 1995).

Since the early 1980s, grassland and heathland habitats have benefited from a shift in agricultural policies. For example, in Germany and Italy the reform of EU policy has released more than 300 000 ha of arable land for conversion to grassland in lowland areas, as part of the 'set-aside' programme. While initially welcomed as an opportunity to increase the ecological values of such areas, 'set-aside' measures can also have negative results — causing people to abandon traditional farming systems and adopt inappropriate forms of forestry or afforestation (Baldock and Long 1987).

Biodiversity protection measures

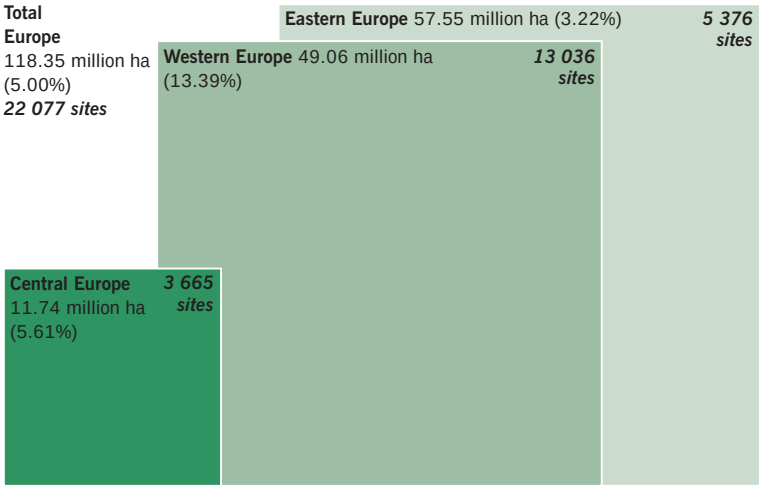
Only 5 per cent of the land area of Europe is currently designated as a protected area (see graphic). The major policy instruments relating to habitat protection are Agenda 2000, Natura 2000, the Emerald Network and the Pan-European Ecological Network. With these it is planned to create a coherent European ecological network of natural and semi-natural habitats and provide or restore corridors between existing protected areas throughout the region.

Agenda 2000 is an action programme designed to strengthen EU policies. The programme will promote new interrelationships between rural areas and biodiversity, involving agri-environmental measures, structural funds, Less Favoured Area measures, afforestation measures, and so on.

In the EU, the Natura 2000 Network (Hoffmann 2000) is expected to become operational within a few years, with more than 10 per cent of EU territory designated for nature conservation purposes. For non-EU countries a less binding programme (the Emerald Network) was set up recently under the Bern Convention. Some eastern European countries have already established Natura 2000 networks.

These developments are key elements in Europe's contribution to the CBD. EU strategy aims to complement biodiversity initiatives at the national level through a series of action plans to integrate biodiversity into other sectoral policies and programmes. Similarly, national biodiversity action plans are being developed throughout much of Europe.

Protected areas: Europe



Note: number of protected areas includes those in IUCN categories I-VI

Source: compiled from UNEP-WCMC 2001b

Financial support for biodiversity in Central and Eastern Europe

Economic transition in Eastern Europe has caused biodiversity funding to dry up. In Bulgaria, for example, domestic financing collapsed in the mid-1990s and up to 90 per cent of all biodiversity financing now comes from foreign sources — the EU and bilateral funds, with €4-6 million provided annually by the Netherlands alone; Germany and Switzerland are also major contributors. However, foreign aid rarely exceeds 10-15 per cent of the required funding. Some popular parks in Central Europe are partially financed by park fees but these never cover more than 50 per cent of the costs of park maintenance (OECD 1999).

Countries in Central and Eastern Europe still possess a wealth of well-preserved landscapes, ecosystems and species that are rare or already extinct in Western Europe. Most protected areas in these areas had been designated by the end of the l970s, often surrounded by large buffer zones and connected by habitat corridors linking sites. However, with economic transition, the system of nature protection came under intense pressure as state financing declined and it is now in jeopardy (see box).

Genetically modified organisms

Genetically modified organism (GMO) technology could play an important role in increasing agricultural production in Europe. However, the release of GMOs into the environment remains a subject of controversy. Experimental releases of GM crops have been conducted in both Western and Eastern Europe but experience with actual cultivation is still limited.

In Western Europe, the public is generally sceptical about GM foods and organisms. There is strong support for labelling, public consultation and more comprehensive regulation and monitoring. Apart from food safety, concerns have also been expressed about adverse effects on the environment and biodiversity; for example, genetic transfers with native species. While developers of GMOs see a huge market opportunity, food producers are under pressure from consumers who wish to avoid GMOs.

Efforts in Western Europe are currently aiming to inform, involve and consult the public about GMOs, in order to reach a consensus on regulation. In Eastern Europe some NGOs are trying to bring the issue into the open and a regional biosafety process, started in 1995 in Hungary, is also furthering discussion. The European Commission has proposed new legislation to harmonize action and to facilitate agreement on marketing authorization (EC 1998). Current European legislation is consistent with the Biosafety Protocol that was adopted in January 2000 as part of the CBD.

The potential risks of GMOs to biodiversity are the subject of ongoing research. Public awareness also needs to be raised to ensure a well-informed and balanced multi-stakeholder dialogue and decision process.

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Biodiversity: Latin America and the Caribbean

The region contains a wide variety of ecosystem types. Tropical moist and dry broadleaf forests cover 43 per cent of the territory; grasslands and savannas 40.5 per cent; deserts and scrub 11 per cent; temperate forests and tropical and sub-tropical coniferous forests 5 per cent; and mangroves the remaining 0.5 per cent (Dinerstein and others 1995). The region's rivers and lake ecosystems and the marine ecosystems of the Pacific and Atlantic coasts are also productive habitats with high diversity of species. The Caribbean contains 7 per cent of the world's coral reefs (about 20 000 km^2) with a great array of marine biodiversity (UNEP 2001).

Seven of the world's 25 biologically richest terrestrial ecoregions are found in the region, containing between them more than 46 000 vascular plant, 1 597 amphibian, 1 208 reptile, 1 267 bird and 575 mammal species (Mittermeier, Myers and Mittermeier 1999, Myers and others 2000).

Habitat loss and degradation

As a result of habitat conversion and loss, 31 of the 178 ecoregions in the region are in a critical state of conservation, 51 are endangered and 55 are vulnerable (Dinerstein and others 1995). Most endangered ecoregions are found in the northern and central Andes, Central America, the steppe and winter rainfall areas of the southern cone, the Cerrado and other dry forests south of the Amazon basin, and the Caribbean (Dinerstein and others 1995). Myers and others (2000) located 7 of the world's 25 hot spots (where exceptional concentrations of endemic species are undergoing exceptional loss of habitat) in the region.

The Neotropics possess 6 of the 12 countries in the world where globally threatened bird species are concentrated, with Brazil and Colombia having the highest numbers in this category (BirdLife International 2000). Together, Brazil, Colombia, Peru and Mexico account for more than 75 per cent of threatened bird species in the Americas (BirdLife International 2000).

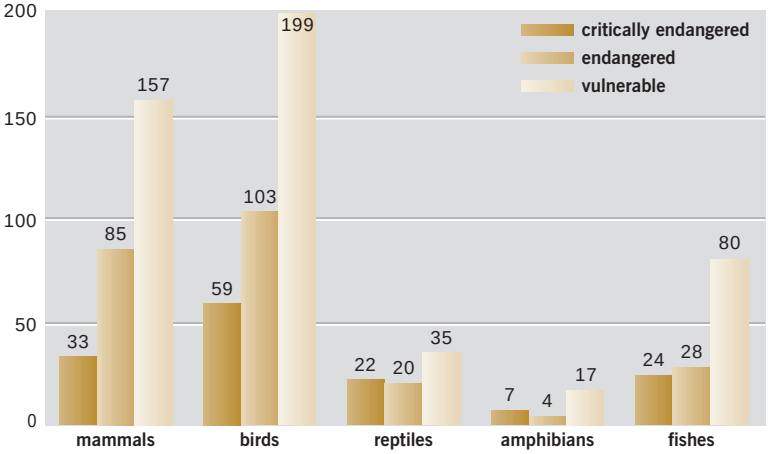
Cloud forests and other humid montane forests have been identified as one of the most threatened habitat types in the region. They are found where persistent cloud cover is in contact with the mountainside, at altitudes of 1 000–3 000 metres and play a critical role in the provision of clean water supplies to human populations in the lowlands. Humid montane forests also harbour the wild relatives and gene pools of many New World crops, including potatoes, maize and beans (Debouck and Libros Ferla 1995).

The principal pressures on cloud forests are clearance for subsistence and commercial agriculture by rural communities, and in some regions for plantations of narcotics. Human population growth and poverty drive these processes but the construction of roads and increased links to commercial markets has also stimulated the production of cash crops. Other major pressures include deforestation for cattle ranching, which in the past has often been supported by government policies.

Lowland tropical rainforests have been the focus of particular conservation concern, being the habitat with the highest species richness and with continuing conversion of major areas to other land uses. The Brazilian Amazon is the largest tropical rainforest in the world, which once had a forested area of 4 million km^2. By 1998, 86.3 per cent of this area remained, with 377 200 km^2 cleared during the preceding 20 years (Fearnside 1999). The mean rate of forest clearing accelerated in the 1990s, and the total area affected by fragmentation, clearing and edge effects is now estimated to comprise one-third of the Brazilian Amazon (Laurance 1998).

Deforestation in the Brazilian Amazon is driven by several processes. A major pressure is the ten-fold population growth in the region since 1960 (Goodman and Hall 1990). In addition, industrial logging and

Numbers of threatened vertebrates: Latin America and the Caribbean

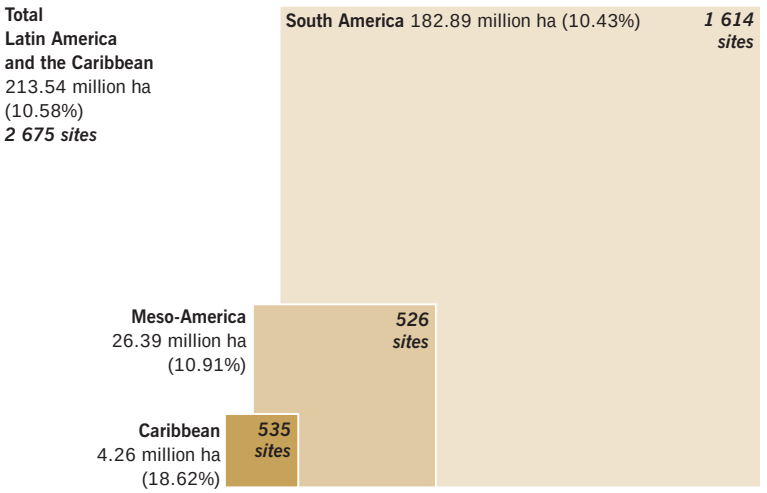


Note: critically endangered (extremely high risk of extinction in immediate future); endangered (very high risk of extinction in near future); vulnerable (high risk of extinction in medium-term future)

The data include all globally threatened vertebrate species with country records in the UNEP-WCMC database (UNEP-WCMC 2001a). Marine species recorded by ocean area are not included

mining and their associated networks of roads, which make accessible new areas of forest to colonizers and ranchers, have been major factors in deforestation. Some 6 per cent of the region falls within the strictly protected category. Major efforts have been made in the field of timber certification and forest preservation to reverse the loss of biodiversity (UNEP-ECLAC 2001). Human-ignited fires have also become widespread, especially in logged and fragmented areas (Laurance 1998).

Protected areas: Latin America and the Caribbean



Note: number of protected areas includes those in IUCN categories I-VI

Source: compiled from UNEP-WCMC 2001b

The forests of eastern coastal Brazil are considered among the most endangered habitats on earth and have been given highest priority for biodiversity conservation (Bibby and others 1992). They contain 7 000 endemic plants and 779 endemic vertebrates — 2.7 and 2.1 per cent of the global total, respectively (Myers and others 2000). In the Bahia region, only 0.4 per cent of continuous forest cover remains of the original forest area of 215 436 km^2 (Mendonça and others 1994). Threats arise from coastal development and uncontrolled logging, agriculture and charcoal production.

Overall, more than 10 per cent of the region is currently protected (see graphic). In addition, the attractiveness of the cloud forests and recognition of their values by concerned individuals has led to the creation of many private forest reserves in the region, often linked to scientific research programmes and ecotourism ventures. A related trend in the 1990s has been the creation of community-managed montane forest reserves.

A new approach to promoting montane forest conservation in the region is to compensate forest owners for the environmental services their forests provide to society, often financed by the collection of a small surcharge on the users of water originating in the forests. Such schemes are being considered in several Latin American countries and have been tested in Costa Rica (Campos and Calvo 2000). Many forest conservation initiatives have been developed in the Amazon, including land-use planning, the establishment of protected areas linked by corridors and extractive and Amerindian reserves. The largest of these is the Pilot Programme to Conserve the Brazilian Rainforest, with support from the G-7 nations. However, further major infrastructure, industrial agriculture, mining and logging projects are currently planned for the Amazon (Laurance and others 2001).

The CBD has played an important role in terms of the response to biodiversity loss. While some countries have incorporated the CBD's objectives in general legislation, others have done so by means of sectoral laws. The former group includes Brazil, Colombia, Costa Rica, Peru and Venezuela. For example, Brazil established a National Programme on Biological Diversity in 1994 together with an accompanying project for the conservation and sustainable use of Brazilian biological diversity (PROBIO), identifying priority conservation areas and actions through a series of assessments. In Peru, the Law for the Conservation and Sustainable Use of Biological Diversity, which covers most CBD commitments, entered into force in 1997. It is expected that the nine Caribbean countries now preparing national strategies on biodiversity will implement the CBD by means of legislation, development of institutional mechanisms and by providing adequate resources (UNEP 2000). Countries that are modifying their sectoral laws include Cuba, Honduras, Mexico, Nicaragua and Panama. However, legislation for the implementation of the CBD has often been developed without reference to other biodiversity-related conventions such as CITES, the Convention on Migratory Species and Ramsar.

National funding programmes such as the Mexican Fund for Nature Conservation have been established as part of national efforts to implement the CBD. Additional sources of funding include organizations such as the World Bank and the Inter-American Development Bank, together with other international agencies, NGOs and bilateral cooperation agencies.

Between 1988 and 1999, the World Bank Group approved 74 biodiversity projects in the region which were declared consistent with the goals and objectives of the CBD. A substantial amount (more than US$700 million) has been distributed among regional efforts to conserve biodiversity, especially since 1995. As expected, most of the resources went to the largest countries. Brazil alone received 56 per cent of the total but this benefit has not been equally distributed among ecosystems, the majority going to the Amazon and Atlantic rainforests.

Unsustainable harvesting and illegal trade

Illegal trade in plants and animals is one of the greatest threats to biodiversity in many countries including Brazil, Colombia, Mexico and Peru. It is difficult to measure the extent of this illegal trade and its impact on lesser-known species. Estimates suggest that Brazil accounts for 10 per cent of the global wildlife trade, which is valued at approximately US$10 000 million per year. Despite ongoing efforts, including development and implementation of national strategies to control illegal trafficking in countries such as Colombia, police records on seizures confirm that illegal trade of flora and fauna remains a widespread problem (Government of Colombia 2000, RENCTAS 2000).

National governments are responding to this issue in a number of ways. For example in Colombia, the sale of some wild animals (both live and as animal products) is permitted for domestic and international markets. There are 50 private establishments with legal authorization to capture caiman (*Caiman crocodiles*), iguana (*Iguana iguana*), boa (*Boa constrictor*), black tegu (*Tupinambis nigropunctatus*) and capybara (*Hydro chaeris hidrochaeris*) for processing and marketing. As a result, in the year 2000, 739 000 caimans, 232 000 iguanas, 3 530 boas, 2 700 black tegu and 10 000 capybaras were captured for market in accordance with national regulations and the recommendations of CITES.

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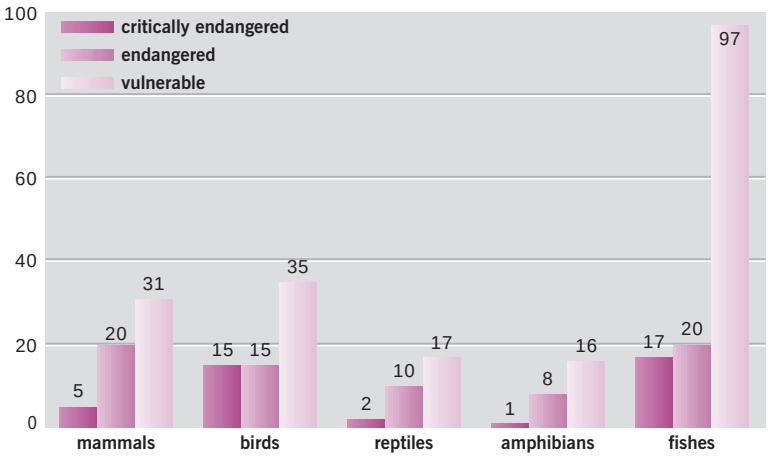
Biodiversity: North America

Habitat destruction and degradation is the most pervasive threat to biodiversity in the region (Wilcove and others 2000). North American wetlands have high biological productivity, providing critical habitats for many species and essential ecological services such as taking up floodwaters and protecting water quality by filtering pollutants (Schmid 2000). Wetland protection is therefore a priority issue for biodiversity conservation in North America. Another key issue is the threat that non-native species pose to native species through predation, competition, parasitism and hybridization.

Numbers of threatened vertebrates: North America



Note: critically endangered (extremely high risk of extinction in immediate future); endangered (very high risk of extinction in near future); vulnerable (high risk of extinction in medium-term future)

The data include all globally threatened vertebrate species with country records in the UNEP-WCMC database (UNEP-WCMC 2001a). Marine species recorded by ocean area are not included

North America contains many different ecosystems, with biodiversity increasing along a north-south gradient and the Hawaiian Islands containing the highest diversity of species. North America contains a large percentage of the world's wetlands with Canada holding about 24 per cent, accounting for about 16 per cent of its landscape (NRC 2001). Wetlands cover about 264 million ha of North America.

According to Canada's endangered species list, as of May 2001 a total of 352 species were at risk of imminent or eventual extinction (endangered, threatened or of special concern) while in the United States 1 231 species were listed as endangered or threatened (Alonso and others 2001, COSEWIC 2001). Some 309 vertebrate species are threatened with extinction in the region (see bar chart).

To safeguard biological diversity, North America has set aside protected areas. More than 14 per cent of the region's land area is now protected, with 4 521 protected sites covering an area of some 264 million ha (UNEP-WCMC 2001b). Canada has signed and ratified the Convention on Biological Diversity (CBD) and continues to work towards introducing a federal Species At Risk Act. The United States is not yet party to the CBD but has a strong Endangered Species Act. The latter has been used effectively by NGOs to protect substantial areas of habitat for threatened species.

Wetlands

Wetlands provide food and habitat for about one-third of bird species in the United States and more than 200 species in Canada. They are also home to some 5 000 plant species and 190 kinds of amphibians in the United States and 50 species of mammals and 45 species of waterfowl in Canada. About one-third of North America's threatened and endangered species live in wetlands (NRC 2001).

Prior to the 1970s, government programmes encouraged wetland drainage and filling to allow conversion to agriculture, settlements and industrial sites (US EPA 1997). As a result, North America, excluding Alaska and Canada's undeveloped northern regions, lost more than one-half of its original wetland habitat (EC 1999) with agricultural expansion responsible for between 85 and 87 per cent of the losses (NRC 2001). Since the 1980s, wetland losses have slowed considerably. Changes in agricultural policies, particularly improvements in hydrological conditions and cooperative efforts to conserve wetlands for waterfowl were factors in these achievements (NAWMP 1998). Although more than

Wetlands and waterfowl

Cooperation between governments and NGOs to restore and improve wetlands across North America is an ongoing success story. Ducks Unlimited, a private organization originally established to preserve waterfowl for hunters, began a cooperative programme between its branches in Canada, Mexico and the United States in the 1990s that has improved more than 3.8 million ha of wetlands (Ducks Unlimited 2000).

Canada and the United States signed the North American Waterfowl Management Plan (NAWMP) in 1986 and Mexico joined in 1994. NAWMP is a partnership between government, NGOs, the private sector and landowners for improving wetlands. During 1988–93, more than 850 000 ha of wetlands and associated habitats were protected in Canada alone through NAWMP (NRC 2001).

250 000 ha of wetlands were lost in the United States between 1986 and 1997, this was an 80 per cent reduction from the previous decade (US FWS 2000).

At the global level, both countries are parties to the Ramsar Convention on Wetlands of International Importance. North America currently has 53 Wetlands of International Importance — 36 in Canada and 17 in the United States (Ramsar 2000).

More than 70 per cent of Canada's wetland resources are now covered by federal and provincial wetland policies and about 15 US states regulate inland wetlands (NRC 2001, Schmid 2000). In the United States, federal subsidies that allowed wetlands to be converted to agriculture ceased in 1985 and a Wetland Plan was issued in 1993 to make wetland regulation more fair, flexible and effective (US EPA 1999, Schmid 2000). Although past US government authority over wetlands has been fragmented and inconsistent, plans for the restoration of the Florida Everglades are testimony to the success of combined efforts among many levels of government, business and environmental NGOs (Schmid 2000).

The Canadian government does not currently track or report on the status of its wetland resources but Canada was the first nation to adopt a federal policy on wetland conservation. Wetland ecosystems make up about 17 per cent of Canada's national parks, and about 10 per cent are excluded from development (Rubec and Thibault 1998).

The reduction in the rate of wetland loss is a considerable achievement but wetlands are still being lost to development. The future of wetland habitat and the biodiversity it harbours may be compromised by changing conditions such as population growth, expansion of agricultural production, economic growth and changes in hydrological conditions and the flow of people (Wilcove and others 1998).

Bio-invasion

Bio-invasion is now thought to be the second gravest threat to biodiversity in North America, after habitat destruction and degradation (CEC 2000). Competition or predation by non-native species imperils nearly half of the species listed as threatened or endangered under the US Endangered Species Act (Wilcove and others 1998). In Canada, alien species have been involved in causing risk to about 25 per cent of endangered, 31 per cent of threatened and 16 per cent of vulnerable species (Lee 2001).

Restoration of the Florida Everglades

The Everglades is the central part of a 23 000 km^2 watershed covering the lower third of Florida. In the early 1900s, large tracts were drained and water supplies reconfigured. Protected from flooding by levees and canals, South Florida became home to six million people along the Miami-Palm Beach corridor and an important sugarcane, fruit and vegetable producer (UNDP, UNEP, World Bank and WRI 2000).

Originally stretching over 11 650 km^2, nearly half of the Everglades wetlands have been lost, reducing the amount of freshwater flowing to the coast, disrupting salinity levels and altering the natural capacity of the ecosystem to store and release water. The state of the Everglades deteriorated most rapidly over the past two decades with sea grass die-offs, the invasion of non-native species, nutrient contamination, large algal blooms in Florida Bay and declines in fishing harvests and some bird populations (UNDP, UNEP, World Bank and WRI 2000).

Regional efforts to address the problems began in the early 1980s but it took until 1998 for all parties — the sugar industry, environmentalists, real estate developers and American Indian tribes — to come together in support of a comprehensive plan to restore and preserve the Everglades. Developed by the Army Corps of Engineers, it is the world's most ambitious and extensive wetlands restoration effort, costing the federal government US$7.8 billion. It will take more than 20 years to complete (Alvarez 2000, Army Corps of Engineers 2000).

Invasive aquatic species are particularly threatening to wetland and freshwater ecosystems (see box below) and can also pose serious health risks. For example, human cholera bacteria were found in ballast tanks and in oyster and fin-fish samples in Mobile, Alabama, in 1991 (ANS 2000). Alien aquatic

Bio-invasion

Bio-invasion is the influx of alien invasive species. Alien species are considered invasive when they become established in natural habitats, are agents of change, and threaten native biological diversity. Alien invasive species include bacteria, viruses, fungi, insects, molluscs, plants, fish, mammals and birds (IUCN 2001).

Species that become invasive can be introduced either intentionally or unintentionally through pathways (or vectors). These include transportation (by water, land and air; in the goods themselves, in dunnage, packing materials or containers, in or on ships, planes, trains, trucks or cars); agriculture; horticulture and plant nursery stock; aquaculture industry; live food fish industry; bait fish; ornamental pond, water garden and the aquarium pet trades. Where there are no natural predators, they can come to dominate ecosystems, and can alter the composition and structure of food webs, nutrient cycles, fire cycles, and hydrology and energy budgets, threatening agricultural productivity and other industries dependent on living resources (Alonso and others 2001).

As an example, purple loosestrife (*Lythrum salicaria*), which was introduced from Europe in the mid-1800s as a garden ornamental, has been spreading in North America at a rate of 115 000 ha a year, invading wetland habitats where it dominates native plants and deprives waterfowl and other species of food sources (Haber 1996, Pimentel and others 1999). When non-indigenous aquatic weeds such as purple loosestrife, Eurasian water milfoil and hydrilla replace native species, they establish dense colonies that can impair navigation, water-based recreation and flood control; degrade water quality and wildlife habitat; accelerate the filling of lakes and reservoirs; and depress property values (Haber 1996).

species are expected to contribute to the extinction of native freshwater species in North America at a rate of 4 per cent a decade over the next century (Ricciardi and Rasmussen 1999).

The high economic costs of damage caused by bio-invasions in North America is causing increasing concern. Both countries have developed monitoring plans and information systems to help control bio-invasion (Haber 1996, Kaiser 1999).

Responses to the challenge of invasive species include legislation, policies, and plans and programmes that focus on preventing the invasion of new species and the eradication or control of established ones. Canada and the United States cooperate in programmes related to invasive species in the Great Lakes, for example. Despite requirements for ships to exchange ballast water at sea, however, the influx of new species into the Great Lakes continues and is considered to be a serious threat to the integrity of the Great Lakes ecosystem.

As trade increases, new invasions are expected. In addition, it may be that global climate change could create conditions that are even more conducive to bio-invasion (Holmes 1998). North American as well as global cooperation is essential to stem the tide of bio-invasion and the damage it causes.

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Biodiversity: West Asia

Resources

The region has wide variations in terrestrial and aquatic ecosystems. Main terrestrial habitats include Mediterranean forests, rangelands and deserts. Marine ecosystems include mudflats, mangrove swamps, sea grass and coral reefs. Rivers in the Mashriq and springs in the whole region represent freshwater ecosystems.

The estimated number of endemic vascular species in the region is 800 (Batanouny 1996), and in some hot spots such as the Socotra Islands of Yemen, 34 per cent of the total number of vascular plants are endemic (Al-Saghier 2000, Government of Yemen 2000). There are seven endemic mammal species and ten endemic birds (UNDP, UNEP, World Bank and WRI 1998).

The seas are rich in species diversity with 200 species of crabs, 20 species of marine mammals and more than 1 200 species of fish and more than 330 species of corals in the Red Sea and the Gulf (Fouda, Hermosa and Al-Harthi 1998). More than 11 per cent of the corals are endemic to the Arabian Peninsula sub-region (Sheppard, Price and Roberts 1992). There are up to 12 000 marine species in the Mediterranean, representing 8–9 per cent of the world sea species richness (Bianchi, Dore and Morri 1995). Substantial numbers of vertebrates are threatened with extinction in the region (see bar chart).

Habitat destruction and fragmentation have increased dramatically in most countries over the past three decades due to human population and resource consumption growth. Degradation of unique terrestrial and aquatic ecosystems and loss of genetic resources are the main biodiversity issues in West Asia. Water resource management and the maintenance of inland water biodiversity, as well as overhunting of large mammals and birds, are therefore among the most important issues affecting biodiversity in the region.

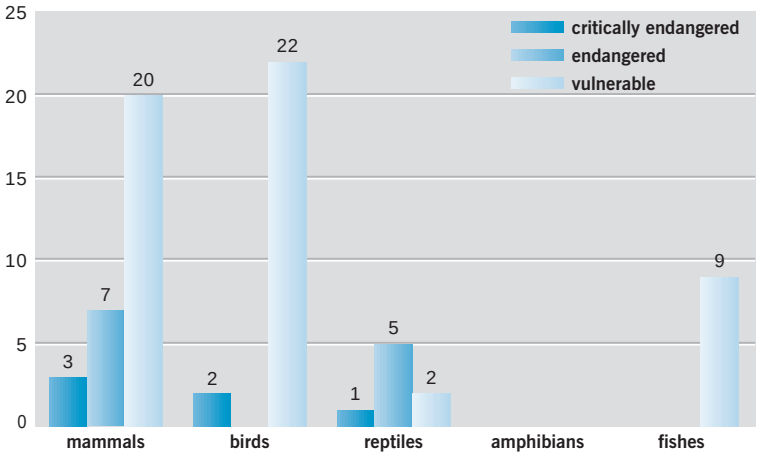
Habitat degradation and loss

Rapid population increases and changes in lifestyle have contributed to the degradation of wetland ecosystems due to increased exploitation of surface and groundwater. In Jordan, groundwater extraction for urban needs increased from around 2 million m^3 in 1979 to around 25 million m^3 in 1993 (Fariz and Hatough-Bouran 1998) while an additional 25 million m^3 per year was used for irrigated agriculture. As well as water extraction, pollution and impacts from refugee camps in the area have led to the deterioration and drying up of the Azraq wetlands natural reserve (Fariz and Hatough-Bouran 1998). As a consequence tourism in Azraq has declined. In the eastern part of the Arabian Peninsula, many of the date palm oases and natural freshwater springs have been lost in the past two decades (Bundy, Connor and Harrison 1989).

By far the most serious wetland change in West Asia over the past three decades has occurred in the lower Mesopotamian marshlands, where serial satellite images confirm a loss of around 90 per cent of the area of lake and marshlands (UNEP 2001). This loss may be attributable in part to the large number of dams now present on upstream parts of the Tigris-Euphrates system, but appears to be primarily a result of major hydrological engineering works in southern Iraq, notably the completion of the Major Outfall Drain (or 'Third River') which diverts water to the head of the Gulf. However, despite some negative impacts of damming on indigenous biodiversity, the loss of some habitats such as wetlands has been offset by the creation of large artificial habitats elsewhere in the region. For example, the 630 km^2 Assad Lake in Syria on the Euphrates River is considered an important site for migratory and wintering birds in West Asia.

The rapid decline of the lower Mesopotamian marshlands represents one of the most significant environmental events to have occurred globally during the past 30 years. Loss of such an important habitat

Numbers of threatened vertebrates: West Asia



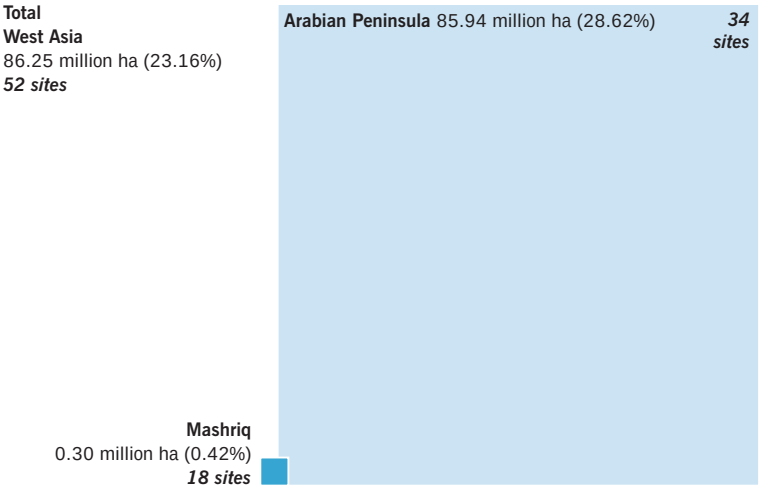
Note: critically endangered (extremely high risk of extinction in immediate future); endangered (very high risk of extinction in near future); vulnerable (high risk of extinction in medium-term future)

The data include all globally threatened vertebrate species with country records in the UNEP-WCMC database (UNEP-WCMC 2001a). Marine species recorded by ocean area are not included

illustrates the pressures on wetlands in the region, which are likely to intensify in future as demand for water continues to increase.

Food self-sufficiency policies in the region have resulted in the cultivation of marginal lands for irrigated intensive agriculture. This has strained water resources and caused salinization, with negative effects on freshwater biodiversity. The breakdown of traditional systems of resource management has also had a major impact on biodiversity. For example, the traditional Al-Hema system, which facilitated the sustainable use of rangelands and other natural resources by setting aside large reserves during times of stress (Abu-Zinada and Child 1991, Daraz 1985) was abandoned in the 1960s in the Arabian Peninsula and Mashriq countries. While about 3 000 hema reserves existed in Saudi Arabia in 1969, only 71 were still in existence under various degrees of protection in 1984 and only nine were on the 1997 Protected Areas list (WCPA 2000).

Protected areas: West Asia



Note: number of protected areas includes those in IUCN categories I-VI

Source: compiled from UNEP-WCMC 2001b

Coastal and marine biodiversity is threatened by several human activities including pollution (oil spills, industrial and domestic discharges into the sea), physical alteration of habitats (sand dredging and landfills), climate variability and alien species introduced by ballast water (ROPME 1999, UNEP/MAP 1999). The extent of mangroves has been decreasing along the shores of the Gulf over the past 30 years due to unplanned coastal development to the extent that only 125–130 km^2 of mangrove patches remain. In Saudi Arabia, more than 40 per cent of the Gulf coastline has been reclaimed and almost 50 per cent of the mangroves lost (Sheppard, Price and Roberts 1992). In the Arabian Peninsula seas, about 20 000 km^2 of coral reefs or 7.9 per cent of the total area of world corals have been exposed to bleaching due to increases in sea water temperature caused by El Niño (UNDP, UNEP, World Bank and WRI 2000). It is feared that global warming will intensify this phenomenon. In the Mashriq sub-region many marine species, including Mediterranean monk seals, marine turtles and marine sponges, are threatened by the continuous deterioration of coastal water quality due to sedimentation, nutrient discharge and eutrophication (Lakkis 1996, Tohme 1996).

Loss of terrestrial species

A comprehensive decline in the larger terrestrial species has been recorded. This is primarily because of excess hunting resulting from the decline of traditional resource management practices, and the increased availability of four-wheel drive vehicles and automatic weapons (Gasperetti, Harrison and Büttiker 1985, Gasperetti, and Gasperetti 1981, Thouless 1991). While wild goat (*Capra ibex*), and gazelles (*Gazella gazella*, *G. dorcas* and *G. subgutturosa*) are still present in the region they have been much reduced in range and numbers. The leopard, which was formerly widespread, persists in a few isolated areas. The cheetah is on the verge of extinction, if not already extinct, the last confirmed specimen being taken in 1977. The Arabian oryx (*Oryx leucoryx*) was extinct in the wild but has been successfully reintroduced using captive stock.The ostrich is believed extinct, the Arabian bustard (*Ardeotis arabs*) has been reduced in numbers and is possibly extinct in Saudi Arabia, and the Houbara bustard (*Chlamydotis undulata*) now winters in much reduced numbers. Programmes for captive breeding of threatened species have operated since the 1980s, with re-introduction programmes for the Arabian oryx, Houbara bustard and some gazelle species in Jordan, Oman, Saudi Arabia and Syria (GCEP 2000).

Addressing biodiversity loss

Most countries have ratified the Convention on Biological Diversity. In addition, some have ratified other biodiversity-related conventions such as the Convention on International Trade in Endangered Species (CITES). Countries are also adhering to other

international and regional agreements such as the Mediterranean Action Plan (MAP) and Regional Organization for the Protection of the Environment of the Red Sea and Gulf of Aden (PERSGA). The establishment of protected areas in West Asia has been gaining momentum. Local people are generally unhappy with the existing biodiversity conservation programmes because they are not involved in decision-making (Thouless 1991). However, the situation is improving in some countries such as Lebanon and Jordan (Chatty 1998).

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Biodiversity: the Polar Regions

The polar regions face threats from climate change, ozone depletion, altered land use and the unsustainable use of natural resources. The ocean areas include some of the largest marine ecosystems on Earth and are threatened by commercial fisheries and the harvesting of marine mammals.

Arctic

The Arctic has considerable biological diversity (see table below). There are also robust populations of plankton in the marine environment. The Arctic fisheries are an important resource: the Bering Sea fisheries alone provide half the US catch and 2–5 per cent of the global catch (CAFF 2001).

For centuries the Arctic has attracted hunters of mammals such as whales, seals, walruses, polar bears and otters. Many species have been repeatedly driven to near extinction and some are below safe biological limits. Hunting continues but is now more tightly regulated. Even so, marine mammal populations in decline include local populations of the Beluga whale, walrus, Steller's sea lion, harbour seal, northern fur seal and the fin whale. For many more marine mammals, the trend is unknown.

Several bird populations and fish species are in decline. The latter include local populations of Atlantic cod, Arctic cod, Greenland halibut and wolf-fishes. Many wildlife populations have suffered starvation due to human activity such as overfishing. For example, in the mid-1980s the capelin stock of the Barents Sea collapsed due to overfishing, resulting in the starvation of hundreds of thousands of harp seals. At least 50 000 more were drowned in fishing gear. Norway banned capelin fishing during 1987–90, allowing the capelin population to recover and fishing to resume but at more sustainable levels (NCM 1993). Puffins have been another casualty. They feed their young mainly on herring fry. In the late 1970s, some 1.4 million pairs of puffins nested at the southwestern end of the Lofoten Islands. In the 1980s, the colony contracted at a rate of 10–15 per cent a year. By 1995, it was less than half its former size because most puffin chicks starved to death due to the overfishing of herring fry since the 1960s. By the mid-1990s, puffins had still not recovered despite an increase in the herring population due to strict fishing regulations (Bernes 1996).

Reducing exploitation and other responses have had positive impacts on other populations. For example, an Icelandic fishing ban on Atlantic herring between 1972-75 helped the stock to make a gradual recovery and it is now considered to be within safe biological limits. In the 1940s, the Svalbard population of the barnacle goose had been reduced to only 300 birds. It was then totally protected on its winter ranges in the United Kingdom and a nature reserve

Biological diversity in the Arctic: number of known species

	Global	*Arctic*	*Arctic %*
fungi	65 000	5 000	7.6
lichens	16 000	2 000	12.5
mosses	10 000	1 100	11.0
liverworts	6 000	180	3.0
ferns	12 000	60	0.5
conifers	550	8	1.2
flowering plants	270 000	3 000	1.2
spiders	75 000	1 000	1.2
insects	950 000	3 000	0.3
vertebrates	52 000	860	1.6
fishes	25 000	450	1.8
reptiles	7 400	4	>0.1
mammals	4 630	130	2.8
birds	9 950	280	2.8

Source: CAFF 2001

Polar bear populations in the Arctic

Polar bear populations are stable in the pale blue areas, increasing in the dark blue area. Trends are unknown in grey areas. Largest images of the polar bear denote populations of 3 500, smallest images populations of 500

Source: CAFF 2001

was established. Today, there are 23 000 in the Svalbard population. Similar increases have occurred in Greenland and Russia (CAFF 2001, Bernes 1996).

Other pressures on Arctic biodiversity are climate change, and habitat loss and fragmentation. The warming trend is reducing the ice habitat for species such as the polar bear and walrus, and is causing more severe climatic episodes such as ice storms that raise mortality rates (CAFF 2001, Crane and Galasso 1999). The Arctic countries have begun a major project (Arctic Climate Impact Assessment) to develop recommendations for action on the effects of global warming in the Arctic. These countries have also taken several steps to reduce habitat loss and prevent fragmentation. An important response has been to increase the number of protected areas from 280 in 1994 to 405 in 2001 and overall coverage from 2 million km^2 to 2.5 million km^2. However, this increase has resulted from the domestic actions of individual Arctic countries with little circumpolar collaboration. In 1996, the Arctic countries agreed to cooperate to implement a Circumpolar Protected Area Network Strategy and Action Plan but there is little evidence of progress on implementation (AC 2000).

Protected areas in the Arctic

	Number of areas	*Total area (km^2)*	*% of country's Arctic land area*
Canada	61	500 842	9.5
Finland	54	24 530	30.8
Greenland	15	993 070	45.6
Iceland*	24	12 397	12.0
Norway**	39	41 380	25.3
Russian Federation*	110	625 518	9.9
Sweden	47	21 707	22.8
United States (Alaska)	55	296 499	50.2
Total	**405**	**2 505 943**	**17.0**

*Notes: * large marine components are included; ** most of the area protected is in Svalbord, only about 7 per cent of the Arctic mainland is protected*

Source: CAFF 2001

Antarctic

The Antarctic terrestrial ecosystem is structurally simplistic with a small number of species. Marine biomass in the Southern Ocean can be immense but species richness is generally low (Wynn Williams 1996). The benthic (bottom) fish fauna of the continental and upper slope of Antarctica includes 213 species confined to 18 families (Eastman 2000). Seals, whales and seabirds dominate the higher levels of the Southern Ocean. Knowledge of Southern Ocean marine diversity is confined largely to the continental shelves and slopes. Little is known about the fauna of the deep sea around Antarctica.

Historic sealing and whaling activities have had a significant impact on these populations in the Southern Ocean, at one point threatening extinction of some species. Today, strict international agreements govern the harvesting of Antarctic seals (Convention for the Conservation of Antarctic Seals) and whales (International Whaling Convention, which also designated large areas of the Southern Ocean as a whale sanctuary). Only limited numbers of seals are taken for scientific purposes, while approximately 440 minke whales are killed each year.

Fish and krill (tiny planktonic crustaceans) are now primarily the targets of human exploitation in the Southern Ocean. From 1969-70, when records of commercial fishing began, to the end of 1998, a total of 8 739 800 tonnes of krill and fish had been taken from the Southern Ocean (CCAMLR 2000a). In 1982, the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) was established to promote the conservation and rational use of marine living resources south of the Antarctic Convergence. Southern Ocean fisheries are now managed within the framework of CCAMLR.

Although there is uncertainty in its assessments, CCAMLR estimates that the level of illegal, unregulated and unreported (IUU) fishing in the Southern Ocean — which has been a major problem for decades — had decreased in 1998 but has since increased despite stronger CCAMLR measures to combat IUU fishing. The high level of illegal catch of Patagonian toothfish (*Dissostichus eleginoides*) in the South Indian Ocean has become a major concern as it threatens the sustainability of stocks (CCAMLR 2000a). To address IUU catches, CCAMLR adopted a Catch Documentation Scheme requiring all landings, trans-shipments and importations of toothfish into the territories of contracting parties to be accompanied by a completed catch document. In 2000, CCAMLR took further steps to combat IUU fishing by urging all parties to avoid flagging or licensing vessels with a history of engagement in illegal practices (CCAMLR 2000b).

CCAMLR regulation has reduced the incidental by-catch of seabirds and marine mammals in legal fisheries to low levels but illegal fishing still takes its toll. For some seabird populations, long-line fisheries represent a major threat. This led to the listing in 1997 of all albatross species on the protected species list of the CMS. Albatross and petrel species, such as the wandering albatross (*Diomedea exulans*) and the Antarctic giant petrel (*Macronectes giganteus*), have also been listed as vulnerable in the IUCN Red List (Hilton-Taylor 2000). The final draft of the Agreement on the Conservation of Albatross and Petrels was recently completed in Cape Town, South Africa.

Changes to the distribution and composition of terrestrial flora and fauna, attributable to recent warming over Antarctica, have been observed over the past three decades. Composition and distribution of marine species is also expected to change with a changing climate. It has been indicated that the marked increase in the number of Adelie penguins (*Pygoscelis adeliae)* in the Ross Sea area in the 1980s showed remarkable synchronization with the climatic variation in the same region (Taylor and Wilson 1990, Blackburn and others 1990). At Palmer Station on Anvers Island, where Adelie penguins are known to have nested only prior to the 1950s, gentoo and chinstrap penguins are now breeding and have expanded their ranges southward in the Peninsula within the past 50 years, in correlation with pronounced regional warming (Emslie and others 1998).

Changes in the extent and thickness of ice affect the timing, magnitude and duration of the seasonal pulse of primary production in the polar regions. It has been suggested that sea ice extent affects krill availability which in turn may affect krill predators. Regional warming and reduced krill abundance may therefore affect the marine food web (Loeb and others 1997). The density and abundance of minke whales has been observed to be lower in seasons with warmer sea surface temperatures, fewer cold-water intrusions, and smaller sea ice extent, possibly owing to the shift in availability of prey (Kasamatsu 2000).

Along the west coast of the Antarctic Peninsula, springtime ozone depletion can lead to a twofold increase in biologically effective UV-B radiation (Day and others 1999). UV exposure affects phytoplankton, including inhibition of primary production. This is a major concern in view of the phytoplankton's key role in the short food chain of the Antarctic marine ecosystem. The spring bloom of phytoplankton coincides with the springtime ozone hole and the subsequent period of high UV-B radiation. Reduction of phytoplanktonic production associated with the ozone hole is estimated to be 6–12 per cent (Smith and others 1992).

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OUR CHANGING ENVIRONMENT: Iguazú National Park

Landsat imagery on this page shows how land-clearing and logging have opened up a previously forested landscape. The protected area of Iguazú National Park, located in Argentina on the border with Brazil and Paraguay, is sharply defined as the dark green enclave on the right of the images, the only remaining original forest in the region. Conservation of this park, a World Heritage site, is critical because it harbours one of the most complete remnant patches of the highly endangered Paranaense forest. The park is rich in fauna and includes 68 species of mammals, 422 of birds, 38 of reptiles and 18 of amphibians, a large number of which are threatened or vulnerable.

Landsat data: USGS/EROS Data Center
Compilation: UNEP GRID Sioux Falls