The importance and vulnerability of the world's protected areas

Squandering Paradise?

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The importance and vulnerability of the world's protected areas

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WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by:

- conserving the world's biological diversity
- ensuring that the use of renewable natural resources is sustainable
- promoting the reduction of pollution and wasteful consumption

Front cover photograph © Edward Parker, UK
The photograph is of fire damage to a forest in the National Park near Andapa in Madagascar

Cover design Helen Miller, HMD, UK

Preface

It would seem to be stating the obvious to say that protected areas are supposed to protect. When we hear about the establishment of a new national park or nature reserve we conservationists breathe a sigh of relief and assume that the biological and cultural values of another area are now secured.

Unfortunately, this is not necessarily true. Protected areas that appear in government statistics and on maps are not always put in place on the ground. Many of those that do exist face a disheartening array of threats, ranging from the immediate impacts of poaching or illegal logging to subtle effects of air pollution or climate change. Far from safeguarding the world's biological diversity, many protected areas are badly in need of protection themselves.

Yet in most countries protected areas are the corner stone of conservation; if they are degraded then there can be little hope for the survival of many threatened species. Such changes also directly threaten the many indigenous people that maintain their traditional lifestyles inside protected areas.

Until recently, our knowledge about threats to protected areas was mainly gleaned from scattered reports and word of mouth accounts. Today, recognition of the seriousness of what can justifiably be called a crisis is stimulating efforts to identify threats and assess performance.

The current report, which WWF Netherlands is pleased to have funded, is the most detailed assessment of threats to protected areas yet attempted on a global basis. It shows what is going wrong, why problems arise, where the crisis points are and what we should be doing about it.

The report sometimes makes gloomy reading. But the news is not all black. The research summarised here suggests that, whilst far from perfect, most protected areas are doing a fair job of protecting biodiversity most of the time. In some cases the situation is still deteriorating, while in others things are improving. One of the threats highlighted in a case study originally prepared for this report, on proposals for a major expansion of salt mining in El Vizcaino biosphere reserve in Mexico, has recently been averted and we congratulate the Mexican government on a far-sighted decision.

Sadly, such successes are still too rare and for example the bushmeat crisis in the Congo Basin serves as a stark reminder of just how fast wildlife can be lost from protected areas; throughout the region mammals, birds and reptiles are being hunted to feed an apparently ever-growing market for wild meat. A Canadian government report, published in spring 2000 as this report was going to press, reminds us that problems are not confined to the poorer countries.

Please read this report. And, much more importantly, please support the work of the governments, conservation organisations and community groups that are struggling to ensure that "protected areas" really do equal "protection".

Hans Wijers
Chairman, WWF Netherlands

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A note on the tables
Where protected areas are listed in tables in the text, wherever possible their IUCN category and area in hectares are included after their name.

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Summary
Squandering Paradise?
The importance and vulnerability of the world's protected areas

Protected areas are a vital component of any conservation strategy and also serve a host of other social, cultural and economic needs. Yet the quality of many protected areas is currently declining as a result of an onslaught of threats and pressures. Many more remain insecure and their long-term future in uncertain.

This report explains why protected areas are important, looks at the trends and nature of the threats facing them and makes some predictions about the likelihood of losses. It is illustrated with a range of specially prepared case studies and examples. It ends with some proposals and a call for action in the lead-up to the World Parks Congress in 2002.

A vital part of any landscape

Protected areas are the cornerstones of all national and regional conservation strategies. They act as refuges for those species that cannot survive in managed landscapes and as areas where natural ecological processes can continue unhampered by human interference. They are a vital resource for continuation of natural evolution and, in many parts of the world, for future ecological restoration. Human beings benefit directly from the genetic potential contained in the world's plants and animal species, a significant proportion of which are currently at risk. Most people also believe that we have an ethical obligation to prevent extinctions caused as a result of our own actions.

Protected areas also play a number of key social and economic roles. Many indigenous and local peoples are given vital protection by protected areas, where they can continue traditional lifestyles that are now often impossible elsewhere. A disproportionate amount of the world's drinking water comes from areas where natural forest has been preserved and protected areas also help to maintain healthy rivers systems and smooth out the impacts of floods and soil erosion. Marine protected areas maintain coastal fisheries and in consequence are often supported by neighbouring communities. National parks and nature reserves are important "green lungs", providing space for people to relax, practice sports and experience nature and wilderness. They help to protect traditional cultural and spiritual values. In many countries, key national parks are regarded as part of the nation's "ecological heritage areas" as important as, say, Chartres cathedral or the Taj Mahal.

Unfortunately, the quality of many protected areas is declining

There is an assumption that once a protected area has been identified and declared, its values will be preserved. Sadly, this is not necessarily the case. The quality of protected areas and associated biological diversity can suffer in many ways, ranging from the removal of key species (such as poaching of elephants or great apes) through various types of more general ecological damage to, in extreme cases, almost total destruction. Even if protected areas themselves remain relatively intact, they can be badly affected as a result of isolation and fragmentation if land use in surrounding areas changes dramatically. The report identifies a wide range of threats, from the impacts of human settlement and illegal hunting and fishing through to more complex impacts such as air pollution and climate change.

Three general trends can be identified. First, problems seldom come singly. If a protected area is under threat it is likely to be facing a whole range of *different* threats; it is quite unusual for a protected area to be perfectly secure except for one overwhelming problem. (There are rare exceptions, such as when a previously well-managed national park is subjected to mining or oil drilling).

Secondly, protected areas only work in the long-term if they have the support of the people who live inside them or around them. The notion of a protected area as a pristine, empty wilderness is a myth in most places. Protected areas contain human populations – many belonging to communities resident for hundreds or even thousands of years. These communities need to agree with and participate in the management of the protected area.

Third, many problems are beyond the control of individual protected area managers and their staff: a few poorly funded conservation personnel cannot address threats from pollution, drainage, highly organised poaching operations or war. Indeed, the underlying causes of the threats – including such pervasive issues as poverty, over-consumption by a minority and the breakdown of the rule of law – are often far more significant than the concrete actions that actually do the damage within a national park or wilderness area.

The "paper parks" phenomenon – when is a protected area actually protected?
Pressures are increased by the fact that many of the world's "protected areas" are not actually protected in any very real sense at all. A substantial number are what has become known as "paper parks" – that is protected areas that have been declared by a government but have never been implemented. While declaration can itself help protect the area from some pressures, far more is needed in most cases, including proper legislation, management plans, staff, equipment, capacity and – perhaps most important of all – the support and co-operation of neighbouring communities. Although protected areas cover up to 8 per cent of the world's surface, most of them are expected to survive on minimal resources.

People
The relationship between local people and protected areas is one of the most vexed in conservation. Those responsible for protected areas – including both governments and NGOs – have sometimes got things badly wrong, creating tensions and conflicts through a failure to address questions of people's needs early enough in protected area planning. These issues are explored.

But how threatened are protected areas?
We still know very little about the status of most of the world's protected areas. Governments list names and areas in the *UN List of Protected Areas*, published every three years, but this says nothing about whether they are effectively managed or not. Those surveys that have been carried out tend to be partial and incomplete. Nonetheless, after examining the available evidence some preliminary conclusions are possible:

- **Few protected areas are completely secure and many are under threat**. A recent survey of ten key forest countries found that only 1 per cent were regarded as secure, 1 per cent had lost almost all their conservation values, a quarter were suffering serious degradation and the rest were, whilst currently reasonably secure, facing likely future threats.

- **Threats are not distributed evenly around the world**. Experts believe, for example, that virtually all the protected areas in large parts of Africa are undergoing loss of quality.

- **However, damage is not confined to the poorer countries**. In Europe for example, the large landscape protected areas contained in national parks are often continually under pressure from intensive agriculture and air pollution.

- **Many protected areas are currently only protected by their isolation**. As development increases, their quality is also likely to decline.

Responding to the challenge

While most protected areas still continue to protect biodiversity, protection is all too often imperfect in the present and uncertain in the future. This is hardly surprising. At present, protected areas cover almost 10 per cent of the world's land surface but are managed on minimal resources. In the final section, we suggest some generic steps towards improving management and alleviating threats to the protected areas of the world.

Step 1: Don't automatically blame the manager: many of the problems facing protected areas are beyond the capacity of individual protected area managers. Blaming managers for these wider failings simply leads to discouragement. An important step in addressing threats is to help build a culture of pride, professionalism and a sense of international community amongst protected area managers.

Step 2: Make the arguments for protected areas: protected areas are often undervalued as luxury "wildlife areas" with little relevance for the bulk of the population. Making the arguments for protected areas as wider social and environmental resources is essential.

Step 3: Integrate people with protected areas: human needs are inextricably tied up with the future of protected area management. If protected areas are to work in the long term, social issues have to be addressed as an integral part of management.

Step 4: Increase the capacity of protected area staff: protected areas still need well-trained and adequately funded staff. Indeed, many protected areas (and the people that they contain) are threatened by outside forces that are allowed access through a more general breakdown in the rule of law.

Step 5: Implement protected areas: many protected areas currently exist on paper only and have not been implemented on the ground. The need to convert paper parks into real parks is now an urgent priority in many parts of the world.

Step 6: Spread the word: making the case for protected areas is not sufficient in itself; it is important to win over the mass of civil society – to create the same kind of pride in natural heritage as exists in most countries for cultural heritage.

Step 7: Strengthen legislation: updating, strengthening and above all implementing legislation to enact protection, and to make protection stick, is another extremely important element in the portfolio of responses needed to make protection work.

Step 8: Increase partnerships and help secure long-term funding: greater thought about the permanence of projects is an increasingly important factor in the long-term management of protected areas, including widening the scope of partners involved in the protected area.

Step 9: Monitor success and failure: monitoring protected areas, both to help managers and to provide some measure of accountability, will be an increasingly important tool in management effectiveness in the future.

Step 10: Integrate protected areas into surrounding land: last, but perhaps most important of all, protected areas will only work in the long term if they are integrated effectively into wider landscape, ecoregional or bioregional approaches to management

The World Commission on Protected Areas has committed itself to launching a major initiative to assess and improve management effectiveness at the World Parks Congress in 2002. WWF will be working with WCPA to develop this over the next two years.

Introduction
Why protected areas?

Protected areas as defined by the World Commission on Protected Areas are areas *especially dedicated to the protection and maintenance of biological diversity*, that is they are defined principally for their usefulness in maintaining the world's rich stock of wild plants and animals. This is both their great strength and – from a political perspective – their weakness. Although the World Commission qualifies its definition by adding *and of natural and associated cultural resources*, it is as wildlife habitats that the world's national parks, wilderness areas and reserves are generally regarded and the political support they receive is therefore largely dependent on the strength of scientific, ethical or emotional feeling towards wildlife preservation.

In fact, this perception is now out of date; modern approaches to protected areas perceive and manage them as much more than simply nature reserves. The *Santa Marta Declaration*, agreed in 1997 at the "First Latin American Congress on National Parks and Other Protected Areas[1]", laid out a manifesto for protected areas in the 21st century:

> *We have a new vision of protected areas that comes from considering these as strategic spaces for countries, because not only are they essential to their growth, to their future development, and to the search for suitable living conditions within those territories, but they also represent one of the main ways to protect our natural heritage.*

WWF and IUCN specifically linked themselves to this new approach in a recent book[2]:

> *If we were to sum up the lessons learned … it would be that in the future protected areas will have to be linked more effectively to sustainable development. Protected areas – and the people responsible for protected areas – will have to be more flexible, more responsive and more adaptable than has sometimes been the case in the past. Protected areas need to continue to expand both physically and philosophically, and to connect with each other, the wider landscape and more generally with society and the economy. A key challenge is to find ways of expanding protected areas without, for example, increasing hardship for indigenous peoples or clashing with the legitimate aspirations of other human communities.*

In a report about threats to protected areas it is perhaps worth beginning with a short analysis of *why* protected areas are such an important – indeed a vital – component of the world's landscapes and seascapes.

The multiple functions of protected areas

Protected areas fulfil a wide range of functions that can for convenience be divided into three main groups:

- Environmental services
- Social and economic benefits
- Maintenance of natural ecosystems and biodiversity

Environmental services

Many, perhaps most, of the world's larger protected areas play a duel role in protecting biodiversity and maintaining environmental services, but the latter benefits are only starting to be perceived by the wider human community.

Natural vegetation is a key factor in maintaining the quality and function of many of the world's major watersheds. For example, Puerto Rico obtains half its drinking water, a limited resource, from one remaining area of natural rainforest[3] - the largest protected area in the island. Several of the world's major cities including Tegucigalpa, San José Costa Rica, Kinsgston Jamaica, Quito, Freetown, Sydney, Cairns, Los Angeles, Manchester and Dar es Salaam[4], rely on protected areas to supply a significant proportion of their drinking water. Bombay, one of the world's largest cities, gets most of its supply from reservoirs whose catchments are protected as part of wildlife sanctuaries[5]. Recognition of the importance that natural vegetation plays in water quality is gradually impacting on industry, for example a water company in Australia used the courts to argue that a timber company should not fell trees in a watershed because of impacts on its core business of supplying drinking water[6]. Protected areas also help protect downstream fisheries and act as a buffer against both flooding and drought.

A related environmental function concerns soil. Many legislative changes associated with protection were introduced specifically to control the related problem of soil stabilisation – such as early reserves in Japan[7] and the European Alps. Soil stabilisation is also an important factor in the designation of protected areas in some of the arid or semi-arid regions of the world where desertification as a result of overgrazing is now a problem. Thailand increased protection of forests following disastrous floods in the early 1980s that were linked to over-logging of steep slopes[8].

Protected areas are increasingly being seen as insurance against extreme environmental events such as hurricanes, floods and drought. A series of environmental disasters in the late 1990s focused attention on the role that natural forests can play in protecting against the worst impacts of extreme weather events. During Hurricane Mitch in Central America, areas with remaining natural forest were affected far less than those where forest had been replaced by plantation or pasture. At the end of 1999, floods in Venezuela were similarly less severe in forested areas. Flooding in China has created a political drive towards increased protection of upstream forests. In coastal areas, mangroves provide protection against tropical storms and floods and this was a factor in selection of, for example, the Sundarbans National Park in Bangladesh. Coral reefs also buffer coastlines against the impact of storms and some have been protected for this reason. Strategic location of protected areas to provide a buffering capacity against the weather is now increasingly regarded as an important factor in their selection and this interest extends to protection against the impacts of climate change including the role of natural ecosystems in carbon sequestration.

Social and economic factors: most protected areas play an important social function as well. Many function as homeland for indigenous people and others, and it is likely that the majority of protected areas include significant human populations. Others provide the natural resource capital needed to maintain livelihoods.

In the case of indigenous peoples, protected areas can sometimes create a unique opportunity to continue traditional lifestyles. Indeed in parts of the world where land-use change is taking place most quickly some indigenous groups are now virtually confined to protected areas (which itself can create a management challenge if human population density increases). Where management is working well, indigenous communities are often closely involved with management decisions and may be taking a lead role in management. In Bolivia, for example, a framework agreement for co-administration of Kaa-lya del Gran Chaco National Park and Integrated Management Natural Area was signed in 1995 between the Ministry of Sustainable Development and the Captaincy of Upper and Lower Izozog, allowing the participation of local indigenous authorities in the administration and management of the protected area[9].

In landscape/seascape protected areas and extractive reserves, human interaction is an integral part of the protected area. In the Brazilian Amazon extractive reserves help protect both biodiversity and the lifestyle of traditional rubber tappers, currently threatened because forest is being replaced by pasture

for major ranching enterprises[10]. Other protected areas can, if sustainably managed, produce a wide range of natural products such as game meat and medicinal plants. In Europe, national parks help maintain traditional methods of agriculture and use of non-timber forest products, such as resin collection in Turkey, management for cork oak in Morocco and upland sheep farming in the UK. Here biodiversity protection is mixed with sustainable development – a process of negotiation and trade-off that takes a long time to reach stability; national parks in Europe are gradually evolving over human generations and protection focuses on landscapes[11].

Many marine protected areas have taken this principle further and make resource management a key part of their function. "No fishing zones" are important to protect marine life but also act as critical nursery areas for the maintenance of artisanal or even larger scale fisheries, so that biodiversity protection is linked closely with protection of human livelihoods[12]. Mangrove reserves also serve as invaluable nurseries for fish.

The majority of the world's population now interacts with protected areas mainly for pleasure. Protected areas therefore have an important recreational function as the "green lungs" for an increasingly urbanised population. Recreation takes many forms, from use of the protected area because of its general location (such as many coastal protected areas where the majority of the visitors are principally interested in lying on the beach) to specific ecotourism and wilderness trekking. A particularly popular protected area can cater for very large numbers of people; for example the 2,263 ha Dyfi Estuary and Ynyslas Dunes National Nature Reserve in Wales, UK attracts almost a quarter of a million visitors every year along with 4000 students carrying out field work[13]. Nuuksio National Park outside Helsinki, Finland[14], receives over a million visits every year in an area of 29 km^2. In more remote areas, visitors may be numbered in a few dozen although their relative impact is likely to be far larger.

Linked to both the issues of homeland and recreational space, some protected areas also have an important historical function, by protecting cultural artefacts or traditional management systems, and an increasing number of areas are identified and designated because of their spiritual or cultural importance to particular groups. The local distinctiveness of an area for a particular community may itself be a reason for protection. In Greece, for example, representatives of local communities are supporting an initiative for the establishment of the protected area in the Parnon mountain range at the eastern part of Peloponnese in southern Greece. The region has high biodiversity but is also used for traditional chestnut (*Castanea sativa*) production[15].

Protected areas provide important, sometimes unique, sites for research and education; most of the major advances in understanding of ecology and ecosystem function have taken place in areas where the ecology is relatively secure.

Maintenance of natural ecosystems and biodiversity: authentic ecosystems – those in which *all the expected ecosystem functions can continue to operate indefinitely* – are essential reservoirs of biodiversity. While a proportion of wild plant and animal species can survive in even highly modified environments, biodiversity tends to decrease in parallel with loss of authenticity in ecosystems.

In a world where ecosystems are becoming increasingly modified and simplified, setting aside protected areas is therefore a critical element in maintaining biodiversity. Such areas serve several functions. They protect those species or genotypes that are unable to survive in managed landscapes and seascapes and provide a reservoir of species that may, as management becomes more sensitive, eventually be able to live within the wider landscape. They also provide an invaluable gene bank for use by human societies.

Many species are now almost totally reliant on protected areas for their continued survival including both small and obscure species and large mammals such as the tiger. Some protected areas have been established in part to protect the habitat of species with very restricted distributions; for example the Wallangarra whitegum (*Eucalyptus scoparia*) is endemic to Girraween National Park in Queensland Australia[16].

The *reasons* for conserving biodiversity are more complex. Much has been made of the practical and economic benefits of biodiversity and wild genetic material in terms of its role in industry, medicine, food production and the production of synthetic materials[17]. According to research at Kew Botanical Gardens in the UK, at least a quarter of the US$300 billion annual world market for pharmaceuticals is based on medicines that owe their origin to plants, animals or microbes[18]. But it would be simplistic, and rather dangerous, to only set store by what is of direct financial benefit to humans. Most people see protection as also being an ethical issue and feel that humans should not be responsible for the current abrupt increase in rate of extinctions being experienced around the world. The balance between the ethical and the rational (which are of course not mutually excusive) is something that changes to some extent over time with passing political and moral fashions.

Part 1
Protected areas – paradise regained or paradise about to be lost?

Summary of Part 1

Extent of protected areas*: protected areas cover almost 9.5 per cent of the world's surface including 1,300 marine protected areas, some very large. The World Commission on Protected Areas recognises six categories, ranging from strictly protected nature reserves to protection that takes place within a working landscape or seascape.*

Degrees of threat*: while all protected areas remain under some threat, it is important to distinguish significant threats – to long-term survival of biodiversity or ecosystem – from relatively insignificant or transitory problems. Significant threats fall into four main categories:*

- *Individual elements of the protected area removed without alteration to the overall structure (e.g. animal species used as bushmeat, exotic plants or over-fishing of specific species).*
- *Overall impoverishment of the ecology of the protected area (e.g. through encroachment, long-term air or water pollution damage or persistent poaching pressure).*
- *Major conversion and degradation (e.g. through removal of vegetation cover or coral, driving roads through the protected area, major settlements or mining).*
- *Isolation of protected areas by major changes of use in surrounding land or water.*

Trends: many different trends – ranging from recovery to continued decline – can follow protection. We identify some generalised trends in protected area quality.

- *Stable protected area*
- *Recovering protected area*
- *Declining protected area*
- *Initial decline in protected area followed by recovery*
- *Previously stable protected area facing a sudden crisis*
- *Initial recovery of protected area followed by decline*

People*: the relationship between local people and protected areas is one of the most vexed in conservation. Those responsible for protected areas – including both governments and NGOs – have sometimes got things badly wrong, creating tensions and conflicts through a failure to address questions of people's needs early enough in protected area planning. These issues are explored.*

Lack of capacity and "paper parks"*: external threats are an inevitable factor in protected area management. However, these are often exacerbated by lack of money and capacity amongst protected area authorities. At one extreme, protected areas are designated by law but never implemented. This phenomenon is known as the "paper park". In others cases protected areas are not given enough resources to be effectively managed or protected. Lack of management capacity is an important contributory factor in threats facing protected areas.*

Underlying causes*: Much of this report is concerned with immediate and long-term threats to protected areas and their consequences. However, most of the immediate threats are the result of underlying causes. Understanding the nature and importance of these is essential for effective action to reduce threats to protected areas. Key underlying causes include:*

- *High consumption levels amongst the richest proportion of the world's population*
- *Pressure for trade and development*
- *Poverty amongst the poorest proportion of the world's population*

Chapter 1
The extent of the global protected areas network

Introduction

Protected areas are the cornerstones of most conservation strategies – permanent areas that can protect biodiversity, ecosystems and sometimes also vulnerable human communities. Such areas also provide us with ecosystems services, such as freshwater, places to relax in, storehouses of genetic material and reservoirs of sensitive wild plants and animals that can, as management improves over the rest of the landscape, hopefully find a place within managed areas as well.

One presupposition of such a strategy is that protected areas really are protected. WWF states for example:

> *To be effective, protected areas need guaranteed, permanent protection under appropriate legal (or similar traditional) structures. In addition to political support at all levels of government, strong policies and a legal framework must be in place to secure a country's long-term commitment to the objectives of such protected areas. Protected areas must also be managed effectively so that the biodiversity values that make the protected area important are maintained*[19].

As far as we can tell, nearly 9.5 per cent of the earth's land surface is under some form of protection status[20]. According to data held by the World Conservation Monitoring Centre (WCMC), at the end of 1996 the world had 30,350 protected areas covering a total of 13,232,275 km^2, representing 8.83 per cent of the total *land* area[21]. However, this figure is likely to be inflated by about one percentage point by the inclusion of large marine protected areas or protected areas having a marine component. There are now approximately 1,300 marine protected areas, some of which cover a very large area[22]. Furthermore, several important terrestrial protected areas have been designated since these statistics were compiled, for example in Brazil, Peru, the Congo and Antarctica.

In addition to the 30,000 or so protected areas listed in the *UN List of Protected Areas*, there are 13,915 records of other designated areas that do not qualify as protected areas according to the IUCN definition, and a further 16,288 records of areas of uncertain status. Less than half the relevant protected area departments responded to requests for information from WCMC. This means that alongside recognised protected areas there are almost an equivalent number of sites that may be protected to a certain extent but where protection is either partial or unconfirmed[23]. There are also about a thousand Ramsar sites covering 70 million hectares; these are wetland sites that have some protection status although may not all be protected areas. The IUCN definition of "protected area" includes a wide range of different land uses. "Protected areas" can vary from strict nature reserves to landscape designations that are a long way from traditional concepts of national parks or wilderness areas.

Defining protected areas

IUCN's World Commission on Protected Areas (WCPA) defines a protected area as:

> *An area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means.*

WCPA further classifies protected areas into six categories, ranging from strictly protected nature reserves to areas that combine biodiversity protection with a range of other functions, such as resource management and the protection of traditional human cultures[24].

Table 1.1: IUCN Categories of protected areas

Category	Purpose
Ia	**Strict nature reserve/wilderness protection area**: managed mainly for science or wilderness protection – an area of land and/or sea possessing some outstanding or representative ecosystems, geological or physiological features and/or species, available primarily for scientific research and/or environmental monitoring
1b	**Wilderness area**: protected area managed mainly for wilderness protection - large area of unmodified or slightly modified land and/or sea, retaining its natural characteristics and influence, without permanent or significant habitation, which is protected and managed to preserve its natural condition
II	**National park**: protected area managed mainly for ecosystem protection and recreation – natural area of land and/or sea designated to (a) protect the ecological integrity of one or more ecosystems for present and future generations, (b) exclude exploitation or occupation inimical to the purposes of designation of the area and (c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible
III	**Natural monument**: protected area managed mainly for conservation of specific natural features – area containing specific natural or natural/cultural feature(s) of outstanding or unique value because of their inherent rarity, representativeness or aesthetic qualities or cultural significance
IV	**Habitat/species management area**: protected area managed mainly for conservation through management intervention – area of land and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats to meet the requirements of specific species
V	**Protected landscape/seascape**: protected area managed mainly for landscape/seascape conservation or recreation – area of land, with coast or sea as appropriate, where the interaction of people and nature over time has produced an area of distinct character with significant aesthetic, ecological and/or cultural value, and often with high biological diversity. Safeguarding the integrity of this traditional interaction is vital to the protection, maintenance and evolution of such an area.
VI	**Managed resource protected area**: protected area managed mainly for the sustainable use of natural resources - area containing predominantly unmodified natural systems, managed to ensure long-term protection and maintenance of biological diversity, while also providing a sustainable flow of natural products and services to meet community needs.

Areas that could fit into one of the six categories but do not fit the overall definition should not normally be classified as protected areas in the sense meant by IUCN. However, at the moment, classification is generally left to governments and some of the interpretations within the resulting global database – published as a regular *UN List of Protected Areas* – are open to question. They certainly lead to disparities between countries. For example, the USA includes all national forests within category V protected areas whereas Canada adopts a stricter interpretation. As a result the USA officially has 38.9 per cent of its forests in protected areas while Canada has 7.7 per cent; these differences are due more to variations in classification than real disparities in the degree of protection[25]. Larger and more general protected areas, classified under Category V, should have an overall aim of prioritising biodiversity conservation without this necessarily being reflected at a stand level throughout the protected area. Intensively managed forests or plantations exist in Category V National Parks in Europe (for example in the Snowdonia National Park in the UK); these are not reserves but exist *within* a protected area and are sometimes in consequence counted as protected.

IUCN has also developed a specific definition of a marine protected area:

> *Any area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment*[26].

Representation in protected areas

Another important factor in considering total protection is the *type* of land being protected. Most modern protected area philosophy stresses the importance of having an ecologically representative protected areas network, meaning that land under protection should include all habitat types in large enough quantities to maintain viable populations of all species[27]. In practice, many countries have not surprisingly put their least valuable land into protected areas – particularly with respect to wilderness protection where the fact that land is not conventionally valuable is often an important factor in its continued survival. Commonly, upland areas and tundra are far better represented within protected area networks than valuable and fertile lowland areas.

A summary of global statistics

Despite the problems outlined above, we are starting to gain a better understanding of the scope and functions of the world's protected areas, with data stored on a centralised database at WCMC in Cambridge, UK. The following statistics, drawn from WCMC data, give an overview of the global status[28].

Table 1.2: Global protected areas network classified by IUCN management category

IUCN management category	Number	Per cent	Extent (km^2)	Per cent
Ia	4,389	14%	978,698	7%
Ib	809	3%	940,360	7%
II	3,384	11%	4,001,605	30%
III	2,122	7%	193,021	1%
IV	11,171	37%	2,459,703	19%
V	5,578	18%	1,057,448	8%
VI	2,897	10%	3,601,440	27%
Total	30,350	100%	13,232,275	99%

Table 1.2 shows that the majority of the world's protected areas are in the stricter categories (I-IV) albeit with over a quarter being Category VI extractive reserves (itself the newest category). Whether this is accurate or not is a matter for debate. Research suggests that in 1989 around 70 per cent of protected areas world-wide are inhabited and it is unlikely that these proportions have changed substantially since then[29]. Inhabited protected areas are unlikely to be strict nature reserves in the sense exemplified in, for example, parts of North America.

Table 1. 3 also clearly shows that some major biomes are currently under-represented in protected area networks most notably many marine ecosystems, temperate grasslands, lakes and temperate broad-leaf forests (and it is significant that two of these are concentrated in the richer developed countries). Indeed,

it is notable that the tropical countries have in many cases protected larger areas than the temperate countries.

Table 1.3: Extent of protection of the world's major terrestrial biomes

Biome	Total area (km^2)	PA number	PA extent (km^2)	% biome protected
Tropical humid forest	10,513,210	1,030	922,453	8.77%
Subtropical/temperate rain forest/woodlands	3,930,979	977	404,497	10.29%
Temperate needle-leaf forests/woodlands	15,682,817	1,492	897,375	5.72%
Tropical dry forests/woodlands	17,312,538	1,290	1,224,566	7.07%
Temperate broad-leaf forests	11,216,659	3,905	403,298	3.60%
Evergreen sclerophyllous forests	3,757,144	1,469	164,883	4.39%
Warm deserts/semi-deserts	24,279,843	605	1,173,025	4.83%
Cold-winter deserts	9,250,252	290	546,168	5.90%
Tundra communities	22,017,390	171	1,845,188	8.38%
Tropical grasslands/savannas	4,264,832	100	316,465	7.42%
Temperate grasslands	8,976,591	495	88,127	0.98%
Mixed mountain systems	10,633,145	2,766	967,130	9.10%
Mixed island systems	3,252,563	1,980	530,676	16.32%
Lake systems	517,695	66	5,814	1.12%
Total	145,605,658	16,636	9,489,665	6.52%

The numbers game: how much is enough?

At various times, both IUCN and WWF have suggested that 10 per cent of the world's land area should be in protected areas[30]. This has drawn criticism as being both too large and too small. Useful though targets are for campaigning and advocacy, they often confuse the picture from the perspective of conservation biology. The question of what type of protection is critical[31]. Ten per cent of the world's land surface in general landscape protected areas would not by any means provide an adequate basis for biodiversity conservation. On the other hand, expecting to find 10 per cent of some habitat types in a pristine state and without human population is plainly unrealistic. In practice, some compromise is usually needed: a variety of types of protection, arranged into as good a network as possible, backed up by buffer zones around protected areas and sustainable management elsewhere and, in most cases, by various forms of accommodation for local communities. Crucially, the question of how much is enough also depends on how well the existing protected areas are managed and on what happens in the rest of the landscape.

Chapter 2
Degrees of threat

While all protected areas are likely to remain under some degree of threat, if only because of the fragility of the things that they are trying to preserve, the importance of these threats depends both on their potential severity and their likelihood. It is important to distinguish *significant threats* – to long-term survival of biodiversity or ecosystem functions – from relatively insignificant or transitory problems.

This is not necessarily as easy as it sounds. Not all threats result in impacts that are immediately visible and conversely the most obvious signs of damage are not necessarily the most significant. Judgements may be difficult and in some cases counter-intuitive. What looks like a huge and very visible threat – for example development of a mine near a protected area – may if properly managed be less damaging than a more subtle and insidious threat from, say, air pollution. (In other cases a mine can threaten the whole fabric of the protected area.)

An issue in one protected area can become a *cause celebre* and the relative dangers overstated in the heat of debate, while in other cases real problems are being overlooked or ignored. Some threats, such as global warming and the impacts of air pollution on tree species, remain subject to intense debate about their extent and severity. In large areas of the world, protected areas are so little studied or monitored that it is almost impossible to know the level or types of threats in any detail.

Threats are also very seldom from a single cause. In an assessment of threats to forest protected areas carried out for the World Bank and WWF, analysis of threats to individual protected areas found that out of 46 representative protected areas in ten countries, no single case was reported of a single threat – say mining or logging[32]. In all cases a variety of threats were reported; if a protected area is under pressure we can conclude that this pressure is likely to be fairly general, although of course the *severity* and impacts of the various threats may be different.

A first stage in understanding the problem comes from distinguishing some broad categories of threat. To date, wholesale destruction of a protected area, whilst far from unknown, is still relatively rare; threats are generally more local or more subtle. (From the perspective of biodiversity conservation they may be no less serious.)

In the following chapter we start the analysis by talking about the *nature* of threats and looking at *trends* in protected area quality, before focusing down onto particularly problems in chapter 5.

Nature of threats to protected areas
Significant threats to protected areas can be divided into four main categories:

- **Individual elements removed from the protected area without alteration to the overall structure** (e.g. animal species used as bushmeat, exotic plants or over-fishing of specific species).

- **Overall impoverishment of the ecology of the protected area** (e.g. through encroachment, long-term air pollution damage or persistent poaching pressure).

- **Major conversion and degradation** (e.g. through removal of vegetation cover, driving roads through the protected area, major settlements or mining).

- **Isolation of protected areas** (e.g. through major conversion of surrounding land)

Individual elements removed from the protected area

This is perhaps the commonest impact on protected areas. It is often the result of continuation of traditional practices by local people after the protected area is established and as such may present no long-term problems (and may even be factored into the management of the reserve as a result of negotiation or co-management). Removal of elements becomes a problem if extraction exceeds replenishment (and as such is a question of sustainability of management).

Unsustainable rates of extraction can result in overall losses to protected area values. In extreme cases, while the main "structure" of the reserve remains intact, many of the keystone species will have disappeared. This can happen for a number of reasons. Sometimes the very creation of a protected area can, by dispossessing people of their traditional land, result in a backlash; without any land security traditional owners abandon sustainable management practices in favour of quick profit[33]. In other cases, increased demand for products leads to higher exploitation, including illegal exploitation within protected areas. Finally, in some areas unsustainable land use *around* protected areas is forcing traditional land users into protected areas in higher concentrations than in the past, thus putting additional pressure on the resources within the reserve.

Examples

Wild plant trade in Turkey: in the late 1980s, Turkey was exporting up to 50 million bulbs a year, including particularly *Anemone blanda*, *Cyclamen hederifolium*, *Eranthis hyemalis*, *Galanthus elwesii* and *Leucojum aestivum*[34]. Despite years of conservation efforts and the introduction of breeding programmes, a thriving trade in wild-collected bulbs of cyclamen and other valuable species continues in many of Turkey's protected areas, putting internationally threatened species at risk[35].

Bushmeat trade in Cameroon: conservation officers estimate that several *tonnes* of bushmeat (wild mammals, birds and reptiles that are sold as food) leave the Dja National Park in southern Cameroon every month, to feed a lucrative market in cities such as Yaoundé and Doula. Demand from a growing middle class and intense poverty in the region create a strong incentive for continued hunting and lack of staff and infrastructure makes it virtually impossible to police the trade, which is almost certainly unsustainable[36] (see also page 52).

Illegal logging in Nepal: removal of valuable tree species takes place in many protected areas, particularly in the tropics. For example, illegal logging is reported to be taking place in the southern part of the Koshi Tappu reserve. Loggers particularly target *Acacia catechu* because of its high value and also simal (*Bombax ceiba*). The logs are transported to other districts and smuggled out, particularly to India. Removal of simal has had a negative impact on the lesser adjutant stork (*Leptotilos japanicus*) and makes the land more vulnerable to erosion[37].

Overall impoverishment of the protected area

The next "stage" of degradation is in some cases simply a more extreme form of selective removal. However, impoverishment also includes erosion of the land-base itself, for example from settlement or conversion to agriculture, leading to loss of the whole ecosystem in places. Impoverishment can also typically result from various forms of pollution – the importance of this problem is now increasingly being recognised – and from the impacts of invasive species and diseases.

Examples

Air pollution in Europe: ambient levels of air pollution reduce – and in some cases extirpate – sensitive species including foliar lichens and mosses, ferns and some sensitive flowering plants. For example in Epping Forest, a protected area near London, within historical times the lichen population has declined from 130 species to just 36 species, of which only 18 are found in the area nearest to the city[38]. *Cladonia stellaris* has been extirpated in the UK in part because of air pollution[39].

Marine pollution in the UK: pollution, while seldom currently at a level to wipe out all life in a marine reserve, can have the effects of regularly depressing sensitive species, changing populations and occasionally causing large-scale "kills" following a major pollution episode[40]. Two out of three existing marine protected areas around the coast of the UK were affected by a single oil spill in 1996[41]. Pollution has been identified as a critical issue with respect to long-term quality of marine reserves in England[42].

Settlement in Nicaragua: shortage of land, uncertainty of land tenure and lack of capacity in protected areas means that many are settled, legally or illegally, by people who often have nowhere else to go. In Nicaragua, protected area officials believe that virtually all the country's protected areas are under threat from settlement[43].

Major conversion and degradation

The most extreme form of damage is also fortunately the least common and generally implies that the governing body – usually the government – has made a tacit decision to "sacrifice" the area. There are widespread fears that this could start to happen more frequently, particularly in cases where reserves have been established in places where there are valuable resources of for example minerals or timber. Major conversion also sometimes occurs as a result of sudden catastrophe, such as fire, and could start to emerge in the future as a result of climate change.

Example

Mining in Venezuela: by means of a presidential decree, the Venezuelan government has opened up the Imataca Reserve to mining. The Reserve is a pristine forest occupying 3.5 million hectares within the Venezuelan Guyana Shield, including the Canaima National Park (a World Heritage Site). In spite of rich mineral resources, the Reserve has been protected since 1961. The decree has met with strong opposition from environmentalists and indigenous peoples. The government has been taken to the Supreme Court because it ignored its own environmental legislation, which also establishes that any change in the use of protected land requires Congressional authorisation[44].

Isolation of protected areas

Even if a protected area remains fully protected, it can be threatened as a result of isolation through major changes to surrounding land. Small isolated areas face serious problems because the populations they contain may be cut off from other populations of the same species and thus eventually become inbred and genetically weakened. Species can also experience serious "edge effects" from climate or other environmental factors if the surviving protected area is too small and has no space to adapt to changing environmental conditions brought about, for example, by global warming. Lack of sufficient buffer zones is recognised as a serious problem in some marine protected areas[45]. For these reasons, conservation ecologists are increasingly stressing the importance of linkages between protected areas through buffer zones, corridors, "stepping stones" for migratory species and the need for a protected areas network[46].

Unfortunately, isolation is a growing threat to many of the world's protected areas. Tackling this requires more fundamental changes in the way in which we manage non-protected land and sea and in the integration of biodiversity conservation into everyday management practices[47].

Examples

Isolation of birds in Bogor Botanical Gardens in Indonesia: the botanical gardens were isolated when the surrounding forests were destroyed in 1936, so that the nearest forest habitat is now at least 5-10 km away. The forest within the gardens has been maintained. Between 1932 and 1952, 62 species of birds were recorded in the gardens, but by the 1980s 20 species had disappeared, four were close to extinction and five more have declined substantially[48].

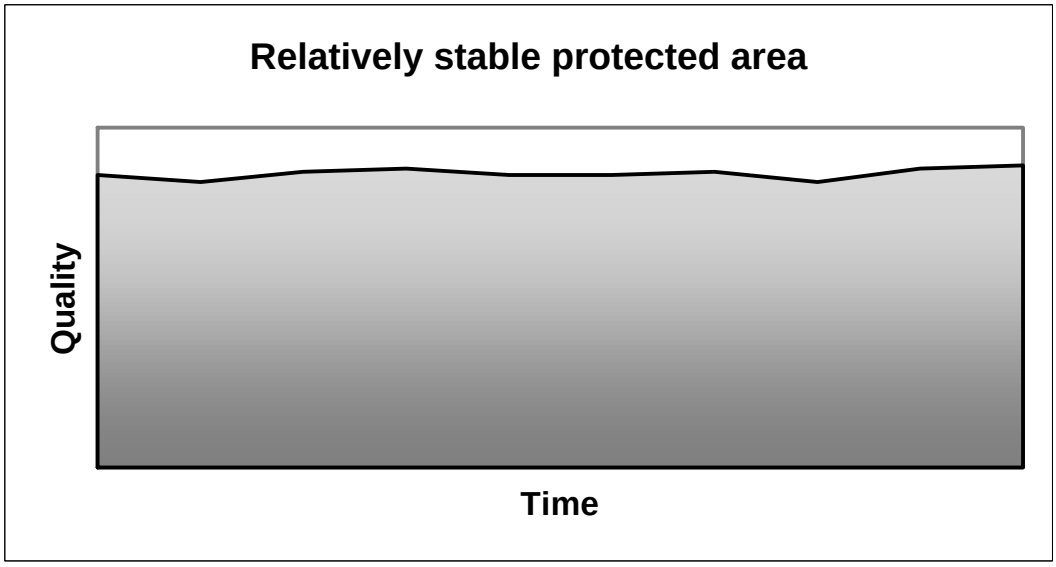
Butterfly distribution in the UK: recovery of the rare silver-spotted skipper butterfly (*Hesperia comma*) was found to be dependent on the availability of suitable grassland patches and its ability to disperse between patches, using "stepping stones" of suitable habitat. Butterflies found it difficult to disperse more than one kilometre over "unsuitable" habitat and none at all managed to colonise vacant grassland as far as 10 km away[49].

Isolation of old-growth forest habitat in southern Finland: Finnish forests have been extensively converted and managed so that, despite the large forest area, natural forest is fragmented and isolated. Pyhä-Häkki National Park, north of Jyväskylä, has been protected since 1912 and made an official national park in 1956[50]. The protected area, covering 1200 hectares, is the largest area of old-growth forest in southern Finland where there are fears that ecological isolation threatens some previously common invertebrate and plant species.

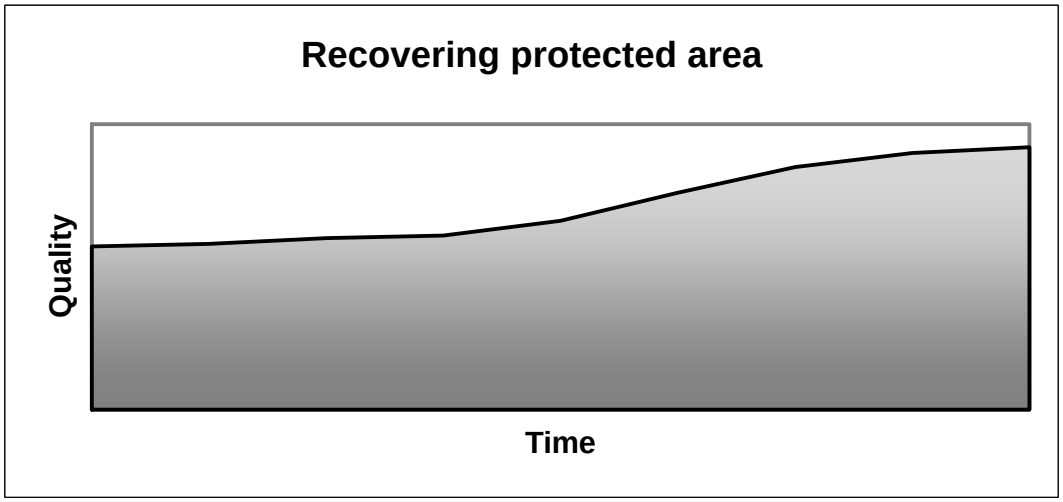
Trends in threats to protected areas

We have already established that the creation of a protected area does not necessarily guarantee protection for the biodiversity, environmental or cultural features that it contains. Indeed, in some cases it appears in the short term to have the opposite effect. However, nor is the fact that the protected area has undergone some damage necessarily a reason to assume that the loss of quality is permanent. Many different trends – ranging from recovery to continued decline – can follow protection and understanding the likely impacts can help in the development of measured responses. Identifying trends in quality can also help pinpoint those protected areas that would benefit most from increased resources and/or special projects to improve management capability. In the following section, we identify some *generalised trends in protected area quality* as a first step in this process.

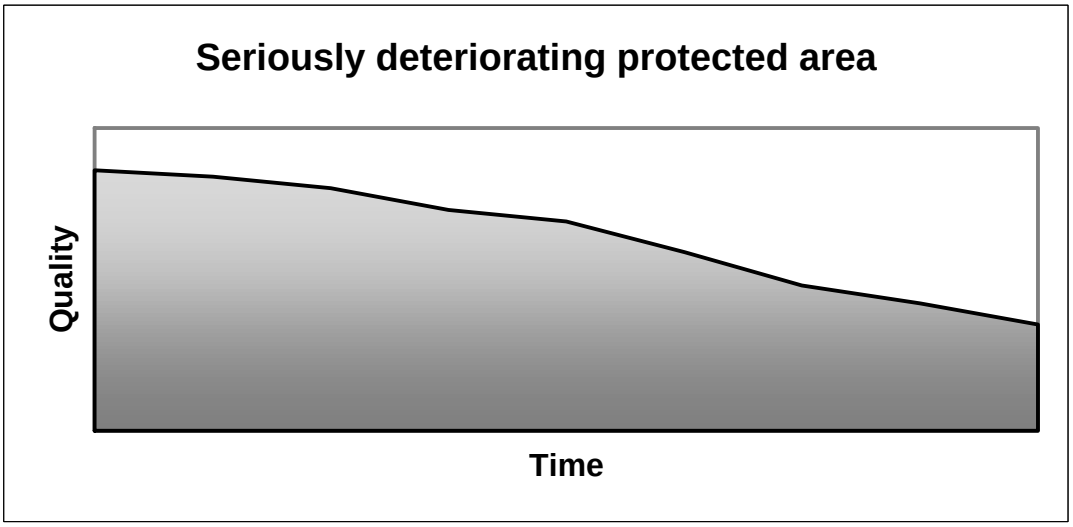
Scenario 1: Stable protected area: often seen in large protected areas remote from human habitation, or in protected areas that attract priority funding and have a high political status.



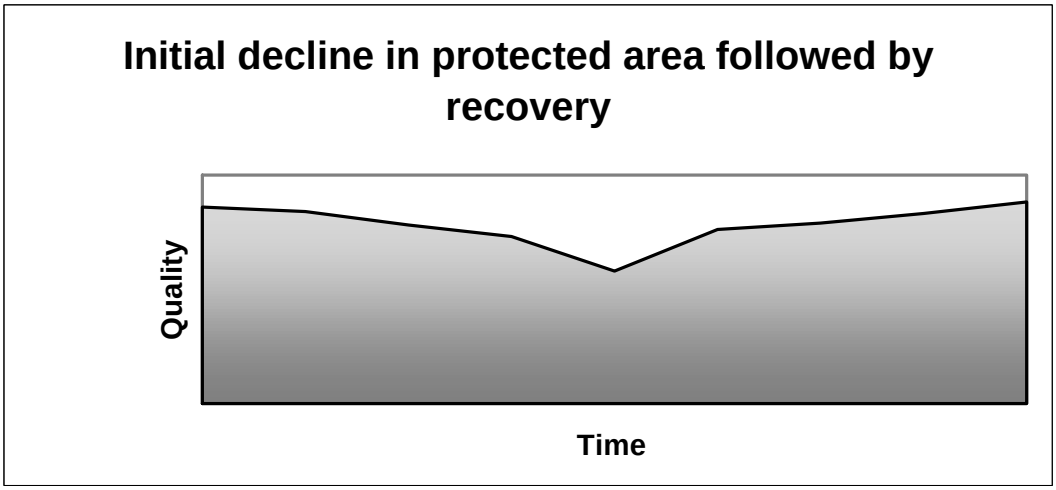
Scenario 2: Recovering protected area: generally associated with smaller protected areas in cultural areas where protection can quickly result in partial recovery, or protection in badly degraded areas that is supported by the population for e.g. recovery of environmental services.



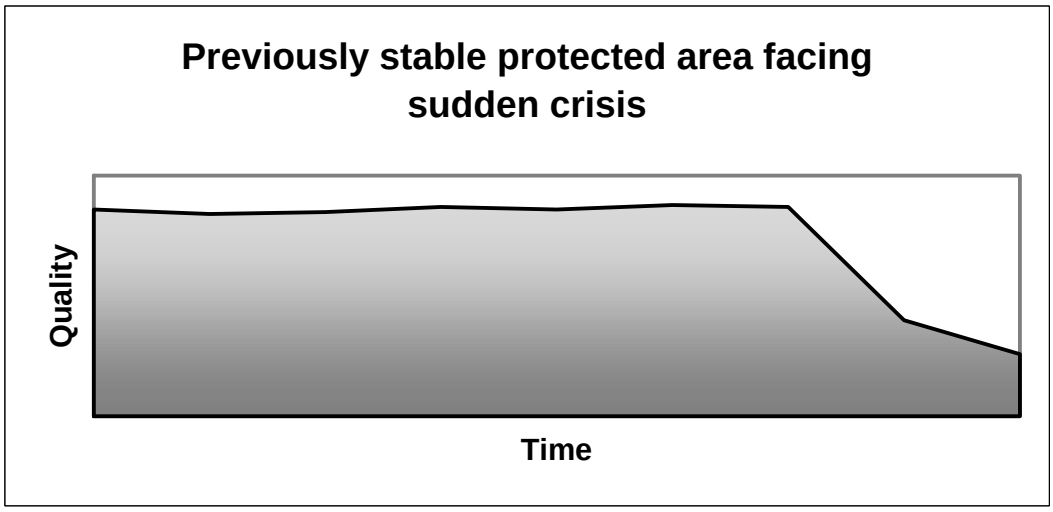
Scenario 3: Declining protected area: where protection status does not halt a decline in quality. This is often associated with protected areas in heavily populated areas and can be the result of lack of capacity or under-management ("paper parks") or extreme pressure for example from human populations or illegal commercial operations.



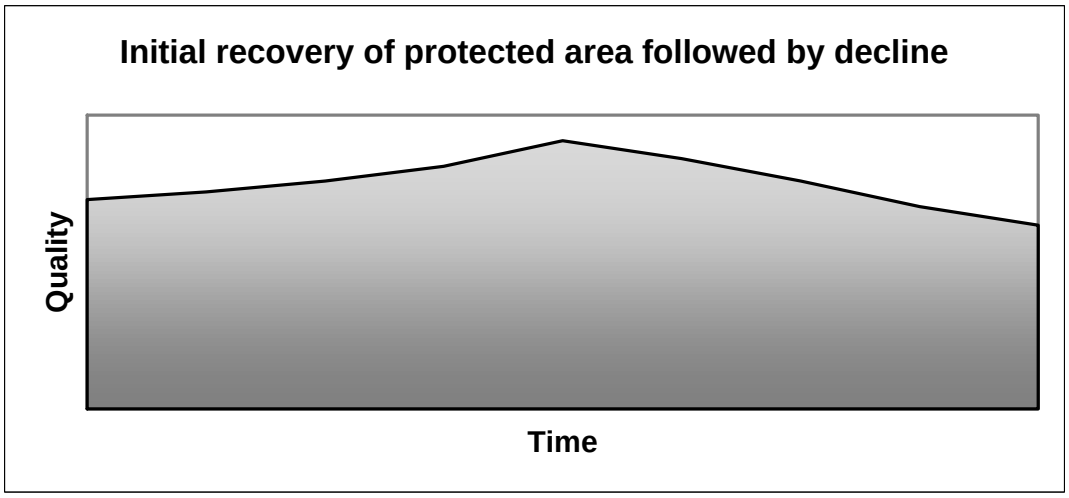
Scenario 4: Initial decline followed by recovery: this trend is perhaps more common than often recognised. Protection status in itself does not guarantee actual protection and in some cases can accelerate decline; for example if local inhabitants feel disenfranchised from the land/sea and traditional sustainable management practices are abandoned. Sometimes the possibility of protection stimulates rapid destruction – "grab it before it goes" – as has happened recently in Norway and Queensland Australia[51]. However, with the provision of proper support, alternative livelihoods (such as ecotourism) and perhaps a gradual acceptance of the protected area, overall quality starts to increase again.



Scenario 5: Previously stable protected area facing a sudden crisis: in this case apparently secure protected areas (for example those summarised in scenario 1) face a sudden decline due to a particular event, for example an unexpected influx in population, an invasive species or new industrial activity, or some wider environmental change. Such a change creates a crisis for protected area managers who have to adapt protection strategies to meet the new circumstances.



Scenario 6: Initial recovery of protected area followed by decline: a possibly increasing trend in the future. This could be caused either because initial support for the protected area among local populations started to decline (for example if hoped-for tourist revenue did not materialise) or because of external factors such as air pollution or climate change.



Chapter 3
People and protected areas

The relationship between local people and protected areas is one of the most vexed in conservation and encapsulates the problems inherent in a trade-off between the common good and the rights and needs of the individual. It is also an area where those ultimately responsible for protected areas – including both governments and others – have all too often got things badly wrong, creating tensions and conflicts through a failure to address questions of people's needs early enough in the planning of a protected area.

News of the creation of a new protected area is usually greeted with delight, and often relief, by the conservation organisations that have been trying to conserve a particular species or habitat. Opinion polls show that the general public still also generally supports protection. However, for the people living in or around a new protected area, the news is often greeted with far less enthusiasm and sometimes also vigorous opposition to the creation of a reserve. For them, protection may mean loss of access to things that have previously been available for little or no monetary cost – such as game, fish, non-timber forest products and agricultural land – or impose restrictions on their activities. In many cases, people have been physically expelled from new protected areas, or forcibly relocated to areas far away from their traditional lands.

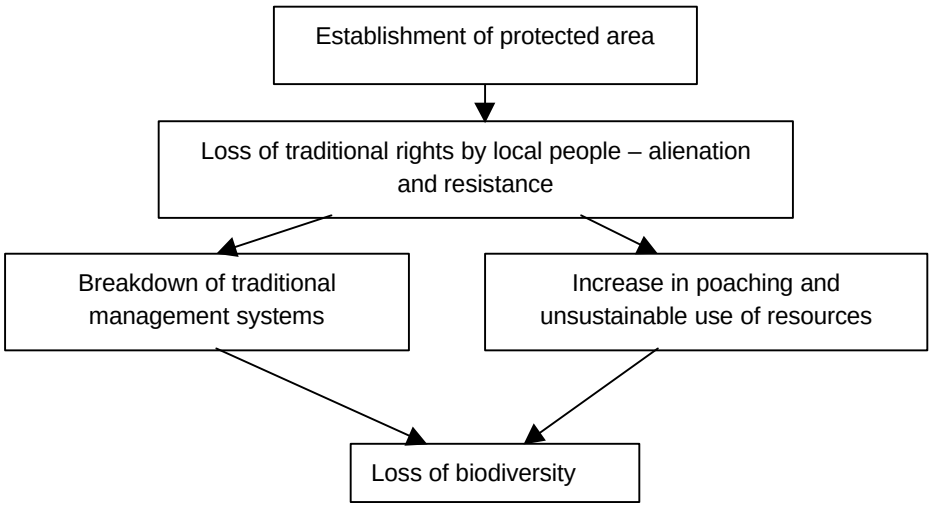
Most conservationists would argue that conservation of biodiversity and ecology are worth some sacrifices by people; indeed that conservation is essential to the long-term future of people as well as wildlife so that today's "sacrifices" are necessary for future generations. Such choices become much more morally suspect when certain groups of people shoulder the majority of the costs. As it is usually the least powerful people who are treated in this way, often including indigenous people, conservation through protected areas can at its worst exacerbate existing social inequalities; in effect putting the needs of wildlife before the needs of the poorest people.

Indigenous people have been expelled from protected areas throughout their history; indeed the Shoshone people were expelled from the Yellowstone National Park in 1872. Other examples include the Ik from Kidepo National Park in colonial Uganda, the Vedda from the Madura Oya National Park in Sri Lanka and the Batwa of Rwanda, Uganda and DR Congo from mountain gorilla reserves[52]. The results of these impositions have been disastrous for some indigenous groups, leading to their virtual extinction. These issues are not confined to developing countries or to indigenous peoples. Impassioned disputes have taken place between environmentalists and first nations in parts of North America over traditional hunting in wilderness areas[53]. Clashes between local people and conservationists over protected areas have recently taken place for example in Eastern Finland on the border of Russian Karelia where protection of an old-growth forest was blamed for the closure of a local sawmill and the consequent loss of 40 jobs [54].

Such clashes have, quite apart from their serious social and humanitarian impacts, also done little for conservation. Many of the problems have been created, or intensified, because local human populations oppose the protected area. Loss of traditional rights can reduce peoples' interest in long-term stewardship of the land and therefore creation of a protected area can in some cases increase the rate of damage to the very values that the protected area was originally created to preserve. For example, when the collective forests of Yuhu village were incorporated into the Yulongxueshan Nature Reserve in northwest Yunnan China, farmers responded by cutting down trees that they had previously managed on a sustainable basis[55]. Putting a fence around a protected area seldom creates a long-term solution to problems of disaffected human communities, whether or not it is ethically justified.

People also can and should play a key role in conservation rather than being regarded as a "problem". In some cases, the presence of indigenous or local people is now virtually essential for the maintenance of the ecology and for example, the Australian government is looking at a mechanism that will allow indigenous landholders to 'self-declare' protected areas on their land[56]. Many of the world's "natural" areas have actually been managed to some extent for hundreds or thousands of years and survival of biodiversity may rely to a certain extent on continuation of this traditional management. This is now well recognised for example in the Mediterranean region[57] but is also an important factor in large parts of the Amazon and the forests of Southeast Asia. Local communities can and do help protect the protected area values, if they agree with them, in situations where park staff have neither the time nor resources to provide total protection.

The biological consequences of badly planned or unethical practices towards human communities



However, this partnership approach has all too often been missed in practice. Examples of indigenous people suffering as a result of conservation have drawn criticism from human rights groups, who now sometimes virtually regard larger conservation organisations as in opposition to their own aims[58]. In an explicit critique of WWF, an anonymous commentator from Survival International wrote in 1996[59]:

> *Lately, it has become fashionable for conservationists to talk about "consulting" local people and to acknowledge the "role" of indigenous peoples in "managing protected areas". This looks good on paper, but they are hardly an adequate substitute for land ownership rights and self-determination. In practice the conservation movement has subjected tribal peoples to state or corporate control. It has violated their rights and, for the most part, failed in its own objective of environmental protection. How long will it be before conservationists start using slogans like "Pandas not People?"*

These critiques, and changes within the political composition of major conservation organisations, have stimulated a change in attitudes. Sally Jeanrenaud and Piers Blaikie have pointed out that early conservationists tended to view people as a "problem" for wildlife. Later, as a result of a changing political perspective within the environmental movement, and of pressure from human rights groups, attitudes began to change. People started to be viewed differently, first rather simplistically as a "resource" and then, gradually, as "partners" in a wider effort towards sustainable management[60].

The need for a new approach has also been explored at some length, both inside and outside the conservation movement[61]. WWF and IUCN/WCPA have, for example, agreed a detailed position on principles on indigenous and traditional peoples and protected areas (see box)[62].

Box: Principles on Indigenous/Traditional Peoples and Protected Areas
The key principles presented in the WWF and IUCN/WCPA document are:

Principle 1
Indigenous and other traditional peoples have made significant contributions to the maintenance of many of the earth's most fragile ecosystems, through their traditional sustainable resource use practices and their profound, culture-based respect for nature. Therefore, there should be no inherent conflict between the objectives of protected areas and the existence, within and around their borders, of indigenous and other traditional peoples practising sustainable use of natural resources; and they should be recognised as rightful, equal partners in the development and implementation of conservation strategies that affect their lands, territories, waters, coastal seas, and other resources, in particular the establishment and management of protected areas.

Principle 2
Full respect of the rights of indigenous and other traditional peoples to their lands, territories, waters, coastal seas, and other resources should be the foundation of agreements drawn up between conservation institutions, including protected area management agencies, and indigenous and other traditional peoples for the establishment and management of protected areas affecting those lands, territories, waters, coastal seas, and other resources. Simultaneously, such agreements should be based on the recognition by indigenous and other traditional peoples of their responsibility to conserve biodiversity and natural resources harboured in those protected areas.

Principle 3
The principles of decentralisation, democratisation, participation, transparency and accountability should be taken into account in all matters pertaining to the mutual interests of protected areas and indigenous and other traditional peoples.

Principle 4
Indigenous and other traditional peoples should be able to share fully and equitably in the benefits associated with protected areas, with due recognition to the rights of other legitimate stakeholders.

Principle 5
The rights of indigenous and other traditional peoples in connection with protected areas are often an international responsibility, since many of the lands, territories, waters, coastal seas, and other resources which they own, occupy or otherwise use, as well as many of the ecosystems in need of protection, cross national boundaries.

The extent to which conservation organisations have really taken aboard human rights interests is still a matter of fierce debate. Such changes are gradual – perhaps almost requiring a generation to pass, as new people become involved, with new ideas and fresh perspectives. It is possible to find large organisations acting in completely different ways in different parts of the world, with some project staff demonstrating high social awareness and conscience while others remain far more conservatively involved in "managing people as a problem". Questions of the extent to which individual rights should be balanced with the wider requirements of other human communities, and of non-human communities, will remain an important discussion point for a long time in the future.

Chapter 4

Lack of management capacity – the "paper parks" phenomenon

External threats are, for the foreseeable future, an inevitable factor in protected area management. However, in many cases these are exacerbated by lack of money and capacity amongst protected area authorities. Protected areas currently cover over 9 per cent of the world's land surface, and considerable areas of the ocean, but many are managed with little or no resources.

At one extreme, protected areas are designated by law and drawn roughly on a map but then never implemented – a phenomenon that has become known as "paper parks". These areas are often remote, may be virtually unexplored and differ little from surrounding land in either the degree of security they offer to biodiversity or the ways in which they are used. More commonly, protected areas are given a minimal infrastructure and a few staff, but nothing like enough resources to be effectively managed or protected. Lack of management capacity is therefore an important contributory factor in the threats facing protected areas. "Lack of capacity" is a general term that can encompass a range of different issues, some of which are listed below:

- Lack of financial resources
- Lack of staff and of staff training
- Inadequate institutional capacity and infrastructure
- Lack of information about the biology of the protected area
- Lack of political/legislative support and/or unclear or contradictory legislation
- Lack of communication with local residents
- Lack of involvement of local residents in preparing and implementing management plans
- Lack of co-ordination among managing organisations
- A poor legal framework and lack of adequate enforcement tools
- Absence of comprehensive land-use plans or management plans
- Poor definition of protected area boundaries
- Lack of agreements about resource use adjacent to or within protected areas
- Rapid turnover of protected area staff

Most of these factors are outside the control of protected area managers, who often find themselves in the position of trying to balance a range of opposing demands and pressures with little or no money, insufficient staff and the legacy of poor initial planning and negotiation of the protected area. As environment ministries (if they exist at all) are usually less powerful than many other parts of a government, protected area managers and their superiors often find themselves out-manoeuvred by for example ministries interested in mining. In some countries, direct involvement of powerful government officials in illegal actions in protected areas has undermined the efforts of protected area staff as has happened in Cambodia[63].

Lack of capacity can reach spectacular proportions. In Jaú National Park in Brazil, five staff are responsible for an area two thirds the size of Belgium (see page 113). WWF Peru identified lack of management capacity as a major problem in a range of the country's protected areas[64]. A survey of park managers in Indonesia found that 93 per cent identified support from and co-ordination with local government agencies as the aspect most in need of improvement with respect to management, and 85 per cent also identified well-qualified park staff as a key requirement[65]. Research suggests that a third of protected areas in China have not been implemented[66]. Ratio of field personel to area of protected areas in Central America varies from 309 hectares per field worker in El Salvador to 35,764 hectares per field worker in Belize[67]. In Thailand, one study showed that the National Parks Division had only 23 per cent of the required manpower[68]. Research in ten forest countries carried out for WWF and the World Bank suggested that less than a quarter (ranging from 0 to 24 per cent) of forest protected areas were considered to be "well-managed with a good infrastructure" in the countries assessed. Between 17 and 69 per cent of forest protected areas in these countries had *no* management[69]. Recent research in the ACP (African, Caribbean, Pacific) countries, carried out for the European Commission and IUCN, identified lack of staff and capacity as a key threat to protected areas throughout the regions[70].

Confusion between different levels of government can also cause problems. For example, in Malaysia the federal government creates laws and policies but state governments have rights over land use. The federal government is reluctant to provide financial assistance for management of protected areas so that most state governments are unable to bear the cost of maintaining the gazetted areas[71].

There are, of course, no clear rules about how much management capacity is needed. In some remote areas, the legislation alone may be enough to deter serious abuse or local people may provide all the eyes and ears needed to guarantee the area's integrity. In highly threatened protected areas far more capacity may be required, or different approaches needed to reduce the threats. Force – such as fences and armed guards – although sometimes necessary in extreme conditions, seldom create long-term solutions and management inevitably entails developing support from human populations in the surrounding area if it is to succeed in the long term.

Is "Paper Park" a useful concept?

Paper Park has been used as shorthand for unimplemented or poorly implemented protected areas. However, critics of the concept suggest that this may not be the best term to use, because it can belittle and thus undermine efforts of cash and resource-strapped protected area managers. The term has caused resentment amongst some protected area managers, who have often worked hard to obtain legal protection for areas and consider the term "paper park" as demeaning of their efforts. In these cases, designation alone often gives some protection (e.g. preventing incursion into the protected area by large companies). In addition, some "paper parks" are fairly secure because of their remoteness or as a result of strong national laws) and managed protected areas may sometimes be at greater risk.

Focusing on ***threatened protected areas***, as we do here, may be a more useful approach.

Chapter 5
The underlying causes of threats to protected areas

Much of this report is concerned with immediate and long-term threats to protected areas and their consequences for conservation. However, most of the immediate threats are in turn the result of several underlying causes and to focus solely on the immediate problems risks both apportioning blame to the wrong people and trying to address the symptoms of the problem rather than their causes. Understanding the nature and importance of these underlying causes is therefore essential for effective action to reduce threats to protected areas.

Key underlying causes include:

- **High consumption levels amongst the richest fifth of the world's population** stimulating agro-industrial, tourism, logging and mining developments that in turn impact on protected areas and on land around protected areas.

- **Pressure for trade and development** and development aspirations that downplay or ignore the environmental implications of development policies, which are in turn often driven by high consumption or the need to service debt repayments in many developing countries.

- **Poverty amongst the poorest proportion of the world's population** leading to increased pressure on protected areas to supply land and resources

High consumption is concentrated amongst a fifth of the world's population, mostly in North America, West Europe, Japan, Australasia, Hong Kong, Singapore and the oil sheikdoms of the Middle East, that together consume 80 per cent of global resources[72]. Maintaining such high consumption levels for a minority requires inputs of labour and resources from the rest of the world and creates an important underlying pressure for rapid use of natural resources. It has direct links to protected areas through, for example, pressure to exploit precious stones or metals within protected areas and through the side effects of intensive agriculture, private transport and high consumption of energy, metals and wood products.

Current economic practices, based on a high consumption, throw away society, have also led to a sharp rise in international debt, particularly in developing countries. Debt remains a crushing problem for many poor countries, and currently exceeds US$1 trillion. In practice, debt servicing is often achieved by cashing in natural resources such as timber[73]. A report of the Commission of the European Communities notes for example that "International debt obligations...can lead developing country governments to accelerate the pace of forest exploitation in order to earn needed foreign exchange"[74]. The UK government's recent decision to write off developing country debts is an important step that needs to be copied far more widely. Commercial banks also often play an important role in promotion of rapid resource exploitation[75] as do some multilateral development banks. The position taken by the World Trade Organisation has made it more difficult for countries to improve environmental controls on the production of goods that they import[76] and the growing market share taken by transnational companies adds further impetus to increased consumption[77].

Poverty is another critical factor in environmental degradation. Recent trends have indicated a widening gap between rich and poor in many countries. A substantial proportion of the world's population remains in absolute poverty. Unemployment encourages environmental degradation through for example deforestation[78]. Economic policies in the North have increased, rather than alleviated, these problems[79]. A report from the Asian Development Bank[80] concludes: "Poverty as such cannot be said to cause environmental degradation, however, often the two are associated with each other… As change occurs it leaves behind winners and losers; typically, the losers have few choices available and are forced to adopt

short-term survival strategies under which longer term resource management considerations appear to be an unaffordable luxury".

The key underlying issues of consumption, trade and poverty are in turn related to a range of other causes, including:

- International debt and the flow of resources from poor to rich
- Pressure for trade and development
- Lack of secure land tenure
- Population
- Social relations, including gender relations
- Corruption
- Inequality
- Lack of capacity
- Lack of education
- War and conflict

These issues provide a backdrop for the more immediate problems that are discussed in the following chapters. People living in poverty, without secure land tenure, strong political rights and in social conditions of great inequality generally do not have much time to put efforts into conservation. (In fact, it is heartening the extent to which people *will* support well-managed and carefully developed conservation projects despite their personal circumstances.) When these problems are compounded by lack of education, poor infrastructure and social conflict then the problems become even more acute. A widespread breakdown in the rule of law means that, in many countries, the very people who should be providing a secure legal framework for environmental protection are themselves flaunting the laws they are paid to uphold. The threats to protected areas discussed in the following report are one part of a much larger social and environmental problem; tackling any one issue in isolation can only ever provide a partial and probably temporary solution.

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Part 2
The growing threats to the world's protected areas network

Summary of Part 2

To a large extent as a result of the underlying causes identified in part one, protected areas now face a range of more immediate threats that can, and do, undermine their integrity and reduce their overall quality. In each of the sections below, problems are discussed and then examples given, in tabular form, of protected areas affected and/or threatened by the issues being discussed. Most protected areas are threatened by several threats at the same time and if a protected area is being degraded by one factor it is likely to be experiencing several others at the same time. For the sake of convenience, we have divided threats into four major categories – these are neither exact nor exclusive.

Major changes in habitat: *are amongst the most important factors impacting on protected areas and are likely to be the most long-term, often resulting from human settlement and including such factors as agricultural conversion, the impacts of fire, large-scale drainage and, in marine systems, destruction of coastal reefs. A critical contributory factor comes from the development of access, through transport links.*

Resource extraction: *is often a less obvious factor but can be just as important; in extreme cases it can result in the disappearance of the species for which the protected area was created in the first place, whilst leaving the overall habitat intact. Critical issues include hunting, fishing and the wildlife trade, along with various forms of fuelwood and fodder collection, semi-legal or illegal logging, mining, and oil and gas extraction. Resource extraction is thus divided between that practised by local people or park dwellers and that emerging from outside interests; sometimes the two overlap as in hunting for the commercial bushmeat trade.*

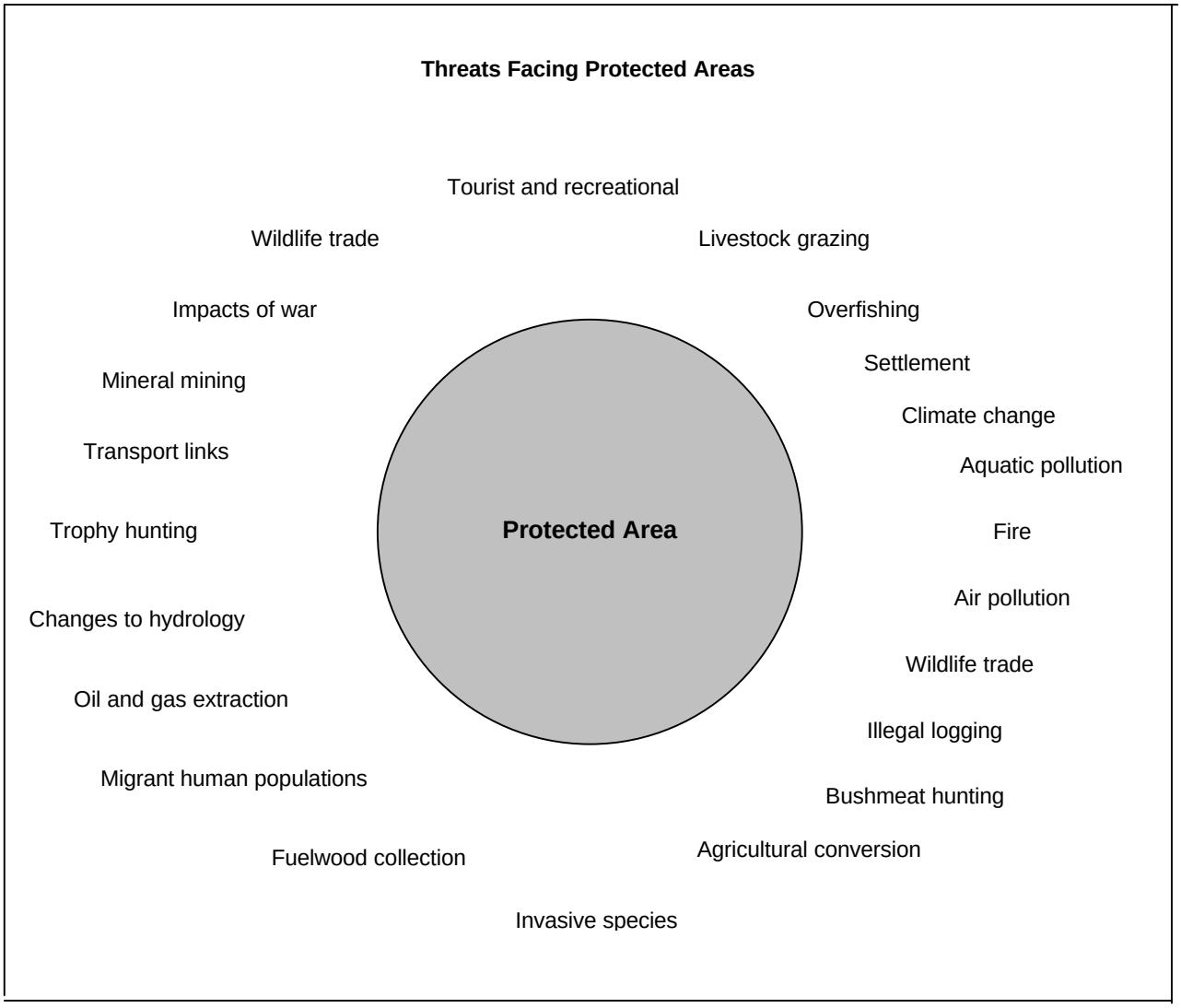
External threats: *are also problems to an increasing number of reserves. The impact of various forms of hydrological disturbance is important, including dam construction, drainage and irrigation (the latter two sometimes also taking place within a protected area as well). Most marine and freshwater protected area managers identify pollution as amongst their most important problems. Air pollution is impacting on biodiversity in protected areas throughout Europe and climate change poses larger and more fundamental threats to whole biomes such as coral reefs, low lying islands, cloud forest and mangroves although many other habitats are threatened. One side effect of climate change, along with other factors, is desertification that is impacting on sensitive protected areas in several arid parts of the world. Tourism is a slightly ambiguous issue, having both positive and negative impacts.*

Political threats: *are a particular issue that deserves special attention because of the unpredictable and extreme nature of the threats they pose. Political opposition to the concept of protection, or to a particular protected area, can cause problems. Armed conflict, including both guerrilla insurrection and full-scale war has an enormous impact on protected areas, alongside the human misery that it brings, both as a result of official and unofficial military action and as a side effect of refugee movements.*

An overview section *gives some preliminary indications of the importance of different threats, where in the world they are most important and whether they are likely to increase or decrease in the future. Some* ***responses*** *to the threats are scattered through the text.*

Introduction

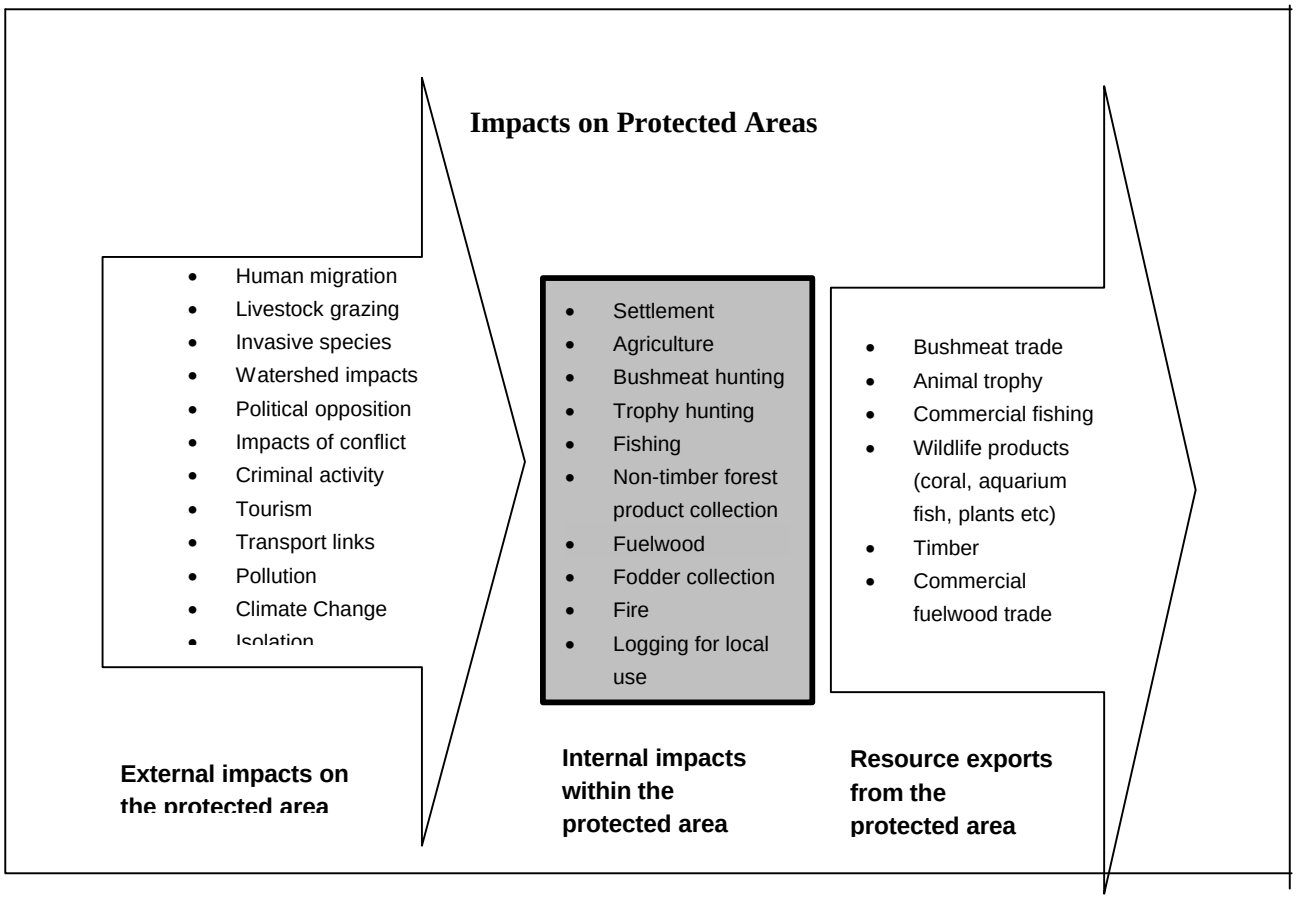
Today, many protected areas are increasing embattled by pressures ranging from immediate threats such as poaching to complex external changes created by long-range air pollution or climate change. Some of the pressures likely to face protected areas are illustrated in the figure below.



These threats are not universally spread, nor are they necessarily of equal severity. However, some trends will become clear in the following chapter.

First, if a protected area is under threat from one particular factor it is, in most cases, likely to be under threat from others as well. Troubles seldom come singly and lack of capacity, strained relations with local communities or a more general breakdown in rule of law is likely to result in a number of "symptoms".

Secondly, the relation *between* threats is complex. In the following diagram, an attempt has been made to divide threats into those coming from the *outside*, those taking place directly *within* the protected area and those resulting from the *removal* of resources from the protected area. These subdivisions are necessarily rather simplified.



In the following chapters, these impacts are discussed in turn. In each case, background is given, followed by a table giving examples of protected areas impacted by the particular threat. Some responses are also scattered in boxes through the text.

Chapter 6
Major land-use changes

One of the most fundamental threats to protected areas comes from major changes to the vegetation through settlement, associated agriculture in the case of terrestrial protected areas and from land-use practices such as fire. Within this section we also look at changes that encourage settlement, including particularly transport systems such as roads and canals.

Human settlement in protected areas

The old "model" of a protected area is of an area of land set aside exclusively for wildlife and wilderness protection where, on occasion, a small number of people can visit under strictly controlled conditions. The relatively small nature reserves common of much of Europe and large uninhabited wilderness areas in, for example, parts of North America and New Zealand typify such areas. However, they are far from the reality of many, perhaps most of the world's protected areas, where human communities are an integral part of the ecosystem.

Research suggests, for example, that 80 per cent of Latin America's protected areas are currently inhabited[1]. The agricultural frontier has already moved into many protected areas in Central America[2]. Most African national parks also contain human communities, some of whom may be oblivious to the aims of protection[3]. In the Dja Reserve in Cameroon, for example, protected area staff believe that most of the inhabitants are unaware that the area is protected, despite the national park having been established for fifty years[4]. Virtually all the large "landscape" national parks in Europe contain human communities; for example the Snowdonia National Park in the UK contains approximately 25,000 people[5]. There is extensive settlement within many protected areas in Asia and the Pacific as well. Research in India, for example, found human populations in 56 per cent of national parks and 72 per cent of sanctuaries, often at higher population densities than the average for the country. Settlement in the buffer zones was even higher, being found in 83 per cent of national parks and 87 per cent of sanctuaries[6]. The sight of impoverished human settlements clustered around the gates of national parks has become an all-too-common phenomenon in many parts of the world.

Human populations in French national parks

Although European nations have often in the past colluded in the expulsion of people from protected areas in developing countries, most large European protected areas contain human populations. In France, for example, six national parks cover roughly 1.3 million hectares (about 2 per cent of the national territory) and are inhabited by over 158,000 people. Many are also located near major urban centres, so that many people enjoy the recreational opportunities. This leads to conflict, particularly with respect to issues of property right and as a result of differing perceptions of nature between rural and urban populations; reconciling demands for development with the requirements of nature conservation have proved difficult[7].

Even when protected areas remain unsettled, clearance of land up to the borders is common in many areas, leaving them as "islands" in a sea of altered landscape and undermining the concept of buffer zones or a protected area network. This was identified as a major problem in a study undertaken by WWF Brazil[8].

Historically, many protected areas have been created without consultation with indigenous and other local people living in or near these areas; this is at the root of many current problems with protected area degradation. Often these populations have been displaced or have lost their traditional access to land,

waterways and resources[9]. Such losses can actually undermine the conservation aims. Many fragile ecosystems and cultural landscapes contained within protected areas rely on traditional management systems to survive and have consequently suffered from the removal of the people who were their traditional stewards[10]. Loss of access rights and land can also *reduce* local peoples' interest in long-term stewardship, so that creation of a protected area can sometimes paradoxically increase the rate of damage.

The legacy of this and other factors, including human population growth, human migration and a search for economic prosperity, is that many protected areas are under pressure from human settlement. Whilst this can, in theory and in practice, be managed in such a way that both human values and other values benefit[11], it currently often results in biodiversity and environmental values being degraded.

The need to balance human and non-human values in and around protected areas is an essential task for the conservation community over the next decade and the issue of human settlement in, and incursion into, protected areas is perhaps the most dramatic example of these pressures. Today, human settlement can act detrimentally on protected areas in a number of ways:

- Expansion of numbers or influence of existing settlements within or around protected areas, either through illegal activities such as hunting or because agreed activities increase in scope and impact.

- Increase in permanent settlement within protected areas because of land shortages in surrounding areas or because the land within the protected area offers particular benefits.

- Sudden, temporary incursions of human populations for a particular purpose, such as transhumance and search for good pasture or seeking particular economic goals such as mining or trophy hunting.

- Temporary settlements around protected areas due to political problems or environmental disaster, including for example war refugees or refugees following "natural disasters", such as flooding, hurricanes or the impacts of drought.

Many of these issues are discussed elsewhere in this report. Whereas settlement patterns can create long term problems (or opportunities) sudden incursions are extremely difficult to either plan for or manage. Changes in settlement patterns can occur suddenly as a result of political, environmental or economic changes and only the most remote or uninhabitable protected areas are likely to remain free of risk in the long term. Sudden changes in government policy can result in influxes of people to land close or adjacent to protected areas, as happened during the Indonesian transmigration programme when people from Java were settled in remote areas of Kalimantan[12]. Impacts of actions taken far away can spread to many different parts of the world. For example, a collapse in the price of tin in the early 1980s, caused by problems and miscalculations within the London Metals Exchange, created a wave of redundancies within the Bolivian tin mining sector. There was a consequent move by many miners into the Amazon where they mined, illegally, for gold, impacting on several protected areas within the region and polluting rivers[13]. The impacts of war refugees in for example Central Africa are described on page 153.

In some situations, protected areas are now playing a key role in providing a home for indigenous peoples that have otherwise been displaced by land-use activities such as logging or agriculture. This leads to an increased density of human population within the protected area, perhaps above the carrying capacity for traditional subsistence activities, and also presents protected area managers with fresh management challenges that they may be ill equipped by training or temperament to address. They also offer protected areas an important role in protecting fragile human communities; until now this has been insufficiently recognised or explored. In Table 6.1, some examples are given of settlement in protected areas that is currently incompatible with the stated aims of the protected area.

Table 6.1: Human settlement in protected areas

Country	Protected Area	Details
Bolivia	Amboró National Park (II, 637,600 ha)	Extensive settlement has taken place since the protected area was first established[14].
China	Caohai Nature Reserve in Guizhou	The reserve over 19,000 residents and a population density of 200 persons per square kilometre *inside* the reserve putting severe strain on biological resources[15].
Côte d'Ivoire	Tai National Park (II, 350,000 ha)	Extensive encroachment took place during the 1980s and 1990s[16].
Ethiopia	Bale Mountains National Park	Re-occupation by some of the original inhabitants has taken place following the end of the civil war[17].
Guatemala	Laguna Lachua National Park (Ia, 15,000 ha)	Affected by settlement throughout the buffer zone and nearby protected forests have been largely destroyed by squatter settlements. The protected area is increasingly isolated with natural forest cleared right up to the boundaries[18].
Nicaragua	Consiguina	The protected area is threatened by colonisation (Nicaraguan protected area officials believe that virtually all the country's protected areas are under threat from settlement)[19].
Philippines	Mount Apo National Park (II, 72,113 ha)	The national park has undergone intense settlement and over 50 per cent of the original protected area is now deforested; similar problems affect the Mount Malindang National Park[20].
Solomon Islands	Queen Elizabeth National Park on Guadalcanal	Gradually degraded since it was established and is now largely cleared[21].
Thailand	Doi Inthanon National Park (II, 48,240 ha)	Invasion and poor farming practices have badly degraded the protected area where for example 15 per cent of the land has been converted to agriculture[22]. An estimated 60 per cent of the over 8,000 people residing within 5 km of the park rely on illegal collection activities[23].
Venezuela	El Alvila National Park (II, 85,192 ha) Península de Paria National Park (II, 37,500 ha)	A reported 100,000 landless people have settled within the El Alvila park boundary[24]. Increasing encroachments are also reported from the National Park of Paria Peninsula[25] and other protected areas.

Conversely, protected areas are sometimes also used as a way of *expelling* human communities for political reasons. It is widely thought, for example, that the military regime in Burma has used the designation of the Myinmoletkat Nature Reserve as an excuse to relocate ethnic Mon and Karen people, despite the latter having a long tradition of conservation in the area[26]. The presence of human communities can have either positive or negative implications for the biodiversity of a particular protected area and simple relationships between "population" and "conservation problems" should be avoided.

Changes in agricultural pressures in protected areas

Agriculture in its various forms consistently emerges as the number one "threat" to biodiversity and natural ecosystems in terrestrial habitats, and agricultural pollution is also a significant damaging factor in many freshwater and coastal marine ecosystems. For example, research on threats to high biodiversity forests identified agriculture and grazing as the number one impact in IUCN's publication *Centre of Plant Diversity* and in the 87 forest ecoregions that appear in WWF's "Global 200" report of critically important ecoregions[27]. Although agricultural expansion is often assumed to be the result of human population growth – making an apparently simple tension between food and wildlife – most of the impacts, particularly on protected areas, are more complex. Agriculture can encroach or impact upon protected areas in a number of ways:

- Incursion and settlement by farmers or landless migrants is a critical problem where land is scarce either due to total population size or because land ownership is concentrated in the hands of a few people, for example in Central America and much of Asia. The need for more agricultural production to meet the increasing demand of the buffer zone community in Pakistan is resulting in clearfelling forest patches within protected areas[28].

- Incursion by nomadic people and grazing animals can conflict with wild mammal populations and/or damage grasslands. Nomadic people use virtually all the protected areas in West Africa and this is a particular problem in Niger, Togo and Benin[29]. Research in India found that average density of livestock inside national parks in India is *higher* than outside[30].

- Increase in intensity of agricultural pressure can impact on protected areas where traditional agriculture is still allowed. Increase in numbers of sheep being kept in the uplands of the Snowdonia and Lake District National Parks in the UK has been linked with vegetation damage. Throughout Europe, agricultural payments from the EU's Common Agricultural Policy are acting as a perverse incentive against conservation aims[31].

- Illegal cultivation, for example of narcotics, such as takes place in protected areas in Colombia. Drug production has been identified as a problem in at least 16 of Colombia's protected areas[32].

- Large agricultural operations near protected areas can damage ecology, for example by disturbing the watershed, increasing soil erosion or changing weather patterns. The spread of major timber and crop plantations in Central and South America has in some cases impacted on protected areas even if these are not directly touched by the developments[33].

- Illegal land clearance to establish agricultural operations. The majority of the important forest fires that impacted on Brazil, Indonesia and other states at the end of the 1990s were created to establish plantations or cattle ranches – many of these also spread to protected areas (see page 44).

- Agricultural pollution runs off into freshwater and eventually also marine systems and directly affects protected areas through eutrophication, pesticide pollution and deposition of heavy metals. Most freshwater protected areas in western Europe, for example, have faced threats of this kind.

- Intensive livestock agriculture can contribute to air pollution, through release of ammonia and its by-products (which is a significant in parts of the Netherlands and Denmark for example) and through the release of methane, a greenhouse gas that contributes to global warming.

- In some areas, particularly in Europe, the abandonment of agriculture in protected areas is resulting in a reduction in biodiversity in areas where traditional cultural practices are now an established part of the ecosystem[34].

Agricultural impacts are thus complex and wide-ranging. They impact, in different ways, on both poor and rich countries and on virtually every type of ecosystem. Remnants of persistent pesticides such as DDT have even been discovered in both the Arctic and the Antarctic, for example being measured in the body fat of the Adelie penguin (*Pygoscelis adeliae*) and the Weddel seal (*Leptonychotes weddelli*)[35]. Table 6.2 outlines a few selected examples of what could be a far longer list of protected areas impacted by agriculture in one form or another. This table focuses mainly on land-use changes; pollution impacts are dealt with elsewhere.

Table 6.2: Agricultural threats to protected areas

Country	Protected Area	Details
Austria/Hungary	Neusiedler see (II, 8,000 ha)/ Fertó-tavi (II, 12,543 ha)Transboundary Park	Agricultural intensification has led to extensive eutrophication and reed expansion (1,009ha in 1855 versus 3,016ha in 1993) as well as occurrence of botulism in waterfowl (over 2,000 dead birds were collected in 1982-3)[36].
Bénin	"W" National Park (II, 502,000 ha)	Degradation as a result of overgrazing now affects 60 per cent of the protected area[37].
France	Mercantour National Park (II, 68,500 ha)	Overgrazing is causing problems for the vegetation in parts of the national park[38].
Honduras	Rió Platano biosphere reserve	Agricultural expansion is threatening this reserve[39]. Small farmers are paid by cattle-ranchers to colonise the forest and later sell land rights to cattle-ranchers.
Mali	Boucle du Baoulé National Park (II, 350,000 ha)	Degradation through transhumance has damaged large parts of the protected area[40].
Portugal	Peneda-Geres National Park (II, 70,290 ha)	Overgrazing is causing problems for the vegetation[41] in some areas.
Romania	Forest protected areas	Grazing is identified as a problem in many protected areas[42].
Slovenia	Triglavski National Park (II, 83,807)	Depopulation, and abandonment of traditional agriculture, is endangering the cultural landscape of the Park[43].
South Africa	Natal Drakensberg Park	There have been several land invasions, with cattle driven into the reserve as a result of frustration with delays in land settlement claims on adjacent land[44].
Spain	Daimiel National Park	Intensive agriculture is impacting on the protected area[45]
Thailand	Khao Soi Dao Wildlife Sanctuary (IV, 74,502 ha)	As in many protected areas in Thailand, local communities have cleared forest in the sanctuary to create agricultural land[46] with almost 14% having been cleared by 1994[47].
Uganda	Queen Elizabeth National Park (II, 197,752 ha)	Lake George, a designated Ramsar site within the park, is threatened by horticultural activities including drainage, use of pesticides and agrochemicals and silting[48].

***Responses*: integrating agriculture and protection**

Agriculture is not always in conflict with protection – rather it depends on the type and the extent of agriculture. In some landscapes, continuation of traditional agriculture is an essential element in maintaining existing biodiversity, where species have become adapted to thousands of years of cultural practices. In other cases, sympathetic agriculture – for example organic agriculture – can play an important role.

In 1999, IUCN held a workshop with IFOAM, the International Federation of Organic Agriculture Movements, to discuss the links between nature conservation, biodiversity and organic agriculture. The editors concluded:

Over the past decade, long-term research projects have accumulated evidence that the results of an organic system are beneficial to biodiversity. A study by the British Trust for Ornithology, funded by the UK Ministry of Agriculture, Fisheries and Food, found higher densities of all bird species studied on organic farms, and populations of skylarks (a species known to have declined because of agricultural changes) were double that of non-organic farms. Research by Oxford University found that the mean number of non-pest butterfly species on organic farms was twice that of similar non-organic farms. The Institute for Organic Agriculture at the University of Bonn found that average plant species also virtually doubled on organic farms, with some endangered species only being present in organic systems. A Swiss study also found dramatic increases in soil biota on organic farms.

This has a number of implications. It shows that modern and efficient agricultural practices exist that can help maintain that proportion of biodiversity that has become associated, over a long period of time, with cultural landscapes. It also means that organic agriculture offers a fresh alternative in areas where biodiversity preservation is a priority, for example in protected areas or in places where biodiversity preservation is given a priority. An organic symbol can also help provide additional income to people living around protected areas[49]*.*

The Central American Biological Corridor provides an example of the integration of agriculture and conservation. The Corridor is a unique, international attempt to mix protection of habitat and biodiversity with sustainable development. Eight governments, over a hundred non-governmental organisations and thousands of local communities are collaborating on a network of protected areas stretching from southern Mexico to Colombia and protecting some of the world's richest forest habitats. In between the protected areas, sustainable land-uses are being promoted including sustainable organic agriculture, forest management and ecotourism.

Agriculture itself leads to a range of other related problems, including the misuse of fire, agrochemical pollution and the collection of fodder that are dealt with below.

Impact of fires on protected areas

Fires as a natural phenomenon, are usually started by lightning; it has been calculated that there are, on average, a hundred lightning strikes to earth every second[50]. Depending on climate, geography, ecology and plant species there are great differences in the likely frequency of natural fires. Under natural conditions some ecosystems will almost never catch fire, including tropical rainforests, mangroves and wetlands. Other areas such as grasslands and some boreal and dry eucalypt forest types can expect, on average, to experience fire at intervals ranging from every few decades to every few years. Fires are characterised into three main types:

- **Surface fires**: relatively low intensity – "cool" and often fast moving fires that may kill annual plants and younger trees but are unlikely to damage mature trees.

- **Crown fires**: are very high intensity – "extremely hot" fires that are often the focus of media attention. The fuels from the ground to the tops of trees all burn violently at the same time. Crown fires can move quite quickly. They develop from surface fires burning in heavy accumulations of litter and woody debris or fuels that "ladder" from the ground to the crowns of trees. Crown fires can kill entire stands of trees and are the most threatening to life and built environment.

- **Ground fires**: burn in the duff, peat, coal or organic soils below ground level. They are often the hottest fires but move slowly. These fires consume soil down to the mineral substrate burning not just trees and surface vegetation but also seeds, roots and many nutrients.

Fire can play an important role in ecology. They facilitate germination and release of seeds from species that require heat to carry out this part of their life-cycle. In forests, fires open up the canopy to allow in light and stimulate fresh growth and increase dead timber, forming important habitats for plants and animals. In some cases, fires can maintain a balance in ecosystem health by reducing pests and diseases. They influence succession of the vegetation mosaic, release nutrients from the soil and change the species mix, giving opportunities to those species that would be out-competed in a mature ecosystem and maintain prairie in some areas by preventing forest from encroaching[51]. However, a change in the number of fires, the time between fires, where fires are burning and the intensity of fires is today having a major impact on the ecology of several important ecosystems, including particularly forests. Several important issues can be identified that relate to protected areas:

- **Increased number and size of fires** in ecosystems where fires would naturally be absent or very rare and in fragmented ecosystems that are too small to absorb the impacts of fires.

- **Impacts of fire suppression** in areas where fire is an important part of the natural cycle, including upsetting the ecology of an ecosystem and increasing the occurrence of occasional more serious fires.

- **Potential effects of climate change** which according to current models could result in an increase in number and size of fires in some places.

In particular, tropical ecosystems are experiencing increasing fire damage. Many fires take place in areas where they would be rare or virtually unknown under natural conditions and are extremely prone to severe fire damage. Forest fires in recent times have burnt huge areas of the Amazon[52] and parts of South East Asia; in many cases the impact may be irreversible. New research from South East Asia and the Amazon shows that fire is not only a cause of depletion of tropical forests, it also increases the vulnerability of forests to future burning[53]. Fire increases the flammability of the forest and makes forests more susceptible to future burning, not only in El Niño years but also under seasonal dry conditions[54]. What was at the time thought to be the biggest forest fire in history took place on the

island of Borneo, burning for several months during 1983. Combined effects of fire and drought destroyed 25,500 km^2 of primary and secondary forest and a further 7,500 km^2 of shifting cultivation and settlements. Kutai National Park was almost completely burnt by the fire and virtually destroyed. In some dipterocarp forest areas left unburnt by the fire, 70 per cent of the bigger trees have since died through drought[55]. Since then, the rate of forest fires in Borneo appears to be increasing. For several months in 1997, an area of South East Asia from the Philippines to Australia was enveloped in smoke haze, caused by forest fires in Java, Borneo, Sulawesi, Irian Jaya and Sumatra. Over a million hectares were affected. More than 40,000 Indonesians became ill as a result and smoke was linked to plane crashes and shipping accidents. Primary forest and at least 19 protected areas were damaged, along with endangered species such as the orang utan (*Pongo pygmaeus*) (see table 6.3 below). Business, including tourism, suffered badly. Most of the fires were started deliberately and often illegally. Commercial interests, including plantation owners, have been identified as major culprits. Impacts were exacerbated by the El Niño climatic phenomena, which may have itself been intensified by pollution-related climate change. Similar rapid increases in forest fires occurred in Brazil, Colombia, Papua New Guinea, Kenya, the Russian Federation and the Mediterranean countries of Europe[56].

Table 6.3: Conservation areas suffering forest fires in Indonesia during 1997

Island	Protected area
Sumatra	Bukit Barisan Seletan National Park Bukit Tiga Pulah National Park Berbak Sembilan National Park Kerinci Seblat National Park
Kalimantan	Muara Kencawangan Nature Reserve Maya Island, Karimata Islands Protected Forest Tanjung Puting National Park Pleihari Martapura Wildlife Reserve Kutai National Park Bukit Soeharto Protected Forest
Sulawesi	Tangkoko Nature Reserve
Irian Jaya	Lorentz National Park Wasur National Park
Java	Gunung Halimun National Park Mount Tepong area Mount Meruba area Mount Malabar area Gunung Arjuno-G Lawu Protected Forest Ujong Kulon National Park
Lombok Island	Mount Rinjani National Park

Information supplied by WWF Indonesia, drawing on GIS data, field reports and press articles. Table first produced in *The Year the World Caught Fire*, by Nigel Dudley, WWF International, Gland, Switzerland 1997.

Current changes in fire frequency occur as a result of increased human creation of fire – for land clearance, vandalism or simply by accident – and also more subtle human induced changes in fire ecology through forestry methods, agricultural practices and ultimately as a result of pollution related climate change[57]. People are the largest cause of fires in many countries, although the proportion and motivation varies; fire is used to improve access and visibility, clear land for farming, reclassify land for development, to gain insurance or as a form of timber speculation[58].

Various forestry practices can create or increase risks of fire including: planting species likely to catch fire; build-up of trash and thinnings; poor planning of fire breaks or having none; draining peatland and negligence or accidents during operations such as prescribed burning. Itinerant charcoal burners for example sometimes fire whole standing trees as a crude charcoal-making technology in the Himalayan regions of India and Nepal, thus risking spread of fire to other areas[59]. Logging operations can also create additional risks, increasing the fuel available through build-up of debris and opening up the canopy creating drier more exposed conditions. Even-aged monocultures lack the "baffling" effect that a natural forest mosaic has to slow forest fires and some commonly planted species are especially liable to catch fire or create more fire prone conditions.

Another important ecological and forest management issue occurs when fire fighting leads to a reduction in the number and size of fires, in areas where it is a regular part of ecology, such as parts of North America, Australia and Scandinavia. Lack of fire changes ecology. This "misuse" of fire *suppression* is an increasingly important issue in protected areas. In fire dominant systems, or in ecosystems where fire plays an important part in the function of the ecology, long-term fire suppression will alter the species mix. Some trees, such as Ponderosa pine (*Pinus ponderosa*) in the southwest USA and chamise (*Adenostema fasciculatum*) in the Californian chaparral[60], rely on fire to maintain their dominance, by killing off less resistant species. They produce litter and standing flammable material supporting frequent fires. If those fires are stopped this may act against certain species and can also create build-up of inflammable material, leading to more serious crown and ground fires that may be virtually impossible for people to put out. Many plants, fungi, insects and other groups rely on fire. Many of the endangered species in boreal Finland are fire dependent. In Canada, fire is sometimes used to stimulate natural regeneration in Lodgepole pine (*Pinus contorta*) forests[61]. All of these issues have direct implications for protected areas.

Deliberate fires, or climate-related fires have impacted on protected areas in many parts of the world, as shown in Table 6.3 that relates to Indonesia and the global survey summarised in Table 6.4. One perspective is that natural fires should be allowed to run free in fire-adapted systems. Yet this creates problems of its own – what are "natural" fires and when should they be allowed to burn? Density of visitor pressure may create additional source of "un-natural" fire ignition; a forest protected area outside Hobart a state capital, in Tasmania, Australia, has suffered three major fires in the last fifty years all through human-induced accidents[62]. A relatively small protected area may not have the physical area to accommodate fire ecology at natural scale. Further fire is potentially dangerous for neighbouring ecosystems, assets and people and leaves an ecosystem that can look unsightly for a long time – a consideration where the protected area also has a strong recreational component. A decision to allow fire to burn in part of the Yellowstone National Park, for example, caused great controversy when it burnt out of control for weeks in 1988 causing the park to be closed, costing millions of dollars to contain until weather put it out and leaving the park blackened. Striking a correct balance between natural fire, protected area objectives, concerns of neighbours, fire-fighting and risks require continual research, thought, consultation and advances in knowledge and attitudes towards land, forests and fires.

Responses: **Project Firefight** – by Peter Moore, Stewart Maginnis, Jean-Paul Jeanrenaud and Bill Jackson[63]

Harmful forest fires can no longer be considered solely the product of a long dry season, human carelessness, or smallholder land preparation. The inability of governments to control such fires questions the assumption that effective control requires only early warning and adequate fire-fighting equipment. Instead, fire-related behaviour of a whole range of stakeholders must be addressed and attention should be focused on policy reform and the removal of perverse economic incentives. WWF and IUCN are running a major programme aimed at securing such policy reform. The primary target groups will be national governments, intergovernmental agencies and the private sector. Secondary target groups include ordinary citizens and local forest-dependent communities. The programme will also develop collaborative partnerships with UNDP, FAO and UNEP. The programme purpose will be achieved through the attainment of the following outputs:

- Enhanced knowledge and skills of key stakeholders concerning fire management and, where necessary, changed attitudes;
- Economic incentives and market mechanisms that improve fire control and forest management and the elimination of perverse incentives that encourage harmful fire-related behaviour.
- Policies and legislation that safeguard forest areas from the harmful effects of fires and a high level political commitment towards their adoption.
- Regularly collated, properly funded and regionally compatible, fire information that informs and shapes national and regional fire management policies and strategies.

The programme will last five years and will develop, support and co-ordinate six regional initiatives in Asia, Central and South America, Sub-Saharan Africa, the Russian Federation and the Mediterranean. A global programme will provide linkages between the components.

Table 6.4: Impacts of fire on selected protected areas in 1997-1999

Country	Protected Area	Details
Australia	Royal National Park (the second oldest in the world) (II, 15,069 ha) Deua National Park (Ib, 82,926 ha)	Fires have affected a number of forest protected areas on the east coast. The last major fires in 1994 saw several large fires around Sydney, evacuations in some suburbs and burning leaves falling in the city centre. In all over 1 million hectares was burned that summer – most of it in protected areas.[64]
Brazil	Serra dos Orgaos National Park (II, 11,000 ha) Ilha Grande State Park (II, 5,600 ha)	Fires have affected many Amazon and Atlantic forest protected areas in the late 1990s. Brazil's National Space Research Institute reported 1,770 wildfires over Mato Grosso and Mato Grosso do Sul in September 1999[65].
Colombia	Los Farallones de Cali Natural National Park (II, 150 ha)	In 1997, 37 fires occurred within protected areas, burning approximately 17,000 hectares of national parks[66]. *Continued…*

Country	Protected Area	Details
Guatemala	Maya biosphere reserve	Two areas of forest in the reserve were burnt in 1998[67].
Iran	Arasbaran Protected Area (V, 72,460 ha)	In late 1998, fires threatened the Arasbarn forests, one of the country's main nature reserves[68].
Kenya	Mount Kenya National Park (II, 71,759 ha)	Many forests were burnt in the Mount Kenya protected area in the late 1990s.
Mexico	Chimalpas National Park	In 1998, serious fires burnt in many areas of Oaxaca state[69]. Some additional protected forests were established as a result of fire damage and future threats.
Nepal	Langtang National Park (II, 171,000 ha)	Natural forest was reported to be burning in different parts of Nepal in mid-March 1998 including the park. Experts estimated that at least 200 ha were affected[70].
Nicaragua	Bosawas Biosphere Reserve	5000 ha were burnt in 1998[71].
Papua New Guinea	Mount Wilhelm Wildlife Protected Area	Fires affected much of the area in September 1997, also threatening rainforest on the peak of Papua New Guinea's highest mountain[72].
Peru	Manú National Park (II, 1,532,806 ha)	In September 1999, a fire destroyed 110 ha of cloud forest in the southeast section of Manú National Park. This was the first fire in the Park for five years. It is suspected that a cigarette butt tossed from a car travelling into the jungle caused the fire[73].
Rwanda	Nyungwe Forest Reserve (IV, 90,000 ha)	In autumn 1997, the reserve in south-western Rwanda was affected by fire, threatening relic cloud forests[74].
Tanzania	Mount Kilamanjaro (IV, 90,000) Ngorogoro Crater (VI, 1,5000,000)	Bush fires affected large areas of Mount Kilamanjaro in 1997, between 2800 and 4000 metres, and again in late 1998 when 70 ha of forest and hundreds of hectares of other vegetation were destroyed[75]. Fires have impacted Ngororo Crater National Park for many years in part because of opposition from local people[76].
Thailand	Khao Yai National Park (II, 216,863 ha)	Large areas of the Khao Yai National Park and 3000 ha of the Huay Kha Khaeng National Park burnt in spring 1998[77], probably due to deliberate burning. The latter burnt again in spring 2000[78].

Transport systems through protected areas

Questions about the impact, desirability and costs of transport systems within or close to protected areas are some of the most contentious relating to the whole question of habitat protection. Conventional environmental wisdom argues that roads or other routes into protected areas encourage damage, through increased tourist pressure or, in less well-managed or more pressured areas, by increased incursion, illegal use and settlement. Dramatic satellite pictures of settlement and accompanying deforestation along roads in the Matto Grosso and Rondônia region of the Brazilian Amazon illustrate the link between roads and forest loss[79]. A Brazilian Space Agency study of 9m

hectares of forest lost in the Amazon from 1991-1996 found that deforestation ranged between 17-33 per cent within 50 km of 3 major road networks[80].

Even the existence of roads *near* protected areas is controversial because of their use to ease invasion or various forms of poaching. Road building within protected areas causes increased recreational pressure and sometimes as a result increased disturbance of wildlife. The importance of maintaining roadless areas has become a conservation issue in, for example, Scandinavia and North America. In October 1999, for example, President Clinton announced steps to protect 40 million acres (16 million hectares) of federally owned roadless forests, in blocks of 5000 acres (approximately 2000 ha) or more, following prolonged lobbying from environmental groups[81].

Clear links exist between road construction and increased environmental damage caused by, for example, poaching. One million tonnes of bushmeat is harvested annually in tropical Africa and wild game hunting in the Congo is three to six times higher in communities adjacent to logging roads, according research carried out by the Wildlife Conservation Society Some of the bushmeat comes directly from protected areas. Similar links exist between roads and illegal logging. For example, in Liberia a road has been built through the Krahn-Bassa National Forest, an area designated as a potential national park and biosphere reserve[82]. In French Guiana, illegal logging, mainly by local people for carvings and to make dugout canoes, is usually only carried out in areas accessible by roads or rivers[83].

Problems are apparently worse when people have no proper land tenure rights, suggesting that disenfranchised and resentful communities on the edge of protected areas are likely to use roads to remove saleable resources. Research by the University of Florida, for example, found that subsistence farmers holding title to land along the Transamazon Highway in the Brazil, are more likely to maintain valuable wood and undertake reforestation activities and are less likely to participate in the timber markets[84].

Road kills can be particularly damaging where National Parks harbour endangered animals. Upgrading the 50 km stretch of the Tanzania-Zambia highway that crosses the Mikumi National Park in Tanzania increased the average road-kill rate to three road kills per day. Vehicles have killed at least 52 species, including the African elephant (*Loxodonta africana)* and African hunting dog (*Lycaon pictus*), and road kills are responsible for 10 per cent of the yearly losses of yellow baboons (*Papio cynocephalus*)[85]. Roads act as conduits for pests and diseases[86] and also increase habitat fragmentation. In New Zealand the introduced Australian possum (*Trichosurus vulpecula*) has migrated along logging tracks into natural forests in protected areas, causing serious damage to native bird populations. Roads have both blocked movement of some native species in Australia and opened up areas to damaging invasive species such as feral domestic cats[87]. Some species of lower plants and invertebrates – and even some small mammals – find it difficult to cross roads so that a road through a protected area may be inadvertently isolating populations, reducing genetic interchange and eventually weakening populations[88]. Roads can also have direct environmental consequences. For example, between 1974 and 1976 in Clearwater National Forest in Idaho, USA, 88 per cent of the over 700 landslides that occurred were connected with road construction, and only three per cent occurred on undisturbed areas of the forest[89].

Roads are not the only issue of concern. A similar range of issues relate to other transport systems, including for example railways (with the Trans-Gabon railway being a particularly important example[90]) and canals within mangroves. Shipping lanes and activity of private boats can have a critical impact on some marine and freshwater protected areas and have for example resulted in damage to mangroves. Table 6.5 contains some examples of protected areas where transport systems have become a controversial issue in the last few years.

***Responses*: Prevention or management?**

Some analysts argue that preventing roads in protected areas can cause more harm than good. Stopping road construction, particularly in areas where local people are living within or near to protected areas, virtually guarantees that they will be economically disadvantaged compared to similar groups in other areas. Indeed the possibility of having a road is often a reason for local communities to support operations such as logging or agricultural development, whatever their other costs. A workshop organised by IUCN in Cameroon in 1999 suggested that opposition to roads by conservationists was likely to alienate many other stakeholders and proposed an integrated approach to roads and development[91]. Staff members at the Dja Reserve argue that lack of roads into the protected area does not seriously inconvenience poachers but makes it more difficult for guards to patrol a large area[92].

Table 6.5: Transport links into protected areas

Country	Protected Area	Issue
Australia	Cradle Mountain National Park (II, 160,883 ha)	Road kills had eliminated the entire local population of 17 Eastern quolls (*Dasyurus viverrinus*) within 17 months of upgrading 3km of road in the protected area[93].
Brazil	Iguaçu National Park, Paraná (II, 170,000 ha)	Existing threats include an illegal 18km road, opened in 1997, through this World Heritage site[94].
Cameroon	Dja Reserve (World Heritage Site) (IV, 526,000 ha)	A European Development Fund project to upgrade a road between Abong Mbang and Lomié in southern Cameroon led to increased logging and poaching, with 27 poaching camps observed within the reserve[95].
Guatemala	Monterico Natural Reserve and Multiple Use Area (III, 2,800 ha)	A local mayor built an illegal canal through a key mangrove habitat on the southern coast, allowing entrance to illegal hunters and loggers and increasing human disturbance within the fragile ecosystem[96].
Philippines	Bicoal National Park	Construction of a national highway and power transmission lines through the national park resulted in an influx of squatters who carried out logging, charcoal making, swidden agriculture and poaching[97].
Russian Federation	Caucasus (Kavkazskiy) State Biosphere Reserve (Ia, 280,335 ha) Altai World Heritage Site	In Kavkazskiy a road is planned along what is currently a long-distance hiking trail to facilitate tourist development, but also potentially increasing illegal hunting and logging. There is currently considerable public opposition to the road[98]. In Altai the government has decided to construct a highway and gas pipeline to China over the Ukok highlands[99].
Spain	Picos de Europa National Park (II, 64,660 ha)	Road construction, road widening and cable car construction together threatens the integrity of Spain's oldest national park[100].
Vietnam	Phong Nha Nature Reserve	A road traverses the site and there are currently plans to upgrade this. It provides ready access to the core area and is used for livestock movement; IUCN has strongly recommended that any new developments be diverted away from the protected area[101].

Chapter 7
Resource extraction in protected areas

Resource extraction is often a less obvious factor in damage to protected areas, as it can take place in many forms without being immediately noticeable to the casual visitor. However, it can be just as important; in extreme cases such as bushmeat and trophy hunting it can result in the disappearance of the species for which the protected area was created in the first place, whilst leaving the overall habitat intact. Resource extraction is divided between that practised by local people or park dwellers and that emerging from outside interests; sometimes the two overlap as in hunting for the commercial bushmeat trade. Local people tend to impact on protected areas through hunting, fishing, fodder and fuelwood collection, water extraction and in forests also by logging. All of these can also have a commercial aspect and most can involve outsiders as well. Larger companies are usually involved in oil and gas extraction, whereas mining can range from the actions of individual itinerant miners to operations by some of the world's largest companies. Salt extraction can also have negative effects on protected areas, for example the impacts of salt works on the El Vizcaino Biosphere Reserve in Mexico[102].

Hunting within protected areas

One of the most easily realisable "assets" contained within many protected areas is those wildlife species that are attractive either directly as a food source and/or as a saleable commodity for their meat, skin, tusks or as live pets or zoo specimens. Protected areas that are established in places where hunting is a traditional way of life are almost inevitably under threat from poaching. When local people are poor, or when the potential value of the wildlife is high, hunting and poaching can become endemic and deeply destructive activities. At worst, protected areas can lose virtually all their large animal species, and in some cultures even small birds, snakes and other reptiles are hunted for food.

Hunting is not of itself necessarily a threat. Traditional bushmeat hunting, undertaken at a sustainable level, can be compatible with protection[103]. Wild game has long been important for rural communities, where for example it forms 70-90 per cent of the protein intake in some parts of Africa[104]. Many protected areas allow limited subsistence hunting within their borders without damaging populations. Problems arise when demand for food exceeds a level that can be sustained by the wild population, particularly if there is a commercial market. Hunting within protected areas falls into a number of categories:

- Hunting for local subsistence: usually for meat and involving either traditional weapons or traps or, increasingly, high powered rifles.

- Hunting to sell meat to local or distant consumers – the bushmeat trade.

- Trophy hunting for furs, skins, tusks or antlers and for sale of body parts as ornaments, clothing or for carving (in the case of ivory).

- Medicinal hunting for body parts known or believed to have medicinal properties, such as the hunting of elephant and rhinoceros for powdered horn, and more recently an increase in hunting of bears for their gall bladders[105], both for use in traditional Chinese medicine.

- Sport hunting for trophies or food.

- Hunting for cultural reasons or to protect livestock in land around protected areas; for example the wolverine is still poached from protected areas in Norway to protect farm livestock from attack[106].

- Live trapping for the pet and zoo market, including of raptors for hunting.

Ivory poaching in Africa's national parks: The extremely large sums of money available for ivory in China and other Asian countries resulted in a dramatic increase in poaching and consequent crash in populations of elephants and rhinoceros from the 1970s onwards. Highly organised gangs of poachers operated across national borders in much of sub-Saharan Africa, often deliberately targeting protected areas because there were high concentrations of animals and in some cases little real protection. The poachers used sophisticated automatic weapons that allowed them to target entire herds, wounding many animals that were not killed outright. This access to high-powered weapons also made the task of controlling poaching more difficult and many wardens were killed during this period.

At the peak of poaching, elephant and rhinoceros numbers declined precipitously. Researchers estimate that up to 70 elephants were being killed every day at some periods in the 1980s in Tanzania. Uganda also lost 95 per cent of its population between 1960 and 1989, Sudan lost 84 per cent of its population in the 1980s and there were similar declines in Somalia and Ethiopia[107].

Following a decade of rhino poaching that largely destroyed populations in Kenya and other East African countries, the poaching wave hit Zimbabwe in 1984. In the next decade, poachers in Zimbabwe killed over a thousand black rhino (*Diceros bicornis*), with 140 animals being killed in 1991 alone. Poaching took place mainly within protected areas, initially by Zambian gangs although an indigenous poaching culture has since developed[108]. The rhino population in Zimbabwe has declined from 3000 in 1980 to an estimated 339 in 1996[109]. Although there have been efforts to control the trade, including a listing of elephant and rhino tusks in CITES, essentially making trade unlawful, the latest reports from wildlife experts are of an upsurge in hunting again[110].

The problem is not confined to Africa. Hunting takes place throughout the world and is often combined with the hunt for highly lucrative traditional recipes; for example consumption of large carnivores has long been associated with increasing male potency. Tigers (*Panthera tigris*) are being rapidly destroyed in some of the traditional "Tiger Reserves" of India, leading to fears for their long-term survival[111]. "Tiger penis soup" is said to sell in some Asian countries for several hundred dollars[112]. Hunters throughout Asia have also frequently targeted elephants, snow leopards (*Panthera unicia*) rhinoceros and bears. Tiger poaching has become important in parts of the Russian Far East, including inside protected areas.

The bushmeat trade: Hunting for meat is also extremely important. Domestic demand for bushmeat (a collective name for any kind of wild meat) has risen dramatically in Africa. Although it is a traditional form of protein for rural communities, the current boom has largely been the result of demands from a rapidly growing urban middle class prepared to pay high prices for choice meats. Huge numbers of monkeys, apes, antelope, elephants and even lizards and snakes are caught and killed every year, despite much of the trade officially being illegal. Much of the hunting takes place within existing protected areas. Hunting methods are often cruel including both trapping and shooting. Some species, such as the pangolin (*Manis* spp.), are often sold live, adding a welfare issue to conservation concerns. Bushmeat hunting consistently emerges as the greatest perceived threat to protected areas amongst conservationists working in Africa[113].

The bushmeat trade has until recently been an almost "hidden" problem, scarcely addressed by the international environmental community. A recent report by the Ape Alliance[114] has done much to rectify this. It outlined a list of problems posed by the trade including threats of extinction amongst the most endangered species, such as great apes and the giant pangolin (*Manis gigantea*), and the destruction of subsistence-based indigenous human communities living in the forest. Although the timber trade has been responsible for increasing the bushmeat trade, because it has opened up easy routes to urban centres, the commercial bushmeat hunting "frontier" is now travelling through or approaching many of the region's prime protected areas.

Poaching was also reported as the commonest threat to protected areas in national parks studied in Latin America by The Nature Conservancy, affecting 70 per cent of the protected areas studied[115]. Some protected areas in Asia are also virtually devoid of wildlife as a result of hunting pressure. Poaching also takes place within Europe, although this is likely to be for domestic consumption rather than trade; for example poaching was noted as posing threats to protected areas in Bulgaria in the early 1990s[116].

Sport hunting impacts on protected areas: Trophy hunting by sports shooters also impacts on mammals in protected areas. An investigation carried out by the British Broadcasting Corporation in 1997 found that a multi-million pound clandestine trophy hunting business exists serving hunters from Europe and America who are prepared to pay up to £100,000 to hunt rare animals, some of which are stolen from protected areas, particularly in Africa. The animals are often drugged and shot in enclosed areas in what has become known as "canned hunts". South Africa is the country worst hit by illegal game hunting with for example lions being regularly stolen from the Kruger National Park[117]. As a result of the television programme, South African investigators examined over 130 cases and raids took place on hunting organisations, where documentary evidence of canned hunts was uncovered.

Broader issues: Poaching pressure often increases in times of emergency – war, civil strife and environmental disaster. For example, in September 1998 exceptional flooding drove animals out of the Kaziranga National Park in the Indian State of Assam. According to field observations by the London-based Environmental Investigation Agency, the flooding allowed poachers to kill hundreds of animals including at least seven rhinos[118].

Smaller scale poaching is also important if it impacts on endangered species. Collection of marine turtle eggs has destroyed populations in many parts of the world and hunters are seldom deterred by the presence of protected areas. Adult turtles are also killed for their meat. Poaching from marine and coastal protected areas is extremely difficult to control without the constant presence of guards and turtle eggs are sold openly in markets in towns near marine protected areas in many countries[119]. Hunting of songbirds for food is causing serious problems to migratory species in Europe and is a particular problem in Malta, with the highest density of hunters in the continent and many instances of hunting within protected areas[120].

Responses: **bans on trade and sustainable hunting levels**

The problems presented by hunting in protected areas are extremely difficult to address, at least in the short term. Simply banning hunting is difficult, when it both cuts across traditional cultures and is the only viable method for local people to make money. Outright bans on trade in products have helped to some extent and conservationists now express cautious optimism about the future of some elephant and rhinoceros populations in Africa, albeit at much lower numbers than in the past[121]. The question of whether bans should be permanent is the subject of heated debate; some argue that for example trade in ivory should be allowed from countries with sustainable management programmes[122]. On the other hand, domestic markets are by their nature more difficult to control, making bushmeat trade a more intractable challenge. Encouragement of sustainable hunting methods is possible in theory, but difficult so long as there is both high value goods and a lack of understanding about population dynamics and the implications of over-hunting.

Hunting affects so many protected areas that a full list would be beyond the scope of a general report of this type. Table 7.1 below therefore selects illustrative examples, to show both the seriousness and the wide geographical scope of the problem.

Table 7.1: Impacts of hunting/poaching on protected areas in selected countries

Country	Protected area	Details
Armenia	Lake Sevan National Park (II, 150,000 ha)	Lake Sevan is famous for its endemic fish species *Salmo ischchan*, now at the edge of extinction due to worsening habitat conditions and severe poaching[123].
China	Several	Pandas (*Ailuropoda melanoleuca*) continue to be taken from protected areas. In November 1999 Tang Xianlin was sentenced to 20 years in prison for selling panda skins[124].
China	Jiangxi Poyang Lake National Nature Reserve	Poachers hunt bird species, generally using small pellets of agricultural pesticides. The reserve is the wintering ground of several endangered species, in particular 98% of the population of the Siberian Crane (*Grus leucogeranus*). Use of poison could also affect predators and human health[125].
Cameroon	Korup National Park, (II, 125,900 ha) Dja Faunal Reserve (IV, 526,000 ha) Lobéké (proposed)	Most large animals in Korup are at a low density due to hunting. Lobeke is a new centre for trade[126]. Officials in Dja, a World Heritage site, estimate that several tonnes of bushmeat leave each month[127]. Bushmeat, including the rare giant pangolin, was openly on sale in Yaoundé in 1999 despite a presidential crackdown[128]. Bushmeat trade affects virtually all protected areas in Cameroon and some have already lost key species[129].
Central African Republic	Ozdala National Park	Hunting of elephants for meat in Ozdala has been practised for some time. It was at least partially controlled by guards before the war but has now resumed[130].
Democratic Republic of Congo	Kahuzi-Biega National Park (II, 600,000 ha) Okapi Game Reserve	Poaching of elephant and buffalo has resulted in extermination from some areas of Kahuzi-Biega. 1500 animal carcasses were recorded from two villages over 18 months[131]. Up to half the gorilla population in the original park sector has been killed[132]. Hunting of bushmeat in Okapi exceeds reproduction rate[133].
Gabon	Minkebe	Bushmeat trade is reported to be likely in the near future, because the "poaching frontier" is approaching the northern end of the park[134].
Gabon	Moukalba M'Passa reserve (IV, 80,000 ha)	Poaching has been responsible for a drastic reduction in animals[135].
Honduras	Rio Platano Biosphere Reserve	Commercial poaching is a threat within the protected area[136].
India	Corbett National Park (II, 52,082 ha)	In December 1997, three tigers were poisoned in Corbett National Park[137], despite this being one of the best-staffed reserves in the country.
Indonesia	Komodo National Park (II, 173,500 ha)	The principal management problem is poaching and depletion of Komodo monitor (*Varanus komodoensis*) prey stocks, such as rusa deer and wild boar[138].
Jamaica	Blue Mountain Forest Reserve (VI, 41,940 ha)	Hunting is reported to be largely uncontrolled in this protected area[139].
Mauritius	Coin de Mire (Gunner's Coin) Nature Reserve	Poaching has reduced the native seabird population[140].

Continued….

Country	Protected area	Details
Niger	Air et Ténéré Natural Reserve (IV, 7,736,000 ha)	Threats include over-use of flora in some valleys by local people, poaching and international trade in live animals and their by-products[141].
Russian Federation	Caucasus (Kavkazskiy) state biosphere reserve (Ia, 280,335 ha)	Illegal hunting by people from Abkhzaia is reported, including gunfights with protected area staff and people killed[142].
Spain	Cabañeros National Park	Two vultures were poisoned in 1999 with poisoned bait used near the park[143]
Vietnam	Cuc Phuong National Park (II, 22,500 ha)	Hunting has reduced populations of large mammals and conflicts with local human populations hamper effective management[144]. In 1996-1997 police detected 1270 cases of illegal trade involving 69,000 animals[145]. Endangered species are often openly on sale[146].

Wildlife trade in protected areas

In addition to the larger animals discussed above, "poaching" can encompass anything from wild plants to invertebrates. For example, the rare slipper orchid, *Paphiopedilium rothschildianum*, known only from Mount Kinabulu National Park in Malaysia, has been stolen and offered for sale in the USA, where individual plants were valued at $5000 each in the 1980s. The pitcher plant *Nepenthes rajah* has also been extensively stolen from the same reserve[147]. The Tubbataha Reefs National Marine Park in the Philippines was threatened in the early 1990s by an illegal seaweed farm. Due to the efforts of local politicians and actions by the coastguard, this development was eventually closed[148]. And in Thailand, amongst the many threats facing Khao Yai National Park is poaching of butterflies and other insects from the protected area that are sold to collectors in Europe, as part of a regular trade[149].

Fishing in protected areas

Fishing activities are similarly critical in many marine and some freshwater protected areas. Although small-scale artisanal fisheries can be problematic, many marine protected areas are established specifically to help preserve these by establishing nursery areas and thus maintaining supplies[150]. Such no-fishing zones are generally established in co-operation with local residents. In these cases, small-scale fishing in the surrounding area, or within the reserve under agreed conditions, pose few problems.

However, many aquatic protected areas face problems of over-fishing caused by incursion from neighbouring communities or by the illegal presence of larger scale operations. Illegal operations are likely to be particularly damaging because they are carried our hurriedly and surreptitiously by people with no long-term interest in the maintenance of the supply. Particular problems include damage to coral reefs from trawling nets, damage to other aquatic life through use of explosive to stun fish and poisons (for example pesticides are sometimes used), and the abandonment of unwanted species. Nets can also damage marine mammals and birds within protected areas. Some examples are given in table 7.2 below.

***Responses*: Local people mount anti-poaching action in a Thai marine reserve**

The local seas around Thailand have traditionally been amongst the most productive in the world, but these are currently under intense pressure as a result of commercial fishing. In Phang Nga province, local fishing communities have been working with NGOs to protect the resources of the Phang Nga Marine National Park, where only small-scale fishing is allowed. The marine protected area is important both for its wildlife values and because it helps to maintain fish populations. Workers organisations patrol the borders to try to prevent illegal incursions; at least one local fisherman has been shot and killed by those involved in illegal fishing. Fishing communities have also lobbied successfully on a political level to increase levels of protection for the area[151].

Table 7.2: Impacts of over-fishing on selected marine and freshwater protected areas

Country	Protected Area	Details
Australia	The Great Barrier Reef (VI, 33,480,000 ha)	Large-scale prawn trawling – both licensed and illegal – has halved populations of some species; for every tonne of prawns caught 6-10 tonnes of other marine life is killed[152]. The government's research body, CSIRO, has identified 50 illegal operators in the 140,000 square mile area[153]
Brazil	Mamirauá Sustainable Development Reserve (Ia 1,124,000 ha)	The reserve and local people are facing threats from large-scale commercial fishing, which is damaging populations of, amongst others, manatees (*Trichechus inunguis*) and black caiman (*Melanosuchus niger*)[154].
China	Yancheng Nature Reserve in Jiangsu	Fishing, collection of shellfish and conversion for shrimp and fish farming are all taking place[155].
Ecuador	Galápagos National Park (II, 761,844 ha[156])	Offshore fishing and illegal inshore fishing has increased rapidly, with numbers of fishermen tripling in a few years and frequent clashes occurring with park guards over quotas[157]. Incidences include purse-seine tuna fishing within 500 metres of shore and confiscation of sea cucumbers: 273,8000 in 1996 and 80,000 in 1997[158].
Kenya	Diani Chale/ Kisite/Mpunguti Marine National Park and Reserve (II, 3,900 ha)	Fishing activities are reported to be a problem in Diani Chale and are the result of conflict between artisanal fishermen, the tourist industry and Kenya Wildlife Service. The government recently altered the boundary of the Kisite/Mpunguti Park by allowing more access to fishing[159].
Mauritania	Banc d'Arguin National Park (II, 1,173,000 ha)	Threatened by encroachment by industrial trawlers and intrusion of Senegalese fishermen who practice small-scale fishing and set up temporary squatter settlements[160].
Philippines	Tubbataha National Marine Park	Extensive damage to coral due to use of explosives to stun fish. Use of sodium cyanide poison to capture ornamental fish for the aquarium trade has also damaged coral reefs[161].
Tanzania	Bongoyo Marine Reserve and others reserves around Dar es Salaam	The reserves have in the past been badly damaged by over-fishing including use of dynamite[162] although this has been much reduced following a government clampdown[163].
Vietnam	Cat Tien National Park	A French company was granted a concession to build 50 ha of fishponds in the reserve in 1997, destroying forage and display areas for the green peafowl (*Pavo muticus*)[164].

Fuelwood collection

Fuelwood is the primary energy source for almost half the world's population, including over 2 billion people in the developing countries. It supplies around 15 per cent of global energy needs, but in many of the poorest countries over 90 per cent of domestic energy comes from wood [165]. Managed properly, fuelwood production has the potential to be a sustainable part of the forest cycle and to provide a renewable alternative to fossil fuels. However, at present collection often contributes to forest degradation and is also as a cause of net deforestation around cities where fuelwood is sold in, for example, parts of Africa[166] and Central America[167]. Its contribution to global deforestation has nevertheless often been exaggerated and it is generally far less responsible than for example clearance for agriculture[168]. In most developing countries, women gather fuelwood and fodder and easy access to fuelwood is therefore also a key element in improving women's welfare[169]. The impact of fuelwood collection on wildlife has been the subject of debate[170].

Fuelwood often continues to be collected from protected areas, either legally through agreements with managers or illegally through incursion and poaching. Low-level collection for domestic use by surrounding communities probably has little long-term impact on the habitat, except if particular types of wood are targeted over time (for example if all dead wood is collected thus removing an important microhabitat). Fuelwood collection becomes more important in several circumstances.

- If it becomes subject to significant trade, as has occurred in parts of Central America. Fuelwood collection is now responsible the majority of timber extractions in parts of the region[171] and significant trade also takes place in parts of Africa and Asia.

- If fuel is collected in protected areas near major urban areas where demand outstrips supply as has occurred in some of the protected areas in the Srinigar region of Kashmir, India[172]. Net losses are even greater if wood is converted into charcoal, which is cleaner and more efficient to transport and burn but takes greater quantities of wood to create. Charcoal burning takes place within many protected areas in the Himalayan region of Himachel Pradesh, India, for example[173].

- In local situations where fuelwood is collected for particular uses, for example connected with tourism, as has occurred in parts of Nepal popular for trekking (see case study)[174].

- In conditions of social crisis where mass movements of people occur, such as after the Rwandan war where refugee camps were set up next to protected areas[175].

- In conditions of economic crisis where large proportions of the population revert to fuelwood either because alternative supplies are unavailable or too expensive. Local damage to forests in protected areas took place during the collapse of the former Soviet Union in, for example, Romania[176] and Georgia[177] as a result of an abrupt downturn in the economy.

Eliminating fuelwood collection from protected areas will be extremely difficult and probably neither necessary nor, from the perspective of human rights and equity, desirable. However, controlling large-scale illegal trade and managing fuelwood collection so that it does not seriously damage ecology are both important elements in improving protected area management.

Fuelwood collection takes place in virtually any protected area where people living inside or nearby burn wood fuel. Table 7.3 below lists a few examples of where this is causing serious problems.

Table 7.3: Examples of fuelwood collection in protected areas

Country	Protected area	Details
Democratic Republic of Congo	Parc National des Virungas (II, 780,000 ha)	A mass exodus of Rwandan people in 1994 led to settlement of 700,000 refugees in camps on the protected area borders leading to deforestation of at least 150 km[2178].
El Salvador	Several	The fuel wood trade in El Salvador, centred on the capital of San Salvador, threatens national parks and mangrove forests along the Pacific coast[179].
Peru	Huascarán National Park (II, 340,000 ha)	*Polylepis* trees are cut for firewood in the park, and this also harms bromeliads such as *Puya raimondi*[180].
Solomon Islands	Queen Elizabeth II National Park	The area suffered from illegal firewood collection and other incursions since its establishment in 1954[181].
Thailand	Phu Hin Rong Kla National Park (II, 30,700 ha)	One of many protected areas experiencing domestic fuelwood collection and small-scale commercial charcoal production on the edges of the forest protected area[182].
Vietnam	Ba Vi National Park (II, 7,377 ha)	Commercial fuelwood collection is reported to be putting stress on the forests in parts of the protected area[183].
UK	Forest of Dean	Retaining dead timber habitat in the reserves is difficult because local people collect dead timber for firewood[184].

Logging and the timber trade

Illegal or semi-legal felling of timber – for local use, local sale or for export in the international timber trade – is a growing problem that threatens many natural forests, including protected areas. Research by IUCN and WWF has identified evidence of illegal logging and trade in over 70 countries around the world[185]. Around 65 per cent of WWF's *Global 200* forest ecoregions are threatened by illegal logging and this is also identified as a key problem in many of IUCN's *Centres of Plant Diversity*. Most illegal logging targets a few valuable species, although larger scale operations sometimes take place in protected areas where management is either very poorly implemented or where the reserve is weakly protected by law. By opening up forests, the illegal timber trade often results in roads or other access routes being built and thus also increases associated activities such as illegal mining, bushmeat hunting and settlement.

It is important to distinguish between small-scale illegal logging – for example to collect firewood – and large-scale illegality associated with commercial sale and trade. In trade, although the agents that carry out illegal activity are frequently local people, they are usually commissioned by or selling to agents and companies. Today, most large companies are careful to avoid overtly trespassing in protected areas, although they sometimes purchase timber illegally extracted from protected areas, for example in the Brazilian Amazon[186]. Large-scale cross border trade in timber logged from protected areas occurs in a number of countries, including Brazil, Cambodia, Vietnam and Liberia. Illegal logging is mentioned as a problem in virtually all tropical reserves near to roads and is increasingly taking place in temperate countries as well. Indeed, protected areas may be particularly at risk from illegal logging. In many areas the most attractive forests, from the perspective of an illegal timber harvest, are forest reserves, indigenous territories or protected areas. These areas have no large-scale industries or government departments with a commercial interest in their protection and are often less well guarded than other areas. *Many illegal logging operations are therefore deliberately targeting the very forests that have been preserved for social and/or biological reasons*. Table 7.4 lists some examples of protected areas threatened by illegal logging.

Table 7.4: Protected areas threatened by illegal logging

Country	Issues
Asia and the Pacific	
Cambodia	Civil war has resulted in massive illegal logging during the 1990s[187]. Senior government figures have been involved[188]. The IMF suspended a US$20 million loan as a result[189]. In 1998, five government groups were reportedly working with former Khmer Rouge guerrillas in logging Bokor National Park south of Phnom Penh[190]. The government claimed that it was unable to prevent soldiers from logging the Bokor and Kiri Rom National Parks[191].
Fiji	The J H Garrick Memorial Reserve has suffered from illegal logging operations due to a lack of active management presence[192].
Indonesia	The Asian Development Bank has reported logging in protected areas[193]. Since 1989, the government has fined companies several million dollars[194]; however many fines were apparently never paid. Even if timber is confiscated it is often stolen and re-sold; in February 1997 it was reported that timber confiscated following thefts from Kutai National Park in Kalimantan had been sold[195]. Illegal logging was reported along the eastern border of the Lorentz National Park in Irian Jaya[196].
Thailand	Large-scale logging has taken place within national parks and protected areas, such as Salween National Park[197]. Introduction of a logging ban in 1989 drove the trade underground, with timber being exported and re-imported with false papers[198]. In 1998, a Thai government report named 42 interior, military, customs, police and forestry officials after 13,000 logs were logged in the Salween National Park[199] and at least 8 of these were later dismissed[200].
Vietnam	Illegal logging takes place in many protected areas. In 1997 the *Voice of Vietnam* radio station reported that since 1995, 9 people have been killed and 170 injured in attacks linked to illegal logging and that the 8,300 forest guards each deal with an average of ten cases a year. Illegal logging is a problem in Cat Tien Biosphere Reserve and the Cuc Phuong National Park[201] and is reported near Phong Na Cave National Park[202].
Africa	
Burundi	Logging and cutting of bamboo are listed as major problems for Kibira National Park[203]
Cameroon	Illegal logging is widespread in protected areas; for example timber poaching is well organised in the Mount Cameroon region, for species such as *Aningeria robusta* and *Milicia excelsa*[204].
DR Congo	Illegal felling has been reported in the past from Salonga National Park[205] and Upemba National Park[206]. The war is likely to have increased extraction.
Kenya	Illegal logging occurs in many protected areas. For example the whole of the Mount Kenya National Park has been selectively logged[207] and there is also illegal charcoal burning[208]. 200 illegal pits of pit sawyers were counted in an aerial survey of Shimba Hills National Reserve in 1997 and roads had been cut into the heart of the protected area[209].
Liberia	Illegal logging has a long history[210]. During the civil war, it helped finance warring factions. Exports leave from the ports of Buchanan, Harper and Greenville and overland to Côte d'Ivoire.
Morocco	Illegal timber and wood extraction is reported in Toubkal National Park[211].
Nigeria	The Cross River National Park is threatened with logging by WEMCO, a Hong Kong-based company. Although officially operating in the buffer zone, WEMCO has built a new pulp mill that will require more timber than can be supplied by the concession area. The company has already faced criticism for illegal logging elsewhere in Nigeria[212].

Continued…

Country	Issues
Rwanda	There are many reports of illegal logging in refugee camps following the civil war[213]. Small-scale illegal commercial logging was reported in the Nyungwe Forest before the war[214].
Tanzania	In the Rondo Forest Reserve, a limited amount of illegal logging takes place, mainly for building poles[215]. Illegal logging has also taken place in protected areas above Morogoro[216].
Tunisia	Illegal felling occurs, mainly by local people for subsistence purposes, including extraction within national parks in the north of the country[217].
Latin America	
Belize	In 1997 Atlantic Industries, a Malaysian timber company was logging in Maya reservations. Thirty-nine villages and two protected areas were affected, and in one case the government revoked the protected status of the Maya Natural Resource Reservations to grant access[218].
Brazil	A 1997 government report found almost 80% of timber harvested in the Amazon was being taken illegally, often from protected areas and indigenous reserves[219]. Illegal logging also damages Atlantic forest reserves [220]. In 1998, two tribal chieftains apparently sold mahogany from an Amazon reserve[221].
Ecuador	Illegal logging is a serious problem in parts of the country. Logging occurs in protected areas, such as the Cotacahi-Cayapas Reserve, the Machalilla National Park and the Cuyabeno Reserve[222].
Guatemala	Park staff members at Laguna Lachua National Park were barricaded in their office and a warden was beaten up in March 1999, after local people had been arrested for illegal logging of mahogany within the reserve area[223].
Honduras	In southern and western zones of the Rio Platano biosphere reserve illegal logging targets precious woods such as mahogany species *Swietenia macrophyla*, *Liquidambar styraciflua* and palm *Roystonea donlapiana*[224].
Europe	
Estonia	Illegal logging is identified as a cause of loss of biodiversity values in some protected areas[225].
Hungary	Bükk National Park is threatened by illegal logging[226].
Lithuania	"Forest theft" is noted as a significant problem particularly in managed reserves, due to low living stadards and high levels of unemployment in rural areas[227].
Italy	Stelvio National Park is affected by illegal logging[228]

Legal and semi legal logging in protected areas: In some cases, governments also allow logging in protected areas, sometimes as a matter of course (e.g. in many Russian protected areas). In many category V landscape reserves, management of secondary forest is an important land-use, as it is in many of Europe's national parks. This means that many "protected areas" are not actually attaining the kind of old-growth characteristics that are essential for some species.

However extraction is also sometimes allowed in more strictly protected areas because of a variety of "special conditions", usually linked to control of tree diseases or fire. Some of these appear to be little more than flimsy excuses for logging. Data from the World Resources Institute's Global Forest Watch programme, for example, shows that logging concessions exist in many of Gabon's national parks[229].

Some examples of government-endorsed logging in protected areas are given in Table 7.5.

Table 7.5: Examples of government-approved logging in protected areas

Country	Protected area	Details
Bangladesh	Chakaria Sundarbans Forest Reserve (IV)	Mangroves have been severely logged[230].
Canada	Wood Buffalo National Park (II, 4,480,200 ha)	Clear-cut logging has been permitted in a portion of the park since the 1950s[231].
Czech Republic	Sumava National Park (II, 68,520)	Damage by bark beetle is being cited as the reason for logging in the 69,000 ha park, the largest park in the Czech Republic[232].
Gabon	All protected areas	Logging activities are granted within all protected areas and logging activities have affected sites in varying proportions[233].
Poland/Belarus	Bialowieza (II, 4,781 ha) Belowezskaya National Parks (II, 71,490 ha)	Forestry takes place in national parks, except in core areas[234]. There are fears that the recent FSC certification of the surrounding National Forest could prevent a proposed enlargement of the Park from 105 to 600km^2 as this indicates that the government plans to continue timber use from the forest[235].

***Responses*: Defending the definition of protected areas**

Several governments have argued that large-scale forest management – including clearcutting – can be carried out without problems in areas dedicated to nature conservation. The World Commission on Protected Areas published a considered response to these proposals in December 1998, from which the following is extracted[236]:

There have recently been attempts to argue that land within IUCN category V and VI protected areas can be used for large-scale industrial activities. This is a serious misunderstanding of the concept of protected areas. All categories of protected areas are intended to be permanent designations that provide long-term protection to biodiversity and other values. The use of such categories, which envisage a degree of human presence and sustainable resource use, does not mean abandoning protection in these areas.

To clarify the situation: WCPA believes that large-scale commercial activities such as clearcutting, plantation establishment and other forms of industrial management, unrestrained tourism and other major infrastructure projects are not compatible with any protected area designations.

Unfortunately, in the case of many governments there are few signs that such practices are actually being abandoned.

***Mining in protected areas*[1]**

The possibility that protected areas might be opened up to mining operations is one of the most visible and at the same time most controversial of the threats examined in this report. Visible because mining *is* highly visible, usually leaving scars across the landscape that can easily be detected in aerial photographs or by even the most casual visits to the site. And controversial because mining, with its dependence on supplies of valuable materials and its possibility of high profits, is a key indicator of how far governments and others are really prepared to go in protecting areas. Mining is also often the first impact on pristine sites and can therefore be responsible for major changes to ecology through its direct impacts, various forms of pollution and its role in promoting unplanned and uncontrolled development.

Large-scale mining is a capital-intensive, high-risk process that includes exploration, extraction, processing, decommissioning and site restoration, trading and recycling. Only a tiny proportion of possible sites actually contain valuable ores, so that when good sites are discovered there is always a strong pressure for them to be exploited, even if they are found within a protected area. Currently, there is a combined trend to exploit lower grade ores and to extract metals from open pits rather than from underground mines, both of which add to the ecological impacts of mining. Currently two thirds of the world's solid mineral production comes from surface mines.

Although a few large companies increasingly control the bulk of mining, governments and small-scale miners both also remain key players in the industry. There are about 6 million small-scale gold miners and other miners extracting diamonds and other gems, together producing about a quarter of developing countries' gold, diamonds and gems. Companies are increasingly acting in consortia and 19 out of the top 25 mining companies are based in industrialised countries. Canadian, Australian and US companies have the greatest share in investments in mining exploration. The military are major users of metal products and have also been used to provide support for mining interests in some countries.

A report for IUCN and WWF suggests that because mining is often the first development in an otherwise pristine area, it is likely to be particularly damaging[237]. On the other hand, research from the Center for International Forestry Research and the Centre for Development Research suggests that a booming mining sector can actually reduce the rate of forest loss in developing countries by stimulating economic development[238].

From our particular perspective in this report, mining is important if it occurs both within and adjacent to protected areas. Recent events have shown that many governments, in both the developed and the developing world, think that mining is somehow exempt from the type of planning regulations usually in place within protected areas. There is furthermore a perception that mining activities can somehow be controlled so that they can be carried out near or even inside protected areas without adversely affecting the protected area values. This view appears to be based more on hope than on evidence. Issues of mining in protected areas have been addressed by a number of institutions and for example at a workshop held in Tanzania in 1994[239]. Recent attempts by the World Commission on Protected Areas to agree a code of practice for mining in protected areas have created strong opposition from some governments.

Environmental impacts: the mining industry has direct and indirect environmental and social impacts at each stage of the mining process.

[1] Much of the research in this section draws on a previous IUCN/WWF report: *Metals from the Forest* by Andréa Finger, published in 1999. However, this earlier report focused solely on impacts in forests; the current text takes a broader perspective.

The trends towards open pit mining and low-grade ores has increased tailings or waste products including crushed rock, cyanide (in gold and silver mines), radioactive waste (in uranium mines), sulphuric acid, and heavy metals. The extraction of 1 tonne of copper, for example, generates between 1-3 million tonnes of waste. The US Environmental Protection Agency estimates that 40 per cent of mining waste may be toxic. The Mineral Policy Centre in Australia has compiled 66 cases world wide of waste impoundment systems that have failed. In April 1998, a tailings dam burst at the Los Frailes mine in Spain, spilling 5 million m^3 of toxic waste into rivers near the Doñana World Heritage Site. Flooding affected 5000-7000 hectares of farmland and marsh, destroying bird habitats and killing 26 tonnes of fish (see case study on page 203). Tailings from illegal gold mines are poisoning the River Kuapas in Kalimantan[240] and have caused extensive pollution in the Amazon region[241].

Mining and processing use large amounts of water and acid mine drainage can occur when acid water leaks from mines; an estimated 7500 km of streams and 90,000 ha of lakes and reservoirs have been contaminated in this way in the USA. “In situ leaching” uses cyanide – a potentially deadly poison – to extract gold and silver from low-grade ores. There have been reported cases of human cyanide poisoning coinciding with mining incidents including a 1995 dam burst in Guyana and a cyanide spill in Kyrgyzstan in 1998. Thousands of waterfowl died from cyanide poisoning near a Nevada mine[242].

The mining cycle is the main source of heavy metal pollution, including arsenic, lead, mercury, and cadmium. The UN Industrial Development Organisation has estimated that 1000-2000 tonnes of mercury have been released into the Amazon, largely as a result of the activities of small-scale miners, often operating illegally[243]. This has been identified as a likely future threat in the Manu biosphere reserve in Peru[244]. Smelting and processing are energy intensive processes that use large amounts of energy and frequently result in pollution from sulphur and nitrogen oxides.

Mining also directly impacts on fragile ecosystems. According to the World Resources Institute mining, roads and infrastructure threatens 38 per cent of forest frontiers, the world’s last remaining large intact forests[245]. Hotspots include the Congo Basin, the Amazon, the Russian Far East and Indonesia. Spillage from mines is a major threat to many freshwater and coastal marine ecosystems.

Many protected areas are threatened by mining. Illegal miners operate in reserves, boundaries are moved, and laws are rewritten to open access for mining. In Ecuador a new law threatens to open *all* protected areas to mining. It promotes mining as a national priority, overturns municipal laws controlling mining interests, favours mining over other property rights, eliminates royalties and allows a single concession approval process for exploration, exploitation and processing[246].

***Responses*: Controlling mining impacts in protected areas**

The World Commission on Protected Areas has developed a position statement on mining in protected areas. “Exploration and extraction of mineral resources are incompatible with the purposes of protected areas corresponding to IUCN Protected Area Categories I to IV, and should therefore be prohibited by law or other effective means. In Categories V and VI, minimal and localised extraction is acceptable only where this is compatible with the objectives of the protected area and then only after the assessment of environmental impacts and subject to strict operating and after use conditions”.

To highlight threats to protected areas, we have drawn on the UNESCO World Heritage list to identify a number of outstanding protected areas impacted or likely to be impacted by mining in Table 7.6.

Table 7.6: Impacts of mining in some World Heritage protected areas

Country	Name	Details
Canada	Jasper National Park (II, 1,087,800)	Potential threats posed by the Cheviot Mine Project, located 2.8 km from the park. To provide an extra buffer zone, the Whitehorse Wildland Park has been created between the proposed national park and mine[247].
Democratic Republic of Congo	Okapi Faunal Reserve (II, 1,372,625 ha)	Ituri forest of Haut-Zaire region with 15 per cent endemism, threatened by small scale and illegal gold mining[248].
Guinea and Côte d'Ivoire	Mount Nimba Strict Nature Reserve, (Ia, 13,000 ha)	A consortium of mining companies has persuaded UNESCO to redraw the boundaries of the WHS to allow mining, despite protests from IUCN[249].
Indonesia	Lorentz National Park (II, 2,505,000 ha)	Largest tract of protected tropical rainforest in Asia and the Pacific and most floristically rich zone of New Guinea, with more than 80 genera and 1200 species of trees. The park is threatened by the expansion of the neighbouring Grasberg-Ertsberg mine[250].
Madagascar	Ankarana Special Reserve (IV, 18,220 ha)	Heavily damaged in the recent past by sapphire mining. In 1999, miners invaded two other protected areas – Isalo National Park and Zombitse-Vohibasia National Park – although negotiation with WWF officials has apparently reduced the immediate threat[251].
Peru	Huascarán National Park (II, 340,000 ha)	It is proposed to develop large copper and zinc deposits 20 km from the WHS; an access road was to cross the park but an alternative is proposed. The park contains humid mountain forests in the valley – *Puya raimondi* (bromeliad) and relict forests of *Polylepis* spp and *Gynoxys* spp.
Russian Federation	Kamchatka Volcanoes and Bystrinsky Nature Park, (1,250,000 ha)	Pacific salmon spawning rivers, coniferous forests dominated by larch (*Larix kamchatskchatica*), spruce (*Pinus ajanensis*) and stone birch. Possible development of gold mines[252].
Russian Federation	Virgin Komi Forests (3,280,000 ha)	The only place in Europe where the Siberian pine (*Pinus sibirica*) occurs. Gold mining is proposed.
Sierra Leone	Loma Mountains and Gola Forest Reserves (VI, 33,201 ha)	Diamond mining is causing damage throughout the protected areas[253].
Thailand	Thungyai – Huai Kha Khaeng Wildlife Sanctuary (IV, 577,464 ha)	The largest protected area in mainland Southeast Asia including tropical dry forest and one of the last lowland riverine forests in Thailand. Lead and antimony mining take place adjacent to the park.
USA	Yellowstone National Park (II, 898,349 ha)	80% of the park is forested mostly with lodgepole pine (*Pinus contorta*). Gold mining proposed, possibly averted through compensation.

Oil and gas

Like the mining industry, oil and gas companies pose many actual and potential threats to protected areas. The wide-ranging methods of extraction, on land and underwater, and the high risks of pollution during transport, use and disposal of fossil fuels, means that a very wide range of impacts is possible. Some key factors include:

- Pollution of the marine environment during drilling and transport; although major oil spills receive the most attention, routine leaks and the practice (disapproved of but still widely implemented) of regular tank washings in oil tankers probably have a greater impact overall. Some marine protected areas have been devastated by major spills, although there is debate about the long-term implications of major oil leaks.

- Pollution of freshwater environments during transport and use is another potential source of damage, particularly in protected areas in delta regions where oil drilling takes place or in places where use of oil by commercial and pleasure craft creates regular pollution episodes. A recent and controversial example is the role of Shell and other oil companies in the Ogoni delta of Nigeria[254].

- Impacts on forests through oil drilling, that can include an increase in settlement and logging as a result of roads, pipelines or seismic lines being cut through primary forest, disturbance from drilling camps, pollution from oil leakage and air pollution. The role of fossil fuel mining in tropical forests has received particular attention[255] although there are issues related to temperate and boreal forests as well.

- Air and water pollution from refineries and from users of fossil fuels together are major contributors to acid rain and global warming (see pages 73 and 76).

- Direct impact on seabed communities as a result of building oil platforms or from drilling. Recent protests about the impacts on oil drilling on temperate coral communities off the coast of Scotland is an example of this[256] and the issue is important in many tropical regions.

- Occasional major pollution episodes as a result of deliberate damage to land or water-based oil drilling operations, most notoriously the effects on marine protected areas following the Gulf War in 1990 when Iraqi troops sabotaged many oil wells and refineries in Kuwait[257].

- Impacts on local communities living in protected areas as a result of oil drilling. In December 1998, Basic Petroleum International Ltd. (a subsidiary of Union Pacific Resources) installed a drilling platform in Guatemala's largest protected tropical forest without prior knowledge or consent of the community. A concession had been granted around El Carmelita and Uaxactun, inside the 16,000 km^2 Maya Biosphere Reserve. The communities harvest "xate" (*Chamaedorea* sp.), and "chicle" (chewing gum, *Manilkara achras*). According to one leader: "The oil workers drove in…and installed the platform in the soccer field right in the middle of the community…In a few years (they) could destroy the forest that we're counting on to feed our families for at least 25 years"[258]. The International Finance Corporation, the private sector arm of the World Bank, funded some of the exploration work[259].

Many governments clearly regard protected areas as suitable for oil and gas production, using arguments about the overall importance of energy supplies and the possibility that oil and gas extraction can take place in a relatively benign way. Even more common is exploration and exploitation near to protected areas, including within buffer zones. Table 7.7 outlines some past and recent examples on land and sea.

Table 7.7: Impacts of oil drilling in protected areas

Country	Protected area	Details
Brazil	Jaú National Park (II, 2,272,000 ha)	Papers from the oil company BP, published in 1987, suggested that there were "a number of National Parks and Protected Areas located within, or adjacent to, BP Group exploration areas"[260].
Burma/Thailand	Series of protected areas	A pipeline from the gas field in the Gulf of Martaban in Burma to Ratchaburi in Thailand cuts across a series of unofficial and official protected areas on both sides of the border[261].
Ecuador	Yasuní National Park and biosphere reserve (II, 982,000 ha)	Drilling has been a controversial issue in the park for many years with companies such as Elf Aquitaine, Brasperto, Occidental, Conoco, BP and Texaco involved[262]. However, this has now been banned over much of the park and is no longer thought to be an important threat[263]
Gabon	Sette-Cama AERF; Wonga Wongué Presidential Reserve (IV, 48,000 ha)	Petroleum exploration and operations take place within the protected areas[264].
India	Kaziranga National Park	Threatened by plans to build an oil refinery nearby[265].
Indonesia	Kutai National Park	Indonesia's Pertamina company has an exploration concession covering most of the protected area and has established a 500 ha enclave of airstrip, offices and other facilities within the protected area[266]. In addition, coal mining in areas adjacent to the protected area threatens its integrity[267].
Pakistan	Kirthar National Park	Federal authorities gave a company gas and oil exploration rights in the country's oldest protected area in 1998[268].
South Africa	Dassen Island	In June 1994 oil from a sunken Chinese carrier washed ashore on the island, threatening endangered Jackass Penguin (*Spheniscus demersus)* populations and other seabirds.
UK	Pembrokeshire Coast National Park Skomer Marine Reserve Lundy Island Marine Reserve	The area was polluted with 65,000 tonnes of oil spilled during the wreck of the Sea Empress, damaging a rare colony of starfish. Around 25,000 seabirds were killed and over 30 designated Special Sites of Scientific Interest and 5 Special Protection Areas were affected[269].
USA	Glacier National Park	Plans for a coal mine just across the US-Canada border are according to park officials "posing the threat of disastrous pollution" to the protected area's western border[270].
USA	Arctic National Wildlife Refuge	Oil development is planned in areas adjacent to the refuge and there are fears that this will lead to impacts on the integrity of the area[271].

Chapter 8
External threats that impact on protected areas

The threats described so far are all at least theoretically under the influence of protected area managers, or the owners of the protected area, who can attempt to control, halt or negotiate away threats from various immediate forms of human mismanagement. The relative success of such moves depends on issues such as capacity, legislative support, political support and degree of training, commitment and will. Unfortunately, many of the most fundamental threats to protected areas come from outside, and cannot be tackled effectively by management choices made within the protected area or its buffer zones. These can range from relatively local issues, such as changes to the hydrology of a watershed, through to national or global issues such as water and air pollution and pollution-related climate change. They also include issues that, whilst being capable of management within a protected area, originate from outside, including the increasingly important impacts of invasive species.

Management of such problems inevitably relies more on what are often distant political decisions and protected area managers have until recently done little more than add their voices to those calling for better pollution control or rational watershed management. However, as the reality of issues such as climate change become increasingly accepted, protected area managers are recognising that they must consider potential impacts in the design and management off protected areas. Examples of positive management include leaving room for habitats to "migrate" up the shore in the case of sea-level rise or up-slope in the case of changing temperatures, maintaining migration corridors between protected areas and in some cases also active management practices. Such techniques are still almost wholly untested and are likely to become a major area of research in the future. In the following chapter, several key "external" influences are summarised.

Hydroelectric schemes, drainage and water extraction in and around protected areas
The integrity and conservation of freshwater systems is one of the priority areas identified by both WWF and IUCN as requiring urgent attention. Freshwater protected areas are in some ways particularly vulnerable because they can be severely impacted by events that occur far away, in other parts of the watershed, further upstream and even in different countries. Pollution is a critical factor and is discussed on page 73 onwards. In the following section we summarise some of the other threats to freshwater systems – from the building of large hydropower schemes to the frequently linked issues of water extraction and changes to water quality.

Dams: The environmental and social impacts of large-scale hydroelectric schemes have received increasing attention over the past fifteen years, with critics arguing that their costs outweighed the potential benefits[272]. Large dams have been identified as causing major social upheaval through displacement of human communities, environmental damage through the diversion of rivers and flooding of land, and more generally a range of detrimental impacts as a result of changes to the hydrological cycle and to local climate patterns[273]. Dams have also affected a number of important protected areas. Some large-scale dam schemes, such as the Three Gorges project in China and the Narmada River dam in India, have become *cause celebres* for organisations involved in human and environmental rights[274]. If dams are built in areas where more general environmental degradation is occurring, they do not even offer a very long term source of water and energy; deforestation and resulting soil erosion has shortened the lives of some dams in the tropics to an estimated fifty years or less[275]. This problem is recognised as being particularly acute in parts of the Amazon[276]. From the perspective of protected areas, dams are important because they will affect all protected areas or potential protected areas downstream, sometimes creating dramatic changes in ecology. Although the large reservoirs associated with dams can themselves create important habitats for waterfowl and fish, the constantly fluctuating levels make it difficult for shoreline species to survive, simplifying and limiting the biodiversity. By flooding existing wetlands dams can dramatically reduce the

environmental richness of a particular area. The examples in table 8.1 below suggest that this is already an important issue for many protected areas around the world.

Water extraction and irrigation: Of equal importance, albeit often in different habitats, is the question of water extraction, usually for irrigation although sometimes also for industry. Poorly developed and managed irrigation systems have had devastating impacts in some dryland areas, either through the rapid exhaustion of groundwater resources or because irrigation has led to changes such as salinisation, abandonment of land and eventual desertification; a direct reverse of the original intention. Water extraction threatens wetlands, particularly in areas where the land is otherwise dry, and poorly managed irrigation schemes also result in the eventual need for replacement land that can threaten nearby protected areas.

Drainage: Agricultural expansion has also led to major problems for many protected areas through drainage, particularly in the case of marshes or other "partial wetlands" where small changes in the water table can be disastrous. Drainage on surrounding farmland can change the ecology of a wetland out of all recognition, even if the area itself has been "protected". For example, the large-scale drainage of wetlands during the first half of the 20th century has had lasting effects on the recently created Seewinkel/Fertö-Hanság Transboundary National Park, between Austria and Hungary. An extensive system of drainage channels was established in the Neusiedler See-region between 1900 and 1970, resulting in loss of several thousand hectares of wetlands. The system is still in operation and has led to a marked drop in groundwater levels even in recent times (by 0.4-0.8 m over the past decades). The process poses a serious long-term threat for the national park's remaining soda lakes, seasonally flooded alkaline steppes, calcareous fens and wet meadows. The lowering of the ground water table not only affects surface water levels and seasonal flooding patterns within the protected wetlands, but it also impedes the vertical transport of salts to topsoil layers, which is vital for the persistence of rare halophytic plant communities and their associated fauna. Attempts to restore the natural dynamics of groundwater levels are so far been limited to a few localities, whereas a regional water management plan would be necessary to solve the problem[277]. Drainage issues have led to clashes between farming and conservation communities in Europe; for example, protection of Cors Focho National Nature Reserve in Wales, UK, the largest remaining raised peat bog of its type in the country, led to a ban on further drainage on surrounding farms and deep resentment in the farming community[278]. Similar controls in the Somerset Levels of England led to farmers burning effigies of conservation staff in protest during the 1980s[279].

The Montreux Record

Research by the Ramsar Convention – the UN convention that provides a focus for protection of key wetland sites – found that in most cases where sites are undergoing degradation, there are multiple causes of damage. The Ramsar Convention's Montreux Record was established in 1990 and lists Ramsar sites where an adverse change in ecological character has occurred, including an identification of major problems (see page 110 onwards). As of February 1999, 380 sites were listed on the Montreux Record, of which only three of those where reasons were given identified a single problem. The commonest criteria were drainage, pollution and eutrophication[280]. So far only four sites have been removed from the Montreux Record, indicating that countries are doing little to improve the ecological character of endangered wetlands[281].

Table 8.1 represents just a few of the examples currently known of protected areas at threat as a result of both hydroelectric schemes and irrigation or drainage.

Responses: A World Commission on Dams

Citizen actions against dams have been amongst the most intense and most widely supported environmental advocacy issues of the last two decades, perhaps most famously in the case of the Narmada Dam in India. Partly as a result, IUCN is currently co-operating with the World Bank in a World Commission on Dams that is attempting to broker some agreements regarding their future[282]. The two organisations convened a meeting of international stakeholders in Gland, Switzerland in April 1997, to discuss an internal World Bank study of 50 Bank-funded dams. The meeting agreed that an independent commission was needed to review the performance of large dams and set guidelines for the future. The Commission is currently carrying out a series of studies and stakeholder consultations in an attempt to reach a consensus on the role and future of large dams.

Table 8.1: Impacts of changes in hydrological systems on protected areas

Country	Protected Area	Details
Algeria	El Kala wetlands (V, 80,000 ha)	Threatened with water extraction for agriculture and settlement[283].
Bangladesh	Sunderbans Wildlife Sanctuary (IV, 32,386 ha)	Threatened with changes to water flow and salinity as a result of abstraction and use in the Ganges Basin[284].
Bulgaria	Srebarna (IV, 1,143 ha)	The area was put on the World Heritage in Danger list in 1992 due to threats from dam construction, irrigation and flood control measures. The changes threatened a floodplain of the Danube with rare plants and birds including the only Bulgarian colony of the Dalmatian pelican (*Pelecanus crispus*)[285].
Cameroon	Waza National Park (II, 170,000 ha)	Integrity of the protected area compromised by reduced flooding following damming of the Logone River in 1978/9[286].
Egypt	Burullus Ramsar Site (46,200 ha)	Threatened by water extraction in the Nile Delta[287].
Hungary	Kiskunsagi National Park (II, 35,860 ha)	Suffers from a lowered water table due to water extraction[288].
India	Keoladeo National Park	Although once a flood prone area, water has become scarce following the construction of the Panchna dam in the catchment area and Keoladeo now faces drought, except in years of exceptionally good rainfall[289].
Jordan	Azraq Wetland Reserve (Ia, 1,200 ha)	Suffers from a lowered water table[290].
Kenya	Kora National Park (II, 178,780 ha)	Ecosystems altered by the construction of several large dams in the vicinity[291].
Morocco	Souss-Massa National Park (V, 33,800 ha)	A dam beyond the protected area borders is affecting the area's ecology[292].

Continued…

Country	Protected Area	Details
Togo	Togodo Wildlife Reserve (IV, 31,000 ha)	There is concern about the direct and indirect impacts of a dam planned on the River Mono on the frontier between Togo and Benin[293].
Turkey	Goksu Delta Special Protection Area (IV, 11,200 ha) Gala Golu Delta Nature Reserve (Ia, 2,369 ha)	Threatened with water extraction for agricultural irrigation[294].
USA	Florida Keys (IV, 960,373 ha)	The health and ecological future of the coral reef is threatened by a variety of factors including reduced freshwater inflow from Florida Bay[295].

Pollution in aquatic protected areas

Pollution is one of the most important threats facing marine and freshwater protected areas; both from the perspective of occasional pollution events that can destroy large numbers of plants and animals in a short time and also from chronic pollution that more gradually degrades and impoverishes the biodiversity. As there are marked similarities between pollutants that affect freshwater and marine environments, the two are considered together below.

A number of pollutants are important:

- Concentrated nutrients that cause excessive algal growth and – when the algae die and decay – shortages of oxygen: a process known as eutrophication. Key pollutants here are sewage effluents, soluble fertilisers[296] and effluent from pulp mills[297]. Freshwaters, particularly in agricultural areas, can become so clogged with filamentous algae that other plants are smothered and most animal species eventually die of oxygen deficiency. In recent years a similar phenomenon has started to be seen in some coastal marine areas, particularly in the Mediterranean[298] and Australia, where dense mats of algae are smothering large areas of the seabed or floating on the surface. (Some of the species causing the greatest damage are alien invasive species – see page 80.)

- Pesticides and other biocides that have leached or drifted from their point of application, or when used in fish farms have in turn damaged or killed aquatic creatures. Persistent pesticides – those that survive unchanged in the environment for long periods of time – are particularly dangerous. Persistent organochlorine pesticides are now being found in high concentrations in the body fat of marine mammals many thousands of miles from where they were used[299]. Some corals are extremely sensitive to herbicides and bleached corals have on occasions contained residues of herbicides[300]. Other pesticides, for example chlordane[301], have caused declines in sensitive invertebrates. Some freshwater species are extremely sensitive[302] to pesticides. Bioaccumulation of pesticides in predators has been responsible for population declines, for example through eggshell thinning and reproductive failure in birds[303]. In recent years accumulation of pesticides has developed from being a developed country problem to one that is important wherever intensive agriculture occurs.

- Trace metals and other persistent toxic chemicals that enter water systems from mining operations, factory effluents and domestic waste[304] or as a result of shipping and boat maintenance. Mining operations, including especially illegal mining, are particularly important in for example the Amazon and Kalimantan. In the former case, use of mercury as part of the processing of gold has polluted huge freshwater areas[305].

- Radioactivity from nuclear power stations and reprocessing plants; this has been identified as a particular problem for example in parts of the North Sea between the UK and mainland Europe[306].

- Fossil fuels entering aquatic systems through exploration, drilling or use in transport.

- Acid pollutants that arrive in freshwater systems as a result of dry and wet deposition of air pollution – these are discussed on page 73.

Protected areas are particularly susceptible to pollution. Water is no respecter of boundaries and when protected areas are located in marine environments or fed by rivers then it is almost impossible to control impacts from other areas within the same catchment or sea. Individual lakes are both in some ways easier to protect but also particularly susceptible when pollution does occur. Some examples are given in Tables 8.2 and 8.3 below.

Table 8.2: Impacts of pollution in freshwater protected areas

Country	Protected area	Details
Canada	Wood Buffalo National Park (II, 4,480,200 ha) Point Pelee National Park (II)	Wood Buffalo has been threatened by pollution from upstream pulp mills[307]. Intensive agriculture is suspected of causing a dramatic decline in amphibians in Point Pelee, with 6 out of 11 species of amphibian and 7 out of 11 species of reptiles having disappeared[308].
China	Dongdongtinghu Nature Reserve	The discharge of wastewater from paper mills and sugar plants into East Dongting Lake has seriously polluted the ecosystem[309].
France	Camargue Regional Nature Park (V, 85,000 ha)	Heavy metals and other chemicals in the River Rhone have contaminated flamingos in the Camargue freshwater and marine tidal area[310].
Greece	Thermaikos Gulf Amvrakikos Gulfs (Ramsar sites, 25,000 ha)	Pesticide residues are affecting the ecology of the region, including creating changes in phytoplankton communities. High accumulations of pesticides were found in birds such as herons and night herons that were feeding on amphibians and fish[311].
Italy	Circeo National Park (V, 8,622 ha)	Eutrophication caused by extensive use of fertilisers has affected aquatic life in streams[312].
Kenya	Lake Nakuru National Park (II, 18,800 ha)	Settlement and development of industry around the lake has created considerable increases in organic and chemical pollutants, especially oil and heavy metals, plus increased sewage discharges[313].
Peru	Lago de Junín National Reserve (V, 53,000 ha)	Pollution from mining affects the protected area – a key site for three threatened and restricted-range species of birds.[314].
Philippines	St Paul Subterranean River National Park	Threatened by logging and agricultural activity in the surrounding watershed that could affect water quality within the protected area[315].

Continued…

Country	Protected area	Details
Russian Federation	Lake Baikal World Heritage Site, including Baikalskiy (Ia 165,724 ha)	Seriously threatened with pollution from a pulp and paper mill at Baikalsk and from agricultural run-off and other pollution[316].
Thailand	Thale Noi Non-Hunting Area (III, 45,700 ha)	Pollution has increased nutrient levels in the lake and residues of DDT, heptachlor and dieldrin have all been found[317].
Tunisia	Lac Tunis	Eutrophication caused by extensive use of chemicals threatens life in the lake[318].

Table 8.3: Impacts of pollution in marine reserves

Country	Protected area	Details
Bangladesh	Sunderbans Wildlife Sanctuary (IV, 32,386 ha)	Impacted by oil spills from tankers. In 1994, oil from a capsized ship spread 15km downstream and affected much of the mangrove area, killing seedlings of *Heritiera* and *Excoecaria* and fishes, shrimps and other aquatic animals[319].
Denmark, Germany and the Netherlands	Wadden Sea Trilateral Conservation Area	The area is currently being polluted by tri-butyltin (TBT) and pesticides. There is increasing evidence that some pesticides are hampering the grazing ability of zooplankton and herbicides are interfering with the photosynthesis of phytoplankton[320].
UK	Marsden Bay Nature Reserve	The death of hundreds of kittiwakes (*Rissa tridactyla*) (seabirds) in 1996 was blamed on illegal sea dumping of industrial waste[321].
USA	Several	When the Exxon Valdez ran aground in March 1989, 240,000 barrels of oil were spilled into Alaska's Prince William Sound, polluting several protected areas along the coast. Some experts believe that routine spills are more damaging than the occasional large disaster[322].
USA	Monterey Bay National Marine Sanctuary Gulf of the Farallones National Marine Sanctuary	Land based sources of water pollution, disposal of dredged material and potential water quality issues as a result of vessel traffic all impact on the Monterey area. Farallones is home to the largest concentration of breeding seabirds in the continental USA, and is affected by oil spills, sewage, toxic chemicals, petroleum products, pesticides and urban run-off[323].

Air pollution and climate change

Atmospheric pollution has played a key role in the decline of a range of wild plant and animal species. It is therefore an important factor in threats to protected areas in the more developed countries, including industrialised parts of Europe, North America and increasingly also in parts of Asia. Such threats are pervasive and largely outside the control of protected area managers or even, in many cases, governments. Atmospheric movements have no respect for national boundaries and can only be tackled by intergovernmental initiatives, such as the Convention on Long Range Transboundary Air Pollution (CLRTAP) in Europe. There is a range of different pollutants affecting European forest ecosystems, and a variety of ways in which these can impact on the environment.

Important elements in the overall pollution conditions include:

- Local industrial pollution can release a range of toxic pollutants including sulphur and nitrogen oxides (SO_x and NO_X) and ozone (O_3), so-called *primary pollutants*.

- Long range pollution, particularly from acids formed in the atmosphere from SO_X and NO_X and possibly also airborne chlorocarbons, so-called *secondary pollutants*.

- Stratospheric pollution effects, including loss of ozone as a result of pollution from chloroflurocarbons (CFCs), halons and other pollutants.

- Global pollution effects, including possible climate change as a result of elevated levels of greenhouse gases such as carbon dioxide (CO_2), methane and others.

- Local agricultural pollution, caused by drift of pesticides and fertilisers.

- Miscellaneous pollution from for example slurry waste, salt used in de-icing, toxic fumes from smelters, particulate waste etc.

Industrial plant, power stations and road vehicles are major sources of local pollution, including sulphur dioxide (SO_2), nitrogen oxide and dioxide (NO and NO_2)[324] and hydrocarbons; the last two can also react together in the presence of sunlight to form ozone (O_3). In addition, ammonia (NH_3) is itself a significant pollutant in some regions, being released from intensive livestock units and fertiliser factories[325]. All of these can, sometimes after chemical transformation in the atmosphere, be transported long distances by prevailing winds. SO_2 and NO_X can fall as dry or wet deposition and in the latter case can be deposited as mist, rain or snow. Ozone impacts in gaseous form. Impacts on forest health can occur through direct effects on trees and the impact of soil acidification. Over the last decade, various theories have been investigated, including:

- Ozone and acid mist[326];

- Soil acidification[327];

- Direct damage from sulphur dioxide;

- Nitrogen saturation; etc.

Recent thinking has tended towards the view that many different factors – including air pollution and other elements – react together to cause damage, the so-called *multiple-stress hypothesis*. A 1997 study for WWF concluded that SO_2 was at high enough levels to be damaging trees in much of central Europe and that the critical dose for ozone is exceeded over most of Europe. The importance of the direct impact

of long-range pollutants, through wet acid deposition, is less clear. Levels of acidity high enough to damage trees do not currently occur over most of Europe, although acidity could be an additional factor in tree decline. More significantly, a variety of pollutants are now recognised as contributing to acidification of soils, and deposition is currently above the critical load for damage to soils in over 82 per cent of the land area of the Nordic countries. Soil acidification can have a range of effects on trees, including damage to roots, in part through liberation of toxic elements such as aluminium, and by causing nutritional deficiencies and particularly magnesium deficiency[328]. Although these effects are best known within Europe, there is increasing evidence for them occurring in others areas of the world including North America[329], Asia and the Pacific[330].

Research has also shown that a number of pollutants act in combination, and in some cases synergistically, so that cumulative effects are greater than the sum of individual effects. Pollutants are known to interact with other stress factors, including climate (frosts and drought) and pests and diseases (eg aphids and fungal pathogens).

Air pollution, biodiversity and protected areas: Several attempts have been made to analyse the impacts of air pollution on wildlife by for example the UK state nature conservation body[331], the International Energy Agency[332] and WWF[333]. Air pollution was identified as an issue within biosphere reserves in 1984[334]. Research for WWF has assessed the impacts on wildlife through a literature survey which identified effects on 1,300 species, including 11 mammals, 29 birds, 10 amphibians, 398 higher plants, 305 fungi, 238 lichens and 65 invertebrates, providing the most detailed survey to date. The results showed that amongst plants alone, over a hundred species have been extirpated, sometimes from quite large areas, due to air pollution in the UK[335].

Protected areas may be particularly at threats from some forms of air pollution. National parks and other conservation areas have tended to be established on land that is less suitable for agriculture or other commercial uses and thus often on acidic or base-poor soils, where effects of acidification are generally more acute. Amelioration efforts, such as liming of soils, will not usually take place precisely because of the absence of commercial activity within most protected areas (and in any case liming can sometimes do more harm than good.)

The WWF project referred to above also pinpointed important European nature conservation areas that are likely to be at high risk from air pollution. Under controls proposed by the 1985 sulphur protocol, some 71 per cent of the protected areas studied are in areas suffering excess acid pollution. Even if countries were to adopt far more radical environmental scenarios, between 20-25 per cent of Europe's protected areas would remain at risk from acidification. High-risk countries include Austria, Belgium, Denmark, Germany, Ireland, the Netherlands, Norway, Sweden, Switzerland and the UK. Air pollution has already had serious impacts on biodiversity in protected areas in many parts of Europe. These issues are complex and have not been studied in detail in many individual protected areas. Table 8.4 below summarises some of examples from the UK – a country that industrialised early and where pollution-related impacts are both quite severe and relatively well studied. It makes links to specific national parks and other protected areas in the UK where these are known.

***Responses*: Liming and pollution control**

Air pollution is a clear case in which the protected area manager cannot alone hope to make many useful responses. While Sweden and Norway spent large amounts of money liming acidified lakes in the early 1980s (a practice that still continues in some areas today) the long term ecological impacts of this remain uncertain. Many liming projects do not control acid surges at the time of snow-melt (as this requires sophisticated and expensive automatic dosing systems) nor do they provide a permanent answer to the acidity problem[336]. The impetus for liming came mainly from anglers rather than conservationists. National and international initiatives to control pollution at source are the only long-term solution to problems such as air pollution and climate change.

Table 8.4: Biodiversity impacts from air pollution with reference to protected areas in the UK

Affected group	Example with UK protected area where appropriate
Algae and phytoplankton	Some species of blue-green algae are are threatened in heavily polluted areas of Europe[337]. In acidified Swedish lakes phytoplankton diversity has fallen by 50%[338]. Research has shown dramatic changes in diatom populations in lakes in the Snowdonia National Park as a result of acidification[339].
Lichens	Both sulphur dioxide[340] and acid deposition damage lichen species, even in remote areas[341]. In the Lake District National Park, increased acid deposition has resulted in a decline in species[342].
Mosses	Many epiphytic or bog species are harmed by air pollution. Research in the Peak District National park in the UK suggests that many *Sphagnum* species are damaged by SO_2, and perhaps also by NO_X[343] and nitrogen deposition.
Fungi	Many mycorrhizal fungi decline in polluted conditions and may also be damaged by fungicide spray and by nitrogen deposition in acidified forests[344]. Fungi can also be damaged by soil acidification[345].
Herbaceous flowering plants	Flowering plants such as the bog rosemary (*Andromeda polifolia*) and sundew (*Drosera rotundifolia*) have declined throughout the Peak District National Park due in part to heavy sulphur dioxide pollution[346].
Coniferous and deciduous trees	Tree planting was abandoned in the Peak District National Park during the 1930s because high air pollution levels impaired growth[347]. More recently, there has been intense controversy about the extent to which current levels of ambient air pollution are affecting the health of trees[348].
Micro-organisms	Diversity of plankton declines in acidified water, with the range of species sometimes being reduced by over 50%[349]. Soil microorganisms are similarly affected by soil acidification.
Soft-bodied invertebrates	Research suggests a link between land mollusc decline and acidification[350], linked to a fall in soil pH and, in cases such as the slug *Limax marginatus* where decline occurs even in calcium-rich habitats, perhaps due to loss of food[351]. In the New Forest, the tree-living snail *Balea perversa* shows declines matching increased air pollution near Southampton, where it is confined to trees with more basic bark[352]. The river limpet, *Ancylus lacustris* has disappeared from acid waters in the English Lake District perhaps as a result of acid flushing[353].
Arthropods	Many aquatic arthropods decline in acid waters. Research in the Snowdonia National Park[354] and the Lake District National Park[355] has found a decline in freshwater invertebrates in acidified streams.

Affected group	Example with UK protected area where appropriate
Fish	Some fish decline due to inability to reproduce, while other species prove resistant to quite severe acidification. Occasional acid "flushes", following flooding or snow-melt, can result in fish kills even in water that is not usually very acid. Fish have declined in acidified water in the Brecon Beacons National Park[356] and Lake District National Park[357].
Amphibians	Many amphibian species decline in acid waters due to poor reproduction capacity[358]. Decline in populations of the natterjack toad (*Bufo calamita*) has been linked to increased acidification of breeding pools in the New Forest[359].
Birds	A few species decline due to loss of food species (chiefly aquatic species affected by loss of fish and invertebrates). In the Snowdonia National Park, a decline in the stream-living dipper (*Cinclus cinclus*) has been attributed to loss of food invertebrates due to acidification[360].
Mammals	Despite some limited evidence of build-up of heavy metals in mammals in polluted areas, the main impacts seem to come from food chain effects, for example on the otter (*Lutra lutra*) in areas where fish have declined[361].

Climate change and protected areas

Concentrations of carbon dioxide, methane and other so-called greenhouse gases are rising at an accelerating rate in the atmosphere, largely as a result of emissions from human activities such as the burning of fossil fuels, burning biomass and intensive farming. This increased air pollution is thought to be having a dramatic impact on the global climate, both by raising average temperatures and by increasing the frequency and severity of extreme events such as droughts and storms. Both rainfall and drought are likely to increase in places and average sea level will probably rise. Forest fires will become more frequent and certain pests and diseases are likely to spread into new habitats as average temperature rises. The world is apparently entering a period of warmer, less predictable climate. Over the past decade, initial and general predictions of climate change have increasingly been replaced by a more robust science, leading to an increasing consensus among researchers. This has been demonstrated most clearly in the successive reports of the Intergovernmental Panel on Climate Change (IPCC), the international scientific advisory body charged with developing an overview on the issues for the UN Framework Convention on Climate Change. The current global warming trend is agreed by a large majority of scientists to be at least partially the result of human induced emissions of greenhouse gases to the atmosphere.

Ecological implications of climate change: Such changes have profound implications for ecology and biodiversity. Historical and palaeoecological studies show that past climate changes, for example, after the ice ages, had dramatic impacts on ecosystems and that individual species can have problems in "moving" fast enough to keep pace with changing ecological conditions. Pollen records and the existence of relict communities, such as the tropical rainforest fragments found in the middle of the Australian desert, bear witness to large-scale changes in the past. Yet past climate changes were almost certainly less abrupt and less extreme than those changes now being predicted to occur. They were also acting on far less fragmented and damaged ecosystems. For example, sustained increased in average annual temperatures of as little as $1^{o}C$ is sufficient to cause changes in the growth and regeneration capacity of many tree species, leading to changes and losses in forest cover. Although warmer conditions can stimulate growth, they also increase many stresses and pressures on species and ecosystems. The net effect is likely to be a loss rather than a gain[362].

Key habitats at threat: some habitats are likely to be particularly at threat:

- Low lying islands: many low sand islands or Pacific atolls are likely to disappear altogether if predicted sea level rise occurs[363].

- Mangroves: are at risk of inundation and salt imbalance due to rising seas. In many cases changes inland mean that there is no space available for mangroves to retreat and in any cases changes may occur too quickly for natural migration[364].

- Coastal zones: including particularly coastal marshes, mudflats and dune systems, all of which could be inundated by rising seas and – in a world where land is at a premium – not have room to migrate back towards the shore[365].

- Coral reefs: many reef systems have suffered bleaching effects in the last few years as a result of increased sea temperatures, with 1993 and 1998 being particularly severe[366].

- High altitude communities: upland forests or mountain top tundra systems are likely to be displaced by migration of vegetation assemblages from lower altitudes[367].

- Polar regions: are already undergoing changes from ice melt and warmer temperatures, threatening individual species and overall ecology[368].

- Cloud forests are particularly at risk as a result of possible drying or other weather patterns[369].

- Fire-prone communities or places where increased drought is likely to result in fire risks[370], including both tropical moist forests and boreal forests

- Relic communities: ecosystems that have survived previous climatic changes in isolated pockets will be particularly susceptible to further ad more severe climate change. These relic ecosystems are often particularly high in endemic species[371].

It is not just isolated or unusual habitats that are likely to be affected. The Intergovernmental Panel on Climate Change suggests, for example, that up to a third of the world's forests will be affected by climate change and stated bluntly that: *forests are highly sensitive to climate change*[372]. Desertification is also likely to increase. Several trends in damage can be identified:

- Disturbance: climate change will increase disturbance, through extreme weather events such as storms and as a result of smaller but ultimately more pervasive changes to seasonality, rainfall and temperature. Climate change will thus add to those other forms of human disturbance, which are currently fragmenting and altering ecosystems.

- Simplification: the net effects of problems with reproduction and migration rates in areas experiencing severe climate change will tend to cause problems for more sensitive, slower growing and slower moving species and instead favour fast growing, short-lived weed and invasive species. The result will be an acceleration of a trend that is already occurring as a result of other forms of human interference, that is replacement of species-rich ecosystems by simplified, species-poor ecosystems.

- Movement: is likely both geographically and altitudinally, as growing conditions alter. The ability of species to migrate fast enough to keep pace with climate change is still largely unknown and will depend upon many factors.

- Age reduction: disturbance, increased fires, changes in pest patterns and the transition of whole communities will encourage an existing trend towards the replacement of old communities, such as old-growth forests, with younger communities.

- Extinction or extirpation: some of the most vulnerable species, including relict species at the edge of their ecological niche and some particularly threatened systems such as mangroves on low-lying islands, could disappear altogether.

These changes have particular implications for protected areas, which are by their nature fixed in space but impacted by changes over time[373]. Changing weather conditions may force the species within a protected area away from the protected zone; indeed in some cases the whole ecology of the area may alter in a quite fundamental way. A protected area may in these cases be left without the very species it was established to protect. In situations where the protected area is surrounded by land that has undergone major modification, or by a barrier preventing further development (such as a dyke at the end of salt marsh) there may be no space for migration of species and vegetation communities, leading to net losses of biodiversity. Impacts on protected areas are likely to be significant and wide-ranging. For example, a study commissioned by WWF-US found that in 7 or more of 9 possible climate change scenarios, 106 important protected areas in the lower 48 states of the USA faced major impacts[374]. Virtually every protected area in the world will be affected to some extent if the more pessimistic predictions of climate change are realised. Management responses to this are in their infancy[375]. In Table 8.5 some protected areas likely to be particularly severely impacted are listed and described.

Table 8.5: Likely impacts of climate change on protected areas[376]

Country/region	Habitat	Protected areas affected
Antarctica	Polar	The Southern Ocean Whale Sanctuary is threatened with fundamental change. Rising temperatures have already caused a crash in the Adelie penguin (*Pygoscelis adeliae*) population of Cormorant Island, while other populations have expanded. A reduction in sea ice is leading to a decline in productivity of algae, resulting in a fall in krill that are fundamental to the survival of whale and seal populations.
Australia	Alpine meadows	Australia's Alpine national parks could be affected by invasion of species usually found at lower altitudes, threatening the rare mountain pygmy possum (*Burramys parvus*) and lack of snow cover could lead to the disappearance of fragile vegetation systems.
Australia	Mangrove and freshwater	Kakadu National Park has recently experienced extension of creeks within the Alligator River system leading to death of 60km^2 of *Melaleuca* forest and loss of freshwater communities; one likely cause is sea-level rise[377].
Belize	Coral reef	Hol Chan Marine Reserve is one of several protected areas in the region that have been severely affected by coral bleaching, usually associated with prolonged periods of high sea temperature.

Continued

Country/region	Habitat	Protected areas affected
China	Subalpine forests	Wolong Nature Reserve was established primarily to protect the giant panda (*Ailuropoda melanoleuca*) but is also rich in many other threatened species. Under likely climate scenarios, alpine vegetation is likely to decrease and be replaced with temperate mixed coniferous and broadleaf forest – in practice the speed of climate change and competing land uses could combine to prevent any natural adaptation.
Costa Rica	Cloud forest	The Monteverde Cloud Forest has experienced an increasing number of "dry days" since the 1970s, restricting the habitat for around 50 montane frog species that inhabit the forest. The reserve provided the habitat for the golden toad (*Bufo periglenes*), which with around 20 other amphibian species apparently became extinct around 1986-7, during a particularly dry year[378].
Denmark	Marine	Vadehavet is an important reserve on the Wadden Sea. The sea and its associated network of mudflats and saltmarshes provides habitat for 6-9 million migratory birds and nursery grounds for commercially important fish. Vadehavet is one of many areas where saltmarshes are threatened with inundation; dykes built behind will hamper any natural sedimentation and creation of new marsh areas.
Italy	Shrub vegetation	Majella National Park is one of several Italian protected areas where *Pinus mujo* scrub is likely to be replaced by surrounding high mountain Mediterranean vegetation. Over the last few years, snow cover has declined and drought increased in the summer.
India	Moist forest	The Kanha and Pench National Parks, created as tiger reserves, could change from moist to dry forest types under projected scenarios.
Indonesia	Tropical rainforest	Kutai National Park in Kalimantan is likely to experience an increasing number of dry years and droughts (despite an overall average increase in rainfall). Reduction in availability of *Ficus* fruit in dry years will have a direct impact on species such as the orang-utan (*Pongo pygmaeus*) and will increase the probability of fire[379].
Malawi	Freshwater	Lake Malawi National Park is part of a range of lakes that contain the world's highest diversity of fish species. Global warming is likely to increase the temperature differential between surface and deep waters, leading to greater vertical stratification, reduced mixing of nutrient-rich deep water and a decline in fish populations.
Panama	Tropical forest	Barro Colorado Nature Monument has experienced several years of unusual drought, creating a change in vegetation type and scientists predict that drought sensitive species may become locally extinct.
Philippines	Coral reefs	The Tubbataha Reef Marine Park suffered coral bleaching during 1995 and 1998 and climate change scenarios suggest that this trend could continue. In addition, increased carbon dioxide levels could reduce the amount of dissolved calcium carbonate in ocean water, which is an essential element for reef-building corals[380].

Continued…

Country/region	Habitat	Protected areas affected
Tunisia	Freshwater	Ichkeul Lake National Park. The most important wintering site for waterfowl in North Africa, is threatened with increased salinity due to sea level rise – with eventual transformation into a salt lake a consequent fundamental change in its ecology.
USA	Coastal habitat	The Blackwater National Wildlife Refuge on Chesapeake Bay provides vital habitat for many migratory waterfowl species. The protected area has already lost a third of its area since 1938 and the sea-level in nearby Baltimore has increased by 20cm during the 20th century. Further sea-level rise could destroy the reserve over the next 30 years[381].
Zambia	Freshwater	Kafue Lakes, Lochinver and Blue Lagoon National Parks are all threatened by increased droughts – in the 1991-92 drought many hippopotamuses died by being trapped in drying mud.

Invasive species in protected areas

The problems posed by invasive species have been called one of the greatest threats to the survival of plant biodiversity[382]. Whilst invasion by species of plants and animals is a normal part of the evolutionary process, humans have increased this pressure as a result of deliberate or accidental introductions of species. Although the majority of introduced species either fail to survive, or hang on in small numbers making little impact on overall ecology, a minority thrive in their new surroundings and, in the absence of their natural predators, can out-compete native species. Harmful invasive species fall into a number of categories:

- Predatory mammals in situations where native fauna is ill equipped to withstand predation; the introduction of rats onto islands, or predatory mammals into New Zealand are two well-known cases[383]. In New Zealand and Australia, species from Europe were deliberately introduced as part of the settlement process by acclimatisation societies[384] and have already caused several extinctions amongst native species. In New Zealand in particular there are no native ground-living mammals (and only two native bat species), allowing development of unique species of ground living birds that take the place of mammalian herbivores. Introduction of mammals has put these groups under enormous pressure.

- Pest and disease species that attack native species (which are often not resistant to the new species); the introduction of the Asian fungus *Pryphonetria parasitica* to North America in 1900 resulted in a decline in the proportion of chestnut trees (*Castanea dentata*) in the woods from 40 to 1 per cent[385]. In Mediterranean Europe, the exotic root pathogen *Phytophthora cinnamoni* is causing rapid decline and death amongst several tree species, particularly cork oak (*Quercus suber*), evergreen oak (*Q. ilex*) and other oak species[386]. In Canada, bovine tuberculosis has been found in elk just outside Riding Mountain National Park, brucellosis has been found in bison in Wood Buffalo National Park, and canine distemper has been found in other wildlife such as wolves[387].

- Plant species that out-compete native vegetation; for example, in wetland areas (protected areas and Ramsar site) invasive species can be particularly damaging. Anzali Wetlands complex (Iran), a protected area and Ramsar site – currently on the Montreaux record – has experienced rapid growth of the water fern *Azolla.* Other Ramsar sites and protected areas that have invasive species include Kakadu in Australia, approximately 6 per cent of which is wetland (43,490 ha). The site has in the past suffered from extensive infestation of *Mimosa pigra* and *Salvinia molesta*. And management still requires constant intervention.[388].

The extent to which protected areas are affected by invasive species depends to some extent on the integrity of the protected area itself. Studies suggest that invasion is more likely if the habitat is disturbed[389], although this remains subject to discussion and some more or less pristine environments have also undergone invasion. Certainly disturbance adds to the risks; most invasive plant species for example are weed species that grow best in disturbed conditions so that if a protected area is disturbed it will result in an increase in invasive species. Roads are also well known routes for invasive mammals to penetrate into new territory. Invasive species are a particular problem in that they cannot be addressed by simple management changes and they are now identified as the primary threat to some of the best funded protected areas in the world, for example in Australia, New Zealand and Hawaii. A recent survey in the USA identified over 194 protected areas where invasive plants are recognised as a problem[390].

Table 8.6: Impacts of invasive species on protected areas

Country	Protected Area	Details
Australia	Kakadu National Park and World Heritage Site (II, 1,975,700 ha)	The Park has extensive infestation weed *Mimosa pigra* and *Salvinia molesta*[391].
Canada	Point Pelee National Park (II, 1,550 ha)	A report from Environment Canada in 1992 stated that 43 per cent of plant species in the protected area were exotic[392]. The 1995 *State of the Parks* survey by Parks Canada identified exotic vegetation in 21 out of 36 parks[393].
Chile	Archipiélago de Juan Fernández National Park (II, 9109 ha)	Introduced species such as *Rubus ulmifolius* and the shrub *Aristotelia chilensis* have displaced much of the native vegetation[394].
Costa Rica	Isla de Coco National Park (II, 2,400 ha)	The protected area, home to three endemic bird species, is subject to over-grazing by feral deer, pigs and goats and to predation of native fauna by introduced cats and rats[395].
Ecuador	Galápagos National Park (II, 761,844 ha[396])	Several islands within the national park are threatened by over-grazing by feral livestock[397]. Guava plants have also invaded parts of the island and invasive species have increased from 77 in 1971 to over 260 today according to WWF research[398].
Ireland	Killarney National Park (II, 10,289 ha)	Invaded by *Rhododendron ponticum* that is displacing native vegetation[399].
New Zealand	Most protected areas	The New Zealand government's *State of the Environment* report for 1997 says that "alien plants and animals have turned many of our protected areas into war zones" and estimates that a third of the protected forests would be suffering significant biodiversity losses from invasive mammals without continual control programmes[400]. Predatory mammals are a particular threat to the large, ground dwelling birds that take the place of herbivorous mammals in New Zealand.

Continued…

Country	Protected Area	Details
Papua New Guinea/ Indonesia	Tonda Wildlife Management Area (PNG VI, 590,000 ha) Wasur National Park (Indonesia II, 308,000 ha)	These two contiguous protected areas are faced invasion by weed species and feral animals, including *Eichornia crassipes* and *Mimosa invisa*. Feral animals include cattle. Horses, dogs, pigs and cats, the giant African land snail, Rusa deer and many introduced fish species[401].
South Africa	Wilderness Lakes	Alien grass, such as *Paspalum vaginatum* and *Pennisetum clandestinum* are invading the mudflats of coastal lakes, making them unsuitable for wading birds. The water fern *Azolla filiculoides* has also become established on Eilandvlei, where dense mats form around the margins of the lake. Alien fish include Mozambique tilapia *Oreochromes mossabicus* and mosquitofish *Gambusia affinis*[402].
United Kingdom	Protected areas throughout England and most of Wales	The introduced North American grey squirrel (*Neosciurus caroliensis*) has out-competed the native red squirrel (*Sciurus vulgaris*) to the extent that the latter is extinct in virtually all its former habitats.
USA	Yellowstone National Park (II, 899,139 ha)	A population of lake trout (*Salvelinus namaycush*) was discovered in 1994; these pose a significant threat to the native Yellowstone cutthroat trout (*Onchorynchus clarki bouvieri*) and to the associated food chain[403]

Responses: controlling invasive species

The problem of plant invaders is international almost by definition, yet there are no international conventions specifically targeted at invasive species equivalent to CITES, the convention that regulates the international movements of endangered species. There are three current international agreements that have some relevance to the control of invasive plants, at least in theory;

- International Plant Protection Convention, which currently is only concerned with agricultural plants.
- Convention on the Law of the Sea, which contains clauses that regulate the discharge of ballast waster, a major source of invasive marine organisms.
- Convention on Biological Diversity (CBD), which calls for contracting parties in Article 8h to prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species.

In 1994, IUCN-The World Conservation Union established an Invasive Species Specialist Group within its Species Survival Commission. It has a membership of over eighty international specialists, plus a wider network of over 550 people interested in invasive species issues. Its mission is "*to reduce the threats posed by invasive species to natural ecosystems and the native species which they contain, through increasing awareness of invasive species and means of controlling or eradicating them*". The group is responsible for the production of a journal, *Aliens*, and has just completed guidelines designed to help governments meet their obligations under the CBD in respect of controlling invasive species.

These guidelines (IUCN Guidelines for the prevention of biodiversity loss due to biological invasion) can be accessed on the IUCN website at: http://www.iucn.org/themes/ssc/index.htm.

Tourism pressure on protected areas

Tourism sits rather uncomfortably under the heading "external threat". It is to some extent under the control of protected area authorities and can be a positive factor, providing income for the protected area and surrounding communities and helping maintain political commitment to the site. The enormous growth in various forms of "green tourism" is a sign that an increasing number of protected areas are likely to be receiving visitors in the future

Tourism is already, or soon to be, the world's largest single industry. Increased leisure, increased spending power and ease of travel has made people, particularly in the developed countries, into regular tourists who are venturing further in search of new holiday destinations and excitement. The relationship between tourism and protection is complex and sometimes tense. For many people, protected areas are created mainly for our own pleasure – with the type of protected area visited depending on whether the "client" is looking for wildlife or fine views, company or solitude, relaxation or adventure; in many cases people are looking for a combination of several things. For some conservation biologists, people should have very little interaction with the most important protected areas that are instead set aside for non-human values and for the protection of species.

Visitors are now a pressure on many protected areas. The energy and other resources used in travelling to tourist destinations is itself an environmental impact. The presence of people within a protected area creates problems of disturbance, vegetation trampling, risks of fire, and litter and waste. Tourists bring their desires for comfort and ease of access, creating a pressure for developments such as roads, hotels, restaurants, shops and trails. Tourists can encourage trade in rare plants, corals, shells and mammal skins. On the other hand, in many countries, tourists actually or potentially supply the funding and political support to ensure a protected area's survival. The most successful and best protected national parks in many developing countries are often those with the best developed tourist infrastructure, most jobs associated with tourism and the consequent clear desire to maintain the protected area values.

The need to accommodate tourism and recreational use effectively within protected areas is now generally recognised[404]. The presence of protected areas close to major cities, and with heavy visitor pressure, that still manage to maintain important wildlife species and landscape values shows that people and protected areas are far from irreconcilable. The Nairobi National Park on the edge of Kenya's capital city has successfully protected wildlife species for many years and Bukit Timah National Park in Singapore protects remaining rainforest within the city boundary. Governments and protected area managers are starting to look carefully at options for maximising the benefits and minimising the detrimental costs of tourism[405]. Problems are likely to arise when tourism is either unplanned or so large-scale that it overwhelms efforts to contain its impacts. Generic examples might include the following:

- Rapid development in sensitive habitats, such as coastal regions, along with poorly planned juxtaposition of mass tourism with particularly delicate protected areas (such as the European Mediterranean, some Caribbean islands and popular coastal areas of the USA).

- The impacts of insensitive tourism in the most untouched areas (such as trekkers in upland Asia, where inexperienced and under-informed tourists are often the major contact that local people have with the outside world).

- Concentration of tourism into particularly famous or beautiful areas at levels that are no longer sustainable (such as some Kenyan game reserves or some national monuments in the USA).

- The impacts of nature tourism, which may itself be relatively sensitive but be taking place in a delicate ecosystem (current examples include the debate about the desirability of whale watching).

- Situations in which a proportion of tourists are willing (often through lack of knowledge) to purchase wildlife products collected inside protected areas (such as coral and shells).

Some examples of specific cases are outlined in Table 8.7 below.

Table 8.7: Tourism pressure on protected areas

Country	Protected area	Issue
Australia	Great Barrier Reef World Heritage Area (VI, 33,480,000 ha)	Over 1.6 million people visit every year, in charter boats, cruise ships and private vessels. Anchor damage to coral reefs is now an important pressure that can sometimes suppress more vulnerable coral species[406]. Other impacts include biophysical impacts on fish, corals and water quality[407].
Australia	Fraser Island World Heritage Area (II, 184,000 ha)	Tourism impacts through camping on dunes require management input if degradation is to be avoided[408].
Brazil	Chapada Diamantina National Park (II, 152,000 ha)	Increased tourist pressure in Bahia state is leading to mammal poaching for skins and losses amongst rare plant populations as a result of increased access and collecting. For example, many orchid species found in the protected area are traded[409].
Canada	Saguenay-St Lawrence Marine Park (II, 113,800 ha)	Whale watching (particularly beluga) in the Québec park impacts on whales. Over 50 companies operated trips in 1998 with 7000 commercial boat trips, along with planes, kayaks and pleasure craft. Boats disturb whales particularly if several vessels circle animals competing for views, or move quickly. Tourist pressure is a possible cause of reproductive failure in the threatened St Lawrence beluga population[410].
China	Various	A recent study by China's National Man and the Biosphere Committee found tourism development projects inside the core zones of 23 per cent of the reserves surveyed[411].
Czech Republic	Krkonose National Park (V, 36,300 ha)	The area is affected by the infrastructure associated with downhill skiing[412].
Greece	Zakynthos	Disturbance of turtle nesting beaches[413] has occurred as a result of tourist developments. Turtles are critically threatened in this part of the Mediterranean but continue to suffer disturbance.
Guatemala	Monterico Natural Reserve and Multiple Use Area (III, 2,800 ha)	The 2,800 ha coastal and mangrove area, containing five villages, encourages small-scale ecotourism but has also suffered from uncontrolled holiday developments, including the construction of illegal holiday homes and the development of a canal through a mangrove[414].

Continued…

Country	Protected area	Issue
Indonesia	Gunung Gede Pangrango National Park (II, 15,000 ha)	The protected area in West Java has suffered serious soil erosion in areas where visitors congregate, particularly on trails leading to the protected area's summit[415].
Italy	Gran Sasso-Laga National Park	A proposed enlargement of ski facilities threatens alpine meadows and associated species. There are plans for tourist developments in three other national parks[416].
Kenya	Masai Mara National Reserve (II, 151,000 ha)	Tourists are having impacts on wildlife in the reserve and some other protected areas, where the density of safari vehicles interferes with animals' activities and particularly their mobility[417]. Visitor disturbance is regarded as an increasing problem in protected areas throughout East Africa.
Malaysia	Wetland and mangrove sites	Despite efforts to maintain ecological integrity in wetland protected areas, development of chalets and increased visitor pressure is occurring in some places[418].
The Philippines	Puerto Galera Biosphere Reserve	There have been dramatic impacts caused by uncontrolled tourist activities in the late 1970's, especially on the coastal area[419].
Russian Federation	Kamchatka National Park	Despite its remote location, uncontrolled tourist developments are taking place within the national park and helicopter flights for tourists disturb rare species of wild sheep[420].
Spain	Throughout	Visitor pressure is identified as a significant problem for protected areas. Over 3 million people visit Spain's national parks every year[421].
Thailand	Tarutao National Park (II, 149,000 ha)	Waste effluents from tourist lodges and other intensive use zones are polluting the protected area, reducing the area's ability to maintain both environmental values and tourism[422].
UK	Cairngorms National Nature Reserve (IV, 25,949 ha)	There is currently a debate about increased development of skiing facilities within the nature reserve, including a proposed ski lift.
USA	Petrified Forest National Park (II, 37,880 ha)	Rock collectors have totally stripped various sites of their fossil tree covering in this Arizona national park[423].
USA	Yellowstone National Park (II, 899,139 ha)	Use of snowmobiles was blamed because they created trails away from the park that were then followed by bison (*Bison bison*) during severe weather in 1996. Over 1000 bison were killed after straying onto private land[424].
Venezuela	Laguna de Tacarigua National Park (II, 39,100 ha)	Severely under pressure from tourist developments[425].

Chapter 9
External political threats

Political threats are a particular subset of external factors that deserves special attention, because of the unpredictable and extreme nature of the threats they pose. Political opposition to the concept of protection, or to a particular protected area, can cause problems. Armed conflict, including both guerrilla insurrection and full-scale war has an enormous impact on protected areas, alongside the human misery that it brings, both as a result of official and unofficial military action and as a side effect of refugee movements.

Political and local opposition to protected areas

Although most people support protected areas in principle, the reality of having one next door – or having one spring up around you – is sometimes very different. Where protected areas are established without sufficient thought given to local people, or without enough consultation, or where there is a clear associated economic loss, then more-or-less organised opposition can appear. Resentment usually emerges tacitly, through illegal activity within the protected area; indeed many of the "threats" throughout this section could be argued as political opposition to protection. More rarely, it manifests as organised resistance to the legal concept of protection and attempts either to change laws to allow greater use of the resources or even to abandon protection altogether. A case in point is the Rural Alaska Access Rights Bill, introduced to the American Congress in October 1999, which if passed would pave the way for new roads, mining interests, tourism and residential development and open more territory in Alaska's five national parks, Denali, Gates of the Arctic, Glacier Bay, Katmai and Wrangell-St. Elias, to snowmobiles and personal watercraft[426]. In parts of the USA, organised opposition has emerged to some protected areas. While some of this has been connected to the far right and the militia movement, other campaigns are rooted within communities who want to see, for example, increased jobs in the logging industry or economic benefits from mining[427]. In many developing countries, local communities are demanding a share of revenues from the protected area.

Table 9.1: Opposition to protected areas

Country	Protected Area	Details
Cameroon	Benoue, National Park (II, 18,000 ha) Bouba-Njida National Parks (II, 22,000 ha) Faro National Park (II, 330,000 ha)	Interviews with local people showed that most perceived no benefits associated with the protected area and thought that parks had been created for outsiders. Most local people were unaware of rules and regulations and complained of crop damage from wildlife[428].
Italy	Gennargentu National Park	The protected area in Sardinia is bitterly opposed by many local people and the issue has become political, with separatists opposing protection because it comes from the central government. Supporters of the parks have been threatened, mayors have had their vehicles burned and forestry service installations have been blown up[429].
Tanzania	General	Although the majority of people surveyed (70 per cent) living next to protected areas support their continued existence, roughly the same number hold negative or neutral attitudes towards park managers. Over two thirds of people report problems from wildlife destroying crops[430].

War, military activities and protected areas

However well a protected area is planned and managed, managers can do little in the face of major political breakdown or war. In some parts of the world, insurgency, guerrilla activity and war threaten existing protected areas in a number of ways.

Guerrillas and soldiers often kill wildlife for food or for sale (much of Africa's bushmeat trade comes from areas of conflict). Rebels in Liberia have been financing their war efforts by logging, including removals from national parks and other protected areas[431]. In Myanmar, Karen rebels have also allowed loggers from Thailand to extract timber from protected areas, again in exchange for money and weapons[432].

Conflict increases lawlessness and the need for resources in general. Wildlife in Uganda's national parks has still not recovered from a shooting spree by soldier's loyal to Idi Amin at the end of Uganda's civil war[433]. War also usually creates refugees who need food and fuelwood; for example refugees from Rwanda's 1997 civil war have caused major deforestation in protected areas near refugee camps in neighbouring Uganda and Burundi. There are many reports of illegal logging in refugee camps following the civil war and genocide and deforestation rate has probably increased as a result[434]. A study in Francophone Africa identified 24 major protected areas that had been directly threatened by conflict and/or political problems between 1980 and 1990; most of these are still under threat from military activity today. They included protected areas in Rwanda, Burundi and D R Congo, two protected areas on the borders between Cameroon and Nigeria and others in Chad, CAR, Congo Brazzaville, Togo, Guinea, Senegal, Mali and Niger. War has also helped create conditions for widespread ivory poaching, in for example the Central African Republic (by rebels operating in Sudan), Angola and Mozambique[435].

Similar problems have affected areas of India threatened with insurgency (particularly the north-eastern states) and apparently logging has occurred in protected areas caught up in the Afghanistan civil war. During a two-year moratorium on logging in Pakistan, an estimated 3000 truckloads of timber came from Afghanistan, much of which had been logged illegally[436]. It has been estimated that 300,000 m^3 of timber is smuggled from Afghanistan to Pakistan every year although the extent to which this involves logging in protected areas is unknown[437]. Guerrilla activity in Colombia and in the recent past also in Peru has created major threats to protected areas in these regions and former conflicts in Central American countries damaged many protected areas. Protected areas also suffer through the loss of infrastructure, withdrawal of donor funding and loss of tourist revenue and, in some cases, the total withdrawal of management structures[438].

In an increasing number of cases, environmental destruction is itself used as a weapon of war. The spraying of up to 10 per cent of Vietnamese forest with herbicides (the infamous "Agent Orange") by the US military is perhaps the best-known example. However, deliberate arson in forests has also been an important guerrilla tactic in Israel – here the aim being more one of economic damage and nuisance value than direct military gain[439]. Following the Gulf War in 1991, the retreating Iraqi army set fire to several oil installations, causing pollution to marine protected areas in the Gulf region. Forest fires have been set in Corsica and Sardinia by separatist movements.

Not all wars affect all protected areas; experience suggests that national parks and wildlife reserves can often be relatively unscathed by a military campaign, even if threats have driven away protected areas staff. Sometimes, military presence can paradoxically help conservation, at least in the short term. The military zone between Russia and Finland has helped preserve large tracts of the old-growth forest in Karelia that is now some of the most important forest habitat in Europe. Similar wildlife refuges, albeit of a temporary nature, exist between North and South Korea for example.

Preparation for war can also create problems. The UK's Dartmoor National Park has almost half its area set aside for regular military training. Whilst this probably has little long-term impact on the ecology (and certainly less than the sheep grazing that also takes place) it is a major impediment to recreation. Conversely, there are cases where military units can be used for conservation purposes and some military areas also deliberately include conservation amongst their management aims. Armed conflict is perhaps the most intractable of the problems described in this report and one that needs to be addressed on a far larger canvas than that of conservation strategies. In Table 9.2 below, some examples of protected areas currently threatened, or likely to be threatened, by conflicts are given.

Table 9.2: Impacts of armed conflict on selected protected areas

Country	Protected Area	Details
Bosnia Herzegovina	General	Illegal logging in protected areas by Bosnian Serbs was reported immediately after the war[440].
Chad	Zakouma National Park (II, 300,000 ha) Manda National Park (II, 114,000 ha)	These and other protected areas in the country have long suffered from the impacts of guerrilla activity and war[441].
Colombia	Los Katíos National Park 72,000 ha (II, 72,000 ha)	Rebel fighters control several protected areas, hampering conservation efforts. Reports suggest that this has had a number of detrimental impacts, including conversion of land for narcotics production as a way of funding the conflict. For example, Los Katios National Park has been affected several times by confrontations between guerrilla and paramilitary groups[442].
Croatia	Plitvicka jezera (Plitvike lakes) (II, 19,172ha)	The World Heritage Site has been listed as threatened since 1991 due to military occupation and civil unrest; some of these problems may now be receding[443].
Democratic Republic of Congo	Garamba National Park (II, 492,000 ha) Kahuzi-Biega National Park (II, 600,000 ha) Okapi Faunal Reserve (II, 1,372,625 ha) Virunga National Park (II, 780,000 ha)	Project staff have been withdrawn from some of the sites and equipment looted. Encroachment is occurring[444]. Poaching in Garamba has already caused a decline in rhino from 1000 in 1960 to 25 today[445]. Virunga was badly affected by refugees, who initially entered the park to address basic fuelwood or subsistence needs and whose motives later became commercial[446].
Ethiopia	Simien Mountains National Park and World Heritage Site (II, 17,900 ha)	Badly impacted during the civil war, when the area was used as a base by the Tigre Peoples' Liberation Front[447]. Widespread availability of automatic weapons has led to continuing shooting of mammals in protected areas.
India	Manas Tiger Reserve (IV, 39,100 ha)	The separatist movement in Assam has led to political tensions, increased poaching and encroachment in the reserve[448].
Israel	Har Ha-Negev Nature Reserve (IV, 104,900 ha)	Used for military exercises including shooting live ammunition[449].

Continued

Country	Protected Area	Details
Niger	l'Aïr-Ténéré National Nature Reserve (IV, 7,736,00 ha)	Threats from insurgents forced IUCN staff to abandon the area[450] and resulting poaching reduced ostrich (*Struthio camelus camelus*) populations by 90%[451].
Rwanda	Parc National des Volcans (II, 15,000 ha)	In Parc National des Volcans the level of poaching also appears to have increased following the civil war[452].
UK	Dartmoor National Park (V, 95,400 ha)	Used for military exercises including shooting live ammunition[453].
USA	Mojave National Preserve	Expansion of the area used by the army for tank exercises by 62,000 ha northwest of the preserve would destroy animal habitats and effect air quality due to dust[454].
USA	Cabeza Prieta National Wildlife Refuge	The US Air Force is permitted to fly over most of the refuge; at times jet fly 200 feet above the sanctuary and helicopters can operate as low as 50 feet. Biologists warn that these activities threaten the endangered Sonoran Pronghorn, of which only 200 are believed to remain[455].

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Part 3
What do we know already?

Summary of Part 3

This section summarises information previously or currently being collected about the status of protected areas.

- *The World Commission on Protected Areas and its forerunner the Commission on National Parks and Protected Areas carried out several surveys during the 1980s-90s. These focused mainly on protected areas under threat or on general status within regions. An initial evaluation of UNESCO biosphere reserves was also carried out for IUCN in 1995.*
- *The World Heritage Convention has maintained the "World Heritage in Danger" list, that lists sites considered to be "in danger" in terms of losing conservation values.*
- *In 1990, the Ramsar Convention introduced a system of listing important wetland sites that are in danger of losing their conservation values, known as the Montreux List – currently over 50 sites are listed around the world.*
- *WWF has carried out a series of studies of the effectiveness of protected areas. Important examples include those in Central America, Brazil, Peru, Colombia, Pakistan, Cameroon and the Forest Score Cards developed by the European Forest Team.*
- *The Nature Conservancy carried out a wide-ranging analysis in selected parks in Latin America and the Caribbean as part of its Parks in Peril programme in 1995.*
- *The World Conservation Monitoring Centre holds the world's largest database of protected areas; WCMC is currently developing a database on management effectiveness.*
- *The Great Barrier Reef Marine Park Authority, IUCN and the World Bank carried out the first global assessment of marine protected areas in 1995.*
- *The World Bank, has sponsored several important studies including studies of African national parks, protected areas of the Indo-Malayan region and a joint study with WWF on threats to forest protected areas in twelve important forest countries.*
- *A number of governments have also undertaken or commissioned studies of their protected area networks and we summarise work undertaken in India and Canada.*
- *Finally, a number of independent studies have been undertaken including work in Indonesia, Gabon and more generally on global status of protected areas.*

Some general conclusions can be drawn:

- *Many protected areas are currently being degraded as a result of a wide range of threats.*
- *Many more are only secure because of their relative inaccessibility; as infrastructure improves in the developing world these will under increasing pressure.*
- *Estimates for the percentage of protected areas suffering serious threat or damage range from a 25-75% in surveys (excepting parts of Europe, Australasia and North America).*
- *Even in the most developed countries, protected areas remain under threat – for example visitor pressures are likely to increase with a country's average level of income.*

Chapter 10
Previous surveys of protected areas

Threats to protected areas have been recognised since the first areas were put into protection. Over the last fifteen years, increasing numbers of protected areas, the speed of development and renewed attention to environmental issues has meant that there have been a number of attempts at more substantial assessments. The following section outlines some of the progress that has been made to date and tries to answer some basic questions about how large the perceived threats are in practice and where the risks are greatest. This is at best a very initial and partial survey. Most studies of protected areas to date have focused on four or five topics:

- Identification of protection areas under particular threat – i.e. a kind of "red list" of protected areas of the world.

- Studies carried out by country protected area authorities to assess the status of protected areas under their authority – such as those carried out in Canada.

- More detailed studies of particular types of protected areas – for example through instruments such as the World Heritage Convention and the Ramsar Convention.

- Detailed studies of individual protected areas, either through the efforts of particular governments (for example Australia) or because of interests from individual researchers (These studies are not looked at in this section, the findings from many are incorporated into section 2).

- Studies that are involved in developing methodologies for assessment – some of which have also resulted in studies of protected area networks in individual countries.

We are currently in the middle of something of a renaissance of interest in protected areas and information is being generated very quickly. Several new studies have emerged during the course of preparation of this report and it is likely that a far more complete picture will be available in the future. For now, it is worth noting that most early studies looked generally at "threat" rather than "status" while many comtemporary methodologies have considered management status and effectiveness rather than overall security or quality of the protected area. (These two are very different: a well managed protected area can still decline if the threats facing it are sufficiently severe, while conversely a totally unmanaged area can through remoteness or good fortune sometimes remain in good condition.) In the following chapter, we give a brief overview of studies to date. Note that here we are interested in summarising results rather than examining methodologies; another report developed through the IUCN/WWF Forest Innovation Project is currently examining options for assessment[1].

World Commission on Protected Areas and IUCN

The World Commission on Protected Areas (WCPA), and its forerunner the Commission on National Parks and Protected Areas, carried out several surveys during the 1980s and early 1990s. Not surprisingly, these focused mainly on protected areas under particular threat. In 1984 it published *Threatened Protected Areas of the World*, that listed 43 threatened protected areas and 13 categories of threats – perhaps the first attempt at a global survey of extent and types of threat[2]. This was followed up in 1991 with *The IUCN Register of Threatened Protected Areas of the World*, which listed 91 threatened protected areas in 50 countries[3].

IUCN also commissioned studies of protected areas in particular areas of the world, which included a first quick survey of management effectiveness. In 1986, major studies were published on the Indo-Malayan realm[4] and tropical Africa[5]. These were necessarily brief overviews with regional analyses

categorised verbally, for example in the Indo Malayan realm: “some good, majority adequate”, “generally fairly poor”, “virtually no protection”. In some areas scores had been assigned for effectiveness although coverage was incomplete.

Then, drawing on information collected for the 1992 World Parks Congress, IUCN and WCMC published a major global assessment of protected areas, extent, issues, threats and status, finally published in 1994. However, despite its length the overview had comparatively little on threats; regional overviews were prepared by different authors who approached the issue in different ways and threats tended to be identified in general terms, with sometimes a few examples[6]. IUCN has also collaborated on the production of an important four-volume study of marine protected areas, including notes on their status (see section under World Bank below).[7] At the time of writing this is being updated, scheduled for publication in late 2000. Finally IUCN produced a major status report on protected areas in Oceania although this did not include analysis of threats or effectiveness[8].

World Heritage Convention

IUCN has also been closely identified with attempts to monitor progress towards implementation of the World Heritage Convention and particularly surveys of threats to World Heritage Sites. The IUCN Protected Areas Programme has provided assistance to the Convention in the form of evaluation, preparation of *State of Conservation Report* and input to training. It contributes information useful to the “World Heritage in Danger” list, a politically important document that lists sites considered by the managing committee to be “in danger” in terms of losing conservation values. However, criteria for inclusion remain fairly vague; some countries ask for protected areas to be added to gain political support for improvement while in others inclusion is regarded as a serious issue. Whilst few formal publications have emerged from this process, the regular minutes of the “Convention concerning the Protection of the World Cultural and Natural Heritage”, and the *Reports on the State of Conservation of Properties inscribed on the List of World Heritage in Danger* provide information. In addition, IUCN produced two status reports on World Heritage Sites during the late 1990s, focusing on forests[9], freshwaters and marine protected areas[10]. The surveys also include information about the “in danger” list – see Table 10.1 below.

Table 10.1: World Heritage in Danger List: Natural Heritage Sites

Country	Site	Date of listing	Main threats
Brazil	Iguacu National Park	30/11/1999	Hydro-Electric Power plans
Bulgaria	Srebarna Nature Reserve	14/12/1992	Habitat loss
Central African Republic	Manovo-Gounda St. Floris National Park	6/12/1997	Civil war
Côte d’Ivoire and Guinea	Mount Nimba Nature Reserve	14/12/1992	Mining threats
DR Congo	Virunga National Park	17/12/1994	Civil war
DR Congo	Garamba National Park	7/12/1996	
DR Congo	Kahuzi-Biega National Park	6/12/1997	
DR Congo	Okapi Wildlife Reserve	6/12/1997	
DR Congo	Salonga National Park	30/11/1999	
Ecuador	Sangay National Park	14/12/1992	Numerous
Ethiopia	Simen National Park	7/12/1996	Decline in *Walia ibex*
Honduras	Rio Platano Biosphere Reserve	7/12/1996	Agriculture

Continued…

Country	Site	Date of listing	Main threats
India	Manas Wildlife Sanctuary	14/12/1992	Civil war
Niger	Air & Ténéré Natural Reserves	14/12/1992	Civil war
Tunisia	Ichkeul National Park	7/12/1996	Pollution
Uganda	Rwenzori Mountains National Park	30/11/1999	Civil war
USA	Everglades National Park	11/12/1993	Pollution
USA	Yellowstone National Park	9/12/1995	Mining threats

The World Heritage Convention also provides for periodic reporting on the status of World Heritage sites and a number of reports have been received from time to time (reporting by many countries has been poor or non-existent and some of those that have reported have largely treated this as an exercise in public relations. But things are changing and the World Heritage Committee is moving to a more structured and rigorous method of regional reporting. The World Heritage Centre is currently looking for appropriate methodologies for assessment in association with WCPA.

Biosphere reserves

An initial evaluation of the coverage and management effectiveness of UNESCO biosphere reserves was carried out for IUCN as an input to an international conference at Seville, Spain in March 1995[11]. Management effectiveness was first defined, with reference to existing definitions and a questionnaire sent around to sites in the International Biosphere Reserve Network. As little over 10 per cent of the recipients replied (36 in total roughly equally distributed between less developed, transitional and developed countries), the survey was only presented as an indication of trends. Approximately 80 per cent of respondents had approved and implemented management plans or had them in preparation.

Table 10.2: Survey of effectiveness in biosphere reserves

Issue	Number of biosphere reserves			
Management	Core area only	Core area and buffer zone	Core area, buffer and transition zone	None
Management plan approved/ in preparation	8	8	19	1
Legal protection	10	9	14	3
Conservation objectives identified	8	9	16	3
Research	Percentage saying yes		Percentage saying no	
Research taking place	86		14	
Research facilities	69		31	

The Ramsar Convention

IUCN also provides an institutional home to the Ramsar Convention at its headquarters in Switzerland. The mission of the Convention on Wetlands of International Importance (Ramsar) is:

> *"The conservation and wise use of wetlands by national action and international cooperation as a means of achieving sustainable development throughout the world"*

The main obligation for those signing the convention – the contracting parties – is to designate sites for the "Ramsar List"; that is areas of wetland of international importance that are managed to avoid changes to their "ecological character". The majority of the over a thousand sites listed are at least partially covered by protected area designation and nearly 50 per cent include a marine component[12]. Such areas need not necessarily be formal protected areas and indeed many will continue to experience commercial and artisanal use of various types, but designation does show that governments regard their conservation as being of particular importance.

In 1990, Ramsar introduced a system of listing sites that are in danger of losing their conservation values, known as the Montreux List. The first list was published as a report in 1990[13], since then regular updates have been contained in minutes of meetings.

Table 10.3: Ramsar sites listed on the Montreux record

Country	Ramsar site	Date of designation	Region and area in hectares	Added to Montreux record
Algeria	Lac Tonga	04/11/83	Et Tarf, 2,700	16/06/93
Austria	Donau-March-Auen	16/12/82	Nieder Österreich, 38,500	04/07/90
Belgium	De Ijzerbroeken te Diksmuide en Lo-Renige	04/03/86	Vlaamse Gewest, 2,360	Placed on list for second time: 17/05/99
	Schorren van de Beneden Schelde	04/03/86	Vlaamse Gewest, 420	04/07/90
Bulgaria	Durankulak Lake	28/11/84	Varna, 350	16/06/93
	Srebarna	24/09/75	Silistra, 600	16/06/93
Costa Rica	Palo Verde	27/12/91	Guanacaste, 19,800	16/06/93
Croaria	Kopacki Rit	03/02/93	17,770	16/06/93
Czech Republic	Litovelské Pomoraví	02/11/93	Olomouc, Sumperk, 5,122	26/02/97
	Novozámecky a Brehynsky rybník (Novozámeckv/Brehynsk y fishponds)	02/07/90	C. Lípa, 923	18/09/94
	Trebonská rybníky (Trebon fishponds)	02/07/90	J. Hradec, Tábor, C. Budejovice, 10,165	18/09/94
Denmark	Ringkøbing Fjord	02/09/77	Ringkøbing, 27,520	04/07/90
Egypt	Lake Bardawil	09/09/88	59,500	04/07/90
	Lake Burullus	09/09/88	Kafr El Sheikh, 46,200	04/07/90
Germany	Wattenmeer, Ostfriesisches Wattenmeer & Dollart	26/02/76	Niedersachse, 121,620	04/07/90

Continued…

Country	Ramsar site	Date of designation	Region and area in hectares	Added to Montreux record
Greece	Amvrakikos gulf	21/08/75	Aitoloakarnania, Preveza, Arta, 23,649	04/07/90
	Axios, Loudias, Aliakmon delta	21/08/75	Thessaloniki, Imanthia, Piera, 11,808	04/07/90
	Kotychi lagoons	21/08/75	Ileia, 6,302	04/07/90
	Lake Vistonis, Porto Lagos, Lake Ismaris	21/08/75	Rodopi, Xanthi, 24,396	04/07/90
	Lakes Volvi & Koronia	21/08/75	Thessaloniki, 16,388	04/07/90
	Messolonghi lagoons	21/08/75	Aitoloakarnania, 33,687	04/07/90
	Nestos delta & adjoining lagoons	21/08/75	Xanthi, 21,930	04/07/90
Guatemala	Laguna del Tigre	26/06/90	El Petén, 48,372	16/06/93
India	Chilka Lake	01/10/81	Orissa, 116,500	16/06/93
	Keoladeo National Park	01/10/81	Rajastan, 2,873	04/07/90
	Loktak Lake	23/03/90	Manipur, 26,600	16/06/93
Iran	Alagol, Ulmagol & Ajigol Lakes	23/06/75	Mazandaran, 1,400	16/06/93
	Anzali Mordab (Talab) complex	23/06/75	Gilan, 15,000	31/12/93
	mun-e-Puzak – south end	23/06/75	Sistan & Baluchestan, 10,000	04/07/90
	mun-e-Saberi & mun-e-Helmand	23/06/75	Sistan & Baluchestan, 50,000	04/07/90
	Neyriz Lakes & Kamjan Marshes	23/06/75	Fars, 108,000	04/07/90
	Sdegan Marshes & mudflats of Khor-al Amaya & Khor Musa	23/06/75	Khuzestan, 400,000	16/06/93
	Shurgol, Yadegarlu & Dorgeh Sangi Lakes	23/06/75	Azarbayjan-e Grbi, 2,500	04/07/90
Italy	Laguna di Orbetello	14/12/76	Toscana, 887	31/12/93
	Palude della Diaccia Botrona	22/05/91	Toscana, 2,500	31/12/93
	Stagno di Cagliari	14/12/76	Sardegna, 3,466	04/07/90
	Stagno di Molentargius	14/12/76	Sardegna, 1,401	04/07/90
	Torre Guaceto	21/07/81	Puglia, 940	31/12/93

Continued…

Country	Ramsar site	Date of designation	Region and area in hectares	Added to Montreux record
Jordan	Azraq Oasis	10/01/77	7,372	04/07/90
Poland	Jezioro Siedmiu Wysp	03/01/84	Suwalki, Olsztyn, 999	04/07/90
	Slonsk Reserve	03/01/84	Gorzów, 4,235	16/06/93
Senegal	Djoudj	11/07/77	Fleuve, 16,000	16/06/93
	Bassin du Ndiael	11/07/77	Saint-Louis, 10,000	04/07/90
South Africa	Orange River Mouth	28/06/91	Northern Cape, 2,000	26/09/95
	Blesbokspruit	02/10/86	Gauteng, 1,858	06/05/96
Spain	Doñana	04/05/82	Andalucía, 50,720	04/07/90
	Las Tablas de Daimiel	04/05/82	Castilla-La Manc, 1,928	04/07/90
Trinidad & Tobago	Nariva Swamp	21/12/92	Trinidad, 6,234	16/06/93
Tunisia	Ichkeul	24/11/80	Bizerte, 12,600	04/07/90
Uganda	Lake George	04/03/88	Toro Province, 15,000	04/07/90
Ukraine	Karkinitski & Dzrylgatska Bays	23/11/95	87,00	04/07/90
	Tendrivska Bay	23/11/95	Khersonka Oblast, 38,000	16/06/93
	Yagorlytska Bay	23/11/95	Khersonka/Mykolaivska Oblasts, 34,000	16/06/93
UK	Dee Estuary	17/07/85	England, Wales, 13,055	04/07/90
USA	Everglades	04/06/87	Florida, 566,143	16/06/93
Uruguay	Bañados del Este y Franja Costera	22/05/84	Roc, Treinta y Tres, 435,000	04/07/90
former USSR	Issyk-kul Lake	11/10/76	Republic of Kyrgyzstan, 629,800	04/07/90
	Kirov Bays	11/10/76	Republic of Azerbaijan, 132,500	04/07/90
	Lakes of the lower Turgay & Irgiz	11/10/76	Republic of Kazakhstan, 348,000	16/06/93

Ramsar staff and consultants regularly undertake site visits and information on threats is available on an *ad hoc* basis on the convention's web site

NGOs

In the last decade, there has also been a considerable increase in interest in the status of protected areas from NGOs, some of which have put considerable time and resources into developing ways of measuring protected area effectiveness.

WWF

WWF has, both globally and within individual national organisations and programme offices, carried out a series of studies of the effectiveness of protected areas, both for internal planning processes and as a tool for advocacy and policy-making. Some examples are given in the following section. In some cases, most notably in a professional partnership between WWF Central America and the research university CATIE, this has evolved into a sophisticated assessment tool aimed at adaptive management and this has been used for example in the development of the Galapagos National Park management plan[14]. More recently, WWF has been involved in developing rapid assessment methods aimed at identifying strengths and weaknesses at a regional or national level, including a system co-developed with the World Bank[15] that is currently being tested in Algeria, China, Cameroon and Gabon, and in various national and regional studies summarised below.

WWF Brazil

WWF Brazil has analysed the current situation in all the federal conservation areas reserved for indirect use that are over 6 years old, in other words 86 out of the total of 91 protected areas in Brazil. The resulting report[16] reveals that:

- Implementation – of the 86 areas assessed, 47 (or 54.6 per cent) are in a precarious state, to the point that they cannot perform the tasks for which they were created, 32 (37 per cent) were considered to be minimally implemented and a mere 7 (8.4 per cent) could be said to have been implemented to a reasonable degree.

- 96 per cent of the areas in the Northern Region have less than half the ideal number of staff. Nationally, 73 per cent of the conservation areas are understaffed. For example, Jaú National Park in Amazonas, the largest protected area in Brazil and the second largest tropical forest park in the world, has only 5 staff (two from IBAMA and three service providers) to manage and inspect an area of 22,720 km^2, two-thirds the size of Belgium.

- 62 per cent of the conservation areas in Brazil are being used in ways that clash with the purpose of the law.

- Approximately 45 per cent of the conservation areas have less than half the funding they need for implementation.

- In the Northern Region, 35 per cent of the conservation areas have equipment or vehicles, but not the supplies or materials to use them (such as gasoline), or vice-versa.

- About 28 per cent of the conservation areas have inadequate infrastructure in place; they do not even have any administrative headquarters. The same number of protected areas has legalised less than half their lands.

- Not a single one of the conservation areas in the Southern Region has a management plan.

As a result, the number of areas in Brazil that are really protected is much lower than indicated by official statistics. Officially, the 86 conservation areas studied by WWF provide protection for 1.85 per cent of Brazil's national territory. However, aside from the parks and reserves classified as precarious, only 0.4 per cent of Brazil's territory is effectively protected.

Vulnerability – of the 86 areas assessed, 37 (43.1 per cent) were felt to be somewhat or very vulnerable to human activity, while 49 (56.9 per cent) were considered to be only slightly vulnerable.

41 per cent of the conservation areas reserved for indirect use are surrounded by spaces in which more than half the land has been cleared. Much of the land in these outlying areas is being used for intensive farming, or has been taken over by industrial hubs, urban centres or mining companies.

After working with the Brazilian National Agency-IBAMA to produce a joint analysis of the data on implementation and vulnerability, a "risk matrix" was created to group the 86 conservation areas into four classifications, in accordance with the degree of risk faced by each area. (Parks or reserves were felt to be at greater risk as their vulnerability scores increased and as their implementation scores dropped). The status of the Brazilian parks and reserves according to the risk matrix is the following:

- 20 conservation areas (23.2 per cent of the total) are at "extremely high risk";
- 17 conservation areas (19.7 per cent) are at "high risk";
- 27 conservation areas (31.3 per cent) are at "medium risk";
- 22 conservation areas (22.5 per cent) are at "normal risk";

In short, three quarters of Brazil's parks and reserves are endangered because of a combination of non-implementation and high vulnerability.

When implementation was studied, several key problems appeared, including the absence of a management plan (this document is mandatory when planning park activities) and the lack of sufficient staff. Furthermore, many of the parks and reserves are being used for activities that come into conflict with the purpose of the protected areas, and in several locations lands have not even been demarcated yet.

In addition to implementation, another major problem revealed by the study was the clearing and settlement of land in the regions surrounding parks and reserves, primarily for urban and agricultural purposes. Most of the protected areas have thus become veritable "forest-islands".

When asked about vulnerability, the respondents in the study mentioned activities that clash with the purpose of the park or reserve (such as illegal logging) and the exploitation of natural resources within the protected areas. These are just two of the problems faced by almost every one of the conservation areas reserved for indirect use. The report also reveals that current conservation areas do not perform their role in terms of research or visitation, and that they are badly distributed throughout Brazil. Brazil's federal budget for 1999 has been slashed, so the situation will probably get even worse. The information in the report was collected in April 1998 by questioning the conservation area supervisors, who are IBAMA employees. Each question was followed by five possible answers, with scores for each question ranging from 0-4 points.

Each conservation area was measured in terms of implementation and vulnerability on the basis of the average score for that area, as follows:

- **Implementation** – areas with an average implementation score of 0-1.99, were considered to be precarious, those with scores of 2.0-2.99 were considered to be minimally implemented areas, and those with scores of 3.0-4.0 were considered to be reasonably implemented conservation areas.

- **Vulnerability** – here the scores were inverted. Areas with an average score of 3.0-4.0 were considered to be highly vulnerable, those with scores of 2.0-2.9 were felt to be vulnerable to an average degree, and those with scores of 0-1.99 were felt to be only somewhat vulnerable.

The WWF report on the degree of vulnerability and implementation in Brazil's national parks and reserves is the first qualitative and quantitative assessment of the country's conservation areas. WWF worked with IBAMA to develop the assessment methodology, which can be adopted by the Ministry of the Environment in future studies on the status of federal parks and reserves. The method would also work well at the state and municipal level.

WWF Brazil's Risk Matrix

A risk matrix is proposed as a planning instrument that will help indicate priorities for the application of human and financial resources to Brazilian Protected Areas. This matrix combines the average levels of implementation and vulnerability for the 86 protected areas covered by this study. The areas are placed into four groups according to the level of overall risk, defined as the correlation between the extent of implementation and the vulnerability of the area (Figure 4). The greater the vulnerability and the lower the level of implementation, the higher the risk faced by the protected areas in question.

The first group, denominated **"extreme risk"**, comprises 20 areas (23.2% of the total) with the lowest level of implementation and the highest vulnerability (Figure 4). The Sauim-Castanheira Ecological Reserve (Amazonas) and the Chapada de Diamantina National Park (Bahia) are examples which have minimum implementation and are highly vulnerable to human interference. In the case of these protected areas, application of resources should be geared to maximising efforts to extend implementation while at the same time reducing vulnerability.

The second group, denominated **"high risk"**, comprises 17 areas (19.7%) with minimum implementation or with reasonable implementation but high vulnerability. The Monte Pascoal National Park (Bahia) and the two Parks in the Cerrado — the Brasília National Park (Federal District) and the Emas National Park (Goiás) — are good examples. Action relating to this group should be designed to minimise the effects of vulnerability inside the protected areas and in the surrounding areas.

The third group, denominated **"medium risk"**, comprises 27 areas (31.3%) with medium vulnerability that have not been implemented. Examples include the Jaú National Park (Amazonas) and the Raso da Catarina Ecological Reserve (Bahia). The recommendation for this group would be to focus on extending the level of implementation.

The fourth group, denominated **"normal risk"**, comprises 22 areas (25.5%) with minimum or reasonable implementation and low to medium vulnerability. Action regarding this group should aim to conclude implementation and take preventive measures to reduce vulnerability still further, especially in surrounding protected areas.

Classification of risk into four groups does not necessarily mean that human and financial resources should be invested primarily in areas classed under extreme risk rather than normal risk. Regardless of the group in which they are placed, all protected areas require resources for ongoing maintenance, and no protected area analysed has been fully implemented. The classification is designed to contribute towards efforts to maximise the effectiveness of the action taken by the organisations responsible for managing protected areas and to help channel any additional resources in accordance with the priorities established.

This section has been reproduced (and slightly edited), with permission, from WWF Brazil's project summary.

WWF Pakistan

WWF Pakistan carried out a survey of status, representativeness and threats to protected areas in the country during 1997[17]. The assessment covered issues of protected area size and location, biodiversity, criteria for consideration, representative ecoregions, ecological characteristics and social structure. Threats were identified, although in the final report these were not linked to specific protected areas.

Table 10.4: The main threats identified, by category, identified in Pakistan's protected areas

(Table constructed by the authors with reference to the original paper)

Threats to protected areas in Pakistan	
Issue	Details
Developmental threats	
Introduction of exotic species	Strictly forbidden in protected areas and their buffer zones
Human population expansion	Increased settlement in and around protected areas is leading to degradation of natural resources.
Increased agricultural practices	Resulting in clearfelling of forest patches in protected areas
Mining extraction	This sometimes includes building roads causing fragmentation of habitat
Infrastructure construction	Causes habitat fragmentation
Drainage, siltation and pollution	All these threats are causing problems in wetlands in protected areas near human habitation
Social threats	
Pressure from outside hunters	Causes threats to fauna
Human and livestock pressure	Many people are greatly dependent on protected areas resources: fuelwood, timber, fodder, NTPs, for their daily requirements
Lack of commitment/involvement of the buffer zone community	Communities are generally not involved in management or decision-making leading to their lack of commitment
Ill-defined ownership rights	Many protected areas and buffer zones are poorly demarcated
Traditional rights of the community	These are becoming unsustainable with rising population; both human and livestock
Political pressure	Influential people, including high government officials, encourage poachers and influence their court trials while caught poaching
Lack of awareness in the local community	Insufficient institutional capacity causing natural resource degradation
Inter-communal conflicts	These conflicts further resource destruction
Legal and administrative threats	
Conflicts between buffer zone communities and custodian departments	One of the major threats facing wildlife population: major stakeholders are tending to over-exploit these resources and fail to cooperate on management issues
Lack of financial resources	Conservation objectives cannot be achieved without adequate financial inputs
Law and order situation/ political instability	Issues of political instability are diverting needful resources from conservation works
Lack of management plans	Many protected areas lack management plans, biodiversity surveys, history files, maps, etc
Lack of field staff	Causes reduced capacity to conserve
Lack of transport facilities	As above
Weak implementation of existing rules and regulations	As above
Lack of clearly defined boundaries	Core areas and buffer zones are not well defined
Encroachment in protected areas	Causes fragmentation of habitat
Hunting by government officials	Illegal shooting by government officials is setting a bad example to the local population.

WWF Peru

Peru has 49 protected areas and large areas of "reserved zones" that may later become protected areas – recent extension of protection has been entirely through the latter. Protected areas face many threats including resource extraction, uncontrolled tourism, cattle grazing, lack of capacity, high staff turnover, intra-government conflicts and lack of support from local authorities. In 1997 the Centre for Data for Conservation (CDC) in Lima and WWF developed a matrix questionnaire, with USAID funding, and applied this to 14 protected areas. It was used to identify 7 priority areas for action. Nine criteria were used (training, size, infrastructure, zoning, long-term financing, master plan, boundary demarcation, budget and land tenure). The system focuses on management rather than directly on biodiversity conservation. Secondary information was used wherever possible; protected areas scoring lowest were targeted for immediate action. WWF is currently working to update the system in co-operation with CDC and Profonanpe and the survey will be increased to more areas in the future[18]. A threat analysis has been completed for Paracas National Reserve and at the time of writing is underway using secondary information and some fieldwork in Pacaya Samiria National Reserve and Manu Biosphere Reserve[19].

WWF research in Cameroon

An analysis of the protected areas in Cameroon[20], funded by WWF Netherlands and published by WWF Cameroon and the Ministry of Environment and Forests MINEF in 1997, aimed to provide "a rational analysis of the ecological adequacy of the … protected area system and … make propositions to correct any imbalances. The ecological coverage, management and finances of the PA system were investigated and the report suggested a framework for monitoring and evaluation".

A study of the conservation status of the protected area system was carried out as part of the project. It looked at habitat degradation/trend, contiguity with similar habitat and protection. Scores were allocated to each PA: habitat degradation (5=severe, 3=some, 1=insignificant); contiguity (5=poor, 3=average, 1=good); protection (6=inadequate; 4=declining; 2=improving; 0=adequate). A summary of the results is given in Table 10.5 below.

Table 10.5 Ranking of protected areas by conservation status (low score = high conservation status)

PA	Degradation	Contiguity	Protection	Score
Dja Wildlife Reserve	1	1	0	2
Bouba Ndjidah National Park	1	1	2	4
Banyang Mbo Wildlife Sanctuary	1	1	2	4
Waza National Park	3	1	2	6
Benoué National Park	3	1	4	8
Korup National Park	1	1	6	8
Faro National Park	1	3	6	10
Mbi Crater Wildlife Reserve	3	3	4	10
Mozogo-Gokoro National Park	1	5	4	10
Campo Wildlife Reserve	3	3	6	12
Kimbi River Wildlife Reserve	3	3	6	12
Lake Ossa Wildlife Reserve	3	5	6	14
Douala-Edea Wildlife Reserve	5	5	6	16
Kalamaloué National Park	5	5	6	16
Santchou Forest Reserve	5	5	6	16

These data were compared with key threats to the protected areas, listed in Table 10.6 below.

Table 10.6: Summary of key threats to protected areas

Protected Area	Key threats
Dja Wildlife Reserve	Two of the five ethnic groups in the park are dependant on hunting – however effects are only serious at the edges of the reserve. Possible logging concessions along the northern boundary of the reserve are a potential future threat.
Bouba Ndjidah National Park	Threats to security from local bandits are impacting tourism and park management. The northern third of the park has been virtually abandoned by park staff due to incursions of poachers from Chad. Poaching has seriously reduced numbers of black rhino.
Banyang Mbo Wildlife Sanctuary	Three villages are located within the reserve, and a further two villages have cash crop plantations in the reserve. Elephants have been killed following incidents of crop damage.
Waza National Park	Although poaching in the park is not a serious threat species tend to move out the reserve in the dry season to the settled Logone floodplains where poaching is more prevalent.
Benoué National Park	Heavy poaching represents the most severe threat to the park – the black rhinoceros, for example, is no longer found in the park. Wildlife numbers are very low adjacent to the paved and unpaved roads that run alongside and within the park.
Korup National Park	Small logging operations outside the park are opening up the area to hunters and there is an escalation of elephant poaching. Hunters also supply the logging camps with small game. There is a strong bushmeat and NTFP (rattan and chewing sticks) trade between some villages in the park and Nigeria. Pools in rivers are poisoned with the agricultural fungicide Gammalin during the dry season.
Faro National Park	Poaching pressure is heavy in particular from Nigerian poachers.
Mbi Crater Wildlife Reserve	Since 1986, the reserve has been dominated by the activities of a politically influential Fulani businessman. Several structures, including a large house, mosque and barns, have been built on the valley floor, wheat has been planted and large numbers of stock are now grazed in the reserve.
Mozogo-Gokoro National Park	Firewood collection is widespread. Poaching is not a severe problem probably due to the fact that the numbers of desirable species are low (older records suggest this was not always the case).
Campo Wildlife Reserve	Logging is the greatest threat to the integrity of the park, along with associated problems such as immigration and over-hunting. Wildlife populations are decreasing due to poaching and the hippopotamus is no longer found in the reserve.
Kimbi River Wildlife Reserve	A powerful local grazier has introduced cattle into the reserve and has undertaken small-scale felling. Large mammal populations are very low, probably due to poaching.
Douala-Edea Wildlife Reserve	Encroachment and immigration into the reserve pose the greatest threat; the population in the mid-1990s was over 8,000 people. Hunting pressures are heavy, as in some villages it the only form of sustenance and income.
Lake Ossa Wildlife Reserve	Fishing in the lake is not controlled and some minimal trapping of manatees (the preservation of which is the primary aim of the protected area) has been recorded.

Continued…

Protected Area	Key threats
Kalamaloué National Park	A recent (estab. 1987) village in the east of the park is expanding increasing grazing pressures. Chadians enter the park to fish – using nets and poison. Poaching has caused the decline of kob from 2,700 (1979) to 100 (1996) and warthog 5-600 (1979) to about 50 (1996), and topi and reedbuck are no longer found in the park. The Cameroonian armed forces and Chadians apparently carry out poaching. There are frequent acts of armed banditry in the area.
Santchou Forest Reserve	Settlements and farms cover 30-40 per cent of the reserve area. The immigrant farmers have introduced cash crops, such as cacao and coffee. Poaching is widespread and wildlife populations are scarce. It is possible that the government will degazette the reserve.

WWF European forest scorecards

WWF's European Forest Team has carried out an experts' survey of forest status in 19 European countries[21], including the status, planning and management of protected forest areas. The survey is conducted through an extensive questionnaire, filled in by consultants in each country taking part. The survey takes place each year, or every few years, and scores are compared to show trends in management. The results are controversial because they "score" government performance and generate considerable press interest within Europe; they are also currently the most comprehensive attempt to assess effectiveness of protected areas in the region, albeit focused solely on forest protected areas.

The results for the 13 questions relating to protected forest areas are summarised in Table 10.7. Questions were scored according to set criteria. For example, the scoring for the quality of active management is as follows:

Points	Comments
4	All or almost all of the protected forest area that requires active management is well managed in order to sustain or enhance biodiversity values
3	Most of the protected forest area that requires active management is well managed in order to sustain or enhance biodiversity values
2	A substantial part of the protected forest area that requires active management is well managed in order to sustain or enhance biodiversity values
1	Some of the strictly protected forest area that requires active management is well managed in order to sustain or enhance biodiversity values
0	The management of protected forest areas that requires active management do not meet the above demands

Table 10.7: Summary of protected area assessments in the European Forest Scorecards

	Gap analysis of protected forest areas	Area of forest protected forest areas	Govt commitment on area of protected forest areas	Legal implementation of Habitat Dir. (EU countries)	Data quality of ecological representation	Ecological representation in protected forest areas	Data quality concerning size and geog. distribution of PFAs	National geographical distrib. of protected forest areas	Size distribution of protected forest areas	Management plans of protected forest areas	Quality of active management of protected forest areas	Quality of protection of protected forest areas	Trend in protected forest areas
Max points	**2**	**4**	**2**	**2**	**2**	**4**	**2**	**4**	**4**	**2**	**4**	**4**	**4**
Austria	0	0	1	1	1	2	2	2	2	1	3	3	0
Estonia	0	1	1	-	1	2	2	3	2	1	1	2	1
Finland	1	2	1	1	2	1	2	1	2	2	1	4	2
France	0	1	1	1	1	2	2	2	4	2	1	2	0
Germany	0	1	0	1	0	1	1	1	1	1	1	2	0
Greece	0	1	2	2	2	2	2	3	3	2	1	1	0
Hungary	0	2	0	-	1	2	2	4	3	1	1	4	2
Latvia	0	1	2	-	0	1	1	1	2	0	0	1	0
Lithuania	0	2	0	-	0	1	2	3	2	0	1	2	2
Netherlands	0	1	1	1	2	1	2	2	1	2	3	3	1
Norway	1	0	0	-	1	1	2	1	1	1	1	4	0
Poland	0	1	2	-	1	1	2	2	2	1	2	2	2
Romania	0	1	1	-	2	2	1	2	2	1	1	1	1
Slovakia	1	2	1	-	2	3	2	3	3	1	2	3	2
Spain	1	2	1	2	1	2	2	2	3	0	2	2	2
Sweden	2	1	1	1	1	1	1	1	1	1	1	4	0
Switzerland	2	0	1	-	1	1	2	1	1	1	1	3	1
Turkey	0	1	1	-	1	2	2	3	3	1	1	2	1
UK	0	1	1	1	1	1	2	2	1	1	1	2	1

It was concluded that the quality of active management in forest protected areas is generally very poor. The quality of protection is mixed, being fully satisfactory only in the Nordic countries and Hungary while serious problems are reported from Greece, Latvia and Romania.

The Nature Conservancy
Parks in Peril

The Nature Conservancy (TNC) launched its Parks in Peril Program (PiP) in 1990 as a response to the rapid creation of parks in Latin America and the Caribbean (LAC) that have no effective management and a high degree of threat[22]. In 1995, TNC and its partner organisations undertook a broad analysis of the ecological, social and political issues faced by parks in the PiP portfolio. Within each of the Conservancy's LAC regional programmes individual sites were nominated as being representative of the diversity of issues that were making it difficult to manage protected areas effectively. For each site the Conservancy identified case study authors who were external to the Conservancy and the PiP programme, but experts in protected area issues. The case study authors undertook site visits to most of the parks and worked with partner organisations to research, synthesise and analyse existing information. Discussions were held with staff, managers, representatives, staff at other NGOs and local communities. Finally the case studies were reviewed at a workshop of case study authors and Conservancy staff. A set of common themes was reviewed at each site to allow comparative analysis of the results.

Virtually all the parks studied were vulnerable to large-scale threats, which had their origins far from the park boundaries. Results are summarised in Table 10.8 below.

Table 10.8: The Nature Conservancy *Parks in Peril* Programme

Protected Area	Threats
Mexico: Yucatan – Ría Celestún (IV, 59,130 ha) and Ría Largartos (IV, 47,840 ha) Special Biosphere Reserves	Salt mining, roads, colonisation, tourism, marine overuse, grazing (Lagartos only), conflicting policies, pollution.
Belize: Rio Bravo Conservation and Management Area (IV, 68,752 ha)	Potential threats from logging, oil, colonisation, expansion of agricultural frontier and grazing.
Guatemala: Sierra de las Minas Biosphere Reserves	Agricultural expansion by communities in the reserve, problems with tenure, weak government institutions.
Costa Rica: Corcovado National Park (VI, 263,300 ha)	Logging around the park, gold mining, roads, telephone and electricity infrastructures, colonisation around the park, vacation homes and tourism, marine overuse, conflicting policies, weak institutions and policy.
Dominican Republic: Del Este National Park (II, 80,800 ha)	Tourism development outside the park is a potential threat if unmanaged. Other threats include marine overuse, grazing outside the park, inconsistent and unclear policies.
Bolivia: Amboró National Park (II, 637,600 ha)	Access due to highway, potential threat from expanding agricultural frontier – cocoa growing and processing, possible management problems.
Ecuador: Machalilla National Park (II, 55,059 ha)	Overgrazing and timber poaching, uncontrolled tourism, possibly over fishing.
Ecuador: Podocarpus National Park (II, 146,280 ha)	Gold mining, road construction (thus colonisation and logging), potential expansion of grazing and agriculture.
Peru: Yanachaga-Chemillen National Park (II, 122,000)	Potential threats from government sponsored colonisation, park has petroleum, gas and mineral resources that could be potentially be exploited, logging, potential drugs trafficking problems.

The threat that was noted most often by the case study authors was linked to policies. Weak government and changes in laws regarding tenure, were frequently mentioned, particularly as these were areas where park management agencies felt they had least control. Related to this was the fact that the second most common threat was infrastructure development in or near park boundaries. Five of the parks studied had seen recent improvements in the infrastructure and access, leading to potential problems such as logging, colonisation, and resource use in general.

World Conservation Monitoring Centre

WCMC, based in Cambridge, England, is the holder of the world's largest database of protected areas. It produces the *UN List of Protected Areas* every three years and also holds additional information on size, legal status and, to a certain extent, management and threats. Until recently status data have been sparse although WCMC co-ordinated a series of status sheets for World Heritage Sites that included information on protection status[23]. WCMC is currently developing a new database dealing specifically with management effectiveness of protected areas.

WCMC also carried out a detailed expert's workshop of status and threats of forests in the Congo Basin in 1997, in association with WWF. This identified concession boundaries, status of protected areas and threats from logging, hunting and mining. It formed the basis of information used at the Yaoundé Summit of forest ministers from the Congo region[24].

World Resources Institute

WRI has not carried out surveys of protected areas as such, but has co-ordinated a series of important status reports that include impacts on protected areas, particularly with respect to forests, coral reefs and seashore communities in the face of climate change and sea-level rise.

WRI's Global Forest Watch programme is monitoring status of "frontier forests", defined as remaining areas of large near-natural forest. This work includes considerable information gathering on both the location and the status of protected areas including logging concessions, primary and secondary forests and other influences such as mining concessions. Information is published in occasional reports and is available on the web.

A WRI study, carried out with several collaborators, has also identified threats to coral reefs, including but not particularly those in protected areas[25].

Conservation International

CI is currently carrying out a study of 93 protected areas in 23 countries.

The World Bank

Although protected areas have not until recently been a central interest of the World Bank, it has sponsored several important studies.

Marine protected areas: the Great Barrier Reef Marine Park Authority, IUCN and the World Bank[26] carried out the first global assessment of marine protected areas (MPAs) in 1995, based on data available at the beginning of the 1990s. The study was carried out using a range of criteria, including the economic, social and scientific importance of the site. The conclusions of the report were that:

- Marine ecosystems receive far less protection than terrestrial areas.
- Most MPAs were too small to protect species adequately; half were less than 1,000 ha in size, an area too small to encompass breeding, nursery and feeding areas for many of species found within them. Only 2.2 per cent of all MPAs exceeded 1 million ha.

- There was limited information about the effectiveness of MPAs, and an assessment of 383 (out of 1,300) sites found that only about 31 per cent were generally achieving their management objectives.
- Many globally unique habitats were not protected. The study identified 81 existing and proposed MPAs which, if protected or if given improved management, would go a long way to achieve the objective of a global network of MPAs.
- Representation was geographically uneven with most MPAs concentrated in Asia and Oceania.
- All MPAs need to be incorporated into integrated coastal area management systems.

A preliminary survey of management status and threats in forest protected areas carried out for by IUCN for the World Bank-WWF Alliance: In 1997, WWF formed a partnership with the World Bank to implement two forest conservation targets, drawn from the IUCN/WWF *Forests for Life* strategy. The first was to create 50 million hectares of new forest protected areas, while the second aimed to ensure that independent certification of good management took place in an additional 200 million hectares of forest. Following recognition of the scale of threats facing *existing* protected areas, the protected area target was extended to include improvement of management in either unimplemented protected areas ("paper parks") or in protected areas currently threatened or undergoing degradation; this is additional to the original targets. As part of the planning for the new target, the WWF-World Bank Alliance commissioned a survey of the status of forest protected areas.

Information was gathered from two sources:

- A literature survey of threats;
- A questionnaire completed by local experts in ten World Bank client countries containing important forest resources, looking at threats at a national level and a more detailed assessment of the threats to some individual protected areas.

Types and sources of threats were also identified. This included:

- Identifying different "*levels*" of threat, from removal of individual species to complete conversion and degradation
- Suggesting possible *trends* in quality of forest protected areas
- Identifying a range of *immediate and underlying threats*
- Discussing the concept of "*paper park*" and suggesting that an alternative terminology may be more appropriate

Experts' survey of threats to forest protected areas: Because of the lack of information, the project organised a special survey of forest protected areas, focusing on key World Bank client countries with a high forest cover. These were: Brazil, China, Gabon, Indonesia, Mexico, Papua New Guinea, Peru, Russia, Tanzania and Vietnam. The survey used country experts to assess protected areas with respect to several important issues:

- Identification of "paper parks"
- Assessment of management capacity
- Identification of protected areas under threat
- Identification of key threats to protected areas

Experts, including many members of the World Commission on Protected Areas, answered a standard questionnaire that summarised information on both management status and key threats on a national scale and also with respect to 4-5 protected areas within each country. The results were then analysed to draw general conclusions about protected area status for the countries in question.

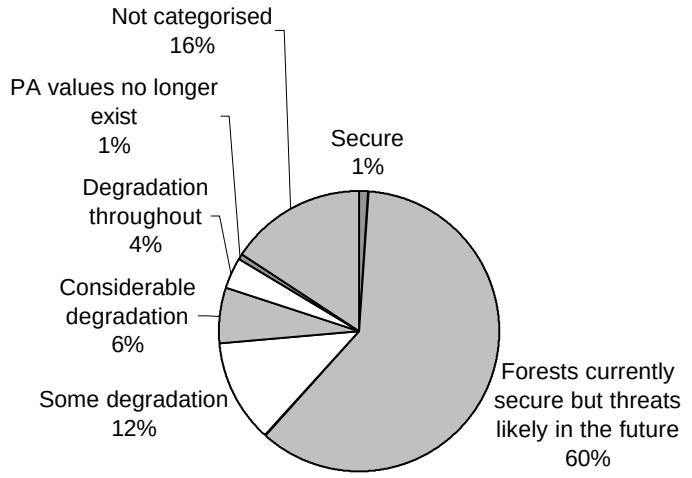
Results: The results suggest that many protected areas remain under threat – but the majority are continuing to retain their conservation values. The survey was limited in both time and resources and results should be treated as a relatively speculative introduction to the issues; further work is required to refine and improve these conclusions. The survey referred to a limited number of countries, albeit covering a wide range of conditions and holding a large proportion of the world's remaining natural forests. Despite the limitations, the work draws on the experience of some of the world's leading experts in protected areas and provides a valuable "first cut" at assessing management status and levels of risk.

The main findings are summarised below and in figure 1.

- Less than a quarter (0 to 24 per cent) of forest protected areas were considered to be "well-managed with a good infrastructure" in the countries assessed, and 17 to 69 per cent of forest protected areas in these countries had *no* management.

- Only 1 per cent of forest protected areas were regarded as secure in the long term. A further 1 per cent had been so badly degraded that they had lost the values for which protection was given. Some 22 per cent were suffering various levels of degradation and 60 per cent were currently safe but faced possible future threats. A further 16 per cent had not been categorised.

Status of forest protected areas in countries included in the WWF-World Bank Alliance survey



These figures give grounds for both alarm and hope. There are clearly many protected areas without adequate management and this is in some cases leading to degradation. However, only a very small proportion were thought to have been ruined and many "unimplemented" protected areas have retained many of their values, suggesting that protection status alone is helping to provide some security.

Governments

A number of governments have carried out surveys of protected area systems, to assess both effectiveness and legislative and resource requirements. Most have focused on individual protected areas, while some have attempted wider surveys. Two examples are given below and some others summarised more briefly.

India[27]

India has a network of 85 national parks and 448 sanctuaries, covering 4.2 per cent of its land area. Under the Wild Life (Protection) Act of 1972, national parks are given a higher level of protection and no human activity or private land holding is allowed within them. Sanctuaries are accorded less protection, and grazing and some community or individual rights pertain. National parks correspond to IUCN category Ia and sanctuaries to category IV.

Surveying management effectiveness: In order to understand current status of protected areas, the Government of India first commissioned the Indian Institute of Public Administration (IIPA) to survey protected areas in 1984, in order to:

- Document, analyse and make public information on the laws, policies, practices and problems relevant to the management of protected areas in India.
- Make recommendations aimed at improving their management.
- Document information on the flora, fauna and habitats of these protected areas.

A detailed questionnaire was sent to the directors of each protected area, covering legal issues, social and human use issues, biological and geographical descriptions, management issues, and also giving space for the perceptions of the protected area directors. There were over three hundred questions. The results showed important gaps in the protected area system, some of which are summarised in Table 10.9. It showed for example that most contained significant human populations, other government departments were the major violators of regulations, cattle densities were on average higher in national parks and clashes between protected area authorities and people were common.

Many of the recommendations made in the report were accepted and adopted by government. Legal procedures were simplified, additional funds allocated and staff training improved; WWF India also successfully filed a case in the Supreme Court, directing the union and the respective state governments to complete the legal procedures required to set up national parks and to rid sanctuaries of unwanted pressures. The results of the survey showed that one of the hardest challenges facing managers was the reconciliation of the local community's demands for resources and incomes from the protected area with the requirements of biodiversity conservation. The law officially prohibited access to almost all the resources but in reality local communities had few other options and had often been using the resources since long before the establishment of the national park or sanctuary. Suddenly restricting access caused hostility and sometimes also severe hardship. Ecodevelopment schemes were therefore introduced aimed at improving conditions amongst local communities that had suffered due to the establishment of a protected area. Ecodevelopment seeks to identify problems and to develop alternative sources of biomass and incomes, through supporting local communities to develop a village level plan exploring and establish either alternative sources of fuel and fodder, or alternatives to such biomass.

Table 10.9: Summary of management status on India's protected areas

Issue	Percentage of protected areas	
	National parks	Sanctuaries
Completion of legal procedures for establishment	40	8
Existence of human communities in the protected areas	56	72
Existence of human communities in the buffer zone	83	87
Existence of rights and leases	43	68
Allowed grazing by domestic livestock	39	73
Underwent grazing by domestic livestock	67	83
Allowed extraction of fodder	14	31
Underwent extraction of fodder	100	100
Underwent extraction of timber	16	43
Underwent extraction of non-timber forest products	36	56
Existence of public thoroughfares	47	57
Illegal occupation and/or use	8	26
Encroachment taken place	7	20
Confrontations between local people and park staff	37	17
Existence of management plans	50	31
Compensation paid for loss of livestock in PA	22	31
Reported management constraints		
Cumbersome legal processes		
Inadequate management inputs and capacity		
Poor support and involvement of local communities		
Lack of a regional perspective		
Lack of research and monitoring		

Survey of best ecodevelopment strategies: The IIPA was also asked to identify the best ecodevelopment strategies for selected protected areas. Between 1992 and 1995, detailed studies were carried out in eleven protected areas and as a result ecodevelopment projects were sanctioned and initiated in nine out of these eleven protected areas. However, this was a lengthy process and it was recognised that it would be necessary to prioritise protected areas for such treatment. The resulting Conservation Prioritisation Project (BCPP) was sponsored by the Biodiversity Support Programme (BSP) and implemented collaboratively by a group of NGOs and individuals, with the administrative support of WWF India. Among the various types of sites selected for prioritisation were national parks and sanctuaries. The prioritisation of national parks and sanctuaries was done collaboratively by IIPA and WWF India.

In order to prioritise, it was decided to use the IIPA and other available databases, and grade each protected area in terms of its biological value, the level of pressures or threats it faces and its management and legal status. The values were ascribed for biological value, pressure of threats and management and legal status. The aggregate findings are given below:

Table 10.10: Valuation of protected areas in India

Biological Value	Human Pressures	Management and Legal Status
Very High 162	High 135	High 166
High 116	Low 118	Low 87
Total 278	Total 253	Total 253

Table 10.11: Final priority ranking of protected areas in India

Priority/Category	Numbers
1. Very High Biodiversity + High Pressure + Low Legal and Management Status	17
2. Very High Biodiversity + High Pressure + High Legal and Management Status	54
3. Very High Biodiversity + Low Pressure + Low Legal and Management Status	19
4. Very High Biodiversity + Low Pressure + High Legal and Management Status	52
5. High Biodiversity + High Pressure + Low Legal and Management Status	25
6. High Biodiversity + High Pressure + High Legal and Management Status	39
7. High Biodiversity + Low Pressure + Low Legal and Management Status	26
8. High Biodiversity + Low Pressure + High Legal and Management Status	21
Total	**253**

As more than a decade has passed since the initial survey, a follow-up survey is currently being carried out to see what has changed in the interim. It includes a questionnaire with 400-500 questions and the setting up of meetings to allow local people to express their opinions of the protected area.

Canada

> *"Maintenance of ecological integrity through the protection of natural resources shall be the first priority when considering park rezoning and visitor use in a management plan."*

The addition of this statement to the Canadian National Parks Act in 1988 spawned several projects in Canada to determine the condition of country's national parks.

The State of the Parks Report's carried out by Parks Canada in 1992 and 1995/6 involved a questionnaire based on a 29 "stress response" framework (see results below for details). The questionnaire was based on a regional approach because parks are part of larger regions and ecological processes do not follow park boundaries.

The questionnaire was completed on a consensus basis by a three to five person team of experts (i.e. park staff, academics, conservationists). Each stress was only considered significant if:

1. it was having a definite ecological impact;
2. the scale of the impact was more than just a local threat;
3. the stress was either increasing or stable.

In 1992 the survey of 34 parks concluded that[28]:

- visitor/tourism facilities were causing significant ecological impact in 22 parks;
- many stresses originate outside park boundaries;
- non-native plants were invading and replacing native plants in 19 parks;
- 19 parks have transportation or utility corridors running through them;
- many parks reported impacts from forestry and agriculture.

In conclusion the report stated that 43 per cent of the reported stresses were increasing, whilst only 12 per cent were decreasing. The remaining stresses were either stable or unknown. A summary is given in table 10.13.

A 1997 report presents the results of the same questionnaire completed by 36 national parks during 1995 and 1996[29]. Among the stressors originating solely within the park:

- 19 parks reported difficulties arising from park management practices. The majority of these concerned the history of fire suppression in parks over the last 50 to 70 years and the resulting loss of fire-maintained habitats;
- high levels of development surrounding many southern parks, were responsible for significant impacts from transportation and utility corridors (25 parks) cutting through parks, and urbanisation (24 parks) adjacent to, and inside, parks;
- tourism and visitor facilities were reported to be causing significant impacts (26 parks), the degree of development and visitation correlating with other impacts, such as the invasion of exotic plant species (21 parks), and pollution from sewage (14 parks) and solid waste (15 parks);
- sport fishing was reported to be negatively affecting fish populations, and causing changes in genetics and the structure of fish communities in 19 parks – the majority of southern national parks;
- other major aquatic impacts were reported from petrochemical pollution (15 parks) and pesticides (14 parks);
- impacts from acidic precipitation were reported for five parks – a decrease from the last survey;
- climate change was reported as causing significant impacts in seven parks.

Among those stressors occurring outside park boundaries, the most significant were from external land uses due to agriculture (17 parks), forestry (20 parks) and mining (16 parks). The effects of these stressors were reported to be widespread and include a whole range of ecological impacts.

Table 10.13: Details of 1992 and 1995/6 Parks Canada Survey[30,31]

Stressor	Number of Parks	
	1992	1995/6
Inside Park		
Park management practices	13	19
Park infrastructure	6	12
Inside and outside the park		
Visitor/tourism facilities	22	24
Exotic vegetation	19	21
Utility corridors	19	24
Urbanisation	17	22
Dams	14	17
Exotic mammals	14	12
Sport fishing	13	19
Acidic precipitation	13	5
Exotic birds	12	12
Commercial fishing	10	9
Petrochemical pollution	10	15
Exotic fish	9	8
Pesticides	9	14
Poaching	8	6
Exotic invertebrates	7	6
Heavy metal pollution	7	2
Exotic micro-organisms	5	3
Human disturbance	4	14

Continued…

Stressor	Number of Parks	
	1992	1995/6
Inside and outside the park		
Vehicle/animal collisions	4	6
Climate change	4	7
Solid waste	4	15
Sewage	4	14
Gound-level ozone	0	2
Stress originating outside the park		
Forestry	17	18
Agriculture	15	17
Sport hunting	13	11
Mining	10	15

The report concluded that the combination of stressors causes a variety of impacts; the most significant of which appears to be habitat loss and fragmentation. For example, in southern Canada the report stated that parks were losing ecological integrity and require increasing levels of active management, including restoration of fire regimes, visitor capacity management and more efforts at regional land use planning.

The effectiveness of comparison made between the two reports were qualified in the 1997 report due to the fact that the 1996 version was done more carefully than the 1992 version. Despite this comparisons were made.

- The origin of stressors relative to park boundaries remained essentially unchanged. The vast majority of stressors are regional in scope (greater than 85 per cent), occurring both inside and outside park boundaries, or from solely outside the boundaries.
- The reported scale of the stressors remained unchanged. The majority of stressors (greater than 75 per cent) occur on a scale of over 10 square kilometres.
- The 1996 questionnaire reported increases in the following stressors: mining, utility corridors, urbanisation, climate change, human disturbance, sport fishing, solid waste, pesticides, sewage, park infrastructure and park management practices.
- An increasing recognition that a problem exists was cited as the reason for the increased concern over park management practices (i.e. suppression of fire) and park infrastructure.
- The 1996 questionnaire reported decreases in stressors in only four categories: heavy metal, exotic mammals, commercial fishing and acidic precipitation. The decrease from commercial fishing was mainly due to the closure of the East Coast ground-fish fishery.

The monitoring of the state of Canada’s national parks went a step further in November 1998, when in response to a Liberal Party election promise, the Panel on the Ecological Integrity of Canada's National Parks was created to produce a report on the status of ecological integrity within the parks. The Chairman of the Panel, Jacques Gérin, has stated that[32]:

- the panel found that some of the parks are under such pressure that they are losing valuable species;
- only one of Canada's 39 national parks, the new Vuntut in the northern Yukon, is free of ecological stress;

- part of the problem is Parks Canada itself. Although it has clear legislation that requires it to put ecological integrity above all else in managing the country's parks, this has not been happening consistently;
- the pool of scientific talent in the parks system was very thin on the ground;
- many of the parks are in trouble because of what is going on just beyond their borders. Clear-cutting often extends right to the edge of national parks, a phenomenon that has a huge effect on animals that live in the park but travel outside it.

The main findings and principal recommendations of the report are:

- Ecological Integrity is the priority mandate for national parks – to maintain the parks unimpaired forever. Ecological integrity is therefore the job of each and every person working for or with Parks Canada.
- One of the key requirements in achieving this mandate is a major increase in the capacity to acquire and use knowledge: more knowledge, better incorporated in decision-making and education.
- A healing process with First Nation peoples is needed in order to achieve more fruitful co-operation towards the common objective of protecting the sacred spaces.
- Parks are not islands; the ecosystem does not stop at the park boundary. There must be systematic co-operation with park neighbours to manage areas that are ecologically healthy and sustainable.
- Use of the parks must always be tempered by the need to protect.
- The message is for all Canadians. Beyond the visitors to the parks, there are 30 million allies to inform and sensitise[33].

Organisation of American States (OAS)

In 1988, the OAS published a survey of management effectiveness of coastal and marine protected areas in the Caribbean. It looked at the degree to which an area was actually protected, in half the relevant protected areas in the region. It showed that 33 per cent of protected areas were fully managed, 43 per cent partially managed and 24 per cent managed in name only[34].

Australia

The Australian government has played a lead role in looking at protected area effectiveness, both through the political process of promoting the issue and by supporting assessments of effectiveness within the national park system. A 1984 inventory of marine and estuarine protected areas included a listing of known threats[35], a detailed survey was published of the Great Barrier Reef World Heritage Area was published in 1998[36] and a detailed assessent of Fraser Island in 1999[37].

Regional studies, academic studies and consultant studies

In 1985, Garry Machlis and David Ticknell carried out a global survey through interviews with protected area managers and conservation officers. The survey covered 135 protected areas in 50 countries. The authors identified 1,534 threats and categorised these into 7 major groups: water, air, soil, vegetation, animal life, management and “other”[38].

In 1995, Cathryn Poff of Yale University surveyed protected area management options in co-operation with WCPA (then still known as CNPPA) through a questionnaire of protected area agencies, non-government organisations and community-based groups. 368 valid replies were received and the questions covered issues of professional experience, management options, funding levels and NGO and community participation. Respondents were also asked to provide predictions of future needs and trends in these areas. The report did not address threats or “exterior” problems as such[39].

Colombia: A study of human occupancy and management problems in Colombia's national parks was completed in the early 1990s. A summary is given in Table 10.14 below[40].

Table 10.14: Summary of human occupancy and management problems in Colombia's national parks

Impact	Proportion of PA's affected
Hunting	76%
Fishing	45%
Fire (burning)	67%
Lawlessness	48%
Logging	79%
Drug Trafficking	38%
Public works	60%
Mining	14%
Settlement	Average area of PA occupied
Area occupied by settlers and owners	8.6%

Indonesia: The consultants A C Nielsen Indonesia[41] conducted research among 67 park managers in Indonesia, initially to judge the impact of the financial downturn of the late 1990s on conservation within protected areas. As part of the survey they listed the percentage of protected areas that had either fairly or very serious impacts from a range of external "threats" and ranked these according to the mean score, as outlined below.

Table 10.15: Summary of attitudes amongst park managers in Indonesia in the late 1990s

(table constructed by the authors of the current study with reference to the original paper)

Impact	Fairly serious (percent)	Very serious (percent)	Mean score
Land encroachment by local people	33	34	2.91
Illegal logging by local people	42	28	2.90
Collection of NTFPs	31	30	2.88
Hunting	36	27	2.85
Fire	16	30	2.64
Mining	18	25	2.38
Demands on land for alternative uses	33	13	2.37
Road building	28	13	2.32
Illegal logging by companies	13	19	2.08
Large natural disturbances	24	6	2.06
Exotic pest and disease species	19	7	1.90

Impacts of the monetary crisis were variable, but the majority of respondents (57 per cent) felt that it had increased illegal logging by local people, and in a substantial number of cases also increased NTFP collection, land encroachment and hunting. It had, on balance, led to a decrease in illegal logging by companies, fire and road building. Issues relating to staff and staff training were by far the most pressing human resource needs within protected areas according to most respondents.

Gabon: An overview of status of protected areas in Gabon was carried out and reported in 1999[42]. The major threats identified are listed in table 10.15.

Table 10.15: Problems facing protected areas in Gabon

(table constructed by the authors of the current study with reference to the original paper)

Problems facing protected areas in Gabon	
Threat	Details
Logging	Concessions have been granted in all protected areas and logging has affected sites in varying proportions depending on location. In Moukalaba and Offoue for example over 50 per cent of the area has been selectively logged while Petit Loango wildlife reserve has only undergone logging in one small area to the north.
Petroleum operations	So far involving two protected areas: Sette-Cama and Wonga-Wongué.
Bushmeat hunting	Becoming more widespread, currently centred mainly on Moukalaba and M'Passa. Other areas are currently protected more by their remoteness than by the presence of staff as they are generally under-resourced.

Latin American regional studies: In 1997, the First Latin American Congress on Protected Areas included analysis of status of protected areas in many countries in the region, including identification of main threats. For example, analysis for Ecuador included the following[43]:

> *"Generally, there are three major types of threats affecting protected areas in Ecuador: governmental activities (oil operations, mining, and development works); private sector activities (agriculture, logging, aquaculture, fishing, mining); activities of rural populations (colonization and expansion of the agricultural frontier, inappropriate soil practices, overexploitation of natural resources). Oil and mining operations, road construction, and deforestation are the most damaging actitivies for protected areas (...) The Cayambe-Coca and Cotacachi - Cayapas Reserves face the worst threats from mining operations, especially gold mining. Informal gold mining within the Podocarpus National Park is also a problem deserving especial attention, since it is an illegal activity that produces pollution and deforestation."*

Conclusions

Drawing clear conclusions from the forgoing is difficult. In Table 10.16 a summary of some of the results is attempted.

It is clearly difficult to assess degree of threat to protected areas, because:

- All protected areas are under some degree of threat
- Data are often poor or absent
- Any criterion of threat only gives partial information
- Experts often disagree on the degree of threat
- Threats change over time

Nonetheless, it appears that in most countries there is a general understanding emerging about which protected areas are likely to be most at threat. There is also clearly likely to be an overlap between under-managed and threatened protected areas so that information on management infrastructure and capacity is likely to give an indication about likely status, or at least degree of threat.

Some general conclusions can be drawn:

- Many protected areas are currently being degraded as a result of a wide range of threats.
- Many more are only secure because of their relative inaccessibility; as infrastructure improves in the developing world these will be (and are starting to be) under increasing pressure.
- Estimates for the percentage of protected areas suffering more or less serious threat or damage range from a quarter to three quarters in national or global surveys (excepting parts of Europe, Australasia and North America)

Even in the most developed countries, protected areas remain under threat and threats change over time – for example visitor pressures are likely to increase with a country's average level of income.

Table 10.16: Summary of selected surveys of protected areas under threat, by date

Institution	Source	Date
IUCN and CNPPA	*Threatened Protected Areas of the World*: identified 43 threatened protected areas and 13 categories of threats	1984
Academic survey by Gary Machlis & David Tichnell	*The State of the World's Parks*: survey covered 135 protected areas in 50 countries. More details if pos	1985
IUCN: Indo-Malayan Region and Afrotropical realm	Provided quick summaries of effectiveness	1986
The Organisation of American States	Survey of management effectiveness of coastal and marine protected areas in the Caribbean region, 43% partially managed, 24% managed in name only.	1988
IUCN and CNPPA	*The IUCN Register of Threatened Protected Areas of the World*: lists 91 threatened protected areas in 50 countries	1990
The Ramsar Convention	Implementation Problems at Selected Ramsar Sites – the *"Montreux List":* currently 53 sites are listed	1990
Academic research in Colombia	*National Parks without people? The South American experience*: survey of impacts – e.g. 76% protected areas impacted by hunting	1992
Parks Canada	*State of the Parks 1992 Report*: 43 per cent of Parks reported stresses were increasing.	1992
IUCN	*Protecting Nature – Regional Reviews of Protected Areas*: reginal overviews and examples of threats	1994
UNESCO	*An evaluation of the coverage and management effectiveness of biosphere reserves*: identified presence of management plan and legal protection	1995
Great Barrier Reef Authority, IUCN and the World Bank	*A Global Representative System of Marine Protected Areas*: only about 31% of MPAs were generally achieving their management objectives	1995
IUCN, UNESCO and the WCMC	*A Global Overview of Forest Protected Areas on the World Heritage List*: listed key WH sites at risk	1997
IUCN, UNESCO and the WCMC	*A Global Overview of Freshwater and Marine Protected Areas on the World Heritage List*: as above	1997
WWF Pakistan	*Support Strategy for Protected Areas Network in Pakistan*: identified key threats to protected areas	1997
WWF Peru	Identification of priority areas through a survey of 49 protected areas	1997
WWF Cameroon	*Long-term recurrent costs of protected area management in Cameroon*: all protected areas faced threats and over half were suffering degradation	1997
Parks Canada	*State of the Parks 1997 Report*: in southern Canada parks are losing ecological integrity and require increasing levels of active management	1997
The Nature Conservancy	*Parks in Peril: People, politics and protected areas*: virtually all parks studied were vulnerable to large-scale threats that had their origins far from the park boundaries	1998
A C Nielsen for the World Bank and others	A study in Indonesia found e.g. that 34% of managers regarded land encroachment as "very serious"	1998

Continued…

Institution	Source	Date
Indian Institute of Public Administration	Three reports available. 34% of protected areas had low legal and management status in latest completed survey	1984-1999
WWF Brazil	*Protected Areas or Endangered Spaces?*: 75% of parks and reserves are endangered because of a combination of non-implementation and high vulnerability	1999
World Bank/WWF Alliance	*Threats to Forest Protected Areas*: less than 25% of forest protected areas were judged “well-managed with a good infrastructure” in 12 countries assessed.	1999
Analysis of Gabon reported by FAO	Logging concessions granted in all national parks, petroleum operations in 2, bushmeat hunting increasing	1999
The Panel on the Ecological Integrity of Canada's National Parks	Only one of Canada's 39 national parks, the new Vuntut in the northern Yukon, is free of ecological stress	2000
WWF European Forest Team	*European Forest Scorecards:* quality of active management of protected forest areas is generally very poor	2000
World Heritage Convention	*World Heritage in Danger List*: currently 16 sites listed around the world	ongoing

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Part 4
Case Studies

Summary of Part 4

The report has made a strong case that protected areas face a range of important threats and has given a selection of brief examples. In the following section, we look at some protected areas in more detail.

The protected areas have been chosen for a number of reasons – to illustrate a range of different issues, to provide wide geographical coverage and in part as a result of availability of information and interest shown by local WWF and IUCN offices.

These protected areas have certainly not been selected because they are atypically "bad" – indeed some are amongst the better-managed protected areas we studied – nor as a criticism of staff connected with those protected areas. Instead they are meant to provide detailed background to flesh out the points made more theoretically in the chapters on threats.

Chapter 11

	Country	National Park	Main Threat
1.	**Australia**	Kakadu National Park	Introduced plant and animal species, wildfires and uranium mining.
2.	**Cambodia**	Preah Sihanouk (Ream) National Park	Timber exploitation, charcoal production and over-collection of plant species.
3.	**Canada**	Banff National Park	Tourism, development pressures, road traffic and wildlife poaching.
4.	**Canada**	Algonquin Provincial Park	Loss of wildlife habitat and species from logging; acid mine drainage pollution from mining; and decline in wolf population from hunting and trapping at park boundary.
5.	**Central African Republic**	Parc National de Monovo-Gounda St Floris	Wildlife poaching, over-grazing, fire, inadequate resources for Park staff and military conflict.
6.	**Costa Rica**	Monteverde Cloud Forest Reserve	Climate change and a range of human pressures including conlicts over land tenure and expansion of agriculture.
7.	**Cote d'Ivoire**	Mount Nimba Strict Nature Reserve	Armed conflict and iron-ore mining.
8.	**Denmark**	North East Greenland	Climate change.
9.	**Democratic Republic of Congo**	Okapi Faunal Reserve	Population pressures, famine, civil unrest, poaching (bushmeat, ivory), wood extraction, and gold mining.
10.	**Ecuador**	Sangay National Park	Construction of the Guamote-Macas road, poaching, volcanic activity, small-scale mining, gold prospecting, and insufficient staff and budget to manage the Park.
11.	**Ecuador**	Podocarpus National Park	Gold mining, road construction, human settlements inside Park boundaries, forest clearance (using fire and/or chainsaws) for agriculture, and poaching.
12.	**Ethiopia**	Simen Mountain National Park	Human settlement within park boundary, wood and grass cutting, livestock grazing, land conversion for agriculture and lack of park infrastructure due to under-financing and military conflict.
13.	**Jamaica**	Negil Environment Protection Area and Marine Park	Pollution, over-fishing and climate change.
14.	**Mexico**	Calakmul Biological Reserve	Local community pressures, influx of migrants, rapid population growth, timber extraction, hunting, and forest clearing for agriculture and cattle ranching.

15.	**Mexico**	Monarch Butterfly Special Biosphere Reserve	Unsustainable and illegal logging, fuelwood harvesting, forest fires, disease, cattle and sheep ranching and changes in land use.
16.	**Namibia**	Skeleton Coast Park	Oil exploration, off-road driving, proposed dam construction, potential uranium mining, and over-fishing.
17.	**Nepal**	Annapurna Conservation Area	Population growth rate, deforestation, overgrazing, mountaineering, trekkers, road construction, landslides, and fire.
18.	**Nepal**	Sagamatha National Park	Use of native juniper to provide fuel-wood for tourist installations and tourism pressures.
19.	**New Zealand**	Tongariro National Park	Tourism development, invasion by introduced plant and animal species, volcanic activity and mudslides.
20.	**New Zealand**	Te Wahipounamu (South West New Zealand World Heritage Area)	Introduced plant and species, small-scale mining, logging, an underground hydroelectric geo-thermal production installation, and spaghnum moss harvesting.
21.	**Pakistan**	Khunjerab National Park	Conflict between the local community and Park management.
22.	**Spain**	Donana National Park	Water management practices, water pollution from agriculture, development outside park boundaries, poaching, and over-grazing by domestic livestock.
23.	**Tunisia**	Ichkeul National Park	Water management practices, installation of two dams, agricultural practices, development and population pressures.
24.	**UK**	Snowdonia National Park	Tourism, agricultural practices, and plantation forestry.
25.	**USA**	Everglades National Park	Water management practices, water pollution, loss of species, human population and development pressures and climate change.
26.	**USA**	Glacier Bay National Park	Climate change, commercial fishing and tourism pressures.

KAKADU NATIONAL PARK
Northern Territory, Australia

Key threats
Introduced plant and animal species, wildfires and uranium mining.

Biogeographical region: Oceania **Major habitat type(s) / biome(s)**: Tropical grasslands/savannah and dry forests and woodlands **National legal designation**: Commonwealth National Park and Register of the National Estate IUCN Category II **Other international designations**: WWF Global 200 Site - *Selected Important Staging, Breeding, Wintering, & Stepping-Stone Sites For Long-Distance Migratory Birds & Butterflies* (1997); Ramsar – Stage I 1981; Stage II 1987; Stage III 1992 (UNESCO, 1998); World Heritage Natural and Cultural Site (Stage I 1981, Stage II 1987, entire Park 1992).	**Location**: 12º 00'S/132º 03'E **Area**: 1,910,656 hectares **Year of establishment**: 1979 **Ownership**: Kakadu Aboriginal Land Trust, Jabiluka Aboriginal Land Trust, and Gunlom Aboriginal Land Trust own approximately 50 per cent **Management Authority**: Kakadu is special in that a significant part of its Aboriginal freehold land is leased to the Director of Australian National Parks and Wildlife Service (ANPWS).

Description
Kakadu National Park lies approximately 120km east of Darwin and extends south-eastwards from the coast of the Van Dieman Gulf, through floodplains and lowland hills to the sandstone escarpment and dissected Arnhem Land plateau, all of which provides a diverse array of habitats. Kakadu has much of its flora and fauna intact and contains: sandstone spinifex, rainforest, woodland and open forest; riverine fringing forest, paperbarks, floodplain sedgelands, mangroves and samphire, eucalyptus woodlands, open forests, coastal deciduous rainforests and savannah ecosystems.

Whilst Kakadu is renowned for its diversity of indigenous fauna, the species inventory remains incomplete. Scientists so far have recorded some 1700 floral, 65 mammal, 275 bird, 120 reptile, 25 amphibian and 55 fish species. As systematic surveys of different habitats are completed, species new to the Park, and some new to science, are being discovered and species not seen for many years are being rediscovered. In 1972, as part of the Alligator Rivers Region Fact-Finding Study some 65,000 invertebrate specimens were collected which yielded 4,500 species (CSIRO, 1973). Species inventories work continues on selected groups of insects such as termites, butterflies, moths and ants.

Bininj/Mungguy (Aboriginal people) have lived in Kakadu continuously for 50,000 years and there are numerous sacred sites of great cultural significance to Bininj/Mungguy throughout the Park. The use of the Kakadu landscape by Bininj/Mungguy over millennia has almost certainly influenced the vegetation structure. Some flora and fauna is culturally significant to Bininj/Mungguy and their knowledge and use of plants and animals is extensive and complex. The management of the Park must ensure recognition of Aboriginal interests at the same time as fulfilling nature conservation objectives.

Threats
Introduced plant and animal species, wildfires and uranium mining in enclaves within the Park threaten Kakadu. There is also the need to manage the gradual effects of weathering and exposure on the very numerous art and archaeological sites in the Park.

Feral animals, in particular buffalo and pigs, pose a threat to the biological wealth of wetlands and monsoon forests within the Park. A buffalo control programme has successfully reduced buffalo numbers in the Park and the damage caused by buffalo has been shown to be largely reversible. This, with continued opportunistic control of pigs, has produced dramatic responses in the plant and animal life of the wetlands (ANPWS, 1999).

A second threat is from the accidental introduction of non-indigenous plants from seed and mulch used in habitat rehabilitation. The two most invasive species are *Mimosa pigra* and *Salvinia molesta*. A further source of introduction is from vehicles used by construction, contractors and mining vehicles. Park management inspect machinery entering the Park, or being moved from an infested site. Where introduced species occur in enclaves in Kakadu (e.g. *Pennisetum polystachion* at Ranger Uranium mine) co-operative efforts are needed to control and eliminate those species (ANPWS, 1999).

The occurrence of late dry season wildfires (wildfires are often extensive, hot and uncontrollable) further threatens Park biodiversity. Reduced impact is achieved by early dry season burning where required, providing educational information for visitors and residents, controlling visitor camp fires and liasing with park users such as buffalo removal contractors who have traditionally lit late fires.

While the management of non-indigenous species and wildfires has some controls in place, uranium mining poses a much greater threat. Since the discovery of uranium at Jabiluka in 1971 conflict between mining companies, local communities and government agencies has raged. The most recent conflict stems from the Australian government's decision to grant mining concessions to Energy Resources of Australia (ERA). In June 1998, ERA commenced work on the Jabiluka uranium lease in an enclave within Kakadu National Park. The first concession, the Ranger (open pit) mine, was granted in 1978. Although a court ruling confirms that the land belongs to the Mirrar, the traditional owners of the area of the mining leases at Ranger and Jabiluka mines, the Australian Government decreed that "*it is in the national interest*" that uranium mining take place – sufficient reason to override legal title to the land. ERA now plans to open a second mine at Jabiluka. Although transcripts of the contract negotiations clearly indicate that the Mirrar never intended to permit mining, ERA is going ahead with the operations. The Government authorities that are supposed to safeguard the land on behalf of the Mirrar appear to have refused to invoke their authority (Institute for Global Communications, 1998).

Jabiluka is within the catchment of Kakadu's wetlands, an immensely valuable component of the natural heritage of the National Park. Any mining, whether for uranium or any other resource, unacceptably jeopardises the natural heritage values supposed to be maintained and enhanced within protected areas such as the Magella wetlands. As such WWF opposes the Jabiluka mine for the damage it may cause to Kakadu. Mining operations threaten to destroy Park habitats – contaminating air, soil and surface and ground water, from the mining, processing of uranium ore and leaching of radionuclides from mine tailings. There are also concerns over the long-term storage and disposal of radioactive tailings.

Conclusions and Recommendations

Kakadu National Park is considered to be one of the premier national parks in the Asia Pacific Region, and one that is often used as a site for training of wetland managers from other countries. For example, WWF’s Tropical Wetlands - Oceania Program has successfully been working with Kakadu Park staff and traditional owners on research, information and personnel exchange on the threat of mimosa and water hyacinth and their control within Wasur National Park, Irian Jaya and Tonda Wildlife Management Area, Papua New Guinea.

The Government of Australia has had to mount an expensive and lengthy diplomatic offensive to halt the listing of Kakadu National Park on the World Heritage in Danger List. WWF believes that the

proposed mine at Jabiluka sends an unfortunate message to Australia's regional neighbours, about what Australia considers to be acceptable activity within a national park (WWF, 1999).

The Jabiluka mine is of particular concern at a time when the pressures and impact from mining in several other protected areas around the world is growing (Finger, 1999).

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PREAH SIHANOUK (REAM) NATIONAL PARK
Gulin Khan Preynop, Cambodia

Key threats
Timber exploitation, charcoal production and over-collection of plant species.

Biogeographical region: Indomalayan **Major habitat type(s)/biome(s)**: evergreen forest, mangroves and coastal landscape. **National legal designation**: National Park IUCN Category: II **Other international designations**: none	**Location**: 10º33'N/103º39'E **Area**: 21,000 hectares **Year of establishment**: 1993 **Ownership**: Royal Government of Cambodia Management Authority: Department of Nature Conservation and Protection, Ministry of Environment.

Description
Ream National Park – or Preah Sihanouk National Park – is located in Gulin Khan Preynop Province in southwest Cambodia, along the Thai Gulf. It is a coastal park encompassing a wide range of habitats. The estuary of the Prek Toek Sap river features extensive areas of mangrove and associated back mangroves (mangroves high up in the tidal frame, often associated with dwarf communities and bare salt-pans if tidal flushing is limited and salinities consequently much higher). Mangrove forests and mudflats dominate the site. To the west of the river there are low hills, rising to 277 metres, covered with lowland and dwarf evergreen forests; isolated hills also occur to the east of the river. The northern and eastern portions of the Park feature freshwater marshes (Frederich, *et al*, 1999). The National Park also encompasses the sparsely inhabited islands of Koh Thmei and Koh Ses situated to the southeast. Long sandy beaches, rocky shores, sea grass beds and coral reefs are found along the coasts of the mainland and islands. An enclave adjacent to the southwestern corner of the Park, containing the Ream Naval base and the Prek Cha watercourse, is omitted from the park.

There are four communes (totalling some 22,000 people) surrounding the Park and twelve villages (with about 12,500 inhabitants) inside the borders (Monyrak, *et al*, 1999). Most people are ethnically Cambodian, with the remainder Chinese and Vietnamese. Immigration to the area is relatively high. In 1995, the Khmer Rouge lost control of the area and people moved back in. Park staff were only able to start actively managing the Park in 1997.

In the 1980's, before the Park was gazetted, large forested areas of what was to be Park were destroyed by timber extraction and land conversion as a result of land speculation. Between 1988 and 1989, Vietnamese loggers removed the remaining large trees and by 1993, illegal logging had severely depleted what was left of the timber resources in and around Ream.

A plywood factory close to Preik Teuk Sap and National Road No.4 used to manufacture plywood from timber extracted from what is now the Park buffer zone. It is now supplied from other areas including another National Park, Bokor. Another factory, owned by a Thai businessman, located near the coast on the west of Koh Samporch has closed as the timber supply from the core zone of the Park has been exhausted. Logging in the Park is now carried out only for domestic purposes, and tends to be restricted to the harvesting of small trees and bark by local people.

Threats
Ream is the second smallest of Cambodia's national parks and experiences intense pressure on its resources. At present the identified key threats are forest clearance, timber exploitation, forest fires and species exploitation (Frederich, 1999). In the buffer zone of the Park, forests are threatened by land clearance as businessmen pay poor local families to clear forestland for development. For example,

mangrove forests in Knong are being cleared for shrimp farms. Logging activities have taken a significant toll on the Park's ecosystems. From the local community perspective, not only has an essential resource been severely depleted, but also revenues to the communities were never realised. Paradoxically, remaining forested landscapes are still threatened by land conversion for agriculture. Most local people feel that the agricultural landscape is more important to them than a forested landscape. Threats to the Park therefore occur on two levels. At the landscape level, caused by illegal logging and conversion of land to agriculture, and secondly, at the species level, where species of high economic value are targeted. The commonality between both types of threat is economic. The value of the Park to those around them is less than the value of short-term, destructive, harvesting

Local people collect over 120 species of wild plants in the Park for medicinal purposes. The collection of edible plants includes forest mushrooms, and along the coast, seaweed. Some families earn their entire income from selling fruits – domestically and internationally – the largest demand is for *samrong* and *khoh si phlae* (a type of acorn). Some *Aquilaria* trees in the area have become infected with a fungus causing the heartwood to produce an incense ingredient, *chan krisna*, of high market value. Low grades of *chan krisna* sell for US$300- 400 per kg and higher quality sells for even more. Collectors, in groups of four or five people, search in the core zones of the Park in the dry season.

Products from the Park, including some fruits, medicinal plants and *chan krisna*, which can bring in worthwhile income, are being depleted. For instance, fruit trees are cut for their harvest. In this way, not only are the parent trees lost, but a continual erosion of genetic variability occurs. Medicinal plants, such as herbs or vines, are also destructively harvested and *Chan krisna* trees are cut down in the search for infected wood, threatening the long-term viability of local species.

Fuelwood is collected from mangroves and interior forests. Wood is also collected for charcoal production, mainly by landless refugees (pers. comm. Jarvie, 1999). The two main varieties of bamboo, *russey thngor* and *russey pok* are collected by local people to make household items such as baskets. Rattan is collected for sale and domestic consumption in basketry. Good quality rattan (collected for sale) – such as *pdao dambong*, *phreah phdao* and *phdao chhveang* – is harvested from remote areas, often within core zones of the Park. Harvesting trips can last several days and are usually conducted by outsiders. Whereas local people harvest rattan for domestic use, outsiders collect for middlemen, selling for about pay Riel 400- 500 for a 5m length. In Snom Prampi there is a small warehouse where large and small diameter rattan is boiled (a step in the rattan preparation process), tied in batches, sold and transported out of the area. Collection at this level is threatening the sustainability of resources within the Park.

Prior negative interactions between Park staff members and villagers have caused some difficulties. In recent times, as Park staff began to manage the park, villagers were arrested for violating park regulations, i.e. for poaching.

Conclusions and Recommendations

The lack of community development initiatives within the Park leads local people to participate in the destruction of natural resources, further reducing productivity of land and aquatic systems. For example, the rapid reduction of forest resources within Ream Park has increased local pressures upon marine fisheries with up to 40 per cent of farmers participating in fishing. This trend is exacerbated by an influx of landless migrants and refugees from other more populated provinces, particularly from the Mekong Delta Region, and the use of unsustainable fishing techniques by Cambodian and Vietnamese fishermen. Sustainable use of park resources might increase the value of biodiversity for all concerned and could well serve to minimise the current, long-term, risks that people pose to the parks.

An example of sustainable management may come from the protection of bamboo groves. If these groves are protected from fire and over-harvesting they offer a sustainable resource for local communities but are of limited biodiversity value.

The issue of land tenure encapsulates the conservation challenges in the Park. People interviewed feel that the Park is not their property, so have little or no interest in its conservation. Park authorities are recognising this and are investigating licensing harvesting quotas of various species (Monyrak *et al*., 1999). Policy options for development of communities, especially the poorest members, in conjunction with conservation goals are required.

One final note, a new initiative announced in December 1999, funded by UK Department for International Development (DFID), AusAid and the FAO, will independently monitor illegal logging throughout Cambodia's forests. This initiative may help decrease the external unsustainable pressure on both Cambodia forested protected areas and local communities (WWF/IUCN, 2000).

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BANFF NATIONAL PARK
Alberta, Canada

Key threats
Tourism, development pressures, road traffic and wildlife poaching.

Biogeographical region: Nearctic **Major habitat type**: Mountain **National legal designation**: National Park **IUCN Category**: II **Other international designations**: Part of the Canadian Rocky Mountain Parks World Heritage Site (1984).	**Location**: 51 35'N/115 59'W **Area**: 664,100 hectares **Year of establishment**: 1885 **Ownership**: Government of Canada **Management Authority**: Parks Canada

Description
Banff National Park (BNP) was Canada's first national park, and the world's third. It is part of the Canadian Rocky Mountain Parks World Heritage Site that is composed of Banff National Park, Burgess Shale Site, Hamber Provincial Park, Jasper National Park, Kootenay National Park, Mount Robson Provincial Park, Mount Assiniboine Provincial Park and Yoho National Park (WCMC, 1998). It is home to a number of outstanding geological and ecological features. In addition to the hot springs, the Castleguard Caves in the remote north-west corner of the Park are Canada's longest cave system. The Park also contains Alberta's southernmost herd of threatened woodland caribou (*Rangifer tarandus*). The Park is divided into three eco-regions: the montane, the sub-alpine and the alpine.

The Rocky Mountains are oriented in a southeastern to northwestern direction along the Continental Divide and consist of the Western Ranges, the Main Ranges, the Front Ranges and the Foothills. Active glaciers and icefields still exist throughout the region, particularly in the Main Ranges. The most significant is the Columbia Icefield, which is the largest icefield in North America's subarctic interior. Covering 325 km^2, the Icefield spans the Continental Divide and the boundary between Jasper and Banff (WCMC, 1998).

There are 53 species of mammals in the Park. Eight species of ungulates can be divided into two distinct families: the deer family, which have antlers that fall off and re-grow each year, and the sheep and goat family, which carry true horns that grow throughout the life of the animal. The moose *Alces alces* is the largest member of the deer family, commonly about the size of a thoroughbred horse. Moose were formerly widely distributed in the Park, but have disappeared from the Bow Valley in recent years. There are also mule deer (*Odocoileus hemionus*), woodland caribou, bighorn sheep *(Ovis canadensis*), mountain goat (*Oreamnos americanus*), wolf (*Canis lupus*), mountain lion or cougar (*Felis concolor*), wolverine (*Gulo gulo*), lynx (*Felis lynx*), black bear (*Ursus americanus*), grizzly bear (*U. arctos*), and wood bison (*Bison bison*) (Parks Canada, 2000). In five hot springs in Banff National Park there is an inconspicuous small endemic but nationally threatened snail called the Banff Springs Snail (*Physella johnsoni*).

Over 260 species of birds have been recorded in BNP including: northern three-toed woodpecker (*Picoides tridactylus*), white-tailed ptarmigan (*Lagopus leucurus*), grey jay (*Perisoreus canadensis*), mountain bluebird (*Sialia currucoides*), Clark's nutcraker (*Nucifraga columbiana*), golden eagle (*Aquila chrysaetos*), mountain chickadee (*Parus gambeli*), rock pipit (*Anthus spinoletta*), the threatened peregrine falcon (*Falco peregrinus*), and harlequin duck (*Histrionicus histrionicus*). Harlequin ducks occur in two separate populations: on both the Pacific and Atlantic Oceans. World-wide they inhabit eastern Asia, North America, Greenland, and Iceland. In North America, the Pacific population numbers over 200,000 while in the Atlantic there are less than 2,000 harlequin ducks

remaining. The latter population has declined significantly over the last century and is threatened in eastern Canada. Harlequin ducks that breed in Banff National Park and other areas of the eastern slopes of the Rockies winter in the Strait of Georgia in British Columbia and are part of the Pacific population. The harlequin is the only North American duck that migrates inland to nest along turbulent mountain streams. They favour areas of low human disturbance, where the waters are clear and clean. Population declines have been attributed to over-hunting, oil pollution, recreational activities, and loss of nesting habitat to hydro-electric projects, road construction, logging, mining, and degradation of riparian areas (Parks Canada, 2000).

Threats

Banff Park management, along with other concerned NGOs and individuals, is attempting to reverse the threats from incompatible uses that have grown out of control from development and tourism pressures. The town of Banff is located in the narrow Bow Valley inside the Park, and its more or less unregulated growth in hotels and ski lodges has triggered a major study of the problems and remedial measures needed (Hamilton, 1999). At the time of writing, legislation was in the final stage of approval, that will set strict limits on development while trying to maintain the town site as part of the World Heritage Site. In addition, Parks Canada Minister Andy Mitchell said that he would limit the number of skiers permitted on the slopes [in Banff] and ban any development that would attract more skiers under the new guidelines (WCPA, 1999).

Several measures have been put in place over the past two years, since the introduction of the new 1997 Management Plan for Banff. These measures have been summarised by Hamilton (1999) and include:

- Restoration of the Cascade wildlife corridor by removing horse corrals, bison paddocks, and closing a segment of the Minnewanka Loop road. (Wolves have been seen using the restored corridor.)
- The airstrip has been closed and use by the local flying club has been terminated.
- The Department of National Defence is finalising its site selection for a new cadet camp now to be located outside the Park.
- Two wildlife over-passes over the Trans-Canada Highway have been completed.
- To improve habitat effectiveness, changes have been put in place in the backcountry to prohibit mountain biking in the upper Bryant Creek area and discourage this activity in two other areas.
- A night-time voluntary closure of the Bow Valley Parkway has been implemented to enhance habitat effectiveness and wildlife movement during the spring.

Despite this extensive list of issues and measures, the extent of threats from tourism and development that BNP continues to face is significant.

In addition, Banff faces other threats from wildlife poaching, and increasing road traffic. During the past ten years at least 60 animals have been illegally killed within the boundaries of Banff, Jasper, Yoho and Kootenay National Parks. Parks Canada recognises the tremendous impact of poaching on wildlife populations. Although the National Parks Act stipulates "*anyone who hunts, disturbs, confines or injures threatened or protected wildlife in a national park may be fined up to Can$150,000, or imprisoned for up to six months, or both*", threatened species such as: bighorn sheep, mountain goat, grizzly bear, bison, caribou, wolf, cougar, black bear, and peregrine falcon continue to be hunted in Banff. In order to stop this Park Wardens conduct vehicle checks throughout the Park and enlist the help of the public through reporting suspicious activities. In addition, in order to protect park wildlife from poachers, wardens encourage the public to report sightings of bears, moose, collared or tagged animals, carnivores, bird of prey nesting locations, or any unusual sightings.

The current rate of habitat fragmentation in the Park threatens the long-term survival of wildlife. The Trans-Canada Highway, the Banff-Radium Highway, the Bow Valley Parkway and the Icefields Parkway are all major travel routes that bisect the Park. For example, the Trans-Canada Highway (TCH) brings high speed and high volume traffic into BNP, and it has the potential to seriously impact wildlife populations by fragmenting habitat, impeding attempts to re-colonise new areas, and disrupting natural movement patterns in the Bow Valley. During the last 20 years, traffic volumes have increased steadily and frequent highway upgrades were necessary. Wide-range species such as bear, wolf and cougar are most severely affected. Moreover, the TCH is a significant source of mortality of the Park's fauna. Roughly half of the reported wildlife deaths in BNP can be attributed to roads. Levels of road-caused mortality for some wildlife populations are equal to or greater than mortality rates in hunted populations outside Park boundaries (Parks Canada, 2000).

Conclusions and Recommendations

Despite Banff being a relatively well-funded and well-managed Park, it still succumbs to a wide variety of threats. As Jacques Gerin, Chair of the Panel on Ecological Integrity of Canada's National Parks noted, *"Panels like ours, and institutions like Parks Canada, tend to focus on today's solutions to yesterday's problems. But, if our national parks are to be kept unimpaired forever, we'd better start planning now for the increased pressures that lie not so far ahead. There are no magic solutions. One essential approach is to "go beyond the park" and to work with others on a region-wide scale to start implementing solutions that will work tomorrow. Otherwise, it's not just the Parks that will suffer, but all of us who live around the parks; all of us, near and far, who have derived economic benefits, enjoyment, or satisfaction from knowing they exist*" (Ecolog, 2000).

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ALGONQUIN PROVINCIAL PARK
Ontario, Canada

Key threats
Loss of wildlife habitat and species from logging; acid mine drainage pollution from graphite mining; and decline in wolf population from hunting and trapping at park boundary.

Biogeographical region: Nearctic **Major habitat type(s)/biome(s)**: Mixed broadleaf and coniferous forest **National legal designation**: Provincial Park **IUCN Category**: IV **Other international designations**: none	**Location**: 45 45'N/78 25'W **Area**: 765,345 hectares **Year of establishment**: 1893 **Ownership**: Government of Ontario **Management Authority**: Ontario Parks

Description
Algonquin is the oldest Provincial Park in Ontario and is situated between Georgian Bay and the Ottawa River. This area lies along the southern edge of the Canadian Shield, (a geological formation of ancient granite and gneiss covering almost half of Canada). Sheets of ice that spread across the continent during the last ice age 11,000 years ago created much of the Park's landscape. The weight of the ice sheets compressed existing soil and gravel in places while scouring it away in some areas and depositing it in others. The diversity of the resulting drainage patterns of more than 1500 lakes, rivers and streams makes Algonquin a haven for wildlife and canoeists. The Park was established to create a wildlife preserve, to stop the advance of land-clearing settlers at the turn of the century, and to protect the headwaters of the six major rivers that originate in the Algonquin Highlands.

Park boundaries cross a transition zone between southern broadleaf forests and northern coniferous forests. There are 34 tree species native to Algonquin including: tamarack (*Larix laricina*), white spruce (*Picea glauca*), red spruce (*P. rubens*), black spruce (*P. mariana*), jack pine (*Pinus banksiana*), white cedar (*Chamaecyparis thyoides*), eastern hemlock (*Tsuga canadensis*), silver maple (*Acer saccharinum*), red maple (*A. rubrum*), sugar maple (*A. sacchaarum*) and red oak (*Quercus rubra*). There are 45 mammal species that include: black bear (*Ursus americanus*), white-tailed deer *(Odocoileus virginianus*), beaver (*Castor canadensis*) and otter (*Lutra canadensis*). Bird species in the Park include osprey (*Pandion haliaetus*) and golden eagle (*Aquila chrysaetos*). Some 60 species of fish and 700 species of insects have also been identified.

Threats
Algonquin's habitat and wildlife are threatened by logging, hunting, trapping and pollution resulting from graphite mining activities (external to park boundary). From its inception logging has been allowed within the boundaries of the Park; this inevitably leads to the Park Management staff having to deal with the competing demands for logging, recreation and protection of natural environments. As early as the 1930s Park Superintendent Frank MacDougall noted that a distinct clash was developing between the loggers and tourists. In an effort to minimise contact between the two groups, logging was banned on islands and along shorelines and portages. The situation however came to a head in the 1960s as a new generation of wealthier and more mobile Ontario residents became concerned about enjoying and preserving parts of Ontario's natural heritage. There was a boom in wilderness canoeing and many people were genuinely shocked to learn that logging occurred within the Park. In 1968, a conservation group, the Algonquin Wildlands League, was formed. The League held meetings, wrote letters and soon created public and media interest in the Algonquin logging controversy.

The Government's response was to conduct over 40 studies on the Park and to appoint an Advisory Committee representing interested groups. The Committee held public meetings in Toronto and with

communities near the Park. In 1974, it passed its recommendations to the government that formed the basis for the first Algonquin Park Master Plan. However, the fundamental aim of the new Plan was to retain logging – due to its economic importance to the surrounding area. It also sought to manage the Park in such a way that environmental values and wilderness areas would be protected. The tool for accomplishing this was the division of the Park into zones. 77.9 per cent of the Park is zoned for logging. Logging areas are separated from canoeists by cutting restrictions along shorelines and portages and restrictions on road placement and hauling hours. The remaining 22.1 per cent of the Park is divided into wilderness, nature reserve, historic and development zones. A second component of the Management Plan was the cancellation of the previous patchwork of timber concessions and the creation of a Crown corporation, the Algonquin Forestry Authority (AFA) (FoAP, 1994). These changes although helpful cannot and do not please everyone nor do they substantially protect the Park's biodiversity. The presence of logging continues to raise strong feelings in many people.

The Park's wildlife is further threatened by hunting. Inside the Park wolves are safe. When they step outside Park boundaries however it is a very different story. Over 60 per cent of Algonquin Park wolf deaths result from shooting, trapping or snaring (Wildlands League, 1999a). The wolves are usually killed within 10 kilometres of Park boundaries a situation that threatens the future of the Algonquin wolf population and is in conflict with Park Management Plan objectives.

On the Park's western boundary sits the Kearney Graphite Mine owned by International Graphite Ltd. Mining activities at this site have contaminated the headwaters of the Magnetawan River, which crosses the western boundary of the Park, with acidic runoff and toxic metals. The Ministry of Natural Resources (MNR) has documented acid leakage and significant declines in the abundance of fish over the 10-years of operation at the site. An MNR fisheries assessment report noted: "*Given the obvious decline in fish abundance in conjunction with the documented decline in lake water chemistry since the development of the mine it is logical to conclude that the loss of fish is related to past mining activities. Remedial measures must solve problems at their source and not just mask symptoms or redirect waters to less sensitive systems*." In June 1998, the Wildlands League, Federation of Ontario Naturalists and Algonquin Eco-Watch, and Sierra Legal Defence Fund, filed an *Application for Investigation* under Section 74 of *Ontario's Environmental Bill of Rights* in an effort to get the government to take action to clean up this pollution (Wildlands League, 1999b). In January 1999, the Ministry of the Environment (MOE) took further steps to deal with the toxic contamination and restore clean water to the Magnetewan. In a posting of the Environmental Bill of Rights (EBR) registry, the MOE is seeking public input to an Order that would: *"require the submission of plans detailing the removal of acid-generating materials such as mine rock*" and "*require the Company to conduct both surface and ground water monitoring to assess the effectiveness of acid-generating material removal*". The federal government has also expressed its concern about the situation by filing a civil action in Ontario Court (General Division) against Applied Carbon Technology (the former owners), Merchant Capital Securities, several individuals and the Ontario Ministries of Environment and Northern Development and Mines (Wildlands League, 1999b).

Conclusions and Recommendations

The Government of Ontario will soon be drawing up a new management plan for the Park (a review that is required every ten years). The Wildlands League, WWF Canada and the Federation of Ontario Naturalists assert that to protect the Park's habitat and wildlife logging must be phased out. The Wildlands League has proposed a phase-out plan to achieve this goal. The plan includes strategies for increasing secondary and tertiary jobs from the surrounding timber supply, and establishing a community transition and Algonquin forest rehabilitation fund. This fund could access the Algonquin Forest Authority's CDN$6.7 million total accumulated surplus and provide employment for foresters in restoration of Algonquin, create interest free loans or grants to local entrepreneurs, and support initiatives to increase tourism and employment that would benefit local communities (Wildlands

League, 1999a). The Wildlands League and other organisations are also campaigning for greater protection of the Park's genetically unique wolf population, and have proposed a wolf protection zone around the Park.

Efforts are continuing to deal with the effects of mining in the Park. The Canadian Government is currently seeking CDN$2.5 million in damages from those listed in the court documents and claims that the mine has caused harmful alteration of fish habitat and resulted in widespread annoyance and harm to the public. Wildlands League Executive Director Tim Gray noted "*this is an all too perfect example of why mining should never be allowed in protected areas*".

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PARC NATIONAL DE MANOVO-GOUNDA-ST FLORIS
Bamingui-Bangoran Province, Central African Republic (CAR)

Key threats
Wildlife poaching, over-grazing, fire, inadequate resources for Park staff and military conflict.

Biogeographical region: Afrotropical **Major habitat type(s)/biome(s)**: West African woodland savannah and seasonal floodplains **National legal designation**: National Park **IUCN Category**: II **Other international designations**: WWF Global 200. (No. 103) Sudanian Savannahs; World Heritage Site (1988); World Heritage in Danger List (1996- present).	**Location**: 9º31'N/21º21'E **Area**: 1,740,000 hectares **Year of establishment**: 1933 **Ownership**: Government of Central African Republic (The Park is public property, but a 1984 agreement between the Government and the Société MANOVO S.A. devolves responsibility for both management of the park and exploitation of its tourist potential to the Société. This agreement, which is renewable, lasts for 20 years.) **Management Authority**: Ministry for Water, Forests, Hunting, Fisheries and Tourism

Description
The Park is situated in the north of CAR, along the border with Chad. The Manovo River marks the Park's western boundary. The international border runs along the Bahr Aouk River while the provincial borders run along the Bahr Kameur and Vakaga Rivers, and the ridge of the Massif des Bongo. The closest town is Ndéle about 40km away and the road from Ndéle to Birao runs through the Park (WCMC, 1997). The Park comprises three main zones, the flood plain of the Bahr Aouk and Bahr Kameur rivers in the north, the Massif des Bongo in the south, and the gently undulating transitional plain between. The lowland areas, which are seasonally flooded, have fine, deep, alluvial soils, although drainage in these areas can be quite poor.

The Massif des Bongo, which is separated from the plain by an escarpment, is chiefly composed of sandstone and is highly eroded. Five major rivers run down from the massif through the park to the Bahr Aouk and Bahr Kameur. These are the Vakaga (on the eastern boundary), Goro, Gounda, Koumbala and Manovo (on the western boundary), and the Park encompasses the complete drainage basins of three of these. However, flow is intermittent towards the end of the dry season.

The predominant vegetation type for much of the Park is Soudano-Guinean woodland savannah which can be divided into five types: *Terminalia laxiflora* wooded savannah with *Crossopteryx febrifuga* and *Butyrospermum parkii*; *Isoberlinia doka* and *Monotes kerstingii* woodland; *Pseudocedrela kotschyi* and *Terminalia macroptera* woodland; mixed lowland woodland or wooded savannah; and *Anogeissus leiocarpus* and *Khaya senegalensis* (WCMC, 1997). The larger mammals, such as elephant, heavily use the Terminalia savannah, in particular, during the dry season. Dry forest of *Anogeissus leiocarpus* and *Khaya senegalensis* occurs along the edges of the plains, particularly along the Gounda and Koumbala Rivers, and in small areas within the plains (WCMC, 1997).

The lowland plains are subject to both flooding and fire, which is reflected to some extent in the vegetation. The most heavily flooded areas support communities of perennial grasses, sedges and annual herbs, while trees and shrubs are confined to patches of higher ground. Predominant species include perennial grasses such as *Vossia cuspidata*, *Echinochloa stagnina*, *Hyparrhenia rufa*, and *Eragrostis* sp., with relative distributions responding to the duration and depth of seasonal flooding.

The vast savannahs of the Park provide the natural habitat for a wide variety of internationally threatened species namely: black rhinoceros (*Diceros bicornis*), elephant (*Loxodonta africana*), leopard (*Panthera pardus*), cheetah (*Acinonyx jubatus*), wild dog (*Lycaon pictus*), shoebill (*Balaeniceps rex*) and crocodile (*Crocodylus niloticus*). The red-fronted gazelle (*Gazella rufifrons*) is the only species of gazelle in the Park.

Within the St Floris region, the most abundant mammal is the kob (*Kobus kob*). Other ungulates present include: the duiker (*Sylvicapra grimmia*), waterbuck (*Kobus ellipsiprymnus*), hartebeest (*Alcelaphus buselaphus*), oribi (*Ourebia ourebi*), topi (*Damaliscus lunatus*), reedbuck (*Redunca redunca*), buffalo (*Syncerus caffer*), wart hog (*Phacochoerus aethiopicus*) and hippopotamus (*Hippopotamus amphibius*). The most common primate recorded is the baboon (*Papio anubis*), with smaller populations of patas and tantalus monkey (*Cercopithecus patas* and *C. tantalus*). The colobus monkey (*Colobus guereza*) is found in low numbers in the dry forest. Other noteworthy large mammals include roan antelope (*Hippotragus equinus*), lion (*Panthera leo*), giraffe (*Giraffa camelopardalis*), and giant eland (*Taurotragus derbianus*) (WCMC, 1997).

Some 320 species of birds have been identified, with at least 25 species of raptor including bataleur (*Terathopius ecaudatus*) and African fish eagle (*Cumcuma vocifer*). There are large seasonal populations of pelican (*Pelecanus onocrotalus* and *P. rufescens*) and marabou stork (*Leptoptilos crumeniferus*), and the Park is moderately important for both waterbirds and shorebirds, particularly in the flood plains to the north. Ostrich (*Struthio camelus*) are common on the plains, moving to woodland areas to lay their eggs. Several species of bee-eater and kingfisher are present along the rivers.

Threats

Manovo-Gounda-St Floris National Park is a highly threatened protected area under pressure from livestock grazing, wildlife poaching, inadequate resources and number of Park staff, and armed military conflict. The Park’s wildlife is threatened as a result of invasion by nomadic pastoralists with their herds of livestock that carry bovine rinderpest disease (a malignant and contagious disease). Most of this illegal grazing occurs during the dry season, with animals moving from the Nyala region of Sudan and from Chad. This is having an effect on the composition of grasslands, with perennial species giving way to annuals and herbs (WCMC, 1997; McNeely *et al*, 1994).

The most significant threat to the Park is the professional poaching of large mammals, particularly rhinoceros and elephant (IUCN, 1998). Many poachers enter the Park from Chad and Sudan, whilst others also come from within the Central African Republic. These poachers use automatic weapons, and are killing significant numbers of threatened species. Numbers of elephants were reduced by 75 per cent between 1981 and 1984. More recent reports from CAR, Congo and Cameroon indicate that rising ivory prices in local markets have renewed interest in elephant hunting, and increasing human population is putting pressure on the elephant's habitats (Wildlife Conservation Society, 1999). As few as ten rhinoceros remained in the Park by 1988 and the giraffe population has also declined. In 1997, uncontrolled poaching had reached extreme levels, with heavily armed professional poaching groups entering the Park, setting up camp, and transporting ivory and meat out by camel trains. During the same year, four Park staff were killed while defending Park wildlife. There is no anti-poaching force currently protecting the Park.

Tourism ceased in June 1996, when security for travellers could no longer be assured due to military conflict. The initial cause of the military mutinies was the non-payment of soldiers’ salaries by the Government. The British High Commission in Yaoundé continues to advise strongly against all but essential travel to CAR. The situation in Bangui remains seriously unstable with outbursts of fighting continuing. The situation in other parts of the country is deteriorating. Expatriates and visitors are

being increasingly targeted by well-armed groups operating both day and night (British High Commission, 1999).

The Park is currently under the administration of one manager and an assistant (WCMC, 1997). There are too few staff to protect and manage this size of Park, and the equipment available for staff is inadequate, with only one vehicle and a few firearms. An IUCN Mission Report (1998) summed up the problems facing the Park, noting that there was serious concern *"about the level of uncontrolled poaching by armed groups that had led to the deaths of four Park staff, decimated more than 80 per cent of the Park's wildlife population, and brought tourism to a halt*."

Conclusions and Recommendations

It is difficult to get current and detailed information on this site due to the military instability in the region. The State party from the Central Africa Republic has not been able to provide additional information to the IUCN on behalf of the World Heritage Bureau but in its recent report, IUCN notes that it is willing if invited and funded to field a mission to the site in 2000 (IUCN, 1999). Poaching and over-grazing are complex problems made more complicated by the armed conflict. One bright spot may be that on 21 December 1999 the World Bank approved a 20-million-US-dollar loan to help the government of the Central African Republic (PanAfrican News Agency, 1999). It is hoped that the loan will enhance the prospects for sustained civil peace and economic recovery, which will lay the foundations for poverty reduction.

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MONTEVERDE CLOUD FOREST RESERVE
Costa Rica

Key threats
Climate change and a range of human pressures including conlicts over land tenure and expansion of agriculture.

Biogeographical region: Neotropical **Major habitat type**: Cloud Forest **National legal designation**: Strict Nature Reserve (WCMC, 1997) **IUCN Category**: not assessed **Other international designations**: WWF Global 200 (No. 8. Talamancan & Isthmian Pacific Forests)	**Location**: 10º17'N/84º48W **Area**: 10,500 hectares **Year of establishment**: 1972 **Ownership**: Private (WCMC, 1997) **Management Authority**: Local NGO, Tropical Science Center based in San José

Description
One of the most famous cloud forest sites in the world is Tilarán Cordillera – the Monteverde Cloud Forest Reserve. Monteverde is located high on the ridge above the coastal plain near the town of Santa Elena. The Cloud Forest Reserve comprises six forest types: cove forest, leeward cloud forest, oak ridge forest, windward cloud forest, elfin forest and swamp forest. The reserve is located in a much larger forest area of about 60,000 hectares, which also includes the Children's Eternal Rain Forest (Monteverde Conservation League), Santa Elena Cloud Forest Reserve (MINAE-Colegio Santa Elena), Reserva Manuel Alberto Brenes (Universidad de Costa Rica) and Arenal National Park (MINAE).

Over 2000 plant species are found in the Monteverde area, although not all are associated with the cloud forest. The most brightly coloured of all toads (El Sapo Dorado) occurs only in one small part of the Monteverde Cloud Forest. Over the years, Monteverde has built up a rich research heritage, especially on vegetation, birds and now on the impacts of climate change.

Threats
Many of the cloud forest sites in Costa Rica are protected, this does not however make them immune to threats of deforestation for agriculture and grazing, increased tourism numbers and associated problems such as infrastructure development and increased rubbish, or conflicts over land tenure. In particular, and the focus of this case study, climate change is posing a very real threat to the biological diversity of these forests. Furthermore, a major weakness of all cloud forest reserves in Central America is the failure to include habitats on lower slopes, particularly on the Pacific slope, that are ecologically linked to the higher montane environments. Such areas of dry or humid forest are distinct habitats, but they are also critical to many cloud forest species that have seasonal altitudinal migrations in and out of the cloud forest itself.

Recent studies conducted at Monteverde have shown a decline in amphibians, including the extinction of the world's only population of golden toads (*Bufo periglenes*) as a result of climate change (Pounds *et al*., 1999). In April 1999 two papers (Pounds *et al*., 1999; Still *et al*., 1999) were published that make a scientifically convincing case that global climatic change is responsible for ecological events – in this case species extinction. The (1999) study by Pounds *et al*., examined whether changes such as recent rises in sea surface temperatures (SSTs) have an impact on the biodiversity in cloud forests in Monteverde. For example, it was observed that 20 of 50 species of anurans (frogs and toads) in a 30 km^2 study area, including the endemic golden toad, disappeared following synchronous population crashes in 1987. The results of the study indicate the crashes probably belong to a series of demographic changes that have also altered communities of birds, reptiles and amphibians in the area

and are linked to recent increases in SSTs. The biological and climatic patterns suggest that atmospheric warming has raised the average altitude at the base of the orographic cloud bank (which forms as moist air rises up the mountain slope and then cools, condenses and forms clouds), as predicted by the lifting-cloud base hypothesis (Still *et al*., 1999).

The climate changes at Monteverde are all associated with patterns of dry-season mist frequency, which is negatively correlated with SSTs in the equatorial Pacific, and has declined dramatically since the mid-1970s. The papers suggest that if temperature dependent relative humidity surfaces, and thus cloud formation heights, have likewise shifted upwards – organisms such as the golden toad may be affected in various ways. Although these dry periods are associated with warm episodes of El Niño/Southern Oscillation (ENSO), the drying trends remains significant even after ENSO-scale fluctuations are taken into account.

Changes in bird abundance at 1,540 metres support the prediction that species should respond to climatic change according to their distribution along climatic gradients. Accordingly, the number of lower-montane species present in this study plot remained comparatively stable, whereas the pre-montane species increased. A second example, is the red-eyed stream frogs (*Hyal uranochroa*), which at several study sites at Monteverde underwent declines in both 1987 and 1998, the two most extreme years climatically. Pounds has lived and worked at Monteverde for most of the past 20 years, and describes these changes: "*It's not just a matter of noticing that things are a little less common. They're gone*" (New Scientist, 1999).

In addition to the changes in habitat being caused by climate change, other pressures on the Reserve including hunting, both within and in the boundaries to the reserve. Encroachment for human settlements as well as for agricultural activities occur on the lower slopes.

Monteverde and the surrounding area has significant investment in the Santa Elena Cloud Forest Reserve, and amenities such as the Canopy Tour, the Sky Walk, the Sky Trek, the Butterfly Garden, the Orchid Garden, the Serpentarium, the Ecological Farm, Bajo Del Tigre Trail and the Hidden Valley Trail. In the long term, the tourism industry may indeed be under threat if the very biodiversity that people travel to see is in decline.

Conclusions and Recommendations

It is frightening that in such a relatively short period of time, such significant change in species abundance has occurred in the cloud forests of Monteverde. Monteverde's unique habitat and inter-dependent species are threatened by what amounts to long range transport of environmental contamination via our global heating and cooling system.

This case study drives home the message that protected areas face threats from many directions and sources. This has considerable time, cost and priority setting implications for Reserve management and monitoring programmes. The findings at Monteverde fit with the growing belief among climatologists that the first effects of global warming will be apparent at high elevation sites, particularly in the tropics. No protected area is an island even it if is 3000 metres up.

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MOUNT NIMBA STRICT NATURE RESERVE
Côte d'Ivoire and Guinea

Key threats
Armed conflict and iron-ore mining.

Biogeographical region: Afrotropical **Major habitat type**: Tropical forest and west African woodland savannah **National legal designation**: Strict Nature Reserve **IUCN Category**: Ia **Other international designations**: World Heritage Site Guinea Section (1981) Cote d'Ivoire Section (1982); World Heritage in Danger (1992-present); Guinea Section only Biosphere Reserve (1980).	**Location**: 7°34'N/8°24'W **Area**: 5,000 hectares (Côte d'Ivoire), 13,000 hectares (Guinea) **Year of establishment**: 1944 (Guinea and Côte d'Ivoire) **Ownership**: Government of Côte d'Ivoire, and Government of Guinea **Management Authority**: Secretary of State for National Parks, Ministry for Nature Protection (Côte d'Ivoire); Department of Rural Development (Guinea).

Description
The massif of Nimba is situated on the border between Guinea, Côte d'Ivoire and Liberia. The boundary of the reserve follows the international border between the three countries, such that the Liberian portion of the massif is excluded. The highest point in the reserve is Mt. Richard Molard at 1,752m. The reserve is made up of several protected areas – nature reserve (Guinea) 13,000ha; nature reserve (Côte d'Ivoire) 5,000ha; and a Biosphere Reserve (Guinea) 17,130ha. The Nimba Mountains contain the sources of the rivers Cavally and Ya (which forms the Mami River of Liberia) and are cut up by deep, richly forested valleys. Mt. Nimba is a site of extraordinary biodiversity and topographical diversity, with valleys, plateaus, rounded hilltops, rocky peaks, abrupt cliffs and bare granitic blocks, and the whole area constitutes a vast water catchment.

There are three major vegetation types (WCMC, 1990):
- High altitude grassland with *Loudetia kagerensis* near the summit and endemics including *Blaeria nimbana* and *Dolichos nimbaensis*
- Savannah plains varying according to the hardness of the soil and supporting numerous herbaceous plant communities. The savannah is broken by gallery forests that grow between 1,000 and 1,600m
- Predominantly primary forest, located mainly on the foothills and in the valleys, with dominant species including *Triplochiton scleroxylon*, *Chlorophora regia*, and *Morus mesozygia*

Dry forests are rarer in the Reserve than moist forests because of agricultural pressures, and some of the dry forest species have disappeared from many areas. More than 2,000 plant species have been described from the area, and about 16 are thought to be endemic (Davis, 1994; WCMC 1990).

More than 500 new species of fauna have been discovered in Mount Nimba Reserve and there are more than 200 endemic species. Species diversity is exceptionally rich because of the variety of habitats created by the presence of grasslands laced with forest. Mammals include bushbuck (*Tragelaphus scriptus*), Maxwell's duiker (*Cephalophus maxwelli*), black duiker (*C. niger*), bay duiker (*C. dorsalis*), forest buffalo (*Syncerus caffer nanus*), bush pig (*Potamochoerus porcus*), warthog (*Phacochoerus aethiopicus*), scaly anteaters such as white-bellied pangolin (*Manis tricuspis*), and pygmy hippopotamus (*Choeropsis liberiensis*). There are also leopard (*Panthera pardus*), lion (*P. leo*), golden cat (*Felis aurata*), two-spotted palm civet (*Nandinia binotata*), African civet (*Civettictis civetta*), forest genet (*Genetta servalina*), servaline genet (*G. servalina*), African clawless otter (*Aonyx capensis*) and lesser otter shrew (*Micropotamogale lamottei*) (a new genus discovered on Mount Nimba).

One of the most noteworthy species is the viviparous toad (*Nectophrynoides occidentalis*), which occurs in montane grasslands between 1,200 and 1,600m, it is one of few tailless amphibians in the world that are totally viviparous. *N. liberiensis*, also found on Nimba, shares this characteristic (WCMC, 1990).

Threats

The site is threatened by extensive iron-ore mining, years of armed conflict and the arrival of a large number of refugees from Liberia.

Before World War II Guinea was a poor and underdeveloped French territory with few exports. However, following the war mining of bauxite and iron began, and during the early 1950's Guinea rose to become one of France's richest territories. Mining continues to be extremely important to the national economy. Guinea's iron ore is located in the southern area of the country, mostly near and on Mount Nimba and the government has built a railroad from Mount Nimba to the port at Conakry for transporting the ore. The mining activities threaten about 6,000ha of the Mt Nimba Reserve. Roads, wells and mineshafts have been built and workshops and townships established in what had been a strict nature reserve since 1944. Hundreds of square metres of soil have been removed over large areas and, as a result, streams for miles around are contaminated with toxic run-off, particularly ferruginous rock debris. There are more deposits in the central part of the Guinean Mount Nimba and plans to develop and mine these continue. These mining activities whilst destructive in themselves have also opened up the area to deforestation, human settlement, roads and poaching of bushmeat.

The violence that has beset the region for years, in particularly in Liberia and Sierra Leone, is also threatening the Park. Many people trying to escape the horror of the violence have moved into the Park area. There is no hope for this situation to improve until there is an end to violence and the enforcement of human rights in the region.

Conclusions and Recommendations

In December 1999, at the meeting of the World Heritage Bureau, IUCN recommended that Mt. Nimba should remain on the World Heritage in Danger List (IUCN, 1999). This protected area is under-resourced and under-capacity. It faces a politically unstable environment. Armed conflict, refugees and the fact that tourism is prohibited within the strict nature reserves offers little chance of developing an eco-tourism strategy to finance conservation in the protected area.

However, a meeting on 4 October 1999, held under the auspices of the UNESCO Biosphere Programme provides some hope for Mt. Nimba. Fifty African experts met to discuss biosphere reserves threatened by multiple human pressure and political instability on the continent. The newly formed working groups plan to zone and operate reserves, manage cross-border reserves and conduct research and training, as well as strengthen African co-operation in the conservation of biodiversity. With regard to Mt. Nimba, the experts stressed that the site was exceptional for biodiversity in Africa. *"Mount Nimba harbours unique colonies of batrachia and viviparous species,*" Dr Martine Tahoux Touao of the Environmental Research Centre at Abobo-Adjame University in Cote d'Ivoire noted. *Unfortunately*, she added, "*political instability and conflicts in Liberia and Sierra Leone, compounded by growing mining activities, are threatening this rich biodiversity that is of exceptional value to Africa*." (AfricaNews, 1999).

A final note is that the Government of Guinea recently announced that it is working with the World Environment Fund and the UNDP with a view to financing a project for the protection of Mt. Nimba and the sustainable development of the surrounding areas (IUCN, 1999).

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NORTH-EAST GREENLAND NATIONAL PARK
Greenland, Denmark

Key threats
Climate change.

Biogeographical region: Nearctic **Major habitat type(s)/biome(s)**: Tundra, fjords, sea and glacier (High Arctic) **National legal designation**: National Park **IUCN Category**: II **Other international designations**: Biosphere Reserve (1977); Two Ramsar Sites (Hochstetter Forland 1988) and (Kilen 1988).	**Location**: 77°00'N/37°20'W **Area**: 97,200,000 hectares **Year of establishment**: 1974 **Ownership**: Government of Denmark **Management Authority**: The National Forest and Nature Agency and Directorate for Health and Environment, Nuuk, Greenland

Description
The North-East Greenland National Park is the largest protected area in the world, covering some 97,200,000 hectares. Temperatures range from a summer high of 10°C to 20°C (July mean 1°C-6 °C) to a winter low of -40°C to -50°C. The National Park includes high mountains divided by glaciers extending into deep fjords, arctic tundra, lakes, rivers and 'Peary Land' – the northern-most ice-free area in the world. On its north and east coasts it is bounded by the Greenland Sea. There are two Ramsar sites located within the National Park: Hochstetter Forland, which contains an important moulting area for the pink-footed goose and Kilen,an important breeding site for the vulnerable light-bellied brent goose (CAFF, 1994).

The dominant vegetation consists of dwarf-birch (*Betula nana*) and Arctic blueberry (*Vaccinium microphyllum*) heaths in the south, giving way to white Arctic bell heather (*Cassiope tetragona*), mountain aven (*Dryas integrifolia*), and Arctic willow (*Salix arctica*) to the north. The flora of vascular plants comprises 200-300 species in total including a few endemic species such as (*Saxifraga nathorsti*) (WWF, 1999).

The Park supports a resident population of some 200-500 polar bears (*Ursus maritimus*) – one of the reasons why the national park was established – and several species of marine mammals including a small population of 500-1000 walruses (*Odobenus rosmarus*) (Born *et al*, 1997). There are also seals, such as the harp seals (*Pagophilus groenlandicus*) and, less commonly, bearded seals (*Erignathus barbatus*), narwhal (*Monodon monoceras*) and white whale (*Delphinapterus groenlandicus*). Terrestrial mammals include ermine (*Mustela erminea*), about 50 Arctic wolves (*Canis lupus*), the Arctic fox (*Alopex lagopus*), collared lemming (*Dicrostonyx groenlandicus*), Arctic hare (*Lepus arcticus*) and a population of 9,500-12,000 musk oxen *Ovibus moschatus* (Boertmann *et al*, 1992; WWF, 1999).

Avifauna includes the red-throated loon (*Gavia stellata*), barnacle goose (*Branta leucopsis*), pink-footed goose (*Anser brachyrhynchus*), eider (*Somateria mollissima*), king eider (*S. spectabilis*), long-tailed duck (*Clangula hyemalis*), great ringed plover (*Charadrius hiaticula*), sanderling (*Calidris alba*), knot (*C. canutus*), ruddy turnstone (*Arenaria interpres*), long-tailed skua (*Stercorarius longicaudus*), ivory gull (*Pagophila eburnea*), Sabine's gull (*Larus sabini*), glaucous gull (*Larus hyperbereus*), Arctic tern (*Sterna arctica*), ptarmigan (*Lagopus mutus*), raven (*Corvus corax*), gyrfalcon (*Falco rusticolus*), and snowy owl (*Nyctea scandiaca*), Arctic redpoll (*Carduelis hornemanni*), and snow bunting (*Plectophenax nivalis*) together with the endemic subspecies of dunlin (*Calidris alpina arctica*), and rock ptarmigan (*Lagopus mutus captus*) (WWF, 1999).

The Park is part of UNESCO's Biosphere Reserve (MAB), Northern Sciences Network (NSN), which consists of the eight Arctic countries and other countries with significant research activities in Arctic areas. The purpose of NSN is to strengthen MAB activities in northern areas by promoting co-

operative research programmes, exchanging information and by providing training opportunities (UNESCO, 1999).

Threats

In a review carried out for WWF, Moltke and Christensen (1996) suggest that there will be a number of significant ecological impacts resulting from climate change in the National Park. Their findings with respect to global warming revealed that for example, herbivores suffer when there is an uncharacteristic warming in the Arctic winter. The repeated freezing and thawing of snow results in a thick crust that prevents musk oxen and other grazers from reaching the vegetation beneath. This can lead to starvation for many animals. The timing of the thaw is critical to the arrival of migratory birds that rely on the brief summer abundance of insect and plant food resources. A delay in the thaw, caused by heavier winter snowfall, would at least delay the timing of breeding and could lead to a reduction in bird populations (WWF, 1999).

As the Arctic warms, it is expected that species with more southerly distributions will spread northwards and 'out-compete' the more northerly-distributed species. This would result in a northward migration of the forest-tundra, with woody shrub species dominant, to the south and graminoid species to the north. The same would apply to insects, with butterflies (e.g., *Clossina spp., Colias hecla*) constrained to northern areas, and beetles expanding into their territory. However, the migration of species is likely to be very slow in comparison with climatic change, and the initial effect therefore is likely to be an overall reduction in species populations and diversity.

A report by Conservation of Arctic Flora and Fauna (CAFF, 1994), noted that long term global warming would facilitate decomposition and drying thus potentially releasing vast quantities of methane and carbon dioxide, further amplifying warming. Temperature changes, especially warming, are likely to have major effect on Arctic marine ecosystems (CAFF, 1994) such as those found along the coast of the Park.

Artificial warming experiments in the Arctic tundra (WWF, 1999) give some idea of the likely effects of climate change on vegetation. International Tundra Experiment (ITEX) results, confirmed by long-term monitoring in Alaska, suggest that warming will be accompanied by a reduction in biodiversity as species are lost but only slowly replaced by other plants. A disintegration of plant communities would have further impacts on animal populations. Experiments on Spitsbergen (High Arctic, Norway) have shown that a prolonged growing season results in an eleven-fold increase in the number of aphids. The effect of this on tundra plants is unknown (WWF, 1999).

In the southern part of the North-East Greenland National Park, lies the Zackenbergelven's River catchment covering 600 km^2 in area.The Zackenberg Ecological Research Station, was established in this area in 1995. Besides being the base for all kinds of research projects, three monitoring programmes, ClimateBasis, GeoBasis and BioBasis, follow the year to year variability, as well as long-term changes, in a wide variety of local abiotic as well as biotic parameters. The biological programme monitors more than 1200 variables in local plant, arthropod, bird and mammal populations. One initiative of the Research Station, called ZERO-line, is an 8.8 km botanical monitoring transect stretching from sea level to a point above 1,000 metres above sea level, along which changes in vegetation are being monitored. Data to examine ecological responses to climatic change are being collected and analysed along this transect line (WWF, 1999).

Conclusions and Recommendations

The Arctic was considered one of the most remote, pristine and least disturbed biomes in the world. It has low species diversity and some now argue that this makes it more vulnerable to environmental threats such as those brought about by climate change. It is also in the Arctic, because of its remoteness from other environmental variables, that scientists expect to see some of the first ecological changes brought about by global warming. This is now happening. It is intuitively attractive to protect vast

areas of the Arctic such as North-East Greenland National Park, but as with other sites affected by climate change discussed in this report, protected areas can never again be thought of or managed as islands when the threat is global climate change.

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OKAPI FAUNAL RESERVE
Democratic Republic of the Congo

Key threats
Population pressures, famine, civil unrest, poaching (bushmeat, ivory), wood extraction, and gold mining.

Biogeographical region: Afrotropical **Major habitat type**: African Rainforest **National legal designation**: Faunal Reserve **IUCN Category**: II **Other international designations**: World Heritage Site (1996)	**Location**: 1 45'N/28 30E **Area**: 1,372,625 hectares **Year of establishment**: 1992 **Ownership**: Government of DR of Congo Management Authority: Directorate of Conservation

Description
Okapi Faunal Reserve is located in the north-east of DR Congo in the Ituri Forest in the Haut-Zaire Region. The reserve occupies about one fifth of the Ituri Forest. Ninety percent of the reserve lies within the political Zone of Mambasa in the Ituri sub-region, and the remainder within the Zones of Wamba and Watsa in Haut-Uele sub-region. The Reserve's northern boundary is the Nepoko River. The Ituri River, which is a major tributary of the Zaire River, forms part of the southern boundary. Although the Reserve was established in 1992, a captive-breeding centre was established within the reserve area at Epulu in 1952 to supply okapi to zoos around the world.

The Faunal Reserve is of tremendous ecological importance. The forest is a Pleistocene refuge providing exceptional species richness with 15 per cent endemicity, one of the highest in the world. Ituri has the highest okapi density, approximately 2.5 individuals per km^2. Ituri is also listed as one of the key forest sites in Africa important for bird conservation. DR Congo is included in the top 25 countries in the world that possess the most species and endemism (WCMC and IUCN, 1994).

From an elevation of about 600m in the west, where the rolling plateau of the Ituri drops onto the central river basin, the forest rises to more than 1000m giving way abruptly in the east to the savannah hills of the Albertine rift. The majority of the Reserve is composed of gently rolling forested uplands. Soils of the Ituri Forest are frequently deeper than two metres although thin patches occur, particularly on hills.

The most important geomorphological features are the Zaire drainage system and the mountains of the Albertine rift. The Zaire basin is one of the largest and most important drainage systems in Africa. Other important watercourses include the Lenda, Ngayu and Agamba Rivers (Sidle and Lawson, 1986).

Although a comprehensive inventory of flora is not available, floristic diversity is suspected to be high. Four main forest types occur: swamp forest, mixed forest, Mbau forest, and secondary forest. Swamp forest occurs in narrow strips along drainage channels throughout the reserve. Mixed forest typically has a crown height of 30-40m, and a heterogeneous canopy with frequent emergent trees. Typical canopy tree species include *Julbemardia seretii*, *Cynometra alexandri*, *Cleistanthus michelsonii*, and *Klainedoxa gabonensis*. Large emergent trees include *Irvingia excelsa, I. robur, I. grandiflora, Klainedoxa gabonensis, Cannarium schweinfurthii*, *Pachylesma tessmannii* and *Entandrophragma* spp. The under-storey is open but a sub-canopy layer is absent. The Mbau forest is dominated by *Gilbertiodendron dewevrei*, which often occurs in pure stands. Emergents are rarer than in mixed forest but include *Irvingia excelsa* and *Tessmannis africana, Uapaca guineesis* and *Cannarium schweinfurthii*. The shade intolerant species *Entandrophragma* spp. also occur, which is an indicator of

past disturbances. Secondary forest generally occurs in areas that have been deforested. Two threatened endemic cycads *Encephalartos marunguensis* and *E. schmitzi* are present.

There are 52 mammal species including okapi (*Okapia johnstoni*), endemic to DR Congo. The latter has a very localised distribution and the Ituri Forest is one of the major areas supporting okapi populations. Of perhaps 30,000 remaining okapi in the wild, some 5,000 live in the Reserve. The number of elephants (*Loxodonta africana*) in the forest is estimated at 6,700 individuals. Other species include the endemic water chevrotain (*Hyemoschus aquaticus*), African golden cat (*Felis aurata*), leopard (*Panthera pardus*), giant ground pangolin (*Manis gigantea*), giant forest genet (*Genetta victoriae*), anubis baboon (*Papio anubis*), bush pig (*Potamochoerus porcus*), pygmy antelope (*Neotragus batesii*), *Thryonomys swinderianus*, *Syncerus caffer* and giant forest hog (*Hylochoerus meinertzhageni*) (WCMC, 1996).

The Ituri Forest has one of the highest numbers of duiker species in Africa including blue duiker (*Cephalophus monticola*), black-fronted duiker (*C. nigrifrons*), white-bellied duiker (*C. leucogaster*), Peter's duiker (*C. callipygus*), Bay duiker (*C. dorsalis*) and yellow-backed duiker (*C. sylvicultor*). Thirteen primate species have been observed, the largest number known for an African forest, including red colobus (*Colobus badius*), *C. angolensis*, Eastern black and white colobus (*C. guereza*), red-tailed guenon (*Cercopithecus ascanius*), *C. mitis*, *C. lhoesti*, *C. pogonious (mona) denti*, De Brazza's monkey (*C. neglectus*), owl-faced guenon (*C. hamlyni*), *Cercocebus albigena*, crested mangabey (*C. galeritus*), l'houest monkey (*C. l'houesti*) and chimpanzees (*Pan troglodtyes*). Also present are Zaire clawless otter (*Aonyx congica*), brush-tailed porcupines (*Atherurus africanus*), bongo antelope (*Tragelaphus euryceros*), Sitatunga antelope (*T. spekei*), black-legged mongoose (*Bdeogale nigripes*), black mongoose (*Crossarchus alexandri*) and marsh mongoose (*Atilax paludinosus*) (WCMC, 1996).

Ituri has some 329 bird species including spot-breasted ibis (*Lampribis rara*), olive ibis (*L. olivacea*), long-tailed hawk (*Urotriorchis macrourus*), Nahan's francolin (*Francolinus nahani*), black guineafowl (*Agelastes niger*), guineafowl (*Guttera plumifera*), sandy scops owl (*Otus icterorhynchus*), Nkulengu rail (*Himantornis haematopus*), Bate's nightjar (*Caprimulgus batesi*), black spinetail (*Telacanthura melanopygia*), bare-cheeked trogon (*Apaloderma aequatoriale*), Bedford's paradise flycatcher (*Terpsiphone bedfordi*), black-collared lovebird (*Agapornis swinderniana*), lyre-tailed honeyguide (*Melichneutes robustus*), endemic yellow-legged weaver (*Ploceus flavipes*) and the endemic golden-naped weaver (*P. aureonucha*).

Threats

The nearby area of Kivu is one of DR Congo’s most densely populated regions and over the last decade people have been migrating from Kivu into the Ituri Forest in search of new land for cultivation. The forest ecosystem is further threatened by the increase in commercial logging concessions near park boundaries, poaching, commercial hunting for wild meat, gold-mining, and elephant poaching for ivory (IUCN, 1994).

At the 1999 meeting of the World Heritage Committee the threats to protected areas in the Congo were widely recognised. IUCN noted that despite international efforts, little progress has been achieved towards peace in the Democratic Republic of the Congo and much remains uncertain in terms of future biodiversity conservation. Reports indicate that positive gains made over the past decade are being threatened by a range of problems, such as over population, famine and civil unrest. Illegal resource exploitation (poaching, wood extraction, mining and cultivation) has reached high levels in many areas including Okapi. The Park staff continue to operate despite poor equipment, lack of pay and the threat of armed forces and poachers (IUCN, 1999). At present the dedication of the staff is the only hope that the site will not be stripped of its resources.

Conclusions and Recommendations

The Okapi Faunal Reserve faces a vast number and type of serious threats that are beyond the means and control of Park management, yet despite hazardous conditions Park staff continue to do their job. This situation was discussed at a meeting held in Kenya in April 1999 involving representatives from UNESCO, IUCN, GTZ and personnel from all five World Heritage sites in the Democratic Republic of Congo. Results from the meeting included a number of management recommendations, as well as a draft proposal for a Trust Fund to ensure payment of the guards and the implementation of the park management plans.

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SANGAY NATIONAL PARK
Morona Santiago, Chimborazo, Cañar and Tungurahua Provinces, Ecuador

Key threats
Construction of the Guamote-Macas road, poaching, volcanic activity, small-scale mining, gold prospecting, and insufficient staff and budget to manage the Park.

Biogeographical region: Neotropical, Northern Andean Ecoregion. **Major habitat type(s)/biome(s)**: Cloud Forest National legal designation**: National Park** **IUCN Category**: II **Other international designations**: World Heritage site (1983); World Heritage in Danger (1992-present).	**Location**: 2 15'S/78 26'W **Area**: 517,725 hectares **Year of establishment**: 1975 **Ownership**: Government of Ecuador **Management Authority**: Environmental Ministry, Areas Naturales y Vida Silvestre Department (former INEFAN). (Due to decentralisation in the Ecuadorean public sector, park management is no longer headed by a single manager but by three).

Description
Sangay is located in the Cordillera Oriental region of the Andes in central Ecuador. The Park's boundaries cross the four provinces of Morona Santiago, Chimborazo, Cañar and Tungurahua. The Park is dominated by three volcanoes: Tungurahua (5,016m), El Altar (5,139m) and Sangay (5,230m). El Altar has an eroded and glaciated caldera to the west, and is considered extinct. Tungurahua and Sangay are both active. Sangay regularly ejects hot rocks and tephra (ash and debris) and in November 1999, following an explosion from Tungurahua, ash coated the city of Baños.

Sangay National Park is considered to have an extremely complex ecological composition and has received the highest resource analysis rating of any park in Ecuador. Its natural regions, terrestrial and aquatic ecosystems, physiographic formations, geology, history and other unique characteristics make it the most outstanding protected area in mainland Ecuador (WCMC, 1997). It is an important protector of many watersheds, and has archaeological importance of unknown extent (WWF and IUCN, 1997).

The Park can be divided into a number of geomorphological zones including: alluvial fans, eastern foothills and the High Andes. The major rivers, draining eastwards into the Amazon Basin, are the Llushin, Palora, Volcan, Upano and the two Sangay rivers. They are characterised by rapid and dramatic changes in level. Run-off is extremely rapid, due to high rainfall and steep slopes, and erosion is substantial, although controlled by thick forest vegetation. Numerous waterfalls occur, especially in the hanging valleys of the glaciated zone and along the eastern edge of the Cordillera. There are numerous freshwater lakes such as Laguna Pintada which measures 5km in length (WCMC, 1997).

A high diversity of vegetation is present, ranging from alpine zones of the high *paramo* to the subtropical rain and wet forests of the upper Amazon Basin. Important areas of cloud forest are found in the Park below 3,750m on the wetter eastern slopes. Some 93 families, 292 genera and 1,566 species have been identified in the Andean forests of Ecuador above 2,400m, and most of these genera are represented in Sangay (WWF and IUCN, 1997). Species distributions correspond with vegetation zones and there is a distinct altitudinal zonation. Sangay's high elevations provide important habitats for the threatened mountain tapir (*Tapirus pinchaque*). There are also puma (*Felis concolor*), guinea pig (*Caria* sp.) and Andean fox (*Dusicyon culpaeus*). Elsewhere threatened species include the spectacled bear (*Tremarctos ornatus*), jaguar (*Panthera onca*), ocelot (*Felis pardalis*), margay (*F. wiedii*), brocket deer (*Mazama rufina*), pudu (*Pudu mephistophiles*) and giant otter (*Pteronura brasiliensis*) (WCMC, 1997).

Some 400-500 bird species have been observed, although comprehensive inventories have yet to be compiled. The Park contains two Endemic Bird Areas, the Central Andean páramo, home to ten bird species of restricted range, and the Eastern Andes of Ecuador and northern Peru, home to 15 restricted-range species (Stattersfield *et al*, 1998). Noteworthy species include condor (*Vultur gryphus*), seen particularly around the mountain area of Altar, Cubillin and Quilimas, cock of the rock (*Rupicola peruviana*), which exists in substantial populations in inaccessible upper forest areas of the eastern Andean slopes, giant humming bird (*Patagona gigas*), torrent duck (*Marganetta armata*), king vulture (*Sarcoramphus papa*) and swallow-tailed kite (*Elanoides porficatus*) (WCMC, 1997).

Threats

The major threats to Sangay National Park are clearance and encroachment for agriculture and the construction of the Guamote-Macas road. Fire, subsistence poaching, volcanic activity, livestock grazing and small-scale mining also threaten the Park.

There is great pressure on the park and its resources from settlers to clear land for pasture. An area added to the Park in 1992 had a resident population of about 1,000 people, adding to the numerous planning and management problems. There is also a noticeable increase in the presence of *vaqueros* and hunters in the western areas of Culebrillas and Plazapamba. Spontaneous and organised colonisation of the lower slopes of the Andes, around the periphery of the Park, is destroying the vegetation and contributing to erosion and could threaten the important watersheds. Most of the subtropical lowland forest on the eastern park boundary has been converted into cattle pasture and agricultural land. Overgrazing of paramo by cattle and sheep has occurred in the western areas of Filo de Plazapamba and Culebrillas Chico, resulting in extensive soil erosion and compaction.

Other threats includes fire, for exmaple, in 1987 fires burned approximately 500ha in Naranjal Chico and 1,000ha in Atillo destroying native vegetation, and subsistence poaching particularly in the areas around Filo de Plazapamba and El Altar. There has also been and continues to be sporadic confrontation between the residents of Atillo and park guards, the last reported incident occurring in April 1995. Poaching is a major issue around the eastern border of Sangay as many of the indigenous communities that live nearby have depleted game stocks in the forest remnants outside the Park. Some communities make hunting trips of several days into Sangay to hunt large game such as tapir, peccaries, large primates, deer, guans and curassows (UNESCO, 1999). Subsistence poaching occurs by Shuar Indians, who lost the majority of their traditional lands to colonists. There are incursions into the forests along the western and southern boundaries of the Park and into the Llushin River area. There is a potential threat following the discovery of gold ore in the Llushin Grande and Huamboya areas. The area is unsafe – an IUCN team were almost taken hostage in 1995 – and there have been physical assaults on Park staff.

In 1992, Sangay was placed on the World Heritage in Danger List in response to the construction of the Guamote-Macas road. Although the road will only cross the World Heritage site by 8km when it is completed, the Park is significantly affected by direct construction impacts (severe pollution of the Upano River, dynamite use, destruction of biological corridors and microclimate changes) and indirect effects (opening up the area to new settlers, cattle ranching, poaching and timber extraction). Since 1998, however, according to Ecuadorian Institute of Forestry, Natural Areas and Wildlife (INEFAN), colonisation in the Guamboya valley and along Rio Palora and small scale mining activities have been stopped.

The construction of the Guamote-Macas road, is a long held aspiration of the populations of both Chimborazo and Morona-Santiago provinces as it would open up a new route between the highlands and the Amazon jungle regions (Fundacion Natura, no date). Despite approval for the plan by the Ministry of Public Works, no Environmental Impact Assessment (EIA) was conducted for the project.

An IUCN mission to the Park assessed the true magnitude of the damage caused by the road construction in June 1999. Although harsh weather conditions made the inspection difficult, the IUCN team observed landslides along the existing stretch of road approximately every 50 metres. Army Engineer Corps personnel were observed cleaning up portions of the road blocked by landslides – to enable them to get to the area where road construction was to continue. Millions of cubic meters of rock and soil were dislodged with every rain shower causing widespread destruction of vegetation cover and siltation of the Upano River. The damage will continue as the road-bed follows the left bank of the River. It is estimated that it will take decades before the slopes, which were cut seven years ago to build the road, stabilise and stop collapsing. The remaining section is described as even more vulnerable to landslides and erosion. The completion of the road will provide the 'double-edged' benefits of increased market access and improve the economic livelihoods of communities in Chimborazo and Morona-Santiago provinces, but in so doing contribute to further deforestation and poaching in the Park. However, given the construction constraints, it is difficult to understand the technical and economic viability of this road. The construction of the road (20km so far) has also caused concern among local people with regards to land tenure.

Conclusions and Recommendations

The construction of the Guamote-Macas road, without benefit of an EIA, is in violation of Ecuador's protected area legislation. It continues to threaten directly and indirectly the biodiversity of Sangay National Park. On a more hopeful note, IUCN reported to the World Heritage Committee of an offer of technical assistance from the World Heritage Fund (WHF) and of a five year (1996-2001) US$1.6 million project funded by the Government of the Netherlands and jointly implemented by WWF International and Fundacion Natura. The project's objectives aim to: reduce pressure on the Park by human settlements, minimise the social and environmental impacts of development project especially the completion of the Guamote-Macas road, strengthen capacity, and increase protection of the Park. One can only hope that the assistance of the WHF and this joint project will, by working more with the local community, reduce the pressure on the Park and prevent the building of other roads through this invaluable area.

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PODOCARPUS NATIONAL PARK
Loja and Zamora-Chinchipe Provinces, Ecuador

Key threats
Gold mining, road construction, human settlements inside Park boundaries, forest clearance (using fire and/or chainsaws) for agriculture, and poaching (fish, timber, orchids, medicinal plants).

Biogeographical region: Neotropical **Major habitat types**: Montane *Podocarpus* forest, humid, tropical and alpine grasslands **National legal designation**: National Park **IUCN Category**: II **Other international designations**: None	**Location**: 04°13'S/79° 02'W **Area**: 146,280 hectares **Year of establishment**: 1982 **Ownership**: Government of Ecuador, with some areas in and around the Park owned formally and informally according to length of residence, access to government and technical services, ethnicity and economic level. **Management Authority**: Instituto Ecuatoriano Forestal y de Areas Naturales y Vida Silvestre (Ecuadorian Institute of Forestry, Natural Areas, and Wildlife) (INEFAN). Currently, the Ministry of Environment, Ministerio del Ambiente, is the management authority.

Description
Podocarpus National Park (PNP) is the only protected area in southern Ecuador and its boundaries include the region's last substantial tracts of pristine forest at mid to upper altitudes of 950m to 3,700m, with 90 per cent of Park above 1500m (Aldrich *et al*, 1997). The area of the Park straddles the Andes mountains and is a biodiversity hotspot both for plant and animal species and endemics (WCMC, 1995). There are several internationally threatened species such as mountain lion (*Felix concolor*), spectacled bear (*Tremarctos ornatus*) and mountain tapir (*Tapirus pinchaque*) and 600 species of birds have been observed including the bearded guan (*Penelope barbata*) and white-breasted parakeet (*Pyrrura albipectus*). It has rich floral diversity with some 3,000 to 4,000 plant species. The montane forest is dominated by Podocarpus trees (*Romerillos* spp.) which is the only genus of conifers native to Ecuador (Aldrich *et al*, 1997).

The Park area covers the upper watersheds of the Jamboe, Sabanilla, Bombuscaro, Numbala, Loyola, Nangaritza, Quebrada de Campana and Vilcabamba rivers. Several urban areas depend on PNP for their water supply including Zamora with a population of 39,000 and Loja with 140,000 (Brandon *et al*, 1998).

Threats
The Park is threatened by encroachment, road construction, forest clearance (using fire and chainsaws) for agriculture - pasture (beef cattle) and cash crops (sugar cane, coffee, tobacco) – poaching (fish, timber, orchids, medicinal plants) and most severely by gold mining.

During recent years, the encroachment rate of agricultural settlements along the Park's boundary has increased for several reasons including: indigenous communities' loss of traditional lands; transmigration; government policy; land markets and level of infrastructure e.g. roads. For example, with the completion of the road along the eastern boundary of PNP called Proyecto Carretera Marginal de la Selva, colonisation is likely to accelerate around the Park.

PNP has steeply dissected topography that has, in part, protected it from agriculture expansion, a process that has converted much of the area surrounding the Park from forest to arid farms. Along the western boundary edge habitat is affected by fire and grazing. Isolated fires can spread to several neighbouring farms and into Park especially during times of drought (Brandon *et al*, 1998).

Fire changes the composition of vegetation and makes it easier for exotic grasses to invade. At one time officials attempted to curtail burning and required individuals to obtain a permit but attempts to levy burning penalties did not work and the system broke down. Individuals frequently transport their cattle to graze in areas along the Park's western boundary, which has resulted in pasture degradation and erosion. In Zamora-Chinchipe Province much of the forest has been lost to pastures which support a limited number of cattle. Over 70 farms in this province are partially or completely within the borders of PNP.

In Ecuador, all resource extraction is illegal within protected areas yet this has not prevented sport hunting, commercial timber extraction, collection of rare orchids, and artisanal and industrial mining from taking place (Brandon *et al*, 1998). The control of such activities has been seriously constrained by a severe shortage of staff (currently twelve park guards are assigned to patrol the Park's 146,280 hectares). There is also a lack of support from provincial law enforcement agencies, ambiguous government policies, and lack of co-ordination between public agencies. The government appears unable or unwilling to support an adequate number of guards (Brandon *et al*, 1998).

There is no adequate baseline data of wildlife populations within the Park but local accounts report a decline in wildlife from poaching. Three or four times a year, Park staff find individuals attempting to sell birds or monkeys as pets but there is no procedure to get an accurate indication of the scale of the wildlife poaching problem in the area. Illegal fishing using dynamite and *barbasco*, a plant based poison, also occurs in the Park.

Illegal logging occurs but without data from field monitoring it is not known to what extent it threatens the Park. International and local citizens have been found illegally collecting orchids and medicinal plants in PNP.

Mining for gold is a major threat and there is a complex history of economic and political interests to mining in PNP. The increase in gold prices during the 1970s led to a gold rush in southern Ecuador. By the mid-1980s, up to 20,000 miners were working at Nambija, a site to the northeast of PNP. Ecuador's Forestry Laws do not allow mining within any protected area yet in 1985 the then Ecuadorian Institute of Energy and Mines, INEMIN, granted mining concessions to various national and international companies for over 95 per cent of PNP's area. In 1986, a Norwegian-Ecuadorian mining company called Cumbinamasa (also known as EcuaNor) obtained an exploration concession for an area of over 16,00 hectares at San Luis in the core of PNP. In 1987, EcuaNor began exploration but in violation of the terms of the concession agreement by constructing a 32 km trail paved with felled trees to access the concession. With the confirmation of gold deposits, EcuaNor signed a financing deal with Rio Tinto Zinc (RTZ) one of the world's largest mining companies. The newly constructed trail allowed artisanal miners, poachers, and hunters access to Park core area. There were armed clashes between the artisanal miners and EcuaNor miners over access. PNP field staff faced the mining problem most directly and were threatened and injured.

In 1993, the Inter-institutional Committee for the Defense of PNP (ICD-PNP) was formed and began to defend the Park against mining interests. ICD-PNP was made up of individuals, NGOs, Fundación Natura (FN), Fundación Arcoiris (FAI), and public and private institutions in the region.

Artisanal mining can cause substantial damage to a site from removal of vegetation, top soil and use of pressure hoses, which in this steep environment lead to erosion. For example, over 150 tunnels were excavated to depths of up to 30 metres and lengths of 200 metres. Gold extraction is obtained using a process of sedimentation amalgamation and burning, in which mercury is released into the environment in liquid and vapour form. The toxic mercury is washed into rivers causing downstream impacts (Brandon *et al*, 1998).

Miners in the Park organised and formed the Association of Artisanal Miners of San Lius to promote their mining interests in the Park. The artisanal miners petitioned the government but their application was refused. They were outraged given that EcuaNor received exploratory concessions that same year. After heated consultation between NGOs, INEFAN and the Government it was finally agreed that the artisanal miners would leave the Park on two conditions: that they be allowed two months to transport heavy machinery out of the Park; and that they be given a mining concession outside the Park. The military was used to prevent subsequent entrance of other miners to San Luis. However, in January 1995, when conflict broke out between Ecuador and Peru, the military left and the miners moved back in. The Association of Artisanal Miners of San Luis believed they had a right to earn an income and they receive no support from government agencies like the National Directorate of Mining (DINAMI). If they are to be forced out of PNP, they feel no one else, not even the international mining companies, should be allowed to mine in the Park. A final agreement was reached which stated that miners had to leave the Park, that they would not be charged and no new miners could enter the Park. EcuaNor left the Park in 1993.

Unfortunately, up to three new groups of miners is now operating in the Park and some 100 miners are active in the San Luis area. In October 1999, there was a meeting of the ICD-PNP with the Subsecretary of Mining who gave the miners two months to leave the Park. So far, however, due to the current politic and economic situation in the Ecuador, the miners have not moved on. There is an additional threat to the Park's buffer zone in south, where a new group of miners (close to 150) have been working since April 1999.

Conclusions and Recommendations

Gold mining in PNP is one of the underlying causes of deforestation and species loss in the Park. In response, a unique co-operative arrangements between NGOs, state agencies and local organisations evolved to protect PNP - in particular, the efforts of the NGO Fundación Arcoiris (FAI) with the support of Ecuador's national organisation Fundación Natura. The ICD-PNP used lobbying, environmental education and research and worked with public agencies to improve PNP infrastructure. In this case, the role of ICD-PNP strengthened the under-resourced environmental public agencies. The threat is not over as artisanal mining and poaching continue in the Park. In autumn 1999, the Government of Ecuador announced a new law was under discussion that threatens to open its country's 2.5 million hectares of protected areas to mining. It promotes mining as a national priority, overturns municipal laws controlling mining interests, favour mining over other property rights, eliminates royalties and allows a single concession approval process for exploration, exploitation, and processing (WCPA, 1999).

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SIMEN MOUNTAIN NATIONAL PARK
Begemder Province, Ethiopia

Key threats
Human settlement within park boundary, wood and grass cutting, livestock grazing, land conversion for agriculture and lack of park infrastructure due to under-financing and military conflict.

Biogeographical region: Afrotropical **Major habitat types**: Mountain highlands and cloud forest **National legal designation**: National Park IUCN Category: II **Other international designations**: WWF Global 200 (No. 116) Ethiopian Highlands; World Heritage site (1978); World Heritage in Danger (1996-present).	**Location**: 13º10'N/38º10E **Area**: 17,900 hectares **Year of establishment**: 1966 **Ownership**: Government of Ethiopia **Management Authority**: The Amhara Regional Government – Bureau of Agriculture – has assumed the responsibility of park administration and management from the Ethiopian Department of Wildlife and National Parks.

Description
Simen National Park is located in the western Simen Mountains, 120km north-east of Gondar in northern Ethiopia. The Park occupies a huge Central Plateau of vast, grassy plains bordering the northern edge of the Ethiopian Amhara plateau. This area is part of the Simen Massif which includes the highest peak in Ethiopia, Ras Dashan Mountain (4,624m) (WCMC, 1997a). Some cliffs reach 1,500m in height and extend for long distances (the north escarpment extends 35km). The plateau is bordered in the south and north-east by the deep valleys of the Tacazze River and its tributaries. It is bisected from north to south by the Mayshasha River, for which it is the principal catchment area (WCMC, 1997b). The Simen Mountains also form an important part of the Tekeze River Basin.

The flora and fauna of the area remain relatively intact due to the extreme topography and altitudinal range. The Park is a refuge for threatened animals such as Gelada baboon (*Theropithecus gelada*), Simen jackal – also referred to as a wolf or fox – (*Canis simensis*) and Walia ibex (*Capra walie*), a goat species endemic to Simen Mountains.

The vegetation is a mixture of Afro-Alpine woods, heath forest, high montane vegetation, montane savannah and montane moorland. The forests of Ethiopia can be divided into moist and dry forms (WCMC, 1997a). The montane moorland has tree heather (*Erica arborea*), giant lobelia (*Lobelia rhynchopetalum)*, *Solanum* sp., *Rosa abyssinica*, yellow primrose (*Primula verticillata*), *Helichrysum* spp., *Alchemilla*, *Thymus*, *Urtica*, and mosses (Grimmiaceae). Lichen (*Usnea* spp.) drape the high altitude forest trees. Ridge tops and gorge sides support coarse grassland with herbs *Thymus* spp., *Trifolium* spp., *Geranium arabicum*, thickets of *Rumex nervosus*, scattered *Otostegia minucci*, and creepers *Clematis simensis* and *Galium spurium*. Forests of St. John's wort (*Hypericum* spp.) once flourished at 3,000-3,800m, but few still remain. There are high, but unquantified, levels of endemism (WCMC, 1997b).

A total of 21 mammals have been recorded in the Park, of which three are endemic. The internationally threatened Walia ibex occurs on the north escarpment of the massif, with most of the population occurring in the Park. In 1989, the population was estimated at 400 individuals, decreasing to 250 in 1996. The Simen jackal is endemic to Ethiopia. Other mammals include Gelada baboon, hamadryas baboon (*Papio hamadryas*), colobus monkey (*Colobus* sp.), serval (*Felis serval*), leopard (*Panthera pardus*), caracal (*Felis caracal*), wild cat (*F. silvestris*), spotted hyena (*Crocuta crocuta*), jackal (*Canis aureus*), and several large herbivores including bushbuck (*Tragelaphus scriptus*), common duiker (*Sylvicapra grimmia*), and klipspringer (*Oreotragus oreotragus*). The 400 bird species (seven

endemics) include: lammergeier (*Gypaetus barbatus*), Verreaux's eagle (*Aquila verreauxii*), kestrel (*Falco tinnunculus*), lanner falcon (*F. biarmicus*), and augur buzzard (*Buteo rufofuscus*) (WCMC, 1997b).

A park management plan had been prepared that had five specific objectives. They were:

- to preserve the scenic beauty and habitat diversity of a representative sample of the Ethiopian Tropical Seasonal Highland Biome;
- to give particular emphasis to the preservation of Walia ibex and other endemic plant and animal populations;
- to restore and rehabilitate disturbed areas and to undertake measures to conserve watershed values within the park, protected by improvements around the park;
- to encourage and provide for educational, scientific and tourism uses of the park; and
- to manage the park in recognition of its status as a World Heritage site.

However, the plan has not been implemented due to civil unrest, and it is now out of date as it does not take into account the intense human utilisation of the Park.

Threats

Ethiopia's highlands are among the most densely populated agricultural areas in Africa, and wildlife populations in the Park are isolated due to extensive deforestation and grass burning in the surrounding region. Upland and montane forests have been under intense human pressure in Ethiopia for a considerable period, and it is estimated that of an original forest cover of 176,000km^2 of (*Podocarpus/Juniperus*) forest, only 0.9 per cent now remains (WCMC, 1997a). Several mammal species are expected to become locally extinct even if the Park were to be fully protected. Species most affected are the carnivores, notably serval, leopard and Simen jackal, and larger ungulates of the 'lower' afromontane areas that are not extensively represented in the park, notably bushbuck and bushpig. A further risk is that of hybridisation between Walia ibex and free-ranging domestic goats (WCMC, 1997b).

After years of civil unrest during the 1980s, the Park infrastructure was completely destroyed and the Park management was severely constrained by lack of finances. Human utilisation has increased significantly, and the Park has come under pressure from cultivation, wood and grass cutting and livestock grazing. Originally some 2,500 people inhabited the park, although this was reduced by forced relocation of approximately 1,800 inhabitants from the lower slopes of the northern escarpment in 1979. However, following the period of civil unrest in the 1980's, villages have developed within the park boundaries. Some 8,000-10,000 people now live inside the Park (IUCN, 1998).

Farming activities and grazing have thus increased substantially. Farming activities on the steep slopes of Simen are an important factor in the acceleration of soil erosion and grazing, particularly along streamside areas, which affects water quality and increases the sediment load. Some 60 per cent of grassland habitats surveyed in 1996 were considered to be heavily grazed, 25 per cent seriously overgrazed, and only 15 per cent in a natural state.

As a result of human activities, Simen Jackal observations have become increasingly rare. Much of the Walia ibex population has moved out of the Park due to human presence and cultivation activities, and sightings have been made only in the most remote and inaccessible areas (UNESCO, 1998). Bush buck and bush pig populations have also become extremely sparse due to trapping.

A road is currently being built to the Park from Debark, which runs along the Park border. It is feared that this will cause erosion and ecological damage in the highland areas. According to Nievergelt (1996), the road from Debark was expected to facilitate tourism development but given the present conflict this seems unlikely. There are only 100-200 international visitors to the Park each year and the

area has been closed to foreigners due to the border conflict with Eritrea (Foreign and Commonwealth Office, 1999).

The Park was placed on the List of World Heritage in Danger in 1996 due to agricultural encroachment, loss of biodiversity and the impacts of road construction.

Conclusions and Recommendations

It is a considerable ethical challenge to balance the needs of highly threatened species such as the Walia ibex with those of displaced impoverished human communities. The development of a participatory park management plan that considers both biodiversity conservation and sustainable livelihood around and in the park could help managers cope with this challenge.

There may be a need to redefine the boundaries of the park and develop different 'park' management zones to ensure the survival of biodiversity and endemic species in the protected areas – particularly as the Walia ibex are grazing and perhaps breeding out side the park.

The World Heritage Committee has offered to assist Park managers by providing funding and recommending organisation of further stakeholder meetings for the conservation of the Park. It has also discussed the creation of an alternative road to the one which cuts through the Park to decrease disturbance and access for poaching. The Committee also highlighted the need to establish a framework to begin the process and co-ordinate the setting up of an Inter-Agency Committee with donor participation for the sustainable development of the Simen Mountains ecosystem.

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NEGRIL ENVIRONMENTAL PROTECTION AREA AND MARINE PARK
Jamaica

Key threats
Pollution, over-fishing and climate change.

Biogeographical region: Neotropical **Major habitat type(s)/biome(s)**: Marine coral reefs **National legal designation**: Environmental Protection Area and Marine Park **IUCN Category**: II **Other international designations**: none	**Location**: 18°19'N, 78°22'W **Area**: to be confirmed **Year of establishment**: 1997 **Ownership**: Government of Jamaica **Management Authority**: Negril Coral Reef Preservation Society (*NCRPS)*

Description
The Negril Environmental Protection Area and Marine Park (NEPA-MP) is situated on the west coast of Jamaica in the West Indies. Its area stretches some seven miles along white sandy beaches. On November 28th, 1997, on the recommendation of Jamaica's Natural Resources Conservation Authority (NRCA), the Negril Environmental Protection Area Declaration Order was signed which outlined the terrestrial and marine boundaries of the area to be protected. The marine boundaries extend from the mouth of the Davis River in the north to the mouth of the New Savannah River in the south (NCRPS, 1999). In 1999, an Environmental Protection Plan for the NEPA was developed to conserve and protect the Negril Watershed – an area drained by the Orange Fish, Newfound, North and South Negril rivers (NCRPS, 1999). The Negril Environmental Protection Plan establishes long-term environmental goals, sets priorities and outlines a strategy of objectives, programmes, and projects. This plan will guide environmental planning and decision making in the NEPA. It is intended to designate a Negril Environmental Protection Management and Advisory Council to oversee the implementation of the Plan. The Negril Area Environmental Protection Trust (NEPT) has been proposed to form this Council. NEPT's membership includes representatives of the Negril community, and government and private sector organisations (NCRPS, 1999).

The entire island of Jamaica is surrounded by coral reefs, which protect and serve as a habitat for a large variety of fish and other animals, and are an essential component of Jamaica's attraction as a tourist destination. Threats to the natural environment in Jamaica have been going unchecked for years, a fact that adds urgency to its need for protection.

Threats
Virtually all reef communities in Jamaica have been affected by human and natural causes. Over-fishing in particular, as well as pollution from sewage disposal, industry and agricultural runoff, siltation due to poor land use practices, anchor damage and tourism-related activities, have seriously degraded Negril's reefs. Storm damage from hurricanes, coral reef bleaching due to periodic high sea water temperatures, the decline of sea urchins and other algae grazers, and unchecked algal overgrowth of corals have compounded the problem (NCRPS, 1999).

A detailed assessment of water quality and the ecological status of coral reefs in the Negril EPA and Marine Park was initiated by the Negril Coral Reef Society in 1997 (NCRPS, 1999; WRI, 1999). Monthly water quality samples were collected at 41 stations throughout the Park, including upland watershed sites in South and North Negril, Green Island, Davis, Cabarita, and New Savannah Rivers, small creeks and twelve coastal stations in shallow and deep fringing reefs. Over 800 water samples were analysed for nitrate, ammonium, phosphate, chlorophyll and salinity all indicators of water quality contamination.

The benthic communities are dominated (64 per cent cover) by a diverse, multi-layered assemblage of macro-algae with relatively low cover of corals (7 per cent), turf algae (21 per cent) and sponges (2 per cent). The shallow reefs have higher grazing activity due to greater numbers of sea urchins. Corals are being destroyed by a variety of diseases and algal overgrowths in both shallow and deep reefs. The lowest coral cover (2 per cent) found at the Yacht Club reef, is directly threatened by sewage discharges of the South Negril River (NCRPS, 1999).

Over sixty species of macro-algae were collected during the reef-sampling programme. The researchers observed significant nutrient enrichment on the shallow reef sites from raw or partially treated wastewater. The nutrient concentrations have recently increased above the critical threshold for healthy coral reefs, and the coastal waters are in an advanced state of eutrophication. These high nutrient levels, coupled with over-fishing and the physical impact of hurricanes, mean that fast growing macro-algae have replaced the more slowly growing corals and is now the dominant 'space occupying' organism in Negril's reefs (NCRPS, 1999).

Sampling at the watershed stations showed elevated nutrient concentrations especially nitrate, throughout the Park. High phosphate concentrations were found in Davis Cove, North, and South Negril rivers, and North and South Green Island rivers. Sampling at several points showed that phosphate concentration increased as the river flowed downhill through the sugar cane fields and ammonium increased along the same sampling network. Sampling following a moderate rain in Green Island Bay showed high concentrations of ammonium, phosphate, and turbidity (suspended solids) being discharged into coastal waters. It is evident that nutrient enrichment of Negril Marine Park surface waters is chronic and that the peak inputs of pollutants are associated with storm events that include normal rains.

A second coral reef monitoring programme was also established within the boundaries of the Negril Marine Park in October 1997, and five stations on shallow reefs were identified for study. The scientists who analysed the data from the second study, Dr.'s Jim and Karen Porter, noted that "*The growth of algae, which is accelerated by nutrients going into the water in Long Bay, overwhelms the ability of grazing sea urchins ['underwater lawnmowers'] to control the abundance of the nuisance 'weeds' there*". They noted that Long Bay is one of the most nutrient-stressed tropical marine environments in the world. The per cent of live coral cover in Long Bay is so low (less than 6 per cent); that they further conclude that coral loss on this reef seriously threatens the functioning of the ecosystem (NCRPS, 1999).

Negril Coral Reef Society (NCRPS) is an environmental NGO based in Negril. The society was formed in 1990 by a small group of dive operators and local citizens initially concerned about anchor damage to the coral reefs. The organisation has grown to more than 150 members including students, businesses, corporations, individuals and families, from Jamaica and all over the world. The invaluable work of this NGO has led the way to protect Negril coral reefs by providing research, expertise, training and support for the establishment of the protected areas.

In addition to the NEPA Declaration Order mentioned earlier, other legislative tools are also proving useful in the protection of the Negril's reef ecosystem. A few years ago a ban on the sale of all black coral in Jamaica was extended by law to include all coral. There is also national and international legislation to protect sea turtles. The protection of these coastal areas allows for continued tourism and in Jamaica that has a two-fold impact – it provides jobs for local residents and it brings over US$700 million in foreign currency to the island (WRI, 1999).

Conclusions and Recommendations

Poor water quality is killing Negril's coral reefs. The best and only hope for survival of Negril's coral reefs is whole watershed management in an attempt to reduce the flow of nutrients into the coastal zone. The data from the second study also demonstrates the necessity of protecting the bays and reefs in the eastern most sector of the Marine Park on Jamaica's North Coast. These reefs are the richest in the Park, and hold the potential for 'reseeding' the rest of the reserve if conservation efforts elsewhere in the park return the area to conditions favourable for coral growth and development (NCRPS, 1999).

Much credit for the progress to protect the reefs so far can be attributed to members of the community in Negril. But even more of the community must be get involved to develop alternative solutions and initiatives to help reduce inputs, such as sewage, farm runoff, fertilisers, and top soil loss, for the reef systems to flourish again. On a hopeful note, on 24 March 1998, the Honourable Easton Douglas, M.P., Minister of Housing and Environment for Jamaica announced "*a moratorium on development in the area and to help ensure that the carrying capacity of the Negril ecosystem from ridge to reef is not exceeded"* (NCRPS, 1999).

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CALAKMUL BIOLOGICAL RESERVE
Campeche, Mexico

Key threats
Local community pressures, influx of migrants, rapid population growth, timber extraction, hunting, forest clearing for agriculture and cattle ranching.

Biogeographical region: Neotropical **Major habitat type**: Tropical Forest **National legal designation**: Biological Reserve **IUCN Category**: VI **Other international designations**: UNESCO Biosphere Reserve (1993)	**Location**: 18º14'N/89º48'W **Area**: 723,185 hectares **Year of establishment**: 1989 **Ownership**: Government of Mexico, *ejidos* and private. **Management Authority**: Reserve Direction of the National Institute of Ecology

Description
The Calakmul Biological Reserve is located in the southeast of the Yucatan Peninsula of Mexico, near the Guatemalan border. It forms part of a larger system of lowland tropical forests, known as El Gran Petén or La Selva Maya, which spans about 3 million hectares. The reserve is the largest tract of protected tropical forest in Mexico and thus an important site for long-term biodiversity conservation. The forests of the Calakmul shelter numerous ruins of the Pre-classic and Classic Mayan civilisation. Archeologists suggest that this area was once one of the largest and most powerful human settlements in Meso-America. It was designated an UNESCO Biosphere Reserve in 1993, and as such is divided into Core and Buffer Zones for management purposes. About 32 per cent of its total area forms two core zones of 147,915 ha and 100,345 ha. Generally, this means ecologically sustainable production and extractive activities are allowed in the Buffer Zone and no human activity in the Core Zones. The reserve is contiguous with the forests of the Maya Biosphere Reserve in Guatemala, and is linked by forest corridors with the Montes Azules Biosphere Reserve in Chiapas, the Sian Ka'an Biosphere Reserve in Quintana Roo, and the Society Hall Nature Reserve in Belize.

The Reserve is a patchwork of mature disturbed forest, secondary growth vegetation of less than 25 years, and savannah-type flood plains. The most abundant trees include chicozapote (*Manilkara zapota*), source of chicle the main ingredient in chewing gum, and ramón (*Brosimum alicastrum*). Key commercial species are mahogany (*Swietenia macrophylla*) and Spanish cedar (*Cedrela odorata*). Biological inventories have recorded 1500 species of plants, 364 species of trees, 400 species of butterflies, 15 species of fishes, 70 species of reptiles, 350 species of birds and 100 species of mammals live in the reserve. Despite the pressures on its ecosystems, Calakmul provides habitat for ocelot (*Leopardus pardalis*), jaguar (*Panthera onca*), howler monkey (*Alouatta pigra*), spider monkey (*Ateles geoffroyi*) and tapir (*Tapirus bairdii*). The Reserve provides vital over-wintering grounds for many Neotropical avian migrants from Canada and the USA such as the hooded warbler (*Wilsonia citrina*) and Swainson's warbler (*Limnothypis swainsonii*).

Threats
The reserve is threatened by rapid population growth, hunting, timber extraction, forest clearing for agriculture and cattle ranching. Lying within a hurricane zone, the area also suffers from episodes of severe flooding and landslides.

A collaborative study by three organisations: Pronatura Peninsula de Yucatan, A.C. (PPY), WWF and the University of Michigan noted that the future of the Reserve is compromised by a steady influx of migrants and rapid population growth in the *ejido* communities. (An *ejido* is a piece of land

administered by a group of individuals called *ejidatarios* who hold the usufruct rights to their *ejido* granted to them by the Mexican Federal Government (Ericson *et al*., 1999)). Land clearance for agriculture, forestry, cattle-ranching and subsistence level hunting are carried out on *ejidos*. There are 114 communities of mixed ethnic composition living in and around the Reserve. The most recent figures show that in these communities there are about 25,000 individuals with the population doubling every 20 years (Ericson *et al*., 1999).

Calakmul has been the focus of the NGO, PPY's work. PPY's strategy is based on the theory that if people living in and around natural areas receive economic and social benefits from these areas their convictions about preserving these areas will be strengthened. Working together with the Reserve administration, both organisations see the importance of understanding and monitoring the expanding population dynamics of the rural community living in and around the Reserve (Ericson *et al*., 1999). For example, fifty-one percent of the *ejido* communities are under 15 years old and only two percent over 65. PPY has, for example, incorporated an educational reproductive health programme into its work around the Calakmul. The programme is designed to increase family access to existing reproductive health services offered by government health services, as there is often a marked difference between the number of children desired and the number of existing children per family (Ericson *et al*., 1999).

Ejido status in the Buffer Zone was acquired by most of these communities during the 1980s, although many were settled as much as a decade earlier. The Buffer Zone of the southern division of the Reserve is composed of forest extension lands belonging to *ejido* communities north of the Reserve. The lands to the eastern side of the Reserve and a strip stretching between the northern and southern divisions of the Reserve have become rapidly changing frontier zones and are inhabited by migrants dependent on subsistence level economy. There are concerns over the impact of migrant populations settling in these frontier zones and the impact of agricultural activities. For example, many use fire, which can burn out of control, to clear brush and crop residue before the onset of the rainy season.

Although various studies were carried out before the reserve boundaries were drawn, conflict in the Reserve arose from the fact that the borders of the Core Zone cut across territory of pre-existing *ejido* communities and other private property. Additionally, much of this region was colonised prior to the formation of the Reserve, due to government policy that encouraged settlement in this area because it considered it under-utilised (Ericson *et al*., 1999). Migrants also move into the area because they are 'pushed' from their places of origin by lack of land, lack of employment, displacement by commercial agriculture, ecological catastrophe, and social unrest occurring elsewhere in Mexico.

Cattle ranching is another threat and source of conflict. For example, local communities view cattle as a symbol of wealth. While conservationists argue that cattle hoofs compact the fragile limestone soils and the tight root systems of forage grasses prohibit the re-growth of forest vegetation. The future of the Reserve is at stake if conversion of land for cattle in the surrounding *ejidos* becomes more extensive. Timber extraction continues on *ejidos* land despite national legislation that requires a permit to fell trees. Enforcement of forestry legislation has been inconsistent and caused much frustration and anger, so that many ignore the restrictions and continue cutting timber.

Conclusions and Recommendations

There is no denying the desperate need of indigenous people and migrants for land to sustain and feed their families, but unmanaged, and in combination with increasing population, the pressure for resources on protected areas is threatening hard-earned conservation advances. WWF Mexico has been working with residents and Calakmul management to develop a number of ways forward, firstly, by providing support to Reserve Management by developing a proposal for rezoning the reserve. This initiative will include all key stakeholders in the Reserve, and will address both the issues of improving

Reserve zoning to protect the areas critical for conservation, and to address tenure issues so as to reduce human impacts on the reserve. WWF hopes to participate actively in this process, and to provide key inputs in the form of a map of priority areas and staff resources to assist the Reserve management in drafting a new decree law for the reserve.

WWF also proposes to work with local governments and other stakeholders on tourism management. Land-use planning for tourism at the municipal level is essential to prevent new infrastructure from causing damage to the Reserve. By becoming involved in the planning process, local governments can ensure that increased tourism in the region brings benefits to the local communities without threatening the Reserve (WWF Mexico, 2000). At present there are some hopeful signs of progress, such as a tourist guide service run by local residents trained through a collaborative effort between NGOs and government institutions; and, with help from a regional organisation, two *ejidos* with excavated archeological sites in their locality have organised tours of the site for tourists.

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MONARCH BUTTERFLY SPECIAL BIOSPHERE RESERVE
Michoacan, Mexico

Key threats
Unsustainable and illegal logging, fuelwood harvesting, forest fires, disease, cattle and sheep ranching and changes in land use.

Biogeographical region: Nearctic/Neotropical **Major habitat types**: high-altitude oyamel fir forests, pine-oak forests **National legal designation**: Reserva Especial de la Biósfera Mariposa Monarca – REBMM (Monarch Butterfly Special Biosphere Reserve) **IUCN Category**: IV The migration of the monarch butterfly is classified by IUCN as an endangered biological phenomenon. **Other international designations**: WWF Global 200 Site (1997) Selected Important Staging, Breeding, Wintering, & Stepping-Stone Sites for Long-Distance Migratory Birds and Butterflies. BB. Mexican Highlands Monarch Sites - Mexico Transvolcanic Belt Central Mexico.	**Location**: 5 separate polygons within the following co-ordinates: 19º19'30" and 20º00'00" North and 100º05'30" and 100º20'15" West **Area**: 16,110 hectares **Year of establishment**: 1986 **Ownership**: Ejidos (communal land-owners) and indigenous communities, some small parts owned by the federal government. **Management Authority**: The reserve is managed by INE (Instituto Nacional de Ecología- National Ecology Institute) a branch of SEMARNAP (Secretaría Mexicana del Medio Ambiente, Recursos Naturales y Pesca- Ministry of the Environment, Natural Resources and Fisheries)

Description
Each autumn, monarch butterflies (*Danaus plexippus*) east of the Rocky Mountains migrate from Canada and the U.S. to the high-altitude oyamel fir forests in the Transvolcanic Belt of Central Mexico, where they over-winter in extraordinary aggregations of millions of individuals. Research has demonstrated that a well-preserved, functional oyamel ecosystem is critical to the monarch's winter survival. The oyamelS provide microclimatic conditions that prevent the butterflies from desiccating or freezing, allowing them to conserve energy reserves until the spring re-migration back to the U.S.A and Canada. The forest keeps the butterflies cool and serves as a vital protection against the elements.

The Transvolcanic Belt of Central Mexico is one of WWF's priority forest ecoregions worldwide. These relic oyamel forests, characteristic in areas with an altitude between 2,400-3,600 metres, are endemic ecosystems of this ecoregion. Other types of vegetation and habitats in this area of important biological value include the high altitude flatlands and the lake ecosystems of Chapala and Patzcuaro. The area is also home to some 56 species of mammals, 118 species of birds, 4 amphibians, 6 reptile species, 493 vascular plant species and 49 different types of fungi.

Threats
In 1986, a Presidential Decree created the 'Reserva Especial de la Biosfera Mariposa Monarca', the Monarch Butterfly Special Biosphere Reserve. This Decree provided two zones of protection in five of the known monarch over-wintering areas: a core area, in which no logging is allowed, and a buffer zone, in which limited logging may occur. The total land area in this reserve is 16,110 hectares, with only 4,490 hectares, in the core area. Most of this land is owned communally and landowners have not been adequately compensated for the logging limitations imposed by the Decree. This has resulted in continued resource demands on the forests that are incompatible with the survival of the over-wintering monarch butterflies. In November 1997, during a North American Conference on the Monarch Butterfly, the Mexican environmental authorities (INE) committed to review this Decree in order to redefine the Natural Protected Area for monarch butterfly sanctuaries.

The entire Transvolcanic ecoregion is facing the rapid loss of forest cover, desertification, eutrophication and contamination of its fresh water systems. Threats are closely linked to the fact that nearly 75 per cent of Mexico's population is concentrated in this ecoregion. The oyamel forests are very disturbed and seriously threatened by unsustainable and illegal logging, fuelwood collection, forest fires, disease, cattle and sheep ranching, and most critically, by changes in land use for agriculture. Severe poverty, poor distribution of, and inequitable access to, natural resources by the local population, community land tenure issues, lack of proper long-term conservation policies and illegal forest industry development are among the underlying causes of this deforestation. Although a comprehensive analysis of the conservation status of the ecosystems of the entire Transvolcanic Belt does not exist, the forest cover in the reserve area has been analysed and it is evident that it is one of Mexico's most profoundly altered and rapidly disappearing ecoregions (pers. comm. G. Castilleja)

One of the most relevant aspects that make conservation of this ecoregion particularly important lies in the fact that it supplies drinking water to important urban areas including Mexico City, Puebla and Guadalajara. Providing water to these cities is a priority that makes conservation of the high river basins (oyamel forests and other conifers) an obligated strategy. Similarly, the access by the urban population to the neighbouring green areas creates eco-tourism probabilities that although presently are a threat, can motivate the protection and expansion of the decreed conservation areas. The number of protected areas in this ecoregion is high although existing management and capacity are inadequate.

Conclusions and Recommendations

Although the 1986 Presidential Decree had the best intention – to protect the monarch butterfly's migratory over-wintering habitat – it imposed a limit on forest use without effectively offering alternatives to their legal owners: the *ejidos* (communal landowners) and indigenous communities. As a result, most of the conservation schemes proposed have tried simultaneously to conserve the sanctuaries, protect the butterflies and offer the economic alternatives that were lacking in the decree. The concept of sustainable development, however, often becomes lost in the difficulty of harmonising these objectives with concrete actions in the field. WWF believes it is essential to begin by defining the specific habitat needs of the monarch butterfly, in order to determine the characteristics of the natural protected areas that are required to conserve this species. This will lead to the establishment of an effective conservation programme that is compatible with the essential ecological requirements of the over-wintering colonies of the monarch butterfly. However to achieve sustainability, the Monarch Butterfly Sanctuaries need to be protected under a legal framework supported by local communities who in turn need to be compensated for the lack of income that may result from the limitations that any new Decree may impose.

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SKELETON COAST PARK
Namibia

Key threats
Oil exploration; off-road driving; proposed dam construction; potential uranium, coal and base-metal mining; over-fishing; and habour development at Mowe Bay

Biogeographical region: Afrotropical **Major habitat type(s)/biome(s)**: Coastal desert **National legal designation**: Game Park **IUCN Category**: II **Other international designations**: WWF Global 200 (No. 125) Namib & Karoo Deserts and Shrub lands; (No. 126) Kaokoveld Desert; (No. 218) Benguella Current.	**Location**: $17^0$15' – $21^0$15'S; $11^0$45' – $13^0$55'E **Area**: 800,000 1971; 1,745,000 hectares as amended in 1973 **Year of establishment**: 1971 **Ownership**: Government of Namibia Management Authority: Namibian Ministry of Environment and Tourism (NMET) and Namibia Wildlife Resorts Limited (NWR)

Description
The Skeleton Coast Park covers a large area on the Northwest coast of Namibia and is the most isolated park in the country. The name of the Park owes its origin to its reputation for being a graveyard for people, countless shipwrecks and the skeletons of beached whales (NMET, 1999a). The Park stretches some 500 kilometres along the Atlantic coast from the Ugab River to the Kunene River on the Angolan border. The shoreline consists of sandy dunes and small sections of highly eroded granite outcrops. Inland the Namib Desert, the oldest desert in the world, is characterised by vast areas of white sand, barchan dunes in the north, and gravel plains with sparse vegetative cover in the south. The Park is bisected by eight major ephemeral rivers, whose origins commence in the mountains in and immediately adjacent to the eastern portions of the Park. These linear river systems contain rich riparian vegetation, and when combined with the interlaced arid floodplains, provide unique habitats for charismatic large herbivores. The Park lies within a fog belt produced by the cold offshore Benguella Current mixing with warm water masses which deposit moisture inland and moderate the temperature of this coastal desert.

Over 30 mammal and 306 bird species have been identified in the Park. Mammals include: black rhino (*Diceros bicornis*), elephant (*Loxodonta africana*), giraffe (*Giraffa camelopardalis*), lion (*Panthera leo*), springbok (*Antidorcas marsupialis*), gemsbok (*Oryx gazella*), brown hyena (*Hyaena brunnea*) and black backed jackal (*Canis mesomelas*). The dry riverbeds provide routes from inland areas for large mammals. However, most species in the Park cannot survive solely within the Park borders because of the ephemeral water and vegetation supply, and low densities of prey species. Two species that are particularly threatened are elephants and lions whose continued existence depends on the state of the environment within and adjacent to the Park. Bird species that occur in the Park include Namibian endemics such as Ruppel's Korhaan (*Eupodotis rueppellii*) and Gray's lark (*Ammomanes grayi*). The nutrient-rich Benguella System supports a slowly-recovering whale population and gives rise to rich fisheries, which in turn provides food for large numbers of seals and seabirds.

For management purposes the Park is divided into two c.8,000 km^2 southern and northern sections. The northern section is from the Hoanib River northwards to the Kunene River. Public access is almost entirely prohibited for protection of the delicate ecosystem – and the main Park road C34 ends just across the border of the northern section at Mowe Bay. Recently requests have been made to make the area more accessible for tourists by "fly-in safaris". The southern section includes the area from the Uchab River to the Hoanib River, and access is restricted to the south of Seal Beach. The Atlantic Oceans forms a natural uninterrupted western boundary to the Park. To the east of the Park the

Kaokoland is a remote, sparsely populated *veld* region. Skeleton Coast Park is unfenced except at the southern boundary to keep livestock out for veterinary control purposes (e.g., foot and mouth disease). The lack of fencing allows species such as oryx, elephant and lion to migrate between the coast and Kaokoland.

Previously, the Government of Namibia owned and operated directly some twenty resorts and campsites situated in protected areas throughout Namibia. At the beginning of 1999, these resorts and campsites were transferred to Namibia Wildlife Resorts Limited (NWR), a company owned 100 per cent by the Government but to be operated as a fully commercial enterprise. NWR's main objectives are to conduct a wildlife resorts service in conformity with the development strategies and policies of the Government by:

- managing, controlling, maintaining, utilising and promoting, in the national interest, the Wildlife Resorts service to general business principles;
- promoting and encouraging training and research with a view to increase productivity in the wildlife resorts service;
- developing commercially viable enterprises with or without the participation of the private sector; and
- promoting the development of environmentally sustainable tourism with a view to preserving the assets and attractions on which the tourist industry depends (NMET, 1999b).

A GIS-based information system has recently been completed for the Park, drawing together some 20 years of biological records into an easily accessed set of information for Park management and decision-making.

Threats

The Park management concentrates on habitat protection. The gravel plains of the Skeleton Coast are a particularly fragile and ecologically valuable ecosystem. The Park provides important staging grounds for some 26,000 birds during the summer months. A major threat is off-road driving which degrades the plains by compaction, resulting in erosion and which leaves tyre tracks visible for up to 50 years (Bartlett and Bartlett, 1992). Damara terns nest in 'scrapes' in the gravel plains and during incubation and nesting are incredibly vulnerable. Vehicle tracks also destroy endemic lichen species that prevent erosion by stabilising and enriching the soil. The off-road vehicles users are difficult to control. A management plan proposes two solutions: to provide 4x4 routes, and to set up "sacrifice areas" for uncontrolled off-road driving. Both these solutions appear short term if unaccompanied by a change in policy and an education programme for park users.

A second threat is indirectly from the Government itself, which has approved for a portion of the Park to be used for uranium mining and exploration. There is little information available and it is unclear if the government plans to go ahead with this project. Coal has also been found in the Park, and in the recent past, prospecting for diamonds, base metals, and other minerals has been permitted, albeit under strict environmental conditions and contracts. A third threat is from marine pollution from potential spills from offshore oil and gas exploration in the Kudu gas field off the Namibian coast. A hydro-electric dam also has been proposed at Epupa Falls on the Kunene River between Angola and Namibia. Construction of this dam and upstream water abstraction will have impacts on river beds adjoining the Park and its buffer zones.

A harbour has been proposed at Mowe Bay, mainly for fishing, but also potentially as an export harbour should mining be developed, and to serve as a base for patrolling Namibia's northern territorial waters. A pre-feasibility study has been completed, which looked superficially at both the harbour and its extensive infrastructure (e.g., road and rail links, power systems, airstrip, etc.). Such a development, with its knock-on secondary impacts of residential and recreational impacts, would have

dramatic impact on the Park, and is vigorously opposed by environmental groups in Namibia, both on environmental and economic grounds.

Over-fishing is a concern along the coast. The coastal region of the Park lies in the Benguella (upwelling) zone, because it is associated with the strong northward flowing Benguella Current. Upwelling is critically important to fish stocks because it supplies nutrients to the surface of the ocean, which are then utilised by phytoplankton for growth. Although sport fishing is restricted to Terrace Bay, Torra Bay and areas south of the Park (known as the North West Coast Tourist Recreation Area), the long-term impact on fish stocks and dependent coastal bird populations, such as the internationally threatened Damara tern and cormorants, has not been fully assessed. Prior to independence Namibia had no control over inshore and offshore commercial fishing because South Africa's occupation of the country deprived it of an internationally recognised exclusive economic zone (EEZ).

Conclusions and Recommendations

The Skeleton Coast Park is well managed and focuses its efforts on habitat protection to protect threatened species. It is the most remote of Namibia's protected areas and lends itself to wilderness, foot trails, and guided tours, as well as fly-in operations. Yet, it is faced with a surprising number of threats. Namibia's National EIA Policy effectiveness will be tested further if oil and gas offshore reserves are found in economically feasible extraction quantities along the Skeleton Coast. Tourism is one of the fastest growing industries and acknowledged by many to offer the country sustainable economic recovery from years of South Africa rule. Given the slow habitat recovery rate of the coastal desert ecosystem, there is little doubt that tourism must be controlled and tourist vehicles kept off the gravel plains, as well as other sensitive areas. It is clear, therefore, that the Ministry of Environment and Tourism and the new Namibia Wildlife Resorts Agency will have to ensure a balance between tourism and habitat protection.

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ANNAPURNA CONSERVATION AREA
Nepal

Key threats
Population growth rate, deforestation, overgrazing, mountaineering, trekkers, road construction, landslides, and fire.

Biogeographical region: Palearctic **Major habitat type**: Mountain **National legal designation**: Conservation Area **IUCN Category**: VI **Other international designations**: WWF Global 200	**Location**: 28 50'N/83 57'E **Area**: 762,900 hectares **Year of establishment**: 1986, year of gazettement 1992 **Ownership**: Government of Nepal **Management Authority**: King Mahendra Trust for Nature Conservation (KNTNC)

Description
The Annapurna Conservation Area (ACA) is located about 200 km west of Kathmandu. The ACA encircles the major peaks of the Annapurna Himal and includes the catchments of three major river systems. Annapurna ACA is arguably the most geographically and culturally diverse conservation area in the world. It has a unique mix of ecosystems, including subtropical lowlands, high alpine meadows, desert plateaus, and oak, rhododendron and bamboo forests (Wells and Brandon, 1992). It has the world's deepest river gorge and some of the highest mountains in the world. The Annapurna Sanctuary near the centre of the Conservation Area is a natural amphitheatre surrounded by several peaks of more than 6,700m. The wet southern slopes support a rich variety of birds and mammals such as Himalayan tahr (*Hemitragus hylocrius*), serow (*Capricornis sumatrensis*), goral (*Nemorhaedus goral*), musk deer (*Moshus* spp.), and the threatened and rare red panda (*Ailurus fulgens*). Snow leopards (*Panthera uncia*) inhabit the dry northern slopes that extend to the Tibetan border.

Politically ACA includes two zones, five districts and 55 Development Committees. It is home to more than 120,000 inhabitants of different ethnic and tribal groups. The Annapurna region is by far the most popular trekking destination in Nepal attracting more than 67,000 international trekkers each year. An average of one porter per trekker is required in the mountains, thereby creating considerable employment – and impacts.

Nepal's King Mahendra Trust for Nature Conservation (KNTNC), a non-governmental, non-profit and autonomous organisation, manages the Conservation Area and co-ordinates a number of key conservation and development projects. The KNTNC facilitates matchmaking between local communities and sources of appropriate skills, knowledge, and technical and financial assistance that enables local communities to improve their quality of life. Tourists who visit this area are charged an entry fee. The entire entrance fee of US$15 is retained by ACAP and is spent on environmental protection and community development activities within the area. For example, it assists villagers to start seedling nurseries, install fuel-efficient stoves in the tourist lodges, provide management training for local lodge owners, organises environmental awareness classes and litter collection along trails. It has helped install micro-hydro power plants in crowded tourist areas to decrease the use of fuelwood consumption (Himalayas, 1999).

Threats
From its establishment Annapurna has been threatened by a range of issues such as high population growth rate, deforestation, overgrazing, influx of mountaineers and trekkers, litter and fire. The rising human population resulted in a dramatic increase in the demand for a variety of resources. Many of

these resources come from forest-based industries, which depend on the Himalayan forests, along with other forests, for their raw materials.

In some areas, traditional shifting cultivation is still practised. This causes some conservation problems, particularly in the cold desert regions where there is only thin soil cover, severe cold, and a short growing season. Overgrazing by domestic animals such as sheep, goats, cows, mules, horses and yaks has caused large-scale degradation of the vegetative cover in many parts of the Annapurna. Animal rearing is an important occupation in the mountains in areas where agriculture is difficult or not possible due to the environmental conditions.

Overgrazing has deteriorated forests, and the grasslands have become bare and prone to soil erosion. Livestock graze during spring, when the seedlings of various tree species, grasses and herbs are growing. This leads to decreased regeneration. In some cases tree roots may be exposed from trampling and the tree may die. Selective grazing may alter the composition of the forest or grassland ecosystem, causing an increase in the population of undesired species. Indiscriminate grazing leads to the degradation of the soil through compaction that reduces porosity and soil aeration. This reduces the success rate of seed germination. Livestock hooves break down the soil aggregates, so that soil loses its ability to absorb water thereby increasing run-off. Since indiscriminate grazing leaves large parts of the land bare, run-off is more intense and erosion more severe (Himalayas, 1999).

1n the early 1980s, mountaineering and trekking became increasingly popular in Annapurna. These adventure expeditions provide a boost to the local socio-economy. Often, they are a source of valuable foreign exchange for the governments. However, they created localised environmental problems. Tonnes of garbage and refuse were left behind. The adventurers also drew upon the local vegetation for their energy needs and for fodder to feed pack animals. Large expeditions also caused disturbance to the wild animals living in the areas frequented by such expeditions (Himalayas, 1999). Many of the waste problems have now been addressed by ACAP.

Fore is also a problem although campfires are now not allowed in ACA. Cigarettes and matches of trekkers, shepherd camps or roadside charcoal panners may also spread and cause forest fires especially dry forests areas. Other fire hazards come from the forest or pasture being deliberately set on fire to encourage better grass after a limited rainy season or the burning of wild grass or undergrowth to aid the search for wild animals (Himalayas, 1999).

Conclusions and Recommendations

Annapurna was only established in 1986 and the huge task of sustainable utilisation of the natural environment is being addressed in appropriate social, cultural and natural context through a number of projects. With the difficult lessons learned over the years here and elsewhere in Nepal, the KNTNC is aware that local inhabitants must be the focal point of every conservation effort. KNTNC conservation projects strive for a balance between nature conservation, tourism development, and human needs. Its aim is governed by the need for an ecosystem approach to maintaining the long-term integrity of the natural system while accommodating increased human usage including tourism.

To date, tourism has had positive impact in supporting the management of the Conservation area. In 1999, over US$700,000 was raised from tourism fees to pay for conservation activities. The standard of living for the local people has gone up and more people are living in the area. An increase in forest cover has also been documented.

ACAP has thus become a model for integrated conservation and development through out Asia. In Nepal alone, the ACAP model has been duplicated to Makalu Barun, Kanchenjunga and Managlu area.

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SAGARMATHA NATIONAL PARK
Nepal

Key threats
Use of native juniper to provide fuel-wood for tourist installations, tourism pressures.

Biogeographical region: Indomalayan **Major habitat types**: Mountain, alpine meadows **National legal designation**: National Park **IUCN Category**: II **Other international designations**: WWF Global 200 (No. 79) Eastern Himalayan Broadleaf & Conifer Forests; World Heritage Site (1979).	**Location**: 27º57'N/86º44'E **Area**: 114,800 hectares **Year of establishment**: 1976 **Ownership**: Government of Nepal. Many of the resident Sherpas have legal title to houses, agricultural land and summer grazing lands. Management Authority: Department of National Parks and Wildlife Conservation

Description
Sagarmatha (Mt Everest) National Park lies in the Solukhumbu District of northeast Nepal. The Park encompasses the upper catchment of the Dudh Kosi River syste that forms a distinct geographical unit enclosed on all sides by high mountain ranges. The northern park boundary is defined by the Great Himalayan Range that itself defines the border of Nepal and Tibetan Autonomous Region of China. In the south, the boundary extends to Monjo village. All the settlements in the park are technically excluded as enclaves.

Sagarmatha (means 'Mother of the Universe'), and at 8,848 metres is the highest point of the Earth's surface. It represents a major stage of the Earth's evolutionary history and one of the most geologically interesting regions in the world. Its scenic and wilderness value is outstanding. As an ecological unit, the Dudh Kosi catchment is of biological and socio-economic importance, as well as being of major cultural and religious significance (IUCN, 1997).

This is a dramatic area of high, geologically young mountains and glaciers. The deeply incised valleys cut through sedimentary rocks and underlying granites to drain southwards into the Dudh Kosi and its tributaries, which form part of the Ganges River system. Glaciers at the head of four main valleys, Chhukhung, Khumbu, Gokyo and Nangpa feed the upper catchments of these rivers. There are seven peaks over 7,000m (WCMC, 1997). Most of the Park (69 per cent) is comprised of barren land above 5,000m, 28 per cent is grazing land and only 3 per cent is forested.

Six vegetation zones are represented in the Park: lower subalpine, above 3,000m, with forests of blue pine (*Pinus wallichiana*), fir (*Abies spectabilis*) and fir-juniper (*Juniperus recurva*); upper subalpine, above 3,600m, with birch-rhododendron forest (*Betula utilis, Rhododendron campanulatum* and *R. campylocarpum*); lower alpine, above the timber-line at 3,800-4,000m, with scrub (*Juniperus* spp., *Rhododendron anthopogon* and *R. lepidotum*); upper alpine, above 4,500m, with grassland and dwarf shrubs; and sub-nival zone with cushion plants from 5,500m to 6,000m. The tree line is marked by *R. campanulatum* on moist slopes ans *Juniperus indica* on dry slopes. Above 4,000m elevation, dwarf rhododendrons, shrubby cinquefoil (*Potentilla fruticosa* var. *rigida*), willow (*Salix sikkimensis* and *Cassiope fastigiata*) are found. In association with the shrub complex are a variety of herbs such as *Gentiana prolata, G. stellata*, edelweiss (*Leontopodium stracheyi*), *Codonopsis thalictrifolia*, *Thalictrum chelidonii*, lilies *Lilium nepalense* and *Notholirion macrophyllum, Fritillaria cirrhosa* and primroses, *Primula denticulata, P. atrodentata, P. wollastonii* and *P. sikkimensis*. The shrub layer diminishes as conditions become cooler and above 5,000m *Rhododendron nivale* is the sole representative of its genus.

In common with the rest of the Nepal Himalaya, the Park has a comparatively low number (28) of mammalian species, apparently due to the high elevation. The low abundance of mammal populations is also partly due to human activities. Mammals found in the park include common langur (*Presbytis entellus*), jackal (*Canis aureus*), a small number of grey wolf (*Canis lupus*), Himalayan black bear (*Selenarctos thibetanus*), lesser panda (*Ailurus fulgens*), yellow-throated marten (*Martes flavigula*), Himalayan weasel (*Mustela sibirica*), masked palm civet (*Paguma larvata*), snow leopard (*Panthera uncia*), Himalayan musk deer (*Moschus chrysogaster*), Indian muntjac (*Muntiacus muntjak*), mainland serow (*Capricornis sumatraensis*), Himalayan tahr (*Hemitragus jemlahicus*) and goral (*Nemorhaedus goral*) (WCMC, 1997).

Inskipp (1989) lists 152 species of birds, 36 of which have internationally significant breeding populations in Nepal, such as blood pheasant (*Ithaginis cruentus*), robin accentor (*Prunella rubeculoides*), white-throated redstart (*Phoenicurus schisticeps*) and grandala (*Grandala coelicolor*).

There were an estimated 3,500 Sherpas residing in the Park in 1997 (WCMC, 1997) in 63 settlements. However, there has not been an accurate census since the Park was established in 1976. The traditional economy is subsistence agro-pastoralism, supplemented by barter trading with Tibet and the middle hills of Nepal. The main agricultural activities include potato and buckwheat cultivation, and raising yaks for wool, meat, manure and transport. Cattle and yaks are also hybridised locally for trading purposes. Cattle numbers remained constant at about 2,900 between 1957 and 1978. Goats have been removed from the Park. Recently the local community has become involved in tourism, through the provision of guides, porters, lodges and trekking services.

The *Shinga Nawa* – a traditional system of forest guardians traditionally responsible for controlling use of forest resources – has been reinstated. Duties of the Nawas include prevention of greenwood cutting, protection of plantations and reporting of wildlife poaching. Nawas are authorised to prosecute and collect limited penalties from violators of the forest protection rules, and to use the fines for community purposes (WCMC, 1991). Indigenous plant nurseries have been established: seedlings are used to re-establish forest on denuded hill slopes.

Threats

The tourist industry has flourished and heavy pressure from mountaineering expeditions has placed large demands on natural resources and introduced problems with waste disposal. Meeting these growing energy needs is the most critical management issue at the site. At present, Park staff and a considerable number of the Sherpa families resident in lower elevations have shifted to the use of kerosene and micro-power plants to meet their energy needs. However, tourist facilities in the higher alpine zones continue to exploit the alpine bushes to meet their fuelwood needs. The site management is initiating a project to update the information displays at the interpretation Centre at the Park entrance and in the Namche Bazar Visitor Centre. These displays will be designed to inform visitors of the growing energy demands of the tourist industry and suggest ways tourists could help solve the problem. Solutions such as restrictions to the number of visitors to the Park is likely to be resisted by the Sherpa community who derive 75 per cent of their income from tourism (IUCN, 1999).

Demand for construction timber and firewood, another result of visitor pressure, has impoverished the forests to an alarming degree; consequent soil erosion has made reforestation difficult, pastures at lower altitudes are being overgrazed and some water has become unfit for drinking. Between 1975 and 1980, 15 per cent of Nepal's remaining forests were destroyed, due mainly to demand for fuelwood, fodder, and agricultural development. If left unprotected, Nepal's forests may disappear completely within a few decades (WWF, 1999).

Forest management in Solukhumbu District has been strictly controlled since the creation of the Park. The Park's forestry policy specifically outlaws the cutting of live wood, except where a permit is issued for construction timbers. This policy has however been criticised by local people who have complained that timber permit allocation is not always equitable – with the elites being able to gain permits far more easily. There is also a reported 'black market' in permits (Rogers and Aitchison, 1998). The traditional culture of the Sherpas is being changed due to foreign influences – but perhaps with better social integrity than nearly any other tribal group today. Poaching of musk deer for their glands persists (WWF, 1999).

Conclusions and Recommendations

Initial hostility to the establishment of the Park was converted into strong support through economic incentives such as employment in tourism related activities, preferential employment as park staff, registration of land to establish land tenure rights, restoration and protection of religious structures, the return of village forest management and community development activities (McNeely, *et al*., 1994).

In response to fuel wood shortages and increased demand for firewood, the Himalayan Trust of New Zealand has set up three tree nurseries inside the park growing local species. Since 1980, these have been successful in reforesting denuded slopes. Similarly WWF has supported agro-forestry projects in and around the park to supply fuel wood and fodder as well as vegetables to local people. Thamo electricity supplies power to all major villages in the park thus reducing fuel wood needs A local NGO called Sagarmatha Pollution Control Committee, set up in 1993 in Namche, promotes conservation education and clean-up of the rubbish left behind by the tourists and expeditions. It has also been announced that the UK Department for International Development (DfID) will fund a project, run by the UK-based International Centre for Protected Landscapes, looking at ecotourism, conservation and sustainable development in Sagarmatha. The project aims to strengthen rural livelihoods through promotion of tourism and conservation in the Park and surrounding District of Solu-Khumbu District (IUCN, 1999). On a final note, the Park's management plan to begin revising the management plan in connection and commemoration of the Park's 25th anniversary in 2001

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TONGARIRO NATIONAL PARK
North Island, New Zealand

Key threats
Tourism development, invasion by introduced plant and animal species, volcanic activity and mudslides.

Biogeographical region: Antarctic **Major habitat types**: Mountains, volcanoes, forest **National legal designation**: National Park **IUCN Category**: II **Other international designations**: World Heritage site (1988)	**Location**: 39 13'S/175 34'E **Area**: 76,505 hectares **Year of establishment**: 1894 **Ownership**: Government of New Zealand **Management Authority**: Tongariro/Taupo Conservation Board and New Zealand Conservation Authority, Department of Conservation

Description
Tongariro National Park is situated in the Tongariro and Wanganui regions in the middle of North Island, on the central North Island volcanic plateau. Auckland is 330km to the northeast and Wellington is about 320km to the southwest. The Park boundary encircles the Ruapehu, Ngauruhoe and Tongariro mountain massifs that range in altitude from 500 to 1,550m. The Park also contains active and extinct volcanoes and a diverse range of ecosystems.

The Park is important to the North Island as an ecological, geological, recreational and economic resource. The mountains at the heart of the Park are of great cultural and religious significance to the Maori people (*tangata whenua*), symbolising the spiritual links between the community and the environment (Bernbaum, 1997). The Maori people have occupied the region since they first arrived from Polynesia and ethnic mythology identifies the mountains in the Park with *tupuna* or god-like ancestors. Until the land was given to the nation in 1887, the Tuwharetoa tribe occupied the area. Early European attempts to settle in the area and introduce sheep farming commenced in 1856. However, due to economic and agricultural difficulties, these activities ceased in the 1920s. With the exception of Whakapapa village, which largely comprises tourist facilities, there are no permanent settlements within the park (WCMC, 1995).

The Park lies at the southern end of a 2,500km chain of volcanoes which extends north-east into the Pacific Ocean. The Tongariro complex comprises recent cones, craters, explosion pits, lava flows and lakes superimposed on older volcanic features. Violent ash eruptions usually occur at about nine year intervals. The current active vent lies beneath Crater Lake at an elevation of 2,550m on Mount Ruapehu. The water has a pH of 0.8-1.5 and is rich in dissolved minerals; consequently the upper reaches of the Whangaehu outflow are devoid of fish and most invertebrates. Minor hydrothermal eruptions in the lake are not uncommon, whilst more major events such as those in June 1969 and April 1975, may lead to destructive mudflows (WCMC, 1995).

Vegetation in the park is influenced by: altitude, occurrence of Taupo pumice, burning, drainage, erosion, substrate instability, grazing by herbivores and rainfall distribution. Habitats are diverse and range from remnants of rainforest to nearly barren ice fields. From the lowest altitudes to 1,000m in the west and north, about 3,000ha of once nation-wide mixed Podocarp-broadleaf rain forest occurs. This is dominated by *Podocarpus hallii*, *P. dacrydioides*, *Weinmannia racemosa*, *Libocedrus bidwillii* and there are numerous epiphytic ferns, orchids and fungi. The highest levels in the park are dominated by gravel fields and stone fields, which are very unstable and characterised by cycles of vegetation build-up and breakdown.

The vertebrate fauna is restricted mainly to birds although native mammals are represented by short-tailed bat (*Mystacina tuberculata*) and long-tailed bat (*Chalinolobus tuberculatus*). More than 56 bird species have been recorded in the park including four internationally threatened species: brown kiwi (*Apteryx australis*), kaka (*Nestor meridionalis*), blue duck (*Hymenolaimus malacorhynchus*) and North Island fern bird (*Bowdleria punctata vealeae*) (WCMC, 1995).

Threats

As Tongariro National Park is a World Heritage site there is concern about the ash build up at Crater Lake and its potential impact on the park and local community (IUCN, 1999). The eruption of Mt. Ruapehu in 1953 caused one of the country's major civilian disasters. The latest eruption that started in June 1996 is forecast to eventually cause a lahar (mud and lava flow) from the crater. The Minister for Conservation has called for a comprehensive environmental and cultural assessment identifying the risks and assessing impacts of options for their mitigation. The New Zealand authorities are considering a series of measures including: installing an early warning system; building structures off the mountain to contain the lahar expected when the ash-dam fails; and bull-dozing a trench through the ash-dam itself. Park staff are in regular consultation with the local communities of Ngati Rangi and the Ngati Tuwharetoa tribes that live in the vicinity (IUCN, 1998).

Indigenous species have been seriously depleted by species introduced prior to 1922 (WCMC, 1995). The problematic introduced species include: rat (*Rattus rattus*), stoat (*Mustela erminea*), cat (*Felis catus*), rabbit (*Oryctalagus cuniculus*), hare (*Lepus* spp.), brush-tailed possum (*Trichosurus vulpecula*), and red deer (*Cervus elaphus*). Although much effort has been devoted to eradicating exotics, they continue to pose a threat to indigenous species. In fact extermination of introduced flora and fauna is a requirement of the New Zealand National Parks Act 1980 (Section 4(2)(b)). However, given limited resources, control rather than eradication is the current management approach. Native flora have been reduced or eliminated by exotic herbivores such as red deer and possum. In attempts at control, Park Authorities permit licensed sports hunting of deer and possums.

Widespread death of mature beech has occurred on Ruapehu, possibly due to the pathogenic fungus *Sporothrix* sp., spread by the pinhole beetle (*Platypus* spp.) but some regeneration is occurring. Invasive lodge pole pine (*Pinus contorta*) threaten to convert native communities into forest and was a particular problem in the eastern Rangipo desert area, but management measures have controlled and in some areas eradicated the pine. Nevertheless, the presence of seed sources in neighbouring commercial lodge pole pine plantations continues to pose a threat to the Park. Introduced heather has also become established in the Park and is a potential threat presently under study (WCMC, 1995).

There is growing concern over the impact of ski field development and related infrastructure in Tongariro. The main problem is ski huts and their associated sewage and waste disposal, both difficult in alpine environments and inadequate in most cases (*pers comm*, Towle, 2000). Most huts are adjacent to the Whakapapa Ski Field on Mt Ruapehu in an area known as The Top'o' the Bruce. The huts are mainly privately owned by clubs and were established after World War II, with building reaching a peak during the 1960-70s. They were established principally because the standard of transport after the War made it difficult for skiers to access the mountain, ski and return to their accommodation in the space of a day. An access road was built at about 2000m and numerous huts established at or above the road-end on the Whakapapa Ski Field. With improvements in transport and roads in recent years and the development of motels and hotels within easy driving distance of the mountains, the justification for the huts no longer exists. Although, the Department of Conservation (DoC) has proposed that no new huts be established, this does not address the serious issues of waste and sewage disposal which remain (Towle, 2000). According to DoC statistics, very few skiers visit the Park during the summer months-so few skiers actually experience the problems the huts create for other Park users.

Conclusions and Recommendations

Without question, the presence of introduced plant and animal species remains the greatest threat to the biodiversity and protected areas of New Zealand. The threat and uncertainty of volcanic explosions and the impact on the local community and habitat alteration must be included in Park management planning. In the case of Mt. Ruapehu IUCN noted that the Park Authorities are taking a responsible attitude to responding to the cultural and safety issues.

Tongariro is part of the burgeoning tourism industry in New Zealand's protected areas. While tourism presents no real problem for many protected areas, there is mounting evidence of serious localised impacts such as the ski huts in Whakapapa Ski Field. There is a need to co-ordinate to combat development and tension between the ambitions of the tourism industry and nature conservation (McNeely *et al*, 1994).

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TE WAHIPOUNAMU (SOUTH WEST NEW ZEALAND WORLD HERITAGE AREA) South Island, New Zealand

Key threats
Introduced plant and species, small-scale mining, logging, an underground hydro-electric geo-thermal production installation, and spaghnum moss harvesting.

Biogeographical region: Antarctic **Major habitat type(s)/biome(s)**: Temperate rainforest, mountains, coastal, freshwater wetlands **National legal designation**: National Park **IUCN Category**: II **Other international designations**: World Heritage site (1990).	**Location**: 166°26'-170°40'E, 43°00'-46°30'S **Area**: 2,600,000 hectares **Year of establishment**: 1904 **Ownership**: The Crown. A small block of land at Martins Bay is owned by the Royal Forest and Bird Protection Society and there are a small number of private enclaves within the WH area. Most land is currently the subject of a claim by the Ngai Tahu Maori Trust Board before the Waitangi Tribunal. The outcome of the claim will not affect future protection, as the Ngai Tahu are committed to maintaining the protected status of the lands involved. **Management Authority**: New Zealand Conservation Authority, Department of Conservation (DoC)

Description
Te Wahipounamu (South West World Heritage Area) is a complex of spectacular protected areas located on the South Island of New Zealand. It is made up of four National Parks: Fiordland (1,257,000ha); Mount Aspiring (355,543ha); Mount Cook (69,923ha) and Westland (117,547ha); two Nature Reserves; three Scientific Reserves; 13 Scenic Reserves; one Private Protected Land; four Wildlife Management Reserves; five Ecological Areas; five National Park Special Areas; and three National Park Wilderness Areas (WCMC, 1995).

The site offers a landscape shaped by successive glaciations into fjords, mountains, rocky coasts, towering cliffs, lakes and waterfalls. Two-thirds of the area is covered with southern beech and podocarps, some of which are over 800 years old. The Park is also home to the world's only alpine parrot species, the *kea*, as well as the threatened *takahe*.

Te Wahipounamu lies across the Pacific plate to the east and the Indo-Australian plate to the west – one of the most seismically active regions in the world. The mountainous character of the area results from tectonic movement over the last five million years. The uplifted mountains have been deeply excavated by glaciers, resulting in high local relief. Glaciers are an important feature of the area, especially in the vicinity of Westland and Mount Cook National Parks, which contain 28 of the 29 New Zealand peaks above 3,000m. Full exposure to Southern Ocean swells has produced a dramatic "iron-bound" coast on basement rocks, with irregular high cliffs and many offshore rocks and stacks. Inter-tidal rock platforms extending from the foot of low cliffs characterise the Waitutu Conservation Area coast and parts of the adjacent south coast of Fiordland.

The diversity of natural vegetation is distributed along a number of pronounced environmental gradients, such as altitudinal sequences from permanent ice in the high mountains to sea level or inter-montane basins. Other gradients include rainfall/temperature gradients from west-to-east, resulting in a compressed transect from rainforest to grassland; a north-south gradient covering three degrees of

latitude; pronounced ecotones between open wetlands, grasslands, shrublands and forest communities; and distinct sequences of vegetation and soils developed on landforms of different ages (WCMC, 1995).

There is diverse alpine vegetation of shrubs, tussocks and herbs that extends along the summits of the mountains, from about 1,000m in altitude above the tree line to the permanent snowline. Most famous of these is *Ranunculus lyallii*, the largest buttercup in the world. The wetter, milder west is characterised by luxuriant rain forest and wetlands; the drier, more continental east (with colder winters and warmer summers) has more open forest (generally mountain beech), shrublands and short tussock grasslands. The south-west contains the most extensive and least modified natural freshwater wetlands in New Zealand.

The most impressive landform is the marine terraces in southern Fiordland. Ten terraces span an age range of 600,000 years. The vegetation ranges from tall mixed silver beech/podocarp/broadleaved forest on the lower terraces (50-100m altitude), through mountain beech/podocarp woodland at mid-altitudes (300-400m), to mosaics of dwarf manuka/mountain beech/podocarp shrubland and cushion bog on the higher and older terraces (600m).

Excluding the outlying Bounty Islands, the largest breeding congregations of New Zealand fur seal (*Arctocephalus forsteri*) are found along the south-west coast. Although virtually annihilated last century, the fur seal population has recovered steadily, and now numbers are in excess of 50,000 individuals. The south-west area is home to the endemic Fiordland crested penguin (*Eudyptes pachyrhynchus*), with some 1,000 to 2,000 pairs breeding annually. Other threatened species include the southern race of New Zealand falcon (*Falco novaeseelandiae*), Yellowhead (*Mohoua ochrocephala*) and fernbird (*Bowdleria punctata*). In all, more than 100 species of birds have been recorded in the World Heritage area, and more than half of the species that breed in New Zealand.

Threats

Although this area is the least populated of New Zealand, it is threatened by a startling range of threats, the most important being the introduction of exotic plant and animal species. Other threats include: small-scale mining, an underground hydro-electric geo-thermal production installation, and spaghnum moss harvesting.

A number of species were introduced, including rats (Muridae), stoat (*Mustela erminea*), fallow deer (*Cervus dama*), wapiti (red deer) (*Cervus elaphus*), Himalayan thar (*Hemitragus jemlahicus*), goat (*Capra* spp.), chamois (*Rupicapra rupicapra*), pigs (*Sus* spp.) and possum (*Trichosurus vulpecula*), which have had severe ecological impacts on biodiversity. National Park policy aims for the extermination of introduced animals within the Parks. In other protected areas their populations are kept at low levels to minimise impact on native flora and fauna. Control methods include recreational and commercial hunting by foot and helicopter. The Department of Conservation has initiated control programmes in faunal sanctuaries and is developing and implementing recovery plans for the threatened species (WCMC, 1995).

The greatest environmental impact has been the introduction of browsing and predatory mammals. Population increases of red deer in the 1940s and 1950s threatened the integrity of the forest and alpine ecosystems. Other browsing mammals, such as wapiti, fallow deer, goat, chamois and thar, have restricted distributions but have caused severe damage in places. Numbers of all these species have, however, fallen sharply since the advent of commercial hunting from helicopters, with a corresponding recovery of the vegetation, particularly in open alpine areas. Australian brush-tailed possum (*Trichosurus vulpecula*) has caused severe mortality in montane rata/kamahi forests in the north. They are still extending their range into previously possum-free areas such as the Haast district. Rabbit

populations affect some grasslands on the eastern side of the World Heritage area. Introduced mustelids and rodents have had a devastating impact on indigenous bird life. Several species have become extinct and most bird populations have been greatly reduced. The most prolific weed is gorse (*Ulex europaeus*); marram grass (*Ammophila arenaria*) is widespread in South Westland and willow (*Salix* spp.) is a potentially serious threat to streams, but at present is easily controlled.

A major underground hydro-electric power station is situated under the western extremity of Lake Manapouri. The associated high voltage transmission lines and roads have considerable but localised impacts (WCMC, 1995).

On the West Coast, land uses include: grazing, whitebait fishing, small-scale mining and sphagnum moss harvesting. Extensive pastoralism is the main land use to the east of the World Heritage area. In Southland intensive and extensive grazing, exotic and indigenous forestry is practised adjacent to the World Heritage area. Sheep and cattle grazing is permitted under licence or lease on a limited number of grassland areas on valley floors. Mineral exploration, prospecting and mining is permitted only with the consent of the Minister of Conservation. There are no significant mining activities within the World Heritage area, although small-scale gold mining occurs on the beaches and some rivers of the West Coast according to conditions monitored by the Department of Conservation.

Conclusions and Recommendations

As with Tongariro National Park , the introduction of exotic species has had the greatest impact on the several protected areas that make up this site. But animal control on offshore islands has met with remarkable success. For example, Norway rats have been removed from Breaksea Island and Fiordland National Park. These predator free islands may then serve as refuges for the recovery of threatened indigenous mainland species (McNeely *et al*., 1994).

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KHUNJERAB NATIONAL PARK
Gilgit, Pakistan

Key threat
Conflict between the local community and Park management.

Biogeographical region: Indomalayan **Major habitat type(s)/biome(s)**: Mountain **National legal designation**: National Park **IUCN Category**: II **Other international designations**: WWF global 200 (1997) (No. 75). Middle Asian Mountains Temperate Forests & Steppe.	**Location**: 72º55'E to 75º57'E and 36º01'N to 37º02'N **Area**: 226,913 hectares **Year of establishment**: 1975 **Ownership**: Government of Pakistan **Management Authority**: Pakistan Northern Area Parks and Wildlife Department.

Description
Khunjerab National Park (KNP) includes the Khunjerab Pass and is one of the highest Parks in the world with more than half its total area above 4,000 metres. Altitudes range from 3,200 metres to over 6,000 metres. The Park is situated in the north of Pakistan and borders the Tashkurgan Wildlife Reserve in the Province of Sinkiang in China. A transfrontier Peace Park has been discussed to promote international relations between the two countries as well as provide protection of this large, fragile environment (IUCN, 1988). KNP's main objective is the protection of internationally threatened species such as Marco Polo sheep (*Ovis ammon poli*), snow leopard (*Panthera uncia*) , brown bear (*Ursus arctos*) and Tibetan wild ass (*Equus hemionus*) in their natural environment.

Threats
Although the Park was legally established in 1975, its original planning and regulations were never implemented. There were several reasons for this but the most significant was that the Park regulations ignored the local community's centuries-old grazing rights in the area. The Park Authorities had planned to establish a 12 kilometre core zone in the known habitat of the Marco Polo sheep and then gradually eliminate grazing, mainly goats and sheep, from the rest of the Park.

In order to establish and begin to manage zoning in the protected area, Park Authorities had to ban grazing in the central core zone and in return, agreed to compensate the local community for the loss of grazing rights. Unfortunately, compensation was never carried out and this resulted in the loss of local people's confidence and trust in the Park Administration. Moreover, the extent of grazing in the rest of the Park was neither studied nor managed in light of the requirements of the limited Park resources and key stakeholder interests.

In Gilgit in June 1989, a jointly co-ordinated workshop by IUCN and the US National Park Service was organised to help develop new guidelines for the management and planning of KNP. Although the participants of the workshop did not have as much time as they would have liked to conduct comprehensive field visits to analyse conditions in the Park, they did undertake preliminary surveys and met with local communities. Based on these discussions, surveys and meetings, the workshop developed specific guidelines and recommendations for the preparation of a detailed Park Management Plan for Khunjerab. WWF-Pakistan was asked to prepare a new Management Plan based on these guidelines and recommendations.

In August 1989, the local community discovered that their grazing rights in the core zone would not be compensated by the Park Authorities, and they turned against the establishment of the Park. This was at the time when WWF Pakistan was preparing to initiate the new planning process and had sent its

team to the Park. On the day when the WWF planning team was to start field investigations, the people of the area invaded the core zone with thousands of their livestock, drawn from different parts of the Park. While simultaneously registering a lawsuit in the civil court against the Park demanding compensation for the loss of their grazing rights in the core zone and requesting the de-gazetting of the National Park.

The situation further deteriorated when the local people refused to allow Park officials inside the Park boundary. Next local people started to hunt and kill many of the endangered species in the Park, on the understanding that if there was no wildlife left, there would be no reason for the Park. Since it was neither possible nor equitable to develop or implement a management plan without the participation of local communities, resolution and management of the conflict in the Park became top priority for WWF.

During this time, other threats to the Park were also occurring. These included illegal trophy hunting by army and senior civil servants of Marco Polo sheep (*pers. comm.* WWF Pakistan). Poaching of highly threatened snow leopards, Marco Polo sheep and brown bear also occurs across the border in several neighbouring central Asian countries (Chestin and Carey, 1997) and although more specific information is needed for Khunjerab National Park concerning these threats, it is highly suspected that they occur within the Park. Trade in snow leopard skins is lucrative with pelts selling for up to US$3000 each, a substantial sum in Pakistan. Wild cats are one of the wildlife families used by the fur trade, which are entirely wild-caught rather than farmed. Thus, illegal trade has the potential to be among the fastest and most destructive threats when it drives illegal commercial hunting (Nowell and Jackson, 1996). Brown bears are hunted for their pelts and gall bladders for use in traditional medicine.

Poaching of fuelwood occurs particularly at higher elevations during summer stock herding and affects vegetation and, in some areas when combined with livestock grazing, triggers erosion in the vicinity of summer settlements.

In 1989, WWF-Pakistan began a dialogue with key stakeholders stressing the necessity of putting aside their differences in the larger interest of conservation. WWF acted as mediators and commenced negotiations with the local communities and administration, and as a result a number of illuminating facts emerged. The local inhabitants were never considered as recipients of any kind of benefits from the Park. They were not given any share in the Park employment and nothing was done to enhance their economic status through the non-consumptive uses of Park resources. While the Park was established to protect endangered species, a large area of the habitat of key endangered species was totally ignored while another area, which was no longer used by the same species, was preserved at the cost of conflict with the people (*pers comm*. WWF Pakistan)

In light of this new understanding of the situation a new foundation for management guidelines emerged. The conflict was resolved in January 1992 and documented in a joint agreement signed by representatives of local communities, the Park and civil administration. Based on various clauses of the agreement, a management plan was drawn up which addresses both conservation of natural resources, needs of local people and which tries to convert, slowly and gradually, the presence of the semi natural status of the Park to a sustainable natural system. In 1999, WWF Pakistan noted that "*The things are well on the track now*."

Conclusions and Recommendations

Protected areas managers ignore the importance of local people's right to earn a livelihood at their peril. In this case, the lack of consultation and recognition of the local community's rights to grazing exacerbated the situation to the point of direct negative impact on the very species the Park was established to protect. For these local communities WWF Pakistan is their only link with the world

outside their villages. WWF is focusing its project work in these areas towards identifying and safeguarding the natural resources, and is working with these communities by suggesting ways in which they can develop and earn sustainable livelihoods locally.

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DONANA NATIONAL PARK
Huelva and Sevilla Provinces, Spain

Key threats
Water management practices, water pollution from agriculture, development outside park boundaries, poaching, and over-grazing by domestic livestock.

Biogeographical region: Palearctic **Major habitat type(s)/biome(s)**: Wetlands **National legal designation**: National Park (State Network) **IUCN Category**: II **Other International designations**: WWF Global 200 Site – (No. rr) Selected Important Staging, Breeding, Wintering, & Stepping-Stone Sites For Long-Distance Migratory Birds & Butterflies (1997); UNESCO-MAB Biosphere Reserve (1980); Ramsar (1982); UNESCO Natural World Heritage Site (1994)	**Location**: 36º59'N/6º23'W **Area**: 50,720 hectares **Year of establishment**: 1969 **Ownership**: State 47.3%; municipal 17%; private 35.6%, including WWF property "Reserva Biológica del Guadiamar" 3,425 ha. **Management Authority**: DGCONA National Parks Department (part of the Ministry for Environment).

Description
Doñana is located on the southern Atlantic coast of Spain between the right bank of the Guadalquivir River and the Atlantic Ocean. It is situated in the municipalities of Almonte and Hinojos in the Huelva Province, and in the municipalities Aznalcazar and Puebla del Rio in Sevilla Province. Both provinces are part of the Autonomous Region of Andalucia (Comunidad Autonoma de Andalucia). The wider Doñana district borders the towns of Sevilla, Huelva and Cadiz.

The Park is one of the largest and best-known wetlands in Europe. It is particularly important for the large breeding colonies of many bird species, and is the most important wetland for wintering waterfowl in Spain (up to 700,000 birds). It represents the last tract of relatively undisturbed marsh in the Guadalquivir delta, contains a large stretch of undeveloped coastline, and protects one of the few mobile dune systems found on the Iberian Peninsula (WCMC, 1998).

Doñana sits on Quaternary deposits of mainly sand sheet and groups of shifting dunes, some of which move rapidly. Vegetation cover has stabilised some dunes and there are lagoons and marshy areas in the dune slacks. Almost half the Park area comprises swamps on flat clay soil filled with muddy sediments or *marismas* with features including: canals with slight elevations called *vetas* and *paciles* that have been carved by natural drainage; closed hollows *lucios* which hold stillwater; and *ojos* - points at which ground water reaches the surface. The clay sediments of the marshes are rich in calcium and magnesium and the *marismas* form a diverse mosaic of microhabitats of pools, banks, streams, reedbeds and mudflats. The *marismas* flood in winter creating ideal conditions for large flocks of migrating birds (Gil, 1993), taking into account the large variation of flooding levels due to the irregular rainfalls (Mediterranean climate).

Plant communities on the dunes have Atlantic/North African affinities with a notable degree of endemism. *Rhamno-Juniperetum macrocarpae* communities occur on the outer dunes with *Rhamno-Juniperetum sophora* on the dry, inland (established) dunes. Cold sand (*Pseudogley* type) vegetation includes *Oleo-Quercetum suberis* (plantations of cork oak, olive trees and capers), *Ficario-Fraxinetum angustifoliae* and *Viti-Salicetum atrocinerae*. The heathland or *matorral* vegetation varies with water availability. In the damp hollows *Erica scoparia* and *E. ciliaris* occur and on the drier ridges *Rosmarinus officinalis, Lavandula stoechas* and scattered trees such as *Pinus pinea* (introduced

species), cork oak (*Quercus suber*) and *Arbutus unedo* (occidental Mediterranean communities). Some 750 species of plants have been identified including two species new to science and at least 45 new to Europe (WCMC, 1998).

Identified vertebrate species include 24 fishes (of which four are introduced), eleven amphibians, 21 reptiles, and 37 mammals. Mammals include wild boar (*Sus scrofa*), fallow deer (*Dama dama*), red deer (*Cervus elaphus*), otter *Lutra lutra*, small-spotted genet (*Genetta genetta*), red fox (*Vulpes vulpes*), and wild cat (*Felis catus*). The Park contains a significant population of the threatened Spanish lynx (*Lynx pardinus*), numbering about 40 individuals.

Doñana has a rich and diverse avifauna, with some 365 recorded species of resident and migratory birds. The marsh lies on the west Europe to west Africa migration route and is indispensable as a winter habitat for species such as the greylag goose (*Anser anser*) – flocks of up to 80,000, teal (*Anas crecca*) – 200,000, wigeon (*A. penelope*) – 100,000 and avocet (*Recurvirostra avosetta*) – 10,000. It is also a spring nesting area for Mediterranean and African birds including the spoonbill (*Platalea leucorodia*). The *marismas* are used as a feeding area by almost 20,000 greater flamingo (*Phoenicopterus ruber*) – during years of high rainfall, this species also nested in the area. Important breeding wetland species include marbled teal (*Marmaronetta angustirostris*), white-headed duck (*Oxyura leucocephala*), and purple gallinule (*Porphyrio porphyrio*).

Threats

Agricultural practices and mining activities threaten the Park's water quality and wildlife. In 1986, an estimated 30,000 birds died in and around the Park – poisoned from the uncontrolled use of pesticides for production of rice, cotton and strawberries. In April 1998, the Park was further threatened by mining activities. Toxic mine waste from an impoundment reservoir 40 miles north of the Park broke through a dam and entered the Guadiamar River. Emergency measures taken to prevent the flow entering the Park were relatively successful. In June 1999, the Spanish Authorities gave the Aznalcollar mine permission to resume operations. There are still problems resulting from the re-opened mine, the pollution of the surrounding farmland and the Guadalquivir estuary. The Committee of the World Heritage Bureau has expressed serious concerns regarding the re-opening of the mine, construction of tailings dam, aquifer contamination and the need for co-ordinated and effective buffer zone management (IUCN, 1999). The wetlands and wildlife are also seriously threatened by modification of the hydraulic regime from drainage and demand for water from irrigation schemes.

The main problem facing the *marismas* is the continuing land reclamation and agricultural development north of the Park borders. This has caused the diversion of some natural canals or *caños* that once brought water to the *marismas*, causing sedimentation of lagoons and homogenisation of the marshes. The poor water management practices in the Park have worsened some of these effects.

In the long term, Doñana is in danger of drying up unless steps are taken to replenish the over-exploited aquifers whose effects can be observed in the disappearing springs and sources of *La Vera*. A project to build a canal, which would restore, to some degree, the former hydrological system has been considered. River pollution, increased tourism development in the vicinity of the park, poaching, illegal fishing (particularly for crayfish), and over-grazing by domestic livestock also threaten the Park (Gil, 1993).

Problems such as these led to the inclusion in 1990 of Doñana National Park in the *Montreux Record* of Ramsar sites requiring priority attention because of the potential for change in their ecological character. In the same year at the Conference of Parties of the Ramsar Convention passed a recommendation (C.4.9.1) suggesting action to be taken by the Spanish Government and regional authorities.

Conclusions and Recommendations

Doñana is one of the most important European wetlands and provides other important natural values, such as mobile dunes and pine forests ecosystems. The area is severely threatened from agricultural and tourist development and is losing key-species, such as lynx and imperial eagle (*Aquila heliaca*), due to poor management, external projects and lack of local people's interest in the conservation of the area.

For the future, the Doñana National Park will require a higher integration of scientific research and management practices. Further on, long-term restoration and management projects will have to be developed to cover the whole Guadiamar River watershed and the other catchments that influence the Doñana wetlands. This concept is being attempted in the "*Green Corridor of the Guadiamar River*" and "*Doñana 2005*" restoration projects, which started in 1998. Such a catchment-wide approach requires increased public participation and involvement in planning and management activities and in order for this important work to occur more investment needs to take place in local capacity building.

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ICHKEUL NATIONAL PARK
Tunisia

Key threats
Water management practices, installation of two dams, agricultural practices, development and population pressures.

Biogeographical region: Palearctic **Major habitat type(s)/biome(s)**: Mediterranean Sclerophyll **National legal designation**: National Park **IUCN Category**: II **Other international designations**: World Heritage site (1980); World Heritage in Danger (1996-present); Biosphere Reserve (1977); and Ramsar (1980)	**Location**: 37º09'N/9º39'E **Area**: 12,600 hectares **Year of establishment**: 1980 **Ownership**: The lake and djebel are state property whereas the marshes and the lake are the property of the Ministry of Agriculture and administered by the OTD [Office des terres Domaniale] and a private company for fishing. **Management Authority**: Direction Generale des Forêts, Ministry of Agriculture

Description
Ichkeul National Park is situated on the Mateur plain, approximately 25km south-west of Bizerte and 15km north of Mateur, in the Bizerte District, northern Tunisia. The Park is about 30km inland from the Mediterranean coast.

Lake Ichkeul and its associated wetland are an important stopover point and breeding site for hundreds of thousands of migrating birds, such as geese, ducks, storks, and pink flamingos (*Phoenicopterus ruber*). Ichkeul is the last remaining lake in a chain of lakes that once extended across northern Africa. The site has internationally important fossil deposits including late Tertiary and early Quaternary outcrops on the northern shore (IUCN, 1997).

The Park consists of an isolated and wooded massif (Djebel Ichkeul) and a brackish water permanent lake (Lac Ichkeul). The lake is indirectly connected to the sea by the river, the Oued Tindja, which leads into the marine lagoon, Lac de Bizerte and is classed as a 'marine wetland'. There is approximately 1,360ha of mountainous terrain, 8,500ha of lake habitat, the remainder is marshland. The lake is fed by several rivers in the west and south, including the Oued Djoumine. These water sources dry out over the summer months and combined with high levels of evaporation, result in a drop in water level, resulting in an increase in the concentration of salinity from evaporation and the influx of sea water.

There are three distinct habitat types within the Park: mountain, marshland and lake. The mountain and its foothills are dominated by a covering of *Pistacia lentiscus* with wild olive (*Olea europea*), phillyrea (*Phillyrea angustifolia*) and *Smilax aspera*. In the marsh pools and open water areas *Potamogeton pectinatus*, *Zannichellia palustris*, *Ekebergia* spp., *Callitriche* spp. and *Ruppia maritima* (IUCN, 1997) grow. *Potamogeton pectinatus* is abundant in the extreme west of the lake and represents one of the major food resources for the waterfowl flocks. The lake was once fringed by a narrow belt of *Phragmites communis* reeds.

The main invertebrate fauna is typical of brackish water areas although on the edge of the salt marsh there are freshwater species. The dense *Potamogeton* beds contain the most abundant animal populations in the lake. Species include *Nereis diversicolor*, *Gammarus locusta*, *Corophium volutator*, *Sphaeroma hookeri*, *Idotea* spp., *Hydrobia* spp., *Abra* spp. and *Cerastoderma glaucum*. Crab *Carcinus mediterraneus* and also *Balanus amphitrite* occur near the Tindja canal. The principal fish species are

Anguilla anguilla, *Mugil cephalus*, *M. ramada*, *Dicentrarchus labrax*, *Barbus barbus*, and *Alosa fallas*. *Aphanius fasciatus* and *Sygnathus* are commonly found in shallow water.

The Ichkeul wetland is one of the most important sites in the entire Mediterranean region for wintering Palaearctic waterfowl, with records of up to 300,000-400,000 birds present at one time. More than 185 species of bird have been recorded (BirdLife International, 1999). The most numerous species recorded are wigeon (*Anas penelope*) (39,000), pochard (*Aythya ferina*) (120,000) and coot (*Fulica atra*) (36,000). The high records for *Aythya ferina* and greylag goose (*Anser anser*) (700-3,200) indicate that Ichkeul is the most important wintering station in the Maghreb for these species. Up to 600 of the threatened white-headed duck (*Oxyura leucocephala*), 4 per cent of the known world population, were recorded in May 1977 (Morgan, 1982). Additional wetland birds found include mallard (*Anas platyrhynchos*), high numbers of teal (*Anas crecca*), pintail (*Anas acuta*), shoveler (*Anas clypeata*) and black-winged stilt (*Himantopus himantopus*).

One of the most notable mammals recorded at Ichkeul is otter (*Lutra lutra*). However, less than 10 animals are believed to occur (H. Miles, pers. comm., 1987). There are large populations of wild boar (*Sus scrofa*), European genet (*Genetta genetta*), as well as a limited number of crested porcupine (*Hystrix cristata*), mongoose (*Herpestes ichneumon*) and wild water buffalo (*Bubalus arnee*). It is thought that the water buffalo were introduced in the mid-1850s for hunting.

The lake, marshes and mountain are situated in a part of Tunisia that has been settled and influenced by humans over many millennia. The area immediately surrounding the park is very densely populated and includes a number of large towns such as Bizerte and Mateur.

Threats

The Park is threatened by the impact of human activities on the Ichkeul ecosystem. For example, two dams built upstream have reduced the flow of fresh water into the lake. A 1996 report published by the Tunisian Ministry of the Environment found that the inflow of freshwater to the lake had been severely reduced, leading to an increase in the salinity of the lake and marshes. This has had a major impact on the food chain, and resulted in the reduction of *Potamogeton*, a major food source for wintering waterfowl, and the replacement of *Scirpus maritimus* by the species *Ammi visnaga* and *Scolimus maculatus*, which has resulted in up to a 20 per cent loss of food plants. The lakeshore reedbeds have disappeared completely and all reed dependent species have disappeared. The number of migrating birds has severely declined – wintering waterfowl numbers have decreased and in 1996 no groups of teal, shoveler and black-tailed godwit were seen.

Other areas for concern include institutional problems, such as a lack of independent structure and budget, and degradation of the hilly areas in the Park by large open-cast stone and marble quarries which occupied the southern slopes of Djebel Ichkeul until a few years ago.

The activities of 80 families living in the park have resulted in overgrazing and land clearance. Up to 2,000 cattle, sheep and goats and 800ha of cultivation occur within the park boundary (Nelson, 1988). On the park fringes there is intensive agriculture of ploughed land, orchards and pasture. The park is also under threat from commercial fishing, logging and agricultural interests (IUCN, 1996).

The ecosystem made a partial recovery following the heavy rains of the 1995/96 winter, and in the western part of the lake the number of wintering birds was 100,000, although greylag goose and wildfowl species were still low. However, rainfall levels in the winter of 1996/97 were again low (IUCN, 1997).

Conclusions and Recommendations

Recommendations for action by the Tunisian authorities include reaching an agreement on the release of water from the upstream dams to supply water to the park, and establishing a central management authority to make decisions on activities such as fishing, grazing, agriculture, water supply and forestry. The Joumine canal built in 1981 should be filled in, as it drains the Joumine Marsh and encourages the growth of salt tolerant plants. Ecological monitoring in the park should be conducted and the information made available to decision-makers (WCMC, 1997)

A Joint World Heritage Centre, IUCN and Ramsar mission to Ichkeul in February 1999 commented that it was not possible in the foreseeable future (i.e. in the next five to ten years) for the Park to be rehabilitated and restored to the state it was when listed as a World Heritage Site (IUCN, 1999).

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ERYRI (SNOWDONIA) NATIONAL PARK
Wales, United Kingdom

Key threats
Tourism, agricultural practices, plantation forestry and climate change.

Biogeographical region: Palearctic **Major habitat type**: Mountain, coastal **National legal designation**: National Park (includes National Nature Reserves and Sites of Special Scientific Interest (SSSI)). **IUCN Category**: V **Other international designations**: Natura 2000 site. The Dyfi on the Southern border of the park is a biosphere reserve and Ramsar site (1976).	**Location**: 52 54'N/3 49'W **Area**: 214,200 hectares **Year of establishment**: 1951 **Ownership**: Multi-stakeholder including private individuals and the National Trust **Planning Authority**: Snowdonia National Park Authority

Description
Eryri or Snowdonia National Park is located in northwest Wales and is the second largest National Park in England and Wales. The Park's Welsh name Eryri means "place of the eagles" or "Snowdon" from which the Park takes its English name. Snowdonia National Park forms a huge, high landscape, stretching southwards from the Conwy River as far as the River Dyfi in Machynlleth, and eastwards to Bala. It includes the Carneddau, Glyderau, Aran and Arennig mountain ranges as well as the highest mountain in Wales, Yr Wyddfa 1,085m. Peaks include Snowdon itself, Tryfan and Cadair Idris. At the foot of Snowdon and the craggy Llanberis Pass, is a well-located and popular touring centre, as is the attractive mountain resort of Betws-y-Coed. Further south, the stone-built market town of Dolgellau sits beneath the summit of Cadair Idris, while Bala, alongside Wales' longest natural lake, guards Snowdonia's eastern gateway.

A new Park Act in 1949 defined the purpose of national parks in Britain as "preserving and enhancing the natural beauty of the areas and promoting their enjoyment by the public". Eryri National Park therefore attempts to reconcile landscape and nature conservation with recreational needs, tourism, and the local economy, whilst attempting to maintain traditional land uses and the cultural heritage of the area. Later in 1951, Snowdonia was designated under the UK's *1949 National Parks and Access to the Countryside Act*.

Some 10,000 years ago, the glaciers of the last Ice Age moulded the Snowdonia landscape into deep "U-shaped" valleys, shattered scree on cliff faces and rugged mountains. Rivers, lakes and waterfalls, and remnants of ancient deciduous woodlands, are typical of the park, as is the coast, with its sandy bays, dunes and the three beautiful estuaries – Glaslyn/Dwyryd, Mawddach and Dyfi. Many of the highest peaks in Snowdonia are composed of tough igneous rock – volcanic lava and ash. On Snowdon itself, this is mixed with sedimentary rock that once lay at the bottom of the ocean; fossils of small sea creatures can be found today on the summit. Archaeological remains from the Neolithic period, the Roman occupation and the Middle Ages survive through to those of the recent industrial past of gold, lead and copper mining, and slate quarrying on a grand scale (Havord, 1993).

Snowdonia contains arguably some of the most beautiful scenery in Britain and a wide variety of landscapes and habitats for animals, birds and plants. It has some 37km of coastline with sand dunes, estuaries, glacial valleys, and the remnants of broad-leaf woodlands of oak (*Quercus* spp.), ash (*Fraxinus excelsior*), rowan (*Sorbus aucuparia*) and hazel (*Coryllus avellana*) that once covered the mountains, lakes, streams and valleys. There are more National Nature Reserves in Eryri than any other National Park in Britain. It is home to nationally and internationally threatened species such as

the Peregrine Falcon (*Falco peregrinus*), Merlin (*F. columbarius*), raven (*Corvus corax*), and the rainbow coloured Snowdon beetle (*Chrysolina cerealis*) found only around Yr Wyddfa. Populations of otter (*Lutra lutra*) red squirrel (*Sciurus vulgaris*) and polecat (*Mustela putorius*) are significant in the British context as are the bryophyte communities of the western oak woodlands.

The high lime-rich *cwms* contain many alpine plants such as holly fern (*Polystichum lonchitis*), alpine (*Saxifraga nivalis*) and purple saxifrages (*S. oppositifolia*) and the rare Snowdon Lily (*Lloydia serotina*). But most of the mountains and moorland are covered by acid soils supporting rough grasses and heather. There are also club mosses, insectivorous plants such as sundew (*Drosera* spp.) and butterwort (*Pinguicula* spp.) and the frequently seen little yellow tormentil (*Potentilla rotundifolia*), blue heath milkwort (*Polygala serpyllifolia*) and bog orchids (*Hammarbya paludsa*) (Havord, 1993).

Snowdonia also has a high geological importance. The internationally accepted “Cambrian, Ordovician and Silurian” series of rocks were first described here and Darwin conceived his theories of evolution while studying geology in Snowdonia.

Snowdonia, unlike many National Parks in Europe and the US, is not a wilderness area, rather it is a landscape where some 27,500 people live and work. The Park is a stronghold of the Welsh language and way of life. It is positioned within the heartland of Welsh speaking community and an estimated 65 per cent of the Parks’ inhabitants speak Welsh. For many, Welsh is their first language and the language of choice in everyday conversation, commerce, and government.

National Parks in Britain are “national” in the sense that they are of a national value and importance, but they are not nationally owned. The designation of an area as a National Park does not affect the ownership of the land, neither does it remove the rights of local communities or infer special rights to the public. Most of the land remains in private ownership, although there are significant areas that are in public ownership, most notably the Ministry of Defence and the Forestry Commission. In Eryri 69.9 per cent of the land is in private ownership, 15.8 per cent is owned by the Forestry Commission, 0.9 per cent by water companies, 8.9 per cent by the National Trust, 1.7 per cent by the Countryside Council for Wales, 1.65 per cent by other groups, and 1.25 per cent by the Park Authority itself.

Threats

Snowdonia National Park is threatened by increasing pressure from tourism, agricultural activities, particularly overgrazing, and plantation forestry. The increasing urban population in the United Kingdom has an apparently ever-expanding desire to visit the countryside. Over 12 million tourists visit Snowdonia each year. The increasing number of visitors is causing road traffic congestion throughout the Park, erosion on many trails, disturbance to wildlife as well as livestock, in particular during lambing season, and litter.

Within Snowdonia there are several Sites of Special Scientific Interest (SSSIs). SSSIs is a designation given to sites across the United Kingdom covering a range of habitats and species, and including sites of geological and physiographical as well as biological importance (DETR, 1999). However, many sites within Snowdonia have been damaged ranging from ‘short term’ damage to ‘complete loss’ (Countryside Council for Wales, annual report 1991-1999).

In Snowdonia, approximately 80 per cent of the land is used for the production of sheep and beef cattle. Farming is still the economic and social backbone of the National Park, and it contributes to the maintenance of the landscape. Its stone boundary walls, hay meadows, scattered woodlands and rough mountain grazing owe much of their existence to the viability of the farming community. However, inappropriate grant aid, particularly from the European Common Agricultural Policy, has meant unsustainable numbers of sheep and cattle overgrazing many areas and causing erosion, degradation of

woodlands and a change in plant community composition. There are attempts to address this problem, for example through the Tir Gofal agri-environment scheme.

Plantation forestry is another concern in Snowdonia. Today, only 10 per cent of the UK is wooded, and this is mainly plantation of non-native conifer species. Only 4-5 per cent of the original area of ancient native woodland remains in Wales – this is often referred to as 'ancient semi-natural woodland' and is made up of woodlands that existed before 1600 and that include native species (Linnard, 1982). The main negative impacts of forestry activities arise when natural and semi-natural habitats such as blanket bogs, heath lands or native woodlands are converted to forestry plantations. A great many of these new plantations have been located in upland areas. Plantation forestry also does not provide the same diverse habitat for wildlife as natural forest.

The ecological and economic effects of climate change could also be significant. A recent report by the University College of North Wales and others noted potential impacts as the likely disappearance of the Snowdon lily (*Lloydia serotina*) and the arctic char (*Salvelinus alpinus*). The Cwm Idwal SSSI is the site of one of the Environmental Change Network's research stations.

Conclusions and Recommendations

To some it may be considered incompatible with nature conservation to have land in private ownership and to have economic land uses in a protected area, however IUCN acknowledges that a high proportion of the natural beauty and diversity in the world occurs in areas occupied by people. In recognition of this, IUCN established a category of protected landscapes (Category V) in its *Guidelines Protected Areas Management Categories* (IUCN, 1994). The objectives of 'Category V Protected Landscapes' are: "*to maintain significant areas which are characteristic of the harmonious interaction of nature and culture, while providing opportunities for public enjoyment through recreation and tourism, and supporting the normal life-style and economic activity of these areas. These areas also serve scientific and educational purposes, as well as maintaining biological and cultural diversity*" (IUCN, 1994). Category V Protected Areas, such as Snowdonia, perhaps more than any other type of protected area face a complex set of management challenges because of the sheer number, demands and needs of stakeholders; issues of pre-existing land tenure of Park residents before the Park was established; maintenance of traditional ways of life; cultural identity; economic considerations (agricultural subsidies, grant programmes); and layers of political jurisdictions from the municipality to the European Commission. In order for the Parks Authority to protect Snowdonia's riches it must be assured of sufficient funding to enable to them to address its management concerns before they turn into more serious threats.

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EVERGLADES NATIONAL PARK
Florida, United States

Key threats
Water management practices, water pollution, loss of species, human population and development pressures and climate change.

Biogeograhical region: Nearctic with Neotropical elements **Major habitat type(s) / biome(s)**: Flooded grasslands and temperate broad-leaved forest **National legal designation**: National Park **IUCN Category** II **Other international designation(s)**: WWF Global 200 Site (1997) (No. 110) Everglades Flooded Grasslands; Ramsar (1987); Biosphere Reserve (with Fort Jefferson National Monument)(1976) and World Heritage Site (1979).	**Location**: 25°22'N/80°55'W **Area**: 609,681 hectares **Year of establishment**: 1947 **Ownership**: National Park Service, US Department of the Interior **Management authority**: National Park Service, US Department of the Interior

Description
Everglades National Park is situated on the southern tip of the Florida Peninsula, 16km from Florida City. The park is bounded by the Gulf of Mexico to the west, State lands to the north, and the Florida Keys to the south and south-east. It includes most of Florida Bay. The park is at the centre of a complex of protected areas, including Big Cypress National Preserve (21,198ha), Biscayne National Park (41,967ha), Dry Tortugas National Park (26,183ha), Key Largo National Marine Sanctuary (32,388ha), 10 National Wildlife Refuges and the Florida Keys National Marine Sanctuary.

The Everglades National Park is an area of exceptional conservation value. It has the largest continuous stand of sawgrass prairie in North America; the largest mangrove ecosystem in the Western Hemisphere; the most significant breeding grounds for tropical wading birds in North America; the only subtropical preserve in North America; and provides key habitat for several threatened and endangered species (World Heritage, 1998).

Over the past thirty years, South Florida has experienced an accelerated loss of the natural habitat for which it was once famous. Elaborate water controls now disrupt the natural flow, which result in a shortage of clean water at critical seasons, and in the correct quantities. Without sufficient water the Everglades will die.

The Everglades represents the largest and one of the few rain-fed flooded grasslands on limestone substrates anywhere in the world. The Park serves as a vital recharge area for the Biscayne Aquifer, a major source of freshwater for Miami and southeast Florida. The Everglades ecosystem includes estuarine and marine habitats that stretch from brackish, inland mangrove forests and sloughs, through broad transition zones and large coastal bays, to offshore coral reefs. The hardwood and cypress hammocks (small islands of trees rising above the grass) are home to several rare species of plants, butterflies, and tree snails.

The floral diversity of the Everglades is one of the key resources with some 65 taxa endemic to south Florida. Species includes Bromeliads and 25 species of orchids in addition to some 1,000 seed-bearing plants and 120 tree species. There are over 36 threatened animal species and 300 species of birds.

Internationally threatened species include: American alligator (*Alligator mississippiensis*), crocodile (*Crocodylus acutus*), Florida panther (*Felis concolor*), West Indian manatee (*Trichechus manatus*) and loggerhead sea turtle (*Caretta caretta*).

Threats

The main threats to the Park are water management practices, agricultural run-off that affects water quality, loss of spatial extent of wetlands, introduced species, loss of species, human population and development pressures and climate change. The surrounding extensive canal and levee systems restrict natural rain inflows into the Park. At times the water control structures at the park boundary are closed, threatening the already endangered wood stork habitat, while at other times sluices are opened allowing floodwaters to inundate the Everglades destroying nests and eggs, and dispersing important seasonal concentrations of wading birds' food supply.

Added to this are water quality problems from the presence of pollutants from agriculture and other human activities. Nutrient-enriched waters from agricultural runoff affect vegetation patterns reducing dissolved oxygen concentrations and causing algal blooms that have turned large areas of the clear waters of Florida Bay into a “murky green soup”. High levels of mercury have been identified in fish, racoons and alligators. Mercury contamination extends to the Florida panther, a species so endangered that it is estimated that there are less than 30 individuals in the entire State. Fewer than ten survive in the Park. A panther with mercury levels toxic to humans was recently found dead in Everglades National Park.

Created in 1947, the park was established to “save the `Glades”, but real problems continue to beset this landscape. Although much is being done, continuing pressures associated with urbanisation, industry and agriculture require a constant search for new solutions. The population of Southern Florida, which is at present some 6 million people, is projected to reach 8 million by 2010, and 12-15 million by 2050 (Lazaroff, 1999). This growing population competes for the same water that threatened species such as the wood stork or wood ibis (*Micteria americana*) need to survive.

Climate change scenarios imply significant threats for US coastal wetlands most notably the Everglades. Recent sea-level rise is already causing mangrove swamps to encroach on marshes in the southern Everglades. Warmer sea surface temperatures in the future will induce more frequent algal blooms, like the red tide of 1996 that killed more than 150 manatees in Florida Bay (UEA, 1999).

Conclusions and Recommendations

In one of the world's largest ecosystem restoration projects, the US Congress has extended the Everglades Park boundary to protect the Shark River Slough. Historically the Shark River Slough hosted higher concentrations of nesting wading bird populations than any other area in the Park. The enlargement should help turn around the 93 per cent decline these species have suffered by restoring critical, suitable habitat. The National Park Service and the State of Florida have agreed to be partners in enforcing existing water quality regulations to address water quality problems. The Park Service is also working with the U.S. Army Corps of Engineers and other water management agencies to adopt natural rainfall models of manipulating water supplies.

Understanding built up over the past three decades about the changes resulting from the development that has occurred in Florida Bay and other nearby waters will help guide restoration efforts. WWF's objective for the South Florida/Everglades system for the next several years is to work with other conservation groups to help the US Army Corps of Engineers, the National Park Service and other federal and state governmental partners develop and fund the necessary changes. The complete restoration of natural hydrology to a large portion of South Florida will take more than a decade. WWF plans over the next three years to: identify the right strategies for restoring the necessary timing, flow and delivery of water to South Florida; ensure the passage of the necessary legislation in US Congress

and advocate for the allocation of Federal and State funding that will make it possible to continue this important restoration work (WWF-US, 1999).

Restoration of the Everglades presents a significant challenge. The restoration of Florida Bay and other South Florida estuaries depends to a large degree on the health of the Everglades, and is complicated by the complex ecology of these interconnected habitats. The project hopes that it will be possible to counter-balance the effects of three decades of burgeoning development in the region and restore the natural water flow to the 'River of Grass'.

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GLACIER BAY NATIONAL PARK
Alaska, United States

Key threats
Climate change, commercial fishing and tourism pressures.

Biogeographical region: Nearctic **Major habitat types**: tundra, spruce forests glaciers, marine **National legal designation**: National Park and Preserve **IUCN Category**: II **Other international designations**: WWF Global 200 Site (1979) (No.140) Gulf of Alaska Coastal Rivers and Streams; World Heritage site (1979) as part of Canada/USA site: Tatshenshini-Alsek/Kluane/Wrangell-St Elias/Glacier Bay World Heritage Area; Glacier Bay –Admiralty Island Biosphere Reserve (1986).	**Location**: 58 36'N/136 54'W **Area**: 1,304,550 hectares **Year of establishment**: 1925 **Ownership**: US Government, except for about 80ha of Brady Ice Fields (west of Glacier Bay) which are patented mining claims, two private tracts of land of about 80ha on the shoreline near Gustavus, and 4,000ha of tentative native allotment claims which 10 people have identified for subsistence use under the *1972 Alaska Native Claims Settlement Act*. **Management Authority**: US Department of the Interior, National Park Service.

Description
Glacier Bay National Park and Preserve is located in south-east Alaska, along the north-western end of the Alexander Archipelago. The centre of the Park is approximately 144km north-west of Juneau, and about 965km south-east of Anchorage. It is bounded by the Gulf of Alaska to the west, Cross Sound and Icy Strait to the south, the Chilkat Range and Canada to the east, and the St Elias Mountains, Alsek River and Tongass National Forest to the north. In 1992, the Park received greater protection on its northern boundary when the Alsek-Tatshenshini Park in Canada was formed. This new park joined Glacier Bay National Park, Wrangell-St. Elias National Park and Kluane National Park, in Alaska and in Canada, creating the one of the largest internationally protected areas in the world (WCMC, 1992).

Glacier Bay, a large fjord of 105km in length, has experienced four major glacial advances and retreats in recent geological time. Two centuries ago, the Bay was completely filled with the Grand Pacific Glacier and has witnessed an unprecedented rate of glacial retreat of about 95km in the past 200 years. As the main glacier has retreated, 20 separate glaciers, many of them tidewater glaciers, were created.

There are parts of four mountain ranges, running in a north-south direction within Park boundaries: the Fairweather Range to the west, culminating in Mount Fairweather at 4,670m; the tip of the St Elias Range to the north; the Takhinsha Range to the north-east; and the Chilkat Range to the east (IUCN, 1992). The Alsek River, which joins with Canada's Tatshenshini River, is one of very few river systems to breach the coastal range from the subarctic interior, and the Alsek River delta represents the confluence of several streams and rivers in the Park.

There are five terrestrial habitats in the Park: wet tundra; coastal western hemlock (*Tsuga heterophylla*)/sitka spruce forest (*Picea sitchensis*); alpine tundra; glaciers and icefields and meadow/brush thickets. Aquatic habitats include freshwater (lakes, rivers, streams, and marshes) and marine (inter-tidal zones, estuaries, fjords and upper inlets) (NPS, 1999).

Twenty-eight terrestrial mammals are found in the Park, including grey wolf (*Canis lupus*), brown bear (*Ursus arctos*), black bear (*U. americanus*), wolverine (*Gulo luscus*), river otter (*Lutra canadensis*), Canadian lynx (*Lynx canadensis*), black-tailed deer (*Odocoileus hemionus*), moose (*Alces alces*) and

mountain goat (*Oreamnos americanus*). Unique to Glacier Bay is the Glacier Bay water shrew (*Sorex alaskanus*). There are eight marine mammals, including the harbour seal (*Phoca vitulina*), Steller sea lion (*Eumetopias jubata*), and humpback whale (*Megaptera novaeangliae*). Avifauna includes: peregrine falcon (*Falco peregrinis*) and spectacled eider (*Sometaria fischeri*) (NPS, 1999; WCMC, 1992).

Threats

Glacier Bay is threatened by changes in natural conditions from global warming and increasing visitor pressures. The Park was until recently threatened by potential of downstream impacts from a proposed mine in Canada.

A 1997 study on climate change by WWF revealed ‘alarming facts about impacts already occurring’ (WWF, 1997). It reported that some glaciers are projected to disappear within 30 years and rising sea level will have a major impact in low-lying refuges. Many national parks and wildlife refuges – which are visited by 250 million people each year in the USA – are already showing signs of global warming. Protected areas considered most vulnerable to climate change are those in mountainous and low-lying coastal areas such as Glacier Bay (WWF, 1997).

Tourism pressure from an increasing number of visitors and vessels in Glacier Bay has affected humpback whales in the area. Their numbers declined sharply in 1978 and have fluctuated at low levels since 1992. A mid-channel marine corridor in the Bay has been designated for motorised vessels between 1 June and 31 August to protect humpback whales from disturbance while feeding in the rich waters of the Park (NPS, 1999). North and South Marble Islands contain the largest seabird colonies in the Park and fall within wildlife protection zones. These sites, along with certain other islands are closed during nesting season, from 1 May to 1 September.

Commercial fishing has taken place in Glacier Bay and the surrounding area since the turn of the last century. Despite regulatory and statutory prohibitions since 1966, illegal commercial fishing has continued throughout the Park’s marine waters. Disputes over control of the Park’s marine waters, economic importance of the fishery, political power of the commercial fishing lobby and the lack of an equitable solution in the past has thwarted efforts to resolve the issue. However in 1998 after years of contentious debate, the US Congress passed legislation (to take effect in 1999 to phase out commercial fishing in the Park. The Glacier Bay provision responds to public input received by the National Park Service (NPS) that opposes commercial fishing in Park waters and advances the Park’s fundamental purpose of natural resource preservation. The legislation provides a ‘grandfather clause’ that responds to issues of equity and allows long-time fishers meeting historical participation criteria to be allowed to fish for the remainder of their lifetime (Tilmant and Soiseth, 1998).

Public and commercial interest, and economic development in the Tatshenshini-Alsek drainage basin has recently increased pressure on this wilderness area from outside. A recent potential threat was from the development of the proposed Windy-Craggy open-pit copper mine in British Columbia (BC) because of possible downstream impacts. Located 24km from the Park, the mine could have affected water quality in the Tatshenshini/Alsek River system, riparian ecosystems and fisheries, and migratory bird populations in Canada and the United States (NPS, 1998).

Windy Craggy was a giant polymetallic discovery in the far northwest of BC, probed and developed over years by Geddes Resources and then, on the verge of mine development, ‘taken out of the game’ when the Government of British Columbia created the huge Tatshenshini-Alsek Park. At the time the area was expropriated, it was estimated that it held CDN$1.5 billion in copper alone (Kelly, 1998). Although there is no longer a threat from mining impacts, there are ‘footprint’ concerns even before a mine gets established. At the Windy Craggy site independent research has confirmed that the pH levels

in streams draining from the entrance of the 'bulk sampling' tunnels, or 'adits', and the exploration waste rock piles are already dropping (WWF, 1998). The Government of British Columbia's report on the assessment of the Craggy mine (called the "CORE" report) states that there are likely to be "*substantial adverse impacts … on salmon, grizzly bears, sheep and goats. For salmon, events leading to severe impacts* [can be anticipated] *every twelve years*". The report goes on to say, "*The effect of a* [tailings] *dam breach would release toxic and acid-generating materials causing a widespread and permanent impact on fish and other aquatic life habitat*".

Windy Craggy Mountain is in the highest seismic hazard zone in Canada. The largest quake ever recorded in this country occurred only 75 miles away, causing mountain peaks to shoot up 50 feet and glaciers to advance a half-mile in five minutes. The area is now protected within the Tatshenshini-Alsek/Kluane/Wrangell-St Elias/Glacier Bay World Heritage Site.

Conclusions and Recommendations

Glacier Bay is part of one of the largest protected areas in the world, but confronted with a number of threats. However, the Park management's application and monitoring of innovative marine wildlife corridors is serving to protect humpback whales.

The successful end to commercial fishing within Park water and the utilisation of a grandfathering clause may serve as a legislative model for other protected areas. The next step for the National Park Service and State of Alaska is to jointly develop a fisheries management plan to manage co-operatively the outer waters of the Park where commercial fishing is set to continue.

Glacier Bay and the other spectacular protected areas that make up this World Heritage Site are safe for now but diligence and vigilance are required to protect this wilderness area.

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Part 5
Rethinking protection

Summary of Part 5

While most protected areas still continue to protect biodiversity, protection is all too often imperfect at present and uncertain in the future. This is hardly surprising. At present, protected areas cover almost 10 per cent of the world's land surface but are often managed on minimal resources. In this final section, we suggest some generic steps towards improving management and alleviating threats.

***Step 1: Don't automatically blame the manager**: many of the problems facing protected areas are beyond the capacity of individual protected area managers. Blaming managers for these wider failings simply leads to discouragement. A key step in addressing the threats outlined is to help build a culture of pride, professionalism and a sense of international community amongst managers.*

***Step 2: Make the arguments for protected areas**: one of the reasons why protected areas are neglected is because they are undervalued as luxury "wildlife areas" with little relevance for the bulk of the population. This is a misunderstanding of their role. Making the arguments for protected areas as wider social and environmental resources is therefore essential.*

***Step 3: Integrate people with protected areas**: human needs are inextricably tied up with the future of protected area management. If protected areas are to work in the long term, social issues have to be addressed as a central element of protected area management.*

***Step 4: Increase the capacity of protected area staff**: protected areas need well-trained and adequately funded staff with sufficient authority and stature to carry out their jobs.*

***Step 5: Implement protected areas**: many protected areas currently exist on paper only and have not been implemented on the ground. The need to convert "paper parks" into real parks is now an urgent priority in many parts of the world.*

***Step 6: Spread the word**: making the case for protected areas is not sufficient in itself; it is important to win over the mass of civil society – to create the same kind of pride in natural heritage as exists in most countries for cultural heritage.*

***Step 7: Strengthen legislation**: updating, strengthening and above all implementing protected area legislation is another extremely important element in the portfolio of responses needed to make protection work.*

***Step 8: Increase partnerships and help secure long-term funding**: greater thought about the permanence of projects is an essential factor in the long-term management of protected areas, including widening the scope of partners involved in the protected area.*

***Step 9: Monitor success and failure**: monitoring protected areas, both to help managers and to provide some measure of accountability, will be an increasingly important tool in management effectiveness in the future.*

***Step 10: Integrate protected areas into surrounding land**: last, but perhaps most important of all, protected areas will only work in the long term if they are integrated effectively into wider landscape, ecoregional or bioregional approaches to management*

Chapter 12
Rethinking protection

At the risk of repetition, our report has outlined several key concerns:

- Acute threats to some protected areas now – usually from a combination of pressures exacerbated by insufficient capacity amongst protected area managers.

- Lack of implementation and/or capacity, resulting in the possibility (and in many cases the probability) of future threats to protected areas currently only protected by their remoteness.

- Pervasive threats to virtually all protected areas as a result of various global changes, including increases in air pollution and the impacts of pollution-induced climate change.

- An all-too-common resentment towards and resistance to protected areas from local human communities, leading to the undermining of protected area values.

- Reduction in government support for protected areas when they need increased resources.

Protection in theory therefore does not automatically mean protection in practice. Establishing the legislation to gazette a protected area is often only one stage in a long and hard process of encouraging protection. In the case of landscape protected areas, where people are already long-established in the area and protected area status is in effect imposed on an existing community and lifestyle, real benefits may take a couple of generations to manifest. Furthermore, in many of the countries where the richest natural habitat remains, protected areas have become a burden – politically, socially, economically and in terms of law and order – that developing countries can ill afford. For many of these countries, management of protected areas is still not a top priority, though some of their problems may be due to lack of effective management of natural resources in general and protected areas in particular. Problems relating to protected areas are embedded within wider socio-economic problems.

There is also some good news. In the absence of firm data, we are in most cases reliant on the opinions of protected area managers or independent experts for an assessment of the extent to which protected areas are succeeding or failing. From the surveys that have been carried out to date, most of these experts believe that *most protected areas are working most of the time*. Not necessarily perfectly, but enough to maintain their basic values. The problems should not be used to suggest that protected areas don't work or to undermine the importance of protected area. The evidence suggests that they *do* work, but far from perfectly, and that if they are to continue to work they need substantial changes.

Evidence – admittedly often qualitative and fragmentary – also suggests that protected areas are gradually being accepted and integrated into the landscape in areas where they have been established. Changes in attitudes of local people have, at least in some cases, been matched by changes of attitude amongst government departments, protected area managers and the general public using protected areas. However, the examples accumulated in this report suggest that there is still a long way to go.

Most underlying causes of threats to protected areas – over-consumption, poverty, political corruption, break down of the rule of law – take place beyond the borders of the protected area. Waiting for these to be "solved" is likely to mean that many protected area values disappear in the interim. At present, protected areas cover almost 10 per cent of the world's land surface but are often managed on minimal resources – almost as if the act of creating a protected area should be enough in itself. This is not the case. In the final section, we suggest some generic steps towards improving management and alleviating threats to the protected areas. Where possible, we give examples to illustrate what we mean.

Ten generic steps for addressing protected area problems

Step 1: Don't automatically blame the manager: even a cursory examination of the examples quoted in this report show that many of the problems facing protected areas are beyond the capacity of individual protected area managers and even of protected area departments or individual ministries. Widespread problems, such as climate change, transboundary pollution, hydrological changes and a country's transport policy cannot be tackled on a site-by-site level. Other specific problems – like illegal logging or the bushmeat trade – are often simply too large to be tackled at source. All these require wider-scale responses at the level of government, industry and civil society. Blaming protected area managers for these wider society failings simply leads to discouragement, which is often compounded by other problems such as lack of staff and resources.

In many countries, managing a protected area is often a seriously under-resourced job that creates little incentive for staff to stay in post. In part this is because managers are often left to manage, with little back up, little status and little in the way of professional bodies, training courses, conferences or other activities that help to bind professional groups and classes. The resulting rapid changeover of staff is itself a problem in many situations; by the time local communities have got to know one manager a replacement is appointed. The first important step in addressing the threats outlined above is therefore to help build a culture of pride, professionalism and a sense of international community amongst protected area managers. Increased status will help managers do their job and encourage long-term commitment to projects. Links between managers in different areas or countries will help build expertise and spread lessons learned; in cases where protected area networks or migratory species are involved such links are vital. Experience in the small number of countries where many of these steps have been taken should be used to help build the "manager class" elsewhere.

***Example*: Pan Parks**

The Pan Parks project is a pioneer concept to safeguard and restore the natural heritage of Europe by creating a network of outstanding internationally recognised protected areas offering unique, high quality nature-based tourism. Sustainable tourism development meets the growing demand for nature-oriented tourism and provides parks and the communities surrounding them with new opportunities to create a sound and sustainable future, based on the conservation of their natural and cultural heritage.

It is hoped that Pan Parks will become widely known by Europeans as the natural capitals of the continent, and a source of pride to the population. The Pan Parks concept is based on partnership between all actors involved for the benefit of European nature. Pan Parks is looking for co-operation and synergy with other projects and with other organisations sharing common goals referring to nature conservation and restoration issues, sustainable development, and environmental issues.

Pan Parks gives economical, but also effective value to nature. It provides a nature conservation based response to the growing market of nature-oriented tourism by creating a quality brand, which stands for:

- An expending network of well-managed protected areas with high conservation value;
- Sustainable tourism development of protected areas, regions and local communities surrounding protected areas by putting economic value in conservation of nature;
- Responsible high quality nature-based experiences of visitors and tourists;
- Creation of public awareness, support and affection for European natural heritage;
- Generating political and financial support at all levels for nature conservation[1].

Step 2: Make the arguments for protected areas: one of the reasons why protected areas are neglected is because they are undervalued as luxury "wildlife areas" with little relevance for the bulk of the population. As discussed in the introduction, many protected areas actually have far wider benefits – in terms of watershed protection and provision of drinking water, fisheries, flood control and climate stabilisation, for their role in tourism and because they help provide a buffer against extreme climatic events. The freshwater crisis that is now affecting many countries, and the clear and proven links between forests and freshwaters, is one example of how protected areas can be made to link clearly and directly with everyday lives, in this case through protecting watersheds. Full cost accounting can play an important role here, by providing the kind of data that managers and others can use to make the case for protected areas. However, simpler and more descriptive approaches are also important in terms of putting across ideas and objectives. NGOs and civil society can play a role here, by supporting protected areas, providing educational material and if necessary opposing steps that undermine the integrity of existing protected areas. Direct, daily benefits to people, through protecting natural assets and improving the quality of life, are more important for most people than, say, tourist benefits that are still mainly the preoccupation of a privileged minority.

Step 3: Integrate people with protected areas: most protected areas contain people; human needs are inextricably and inevitably tied up with the future of protected area management. If protected areas are to work in the long term, social issues have to be not only addressed as an adjunct to a management plan but as a central part of protected areas. On a day-to-day basis, the challenge for those interested in protected areas is how to make local people part of the solution rather than part of the problem. Management itself must be broadened to reflect the needs of a democratic and pluralistic society.

The type of protected area and the situation of the people living inside it will both influence the ways in which this could happen. Developing human involvement in protected areas means creating pride and excitement about living in an area that is of environmental importance. It means encouraging the same kind of pride in environmental stewardship as exists, for example, in the stewardship of good farmland or in living in a historically important or beautiful built environment. That these feelings exist is well recognised. That they have as yet often failed to be reflected within people living in protected areas is perhaps a sign of failure to communicate an important message. (In fact, people often do appreciate the importance of their homeland if the issue is tackled with anything like sensitivity: pride in home is a very basic human emotion and can often be evoked for environmental reasons.)

For the majority of people in the world –with little money or prospects – the pride must also be accompanied by provision of some essential material resources. The long-term survival of biodiversity and ecology depends upon sustainable management – both inside and outside protected areas.

***Example*: Participatory management planning for Keoladeo National Park, India**

Keoladeo is a Ramsar Site, World Heritage Site and a National Park and is the only walled protected area in India. In 1996, WWF India ran a three-week Participatory Resource Appraisal (PRA) exercise with six villages surrounding the protected area. The exercise identified points of common concern and points of conflict and identified priorities for villagers, park authorities and the government. Local people generally like the park but actively resist many of its regulations including running old and useless cattle into the park to break the grazing ban. A number of recommendations emerged, including an extension of the fodder collection period and the experimental re-introduction of domestic buffalo into the wetlands. It was suggested that park revenue be increased through visitor fees and taxes on commercial businesses in the park and that a jointly managed Keoladeo National Park Trust Fund be set up for welfare schemes. Some joint management agreements were suggested and it was agreed that the park should help in developing key local institutions[2].

Step 4: Increase the capacity of protected area staff: the problems of protected areas will unfortunately not disappear in a haze of good feeling after a couple of conflict workshops and some changes in management style. Many protected areas (and the people that they contain) are acutely threatened by outside forces that are allowed access through inadequate legislation or a breakdown in the rule of law. Protected areas need adequate management, proper protection, and well-trained and adequately funded staff with sufficient authority and stature to carry out their jobs. Elements include:

- A proper management plan, worked out by and with the local community and with milestones, targets, budgets and a long-term vision for the protected area.
- Sufficient staff, with secure jobs that have stature within the community and adequate resources to carry out their work.
- Proper training facilities for staff at all levels, encompassing management, ecology, sociology, people skills, and implementation of the management plan.
- Adequate capacity in terms of transport, infrastructure, equipment, logistical back up and information.
- A proper legislative framework and support from national and local government.
- An adequate mix of skills amongst protected area staff, including management, biological, social and economic skills.
- Local education programmes to engage regularly with the community, exchange information and keep up with changes in the area.

***Example*: Courses for protected area managers**

Opportunities for study and for recognised qualifications are gradually increasing. The International Centre for Protected Landscapes (ICPL), for example, is an independent organisation that provides advice, training and consultancy services to governments and non-government agencies world-wide. Based at the University of Wales, Aberystwyth and linked to the Institute of Geography and Earth Sciences, it also has an expanding postgraduate taught course and research programme. Students have the opportunity to take part in either a residential course or one that involves distance learning.

Step 5: Implement protected areas: many protected areas currently exist on paper only and have not been implemented on the ground. These are amongst the most fragile of all protected areas – protected only by the power of government pronouncement, which counts for little in many situations (and little even amongst some sectors of some governments). Whilst we should never under-estimate or denigrate the hard work and dedication that has often gone into the declaration of a protected area, the need to convert paper parks into real parks is now an urgent priority in many parts of the world. Such implementation should now be a priority for both governments and for international funding agencies. Simply establishing and marking out protected area boundaries is often an important first step. The development of management plans; local legislation; staffing; and the long and complex process of liaison with local communities must also follow. The new target of the World Bank-WWF Alliance, of improving management of 50 million hectares of forest protected areas by the year 2005 is a the kind of model that could be more widely adopted by agencies that have the ability to provide this kind of assistance.

Step 6: Spread the word: making the case for protected areas is not sufficient in itself; it is important to make it loudly and clearly enough to win over the mass of civil society. Fortunately, protected areas have a head start; surveys show that most people do accept the need for and importance of protected areas (although the support sometimes dwindles in the vicinity of protected areas themselves).

It has been suggested that the only way to attract long-term support for protected areas is to create the same kind of pride in natural heritage as exists in most countries for cultural heritage. Key protected areas should in this case occupy the same place in the national psyche as, say, the Taj Mahal, Chartres Cathedral or the Sydney Opera House. This exists to some extent in a few protected areas – such as Yellowstone Park in the USA, Ayers Rock in Australia or the Lake District in England – but in many countries few of the population would be able to name a single significant protected area. The creation of such natural pride takes time and commitment amongst managers, NGOs and others, but is an essential step in developing a solid block of support for protected areas.

***Example*: Protected areas on the web**

An increasing number of the world's protected areas are now running their own web sites, to encourage visitors, provide up-to-date information and even to raise funds. Sites run by Parks Canada, for example, offer information on a range of visitor issues such as location, access, maps, on-line guided tours, pictures, details of wildlife, hazard warnings, fees, camping, things to buy and other attractions in the neighbourhood.

Step 7: Strengthen legislation: it seems a truism to say that protected areas need protection, but in many countries the legislation needed to make protected areas a reality remains incomplete. Updating, strengthening and above all implementing legislation to enact protection, and to make protection stick, is therefore another extremely important element in the portfolio of responses needed to make protection work. This includes, in particular, proper legal and institutional arrangements for sharing the resources and the management of protected areas.

Getting the right level of legislation is important. A World Bank Study showed that communities perceived national laws that have been adopted locally as more acceptable than either indigenous ('bottom up" laws) or national legislation ("top-down" laws)[3]. On the other hand, some kind of overarching national legislation is sometimes needed to provide the necessary legislative "muscle" to ensure that local power groups do not dominate regional legislation to the detriment of both the environment and the socially disadvantaged.

Step 8: Increase partnerships and help secure long-term funding: most protected areas need further development, but most development projects are short term. When the project finishes and staff leave, things can quickly slip back to where they were before. Developing country protected areas are often littered with abandoned visitor centres, decaying accommodation and visitor footpaths disappearing beneath tropical foliage. Each of these ecological ghost towns represents years of effort and considerable sums of money. Development without long-term funding is often little better than no development at all; in fact it can be worse in that it creates hopes and expectations that are not realised. Securing long term funding is easier to say than to achieve; in the reality of international budgets and priorities most projects start with temporary funds and try to secure more in the future. But greater thought about the permanence of projects and more consideration about how this could be achieved are increasingly important factors in the long-term management of protected areas. One important way of stabilising funding and support is to widen the scope of partners involved in the protected area. Building links with local government, with local or national industries and with other potential donors is also a keystone to success.

Step 9: Monitor success and failure: many problems arise or are allowed to continue because few people know that they exist. We have summarised work on monitoring protected areas, both to help managers and to provide some measure of accountability. On the level of individual protected areas, such steps will involve the setting of targets and of milestones, while at a national level they may involve some regular form of assessment or even scoring. Countries such as Australia, which have put great store on monitoring, argue that good information helps both politically and practically. Arguing for resources for monitoring in places where capacity and money is already tight might seem a luxury. But in the long term knowing what is happening is an essential step in making a protected area network function efficiently.

Box: The need to assess management effectiveness[4]

It is clearly becoming important to measure the effectiveness of protected areas and protected area systems. Performance accountability is increasingly being demanded across all sectors of society, and conservation management is no exception. Traditionally, concerns focused on issues of financial and managerial probity but this has now expanded to include concerns for management effectiveness. At present, the IUCN Categories are assigned according to the management *objectives*, but conservation organisations and other stakeholders are equally concerned with the *effectiveness* of this management – a protected area that doesn't work is of little use. The need for some systematic approach to evaluating the effectiveness of protected area management has long been recognised; with those wishing to have information on effectiveness ranging from senior management, government and funding agencies through to NGOs, local communities and the wider community.

But, devising such a system is not as easy as it appears at first sight. Although gross damage to protected areas is usually fairly obvious, by the time such problems are noticed it is often too late to do much about it. Identification of paper parks, for example, may be relatively easy, but not all paper parks are under immediate threat and not all threatened protected areas are paper parks. Identifying the most threatened areas – and importantly also the areas in which further funding or management intervention could make a real difference – is therefore quite a complex procedure.

There is growing interest in finding ways to measure the *effectiveness of management* in protected areas. Such information could be used in a number of ways:

- To identify the *gaps* in a protected area network
- To identifying protected areas at *risk*
- To help *prioritise* conservation effort and funding
- To facilitate *advocacy* to improve management
- As a means of putting *pressure* on institutions that are degrading protected areas
- To help protected area managers to learn from their own and others' past successes and mistakes
- To monitor performance in achieving conservation targets

Assessment systems must be democratic and fully participatory at a local level. It could work with an existing institution or through its own dedicated organisation. Assessment is needed at varying levels, including:

- Projects with protected areas
- Individual protected areas
- National protected area systems
- International protected area systems
- Local, national and international institutions responsible for protected areas

Continued

Such systems should include analysis of, at least: institutional capacity; biological effectiveness; social effectiveness (benefits obtained or social systems involved); financial sustainability; and legal status. Assessment should be sensitive to issues of national sovereignty and the rights of local and indigenous peoples, and should have the support *and involvement* of local and indigenous peoples and local protected area officials. Local knowledge and perceptions should be incorporated into the assessment systems. Assessments will, in the long term, only be effective if they are accepted by and welcomed by the organisations and individuals involved.

An initial framework for assessing management effectiveness of protected areas has been developed by the World Commission on Protected Areas[5]. A number of different *methodological* options are also available and a draft set of principles and criteria for assessment have been devised[6].

Quick survey methods, relying mainly on published information, GIS systems etc, can be used to assess whether biodiversity needs are being met and protected areas are really being protected. Such schemes may be useful to international and national organisations, to give an approximate picture of national or regional progress. Rapid ground survey methods could allow protected area managers, governments, funding agencies, aid organisations and local NGOs to carry out an assessment of protected areas from ecological, social and economic perspectives. In-depth, participatory methods could provide a detailed assessment of the environmental and social aspects of a protected area, for use in management planning, targeting aid projects and assessing progress.

There is also a range of *institutional* frameworks to choose from. One option would be to measure the effectiveness of management in protected areas systems through some kind of national evaluation framework. An alternative or additional system could be some international system. These issues will be thoroughly explored over the next few years.

Step 10: Integrate protected areas into surrounding land: last, but perhaps most important of all, protected areas will only work in the long term if they are integrated effectively into wider landscape, ecoregional or bioregional approaches to management. A lot of what has come before in this section is, one way or another, arguing that protected areas need to be properly respected for what they can provide in both material and more intangible ways. A corollary of this is that protected areas should also be better integrated into these wider landscapes than is often the case at present, not as a more-or-less tolerated exclusion zones but as a necessary and respected breathing space to facilitate other functions.

An important element of such an approach is simply better design and management of protected areas, particularly as they relate to other parts of the protected area networks through corridors, stepping stone and buffer zones. Just as important is the relationship of the protected area with other land uses, particularly those requiring the environmental services provided by the protected area.

References to Part 5

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