Paper presented at IUCN World Commission on Protected Areas Symposium on
"Protected Areas in the 21st Century: From Islands to Networks"
Albany, Australia, 24-29th November 1997

STATE OF THE WORLD'S PROTECTED AREAS AT THE END OF THE TWENTIETH CENTURY

Michael J.B. Green and James Paine
World Conservation Monitoring Centre, Cambridge, UK

1. INTRODUCTION

Protected areas are widely held to be among the most effective means of conserving biological diversity *in situ* (McNeely and Miller, 1984; MacKinnon *et al.*, 1986; Leader-Williams *et al.*, 1990). A considerable amount of resources has been invested in their establishment over the last century or more, with the result that most countries have established or, at least, planned national systems of protected areas. The purpose of this paper is to examine the extent of the world's protected areas globally and regionally and to consider other options for its further strengthening and development during the twenty-first century.

1.1 What is a protected area?

A protected area is defined by the IUCN World Commission on Protected Areas (IUCN, 1994) 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.*

In practice, protected areas are managed for a wide variety of purposes which may include:

- scientific research,
- wilderness protection,
- preservation of species and ecosystems,
- maintenance of environmental services,
- protection of specific natural and cultural features,
- tourism and recreation,
- education,
- sustainable use of resources from natural ecosystems, and
- maintenance of cultural and traditional attributes.

The IUCN definition is rather more precise with respect to what is protected than that used in the Convention on Biological Diversity:

> *A geographically defined area which is designated or regulated and managed to achieve specific conservation objectives.*

Box 1 Definitions of the IUCN protected area management categories

CATEGORY I **Strict Nature Reserve / Wilderness Area: protected area managed mainly for science or wilderness protection**

CATEGORY Ia **Strict Nature Reserve: protected area managed mainly for science**

Definition: 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.

CATEGORY Ib **Wilderness Area: protected area managed mainly for wilderness protection**

Definition: Large area of unmodified or slightly modified land, and/or sea, retaining its natural character and influence, without permanent or significant habitation, which is protected and managed so as to preserve its natural condition.

CATEGORY II **National Park: protected area managed mainly for ecosystem protection and recreation**

Definition: 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.

CATEGORY III **Natural Monument: protected area managed mainly for conservation of specific natural features**

Definition: Area containing one, or more, specific natural or natural/cultural feature which is of outstanding or unique value because of its inherent rarity, representative or aesthetic qualities or cultural significance.

CATEGORY IV **Habitat/Species Management Area: protected area managed mainly for conservation through management intervention**

Definition: Area of land and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species.

CATEGORY V **Protected Landscape/Seascape: protected area managed mainly for landscape/seascape conservation and recreation**

Definition: Area of land, with coast and 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.

CATEGORY VI **Managed Resource Protected Area: protected area managed mainly for the sustainable use of natural ecosystems**

Definition: Area containing predominantly unmodified natural systems, managed to ensure long term protection and maintenance of biological diversity, while providing at the same time a sustainable flow of natural products and services to meet community needs.

(Source: IUCN, 1994)

1.2 How are the different types of protected area classified?

Over 1,388 different terms are known to be used around the world to designate protected areas, each of which is defined within respective national legislation with respect to its objectives and legal protection. There may be only marginal differences between countries for essentially the same type of protected area. For example, there are *managed nature reserves* in the Bahamas, *strict nature reserves* in Bhutan, *nature reserves* in Ontario, Canada, *national nature reserves* in Czech, *nature reserves* and *marine nature reserves* in Indonesia, *nature conservation areas* in Japan and *strict natural reserves* in Sri Lanka, all of which are strictly protected and accessible primarily for scientific research. Conversely, the same term may imply very different characteristics and management objectives in different countries. The classic example is the widely-used term *national park*, the world's first being Yellowstone National Park, established in 1872 as a "public park or pleasuring ground for the benefit and enjoyment of the people." While national parks in many parts of the world (Americas, Africa, South and South-East Asia, Australia and New Zealand) tend to be large, natural areas, some national parks in Europe are distinctive landscapes that have evolved over many hundreds of years as a result of traditional interactions between people and nature. Examples of the latter include all 11 national parks in England and Wales, most national parks in Germany, Cevennes National Park in France and Danube - Drava National Park in Hungary.

In order to address such differences in terminology, IUCN has developed a system of classifying protected areas based on management objectives (IUCN, 1994). Six categories are recognized and defined (Box 1). The relationship between the management objectives listed in Section 1.1 and these six categories is shown in Table 1. Clearly, one or more management objectives may be encompassed to a greater or lesser extent within a particular category. The categories imply a gradation of human intervention, ranging from effectively none in Category Ia/Ib to relatively high levels in Category V. As Category VI was only added to the classification system in the 1994 revision, it does not fit neatly into this general pattern but lies conceptually between Categories III and IV (Figure 1). It should be emphasised, however, that all categories are equally important and relevant to the conservation of biological diversity.

Table 1 Matrix of protected area management objectives and IUCN categories (after IUCN, 1994)

Management objective	**Ia**	**Ib**	**II**	**III**	**IV**	**V**	**VI**
Scientific research	1	3	2	2		2	3
Wilderness protection	2	1	2	3	3	-	2
Species/genetic diversity	1	2	1	1	1	2	1
Environmental services	2	1	1	-	1	2	1
Natural/cultural features	-	-	2	1	3	1	3
Tourism & recreation	-	2	1	1	3	1	3
Education	-	-	2	2	2	2	3
Sustainable use	-	3	3	-	2	2	1
Cultural attributes	-	-	-	-	-	1	2

Key: 1 primary objective, 2 secondary objective, 3 potentially not applicable, - not applicable

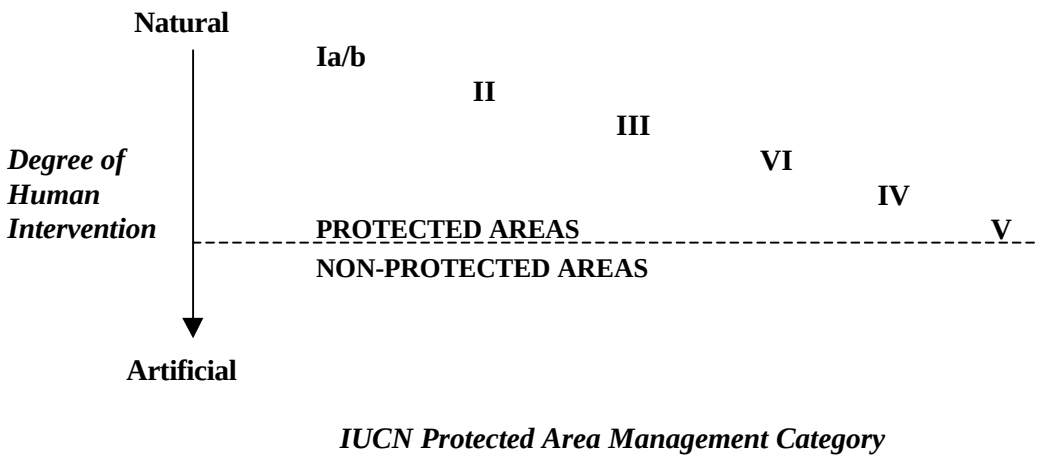


Figure 1 Idealised representation between IUCN protected area management category and the degree of human intervention

Thus, the IUCN management categories system provides a common international standard for classifying the many different types of protected area designated in countries around the world, based on primary management objective. This facilitates accounting and monitoring at national, regional and international levels. Assignment of a protected area to a category, however, is NOT a comment on the effectiveness with which it is managed. Management effectiveness is a separate issue which is discussed in Section 5.

In practice, the IUCN management categories are applied generically at the designation level rather than specifically for individual sites, given that legal provisions tend to apply to the designation. In general, therefore, all protected areas having the same national designation are likely to be assigned the same category. However, it is sometimes necessary to assign categories on a site-by-site basis. In Austria, for example, national parks are established under individual legal instruments rather than a general enabling act which provides for all national parks. Also, in the case of national parks which are managed according to the primary purpose identified for Category II status, some may be too small to protect entire ecosystems, or less than 75% of the total area may be *natural*. In such cases, another of the management categories is likely to be more applicable. In Germany, for example, a few national parks qualify as Category II, but the majority are predominantly man-modified landscapes which are more appropriately classified as Category V. Also, management policies may differ between sites of the same designation. India's national parks, for example, are all classified as Category II with the exception of Nanda Devi and Sundarbans national parks, both of which are closed to visitors. These two sites are more appropriately assigned to Category Ia.

1.3 How are data on the world's protected areas managed?

Historically, the collation of data on the world's protected areas was initiated by the IUCN Commission on National Parks and Protected Areas (CNPPA)[1], partly in response to two resolutions of the United Nations which recognised the importance of protected areas in the wise use of natural resources and led to the compilation of the first *World List of National Parks and Equivalents Reserves* in 1961/1962. In 1981 the former CNPPA established the Protected Areas Data Unit to manage the ever increasing amount of data on protected areas. This unit subsequently became part of the World Conservation Monitoring Centre, which maintains a database and Geographic Information System on the world's protected areas.

[1] CNPPA was founded in 1958 as the provisional Commission on National Parks, established as the Commission on National Parks and Protected Areas in 1960 and renamed the World Commission on Protected Areas in 1996.

The WCMC Protected Areas Database currently holds some 30,350 records of protected areas, as well as 13,915 records of other designated areas which do not qualify as protected areas according to the IUCN definition, and a further 16,288 records of areas of uncertain status. Data on protected areas are gathered directly from protected area management agencies at federal (national) or state (subnational) level, as appropriate. They are validated, by comparing with existing records and other information held by WCMC, and entered into the database as appropriate. WCPA is involved as necessary in the validation process, particularly with respect to the allocation of IUCN management categories to protected area designations for which it is ultimately responsible.

The entire database is regularly updated, approximately every three years to facilitate production of new editions of the *United Nations List of Protected Areas* in synchrony with each IUCN General Assembly (renamed in 1996 as the World Conservation Congress). However, sections of the database may be updated at other times, depending on regional or thematic priorities and the availability of funds. For example, Latin America and the Caribbean was updated in 1996 as part of a World Bank-funded project on critical natural habitats (Ledec *et al.*, in press). Europe was also updated in 1996, under the auspices of a collaborative initiative with European partners (see below), to provide input to the 1998 Dobris +3 report; the marine section was updated over several years as part of a World Bank-funded review of marine protected areas (Kelleher *et al.*, 1995); and forest protected areas are now due to be updated in conjunction with WWF's Forest Campaign and the FAO Forest Resources Assessment 2000.

In the case of European countries, a different mechanism is now used to collect protected areas data. A collaborative partnership was formed in 1996 between the Council of Europe, the European Environment Agency (EEA) and WCMC whereby the three organisations agreed to integrate their existing protected areas databases into a single *Common Database of Designated Areas in Europe*. This is currently maintained at WCMC, forming part of its global Protected Areas Database, and kept up to date using data provided by the EEA Member State National Reference Centres, via their respective National Focal Points. The EEA Topic Centre for Nature Conservation is involved directly in the data validation and updating process.

The WCMC Protected Areas Database holds the following kinds of information:

- text describing the protected areas system of each country, together with definitions of protected area designations based on the national legislation;
- budget and staffing levels of some protected area agencies;
- records of individual protected areas (and other designated areas); and
- text describing some individual protected areas (information sheets).

The analyses presented in this paper are based solely on the records of individual protected areas, which include the following data:

- name;
- legal designation;
- size; and
- year of establishment.

The WCMC Protected Areas Database is linked to the WCMC Biodiversity Map Library, a Geographic Information System (GIS) which includes a spatial layer for protected areas based on their digitised boundaries. This layer is incomplete due to the lack of available maps of national protected area systems, showing the boundaries of individual protected areas. In such cases, it is possible to map the approximate location of protected areas if geographical co-ordinates are known.

1.4 United Nations List of Protected Areas

The *United Nations List of Protected Areas* provides a single definitive list of the world's protected areas, classified according to IUCN's system of management categories. Many countries attach considerable political importance to the *UN List*. Thus, it is in the interests of the respective management agencies to ensure that their protected areas are listed. In order to be listed, a site must meet IUCN's definition of a protected area (Section 1.1). For practical reasons alone, only those protected areas larger than 1,000 ha are actually listed, as well as offshore or oceanic islands of at least 100 ha where the entire island is protected.

1.5 Data used in this analysis

The dataset used for this paper is the same as that used for *1997 United Nations List of Protected Areas* (IUCN, 1998); it includes protected areas known to have been established up to the end of 1996[2]. The only difference is that, whereas the analysis of protected areas for the 1997 *UN List* is restricted to listed sites, the present analysis includes all protected areas irrespective of their size. Nationally designated areas which do not qualify as protected areas *sensu* IUCN are excluded from the dataset.

Constraints

The dataset used in this analysis is subject to the following limitations:

- Inevitably the dataset is not entirely complete. Of the 512 management agencies contacted, only 180 responded despite reminders being sent to non-respondents.
- The size is unknown for 2,942 protected areas, which means that the extent of regional and global protected areas networks are somewhat under-represented.
- The date of establishment is unknown for 6,446 protected areas, which means that the analysis of the growth of protected areas shown in Figure 2 is not completely accurate.
- The new IUCN management categories have been applied for the first time. It is likely, therefore, that not all protected areas have been allocated to the most appropriate category. This is particularly true for national parks in European countries, for which additional time and resources are needed to review many of them on a site-by-site basis.
- The geographical co-ordinates or, more importantly, the boundaries of over 20,000 protected areas are unknown, limiting the extent to which terrestrial and marine protected areas can be treated separately or compared, and constraining analyses of the representativeness of protected areas.

It should also be recognised that the dataset does not include privately owned or managed protected areas which, in some countries, are very extensive as discussed further in Section 5. Many, though not necessarily all, of these sites are likely to qualify as protected areas *sensu* IUCN, but a major task lies ahead in collating information about them.

[2] In particular, it should be noted that no account has been taken of the ratification of the Environmental Protection Protocol to the Antarctic Treaty in December 1997, whereby the entire continent and its dependent marine ecosystems have been designated as a natural reserve to safeguard their status as a global wilderness area and scientific laboratory.

2. GLOBAL PROTECTED AREAS NETWORK

2.1 Growth in number and extent

The world's network of 30,350 protected areas extends over a total area of 13,232,275 km², which represents 8.83% of total land area. However, this percentage needs to be treated judiciously because it is inflated perhaps one percentage point or more by the large number of marine protected areas or protected areas having a marine component. This is considered further in Section 2.3. The network is extensive from a global perspective but there are many gaps at the national level as discussed in Section 3.1.

The number and extent of the global network of protected areas have grown steadily throughout the latter part of this century, as shown in Figure 2 for each five-year period between 1900 and 1994. The number of protected areas established has declined somewhat in the most recent five-year period for which data are complete (1990-1994), as compared to the previous decade. However, there is little or no evidence of any decline in the rate of growth in the extent of this network during the most recent five-year period, contradicting a widely held view that opportunities to expand the network are diminishing. This indicates that there are continuing efforts by governments to establish new protected areas. Moreover, the discrepancy between the slight decline in number of new protected areas and the continued growth in the extent of the network suggests that increasing emphasis is being placed on establishing larger protected areas.

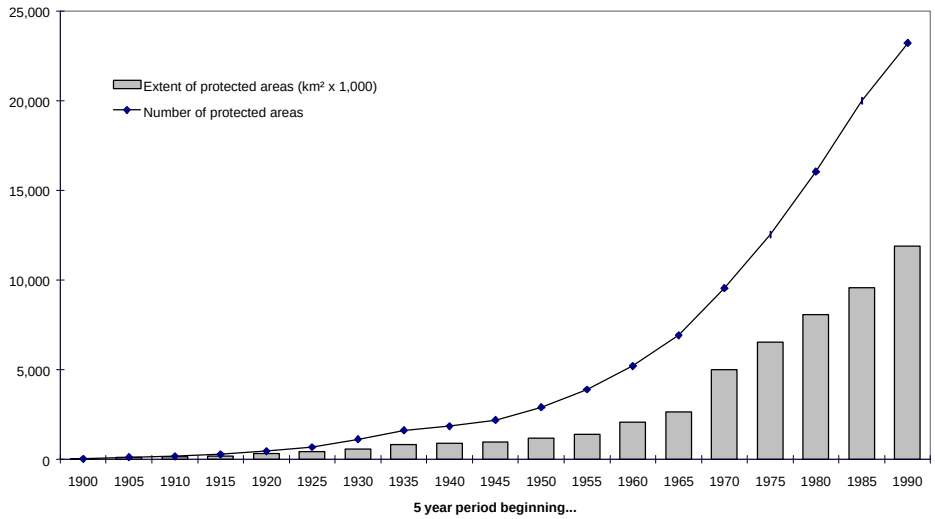


Figure 2 Cumulative growth in the number and extent of protected areas (1900-1994)

2.2 Size

Conservation biology theory advocates that protected areas should be as large as possible in order to:

- maximise the degree to which their contents retain their integrity;
- minimise risks of species' extinctions; and
- maximise representation of ecological communities and their constituent species (Soule, 1983; Wilcox, 1984).

Given that protected areas are often islands of natural or near-natural habitat in a sea of humanity, the larger they are, the better they are buffered from outside pressures.

As shown in Figure 3, 17,892 (59%) protected areas are less than 1,000 ha in size and they account for a total area of 28,713 km², which is only 0.2% of the global protected areas network. Just 1,673 (6%) protected areas exceed 1,000 km², but they comprise 11.56 million km² or 87% of the global network. The six largest protected areas, which exceed 100,000 km², are Greenland National Park, Greenland (972,000 km²), Ar-Rub'al-khali Wildlife Management Area, Saudi Arabia (640,000 km²), Great Barrier Reef Marine Park, Australia (344,800 km²), Qiang Tang Nature Reserve, China (247,120 km²), Cape Churchill Wildlife Management Area, Canada (137,072 km²), and Northern Wildlife Management Zone, Saudi Arabia (100,875 km²).

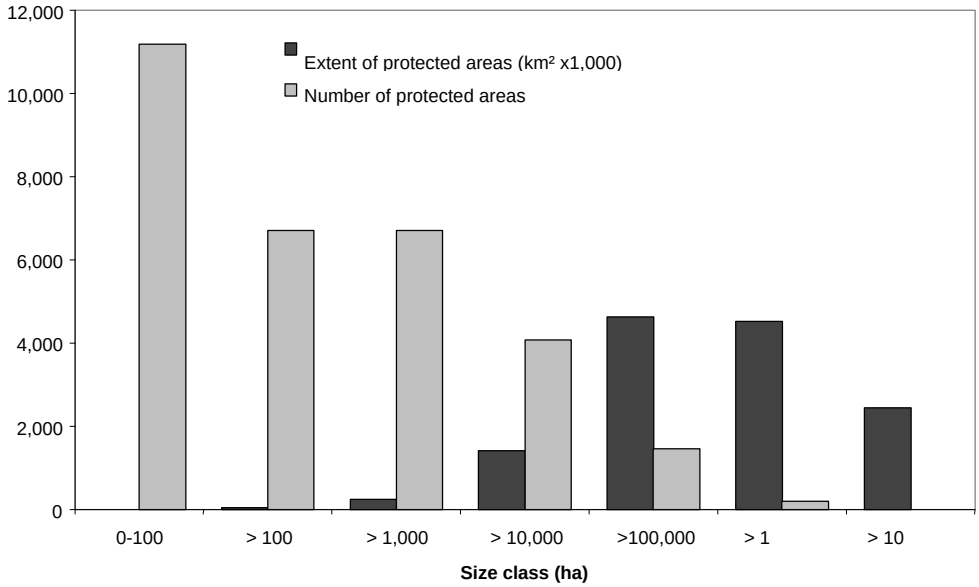


Figure 3 Frequency distribution of protected area sizes

In practice, many protected areas are effectively much larger because they lie adjacent to other protected areas. It is possible to assess the effective size of such protected area complexes using GIS techniques. The results of an analysis of 8,055 protected areas whose boundaries have been digitised are presented in Table 2. They show that the mean size of adjacent protected areas is effectively increased almost threefold, from 3,765 ha to 9,368 ha, through their juxta position. Many of these protected area complexes lie across international borders, highlighting the important role of transfrontier cooperation in increasing the effective size of conservation areas (Table 2).

Table 2 Mean size of protected areas, protected area complexes and transfrontier protected areas complexes having digitised boundaries

Physical relationship	Number	Mean size (ha)
Individual protected areas	8,055	893
Individual protected areas within complexes of adjacent protected areas	856	3,765
Complexes of adjacent protected areas	344	9,368
Transfrontier protected areas complexes[1]	136	8,294

[1] Source: Zbicz and Green (in press)

2.3 Marine and terrestrial protected areas

As indicated in Section 2.1, it is not yet possible to quantify precisely the marine and terrestrial components of the global network of protected areas as digital boundary data are not available for all sites. Of the 30,350 records in the protected areas dataset, 28,776 have been marked with respect to their marine *versus* terrestrial status. Of these, 2,149 are sites known to have at least some marine element, such as open sea, kelpbeds or coral formations, and they cover 2,552,609 km². This includes 824 records classified as islands (where the entire island is protected), of which 583 are not additionally marked as marine.

The two largest *marine* protected areas are Greenland National Park (972,000 km²), which is largely terrestrial, and Great Barrier Reef Marine Park (344,800 km²) which is predominantly marine in character. With the inclusion of Great Barrier Reef Marine Park as marine and exclusion of Greenland National Park, the total area of marine protected areas is 1,580,609 km² and that of terrestrial protected areas is 11,651,666 km², the latter representing 7.78% of the world's total land area.

GIS analysis of 8,055 protected areas whose boundaries have been digitised shows the marine and terrestrial components to total 552,238 km² and 6,642,121 km², respectively. Thus, based on available spatial data, twelve times more land than sea is protected.

Growth in marine protected areas, shown in Figure 4, is similar to that for the global protected areas network (Figure 2), with a steady rise in the number of marine protected areas from 1970 onwards. The marked increase in the total area protected in 1970-1974 can be attributed to the establishment of Greenland National Park during that period. Despite the increasing attention being given to expanding the marine protected areas network, there has been a decline in the number of marine protected areas established in the most recent period (1990-1994). However, the total area of the marine protected areas network has continued to expand, suggesting a trend of establishing fewer but larger new sites.

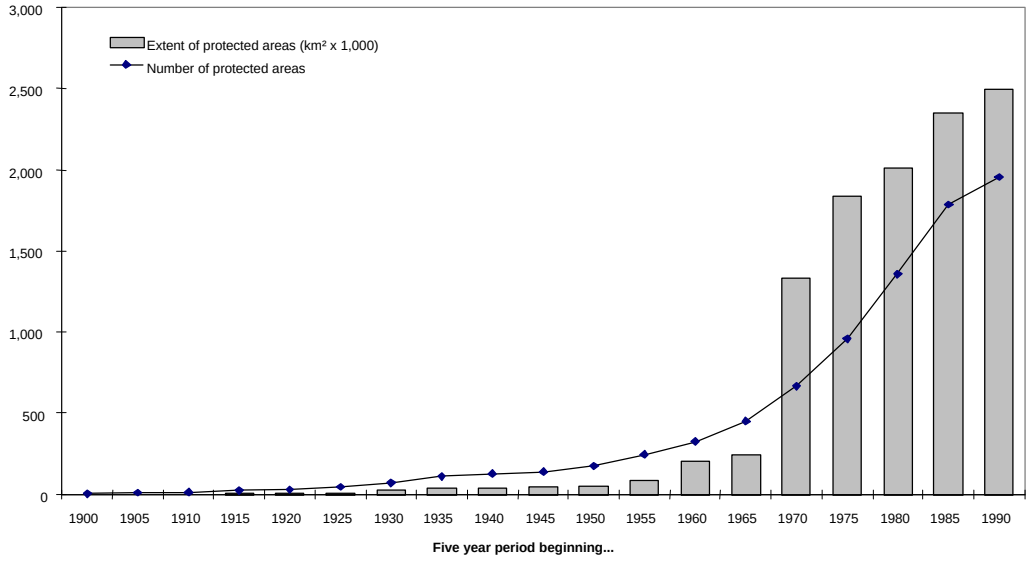


Figure 4 Cumulative growth in the number and extent of marine protected areas (1900-1994)

2.4 Categories of management

The distribution of protected areas with respect to management objectives, based on IUCN management categories, is summarised in Table 3. In general, it is evident that the wide spectrum of services provided by protected areas are fairly well represented within the global network. The exception is Category III which is least widely applied, a reflection of its more limited role in conserving specific natural features.

Most numerous is Category IV, comprising over one-third of protected areas, indicating the importance of active management intervention in maintaining biodiversity. These tend to be among the smaller sites, established for habitat and species conservation. Category V is the next most frequent category: despite their important role in protecting landscapes, especially in Europe and North America where the majority have been established, they are also among the smaller sites.

Most extensive in terms of total area are Categories II and VI, reflecting their respective roles in protecting and providing for sustainable use of natural ecosystems. Fewer in number, in total area they account for 57% of the global network of protected areas due their often much larger size. Indeed, the mean size of Category II and VI protected areas is an order of magnitude greater than all other categories except Category Ib.

Strictly protected areas within Category Ia are fairly numerous, although such sites tend to be small. Some represent core areas within larger complexes of protected areas, but many are key, often isolated, refugial areas of biodiversity. Protected wildernesses (Category Ib) are least numerous but, by definition, they are extensive and contribute significantly to the total area of the global network.

Table 3 Global protected areas network classified by IUCN management category

IUCN management category	Protected areas					
	Number	(%)	Extent (km^2)	(%)	Mean size (km^2)	% total land area
Ia	4,389	(14%)	978,698	(7%)	223	0.65
Ib	809	(3%)	940,360	(7%)	1,162	0.63
II	3,384	(11%)	4,001,605	(30%)	1,183	2.67
III	2,122	(7%)	193,021	(1%)	91	0.13
IV	11,171	(37%)	2,459,703	(19%)	220	1.64
V	5,578	(18%)	1,057,448	(8%)	190	0.71
VI	2,897	(10%)	3,601,440	(27%)	1,243	2.40
TOTAL	**30,350**	**(100%)**	**13,232,275**	**(99%)**	**436**	**8.83**

2.5 Representation of biomes

The extent to which the global protected areas network is representative of the world's major biomes is summarised in Table 4, based on Udvardy's biogeographical classification. However, it should be noted that this analysis under-represents the protection of biomes by about 30% because only 16,636 (55%) of the 30,350 protected areas have been classified. Their total area is nearly 9.5 million km^2, which represents just over 70% of the global protected areas network.

Most biomes remain under-represented within the protected areas network, based on the 10% target established for the protection of biomes at the IV World Parks Congress (IUCN, 1993). Despite the constraints with the data, mentioned above, it is fairly certain that evergreen sclerophyllous, temperate and needle-leaf forests are far short of the 10% target, together with deserts. Least well represented are temperate grasslands and lake systems, with only 1% of these biomes protected. By contrast, good progress has been made in protecting tropical and subtropical forests, tundra, mixed mountains systems and most of all mixed island systems.

Table 4 Extent of protection of the world's major biomes

Biome (Udvardy, 1975)		**Protected areas**		**% biome protected**
Name	**Area (km^2)**	**Number**	**Extent (km^2)**	
1. Tropical humid forests	10,513,210	1,030	922,453	8.77%
2. Subtropical/temperate rain forests/woodlands	3,930,979	977	404,497	10.29%
3. Temperate needle-leaf forests/woodlands	15,682,817	1,492	897,375	5.72%
4. Tropical dry forests/woodlands	17,312,538	1,290	1,224,566	7.07%
5. Temperate broad-leaf forests	11,216,659	3,905	403,298	3.60%
6. Evergreen sclerophyllous forests	3,757,144	1,469	164,883	4.39%
7. Warm deserts/semi-deserts	24,279,843	605	1,173,025	4.83%
8. Cold-winter deserts	9,250,252	290	546,168	5.90%
9. Tundra communities	22,017,390	171	1,845,188	8.38%
10. Tropical grasslands/savannas	4,264,832	100	316,465	7.42%
11. Temperate grasslands	8,976,591	495	88,127	0.98%
12. Mixed mountain systems	10,633,145	2,766	967,130	9.10%
13. Mixed island systems	3,252,563	1,980	530,676	16.32%
14. Lake systems	517,695	66	5,814	1.12%
TOTAL	**145,605,658**	**16,636**	**9,489,665**	**6.52%**

3. REGIONAL PROTECTED AREAS NETWORKS

WCPA is divided into 15 regions for operational purposes, each region comprising a number of countries with their respective marine and terrestrial protected areas. These regions are shown in Map 1. In addition, there are 18 marine regions, as shown in Map 2.

3.1 Growth in number and extent

The extent of the protected areas network within each WCPA region is summarised in Table 5, based on data for each country in Annex 1. In eight of the regions, protected areas exceed 10% of the total area. The very high figure of 46% for the Caribbean is misleading, however, because of the extensive marine component included in the calculation. The Antarctic, North Eurasia and the Pacific are least well represented within protected areas (<3%), while South Asia and Western/Central Africa are in the region of 5% representation.

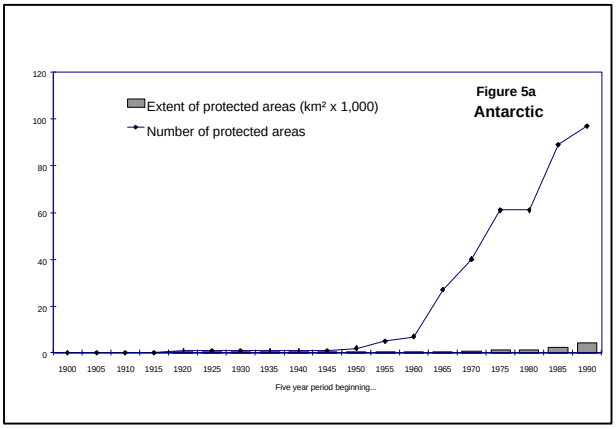
There are many gaps at the national level as illustrated in Map 3. A breakdown of the extent of national protected area systems is provided in Annex 1 for a total of 225 countries and dependent territories. While 77 (34%) of such systems cover more than 10% of total land area and 49 (22%) exceed 5%, 53 (24%) systems cover less than 5%, a further 32 (14%) are below 1% of total land area and a few countries have yet to establish protected area systems, namely Andorra, Comoros, Equatorial Guinea, Guinea-Bissau, Syria and Yemen, and the island territories of Cape Verde, Maldives, Marshall Islands, Micronesia, and Sao Tomé and Principe. Protected areas are also absent from the dependent territories of St Pierre and Miquelon (France), Macao (Portugal) and Anguilla (United Kingdom).

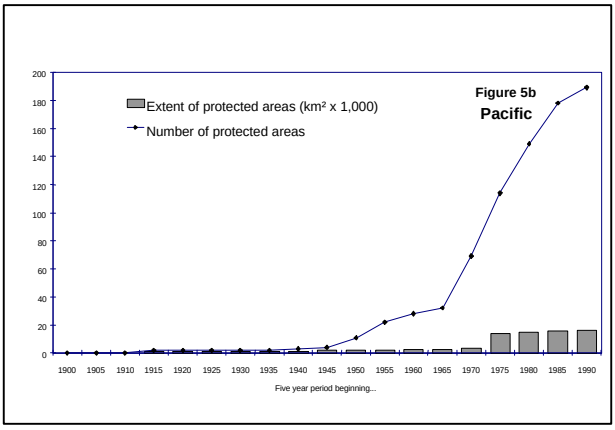
As shown in Figure 5, the number and extent of protected areas have risen steadily and dramatically in most regions since the 1960s or, in the case of Central America, the Caribbean and East Asia, since the 1970s. In many of these regions, such as both Sub-Saharan African regions, Europe, North America, Pacific, South America and South Asia this growth began earlier in the 1920s or 1930s and then accelerated from the 1960s onwards. The exception is South-East Asia, which has seen a steady increase in numbers of protected areas since the 1920s.

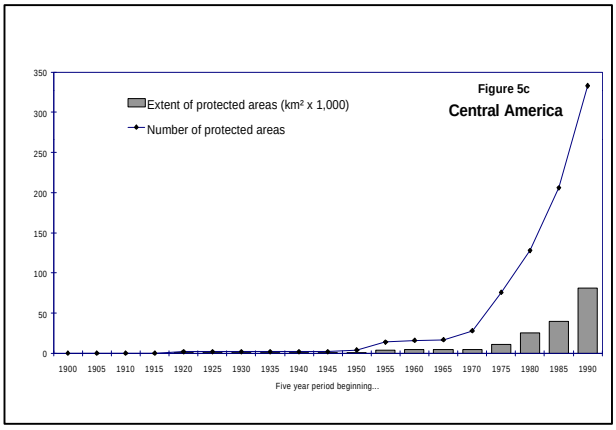
In the North Africa/Middle East Region the 1990s witnessed a dramatic increase in the total area under protection due to the establishment of a few very large protected areas. In Eastern/Southern Africa, North America, Caribbean and in the Pacific it would appear that networks are no longer expanding at their earlier rates, perhaps indicating diminishing opportunities for the creation of large new protected areas. However, in Australia/New Zealand, Central America, South America, South-East Asia, North Eurasia and Europe, there is little or no sign of any decline in growth rates.

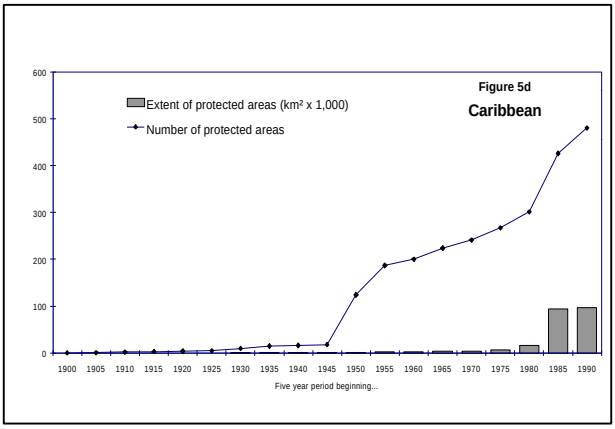
Table 5 Number and extent of protected areas within each WCPA region, classified by IUCN management category

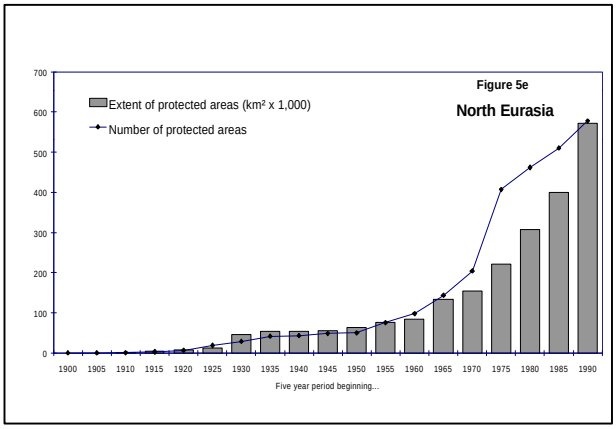
WCPA Region	Area of region (Sq.km)	Ia			Ib			II			III			IV			V			VI			TOTAL		
		No.	Extent (Sq.km)	%	No.	Extent (Sq.km)	%	No.	Extent (Sq.km)	%	No.	Extent (Sq.km)	%	No.	Extent (Sq.km)	%	No.	Extent (Sq.km)	%	No.	Extent (Sq.km)	%	No.	Extent (Sq.km)	%
WCPA Region 'North Africa/Middle East'	12,866,541	30	1,704	0.01	3	32	0.00	60	123,673	0.96	39	12,265	0.10	264	69,836	0.54	125	52,056	0.40	21	778,010	6.05	542	1,037,576	8.06
WCPA Region 'Europe'	5,061,153	513	77,822	1.54	77	6,781	0.13	215	80,509	1.59	457	1,610	0.03	5,333	83,976	1.66	2,654	339,927	6.72	76	12,976	0.26	9,325	603,601	11.93
WCPA Region 'Antarctic'	14,268,633	82	3,172	0.02	0	0	0.00	2	146	0.00	0	0	0.00	14	460	0.00	1	10	0.00	0	0	0.00	99	3,788	0.03
WCPA Region 'Pacific'	556,922	27	853	0.15	0	0	0.00	11	251	0.05	19	281	0.05	50	1,067	0.19	11	46	0.01	34	10,615	1.91	152	13,113	2.35
WCPA Region 'Caribbean'	238,627	20	1,078	0.45	3	16	0.01	67	12,098	5.07	22	28	0.01	231	78,989	33.10	59	14,823	6.21	177	1,605	0.67	579	108,637	45.53
WCPA Region 'North America'	23,443,386	658	54,738	0.23	630	391,914	1.67	1,286	1,633,642	6.97	342	58,472	0.25	1,249	822,686	3.51	2,085	245,301	1.05	461	877,053	3.74	6,711	4,083,806	17.42
WCPA Region 'Australia/New Zealand'	7,947,450	2,184	248,446	3.13	61	40,074	0.50	685	266,109	3.35	940	7,492	0.09	1,636	10,798	0.14	65	59,856	0.75	311	476,249	5.99	5,882	1,109,024	13.95
WCPA Region 'North Eurasia'	22,100,900	173	321,403	1.45	1	635	0.00	55	101,342	0.46	30	105	0.00	368	233,968	1.06	21	482	0.00	0	0	0.00	648	657,935	2.98
WCPA Region 'South-East Asia'	4,498,111	293	27,830	0.62	0	0	0.00	150	190,473	4.23	62	3,944	0.09	151	91,729	2.04	109	20,491	0.46	759	184,397	4.10	1,524	518,864	11.54
WCPA Region 'South Asia'	4,368,713	33	3,397	0.08	0	0	0.00	108	62,994	1.44	1	0	0.00	564	143,200	3.28	9	1,562	0.04	4	1,771	0.04	719	212,924	4.87
WCPA Region 'East Asia'	11,790,494	57	90,731	0.77	24	498,673	4.23	56	74,434	0.63	73	11,382	0.10	306	63,730	0.54	159	60,719	0.51	403	84,012	0.71	1,078	883,681	7.49
WCPA Region 'South America'	18,001,095	253	106,832	0.59	1	1,000	0.01	360	619,788	3.44	75	83,726	0.47	197	229,382	1.27	245	250,138	1.39	306	547,960	3.04	1,437	1,838,826	10.22
WCPA Region 'Central America'	542,750	26	11,430	2.11	0	0	0.00	78	29,383	5.41	27	9,591	1.77	163	14,150	2.61	9	54	0.01	81	21,441	3.95	384	86,049	15.85
WCPA Region 'Africa (Western/Central)'	13,352,849	33	28,575	0.21	5	150	0.00	82	305,268	2.29	3	4,007	0.03	166	359,099	2.69	1	100	0.00	53	58,637	0.44	343	755,836	5.66
WCPA Region 'Africa (Eastern/Southern)'	10,773,580	7	687	0.01	4	1,085	0.01	169	501,495	4.65	32	118	0.00	479	256,633	2.38	25	11,883	0.11	211	546,714	5.07	927	1,318,615	12.24
Totals	**149,811,204**	**4,389**	**978,698**	**0.65**	**809**	**940,360**	**0.63**	**3,384**	**4,001,605**	**2.67**	**2,122**	**193,021**	**0.13**	**11,171**	**2,459,703**	**1.64**	**5,578**	**1,057,448**	**0.71**	**2,897**	**3,601,440**	**2.40**	**30,350**	**13,232,275**	**8.83**

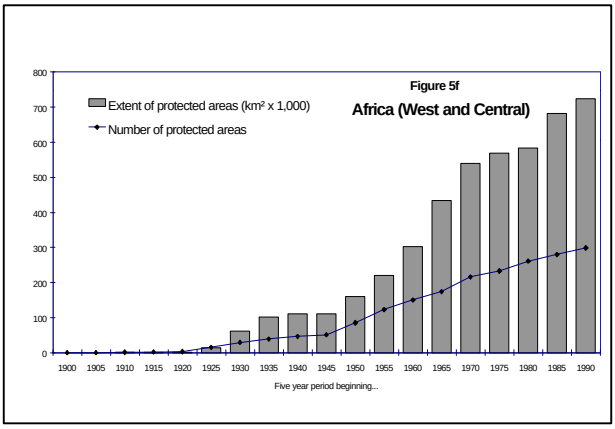












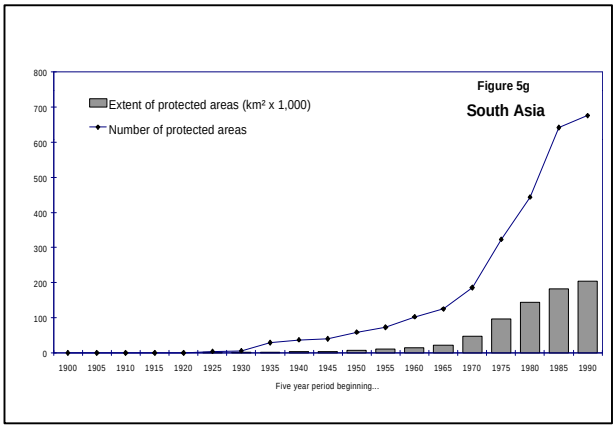
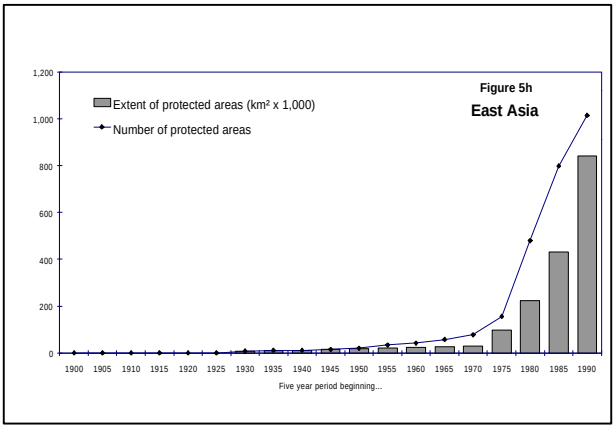
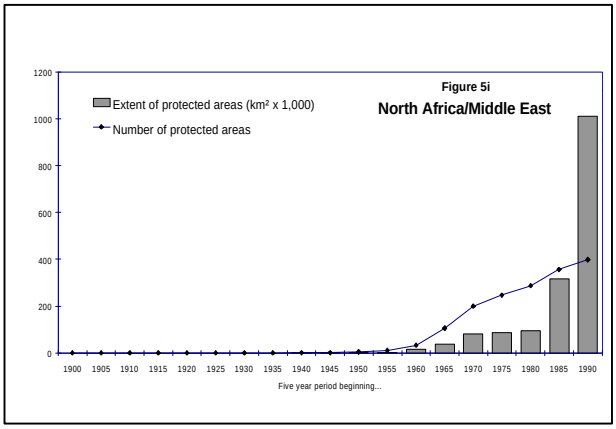
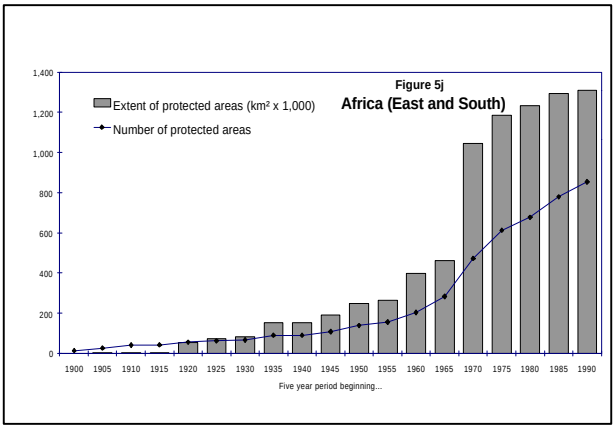
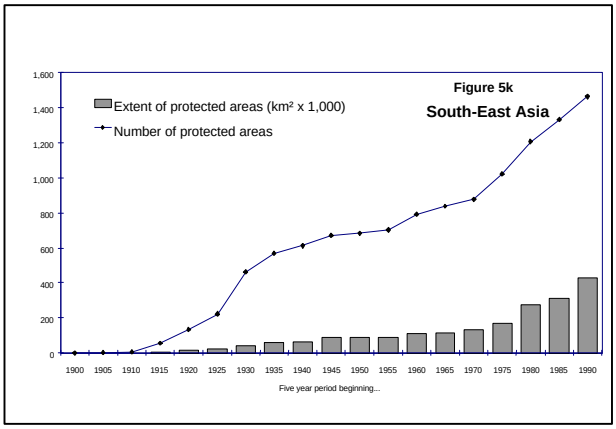


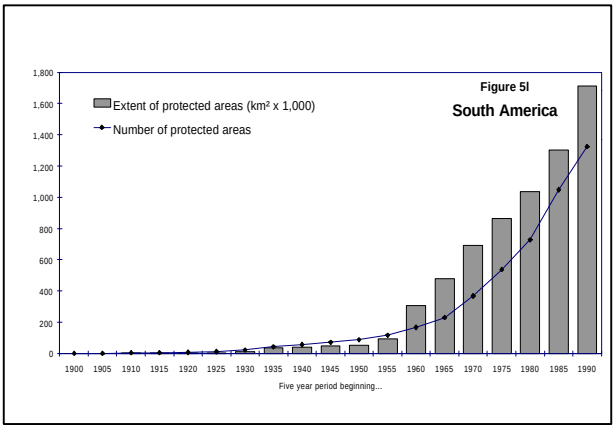
Figure 5 Cumulative growth in the number and extent of protected areas within WCPA regions

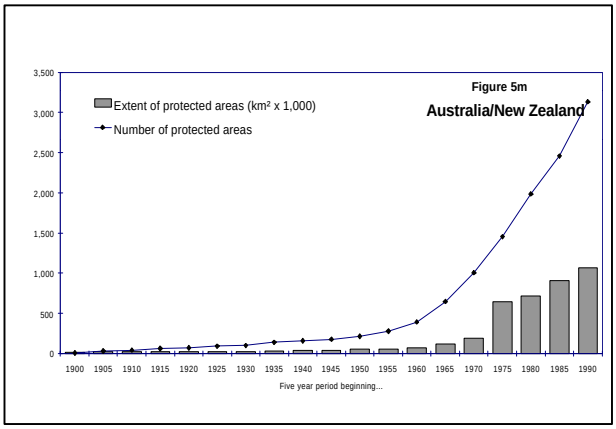


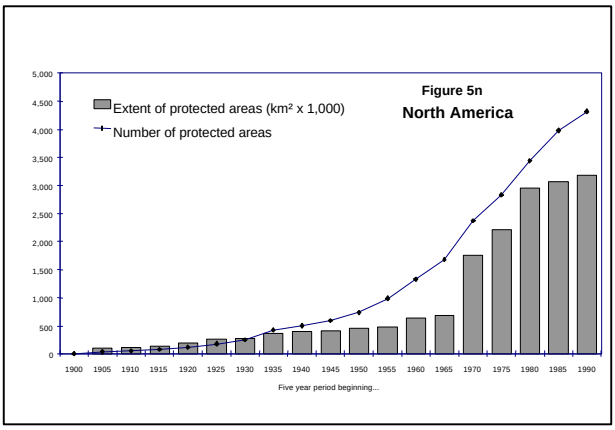












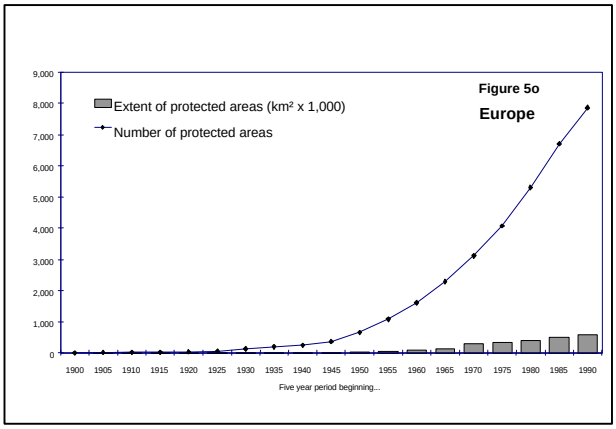


Figure 5 (continued)

3.2 Size and categories of management

Political, socio-economic, geographical and ecological differences between WCPA regions are reflected in the size and management objectives of protected areas.

Size

It is clear from estimates of mean protected area size in Table 6 that fewer but larger protected areas tend to be found in the tropical developing regions of Africa and South America, and in North Africa/Middle East and North Eurasia. Opportunities for establishing large protected areas are clearly much more limited in the islands of the Pacific and in Europe, with its much earlier history of industrial development.

Table 6 Mean size of protected areas within WCPA regions

WCPA region	Protected areas		
	Number	Extent (km^2)	Mean size (km^2)
Antarctic	99	3,788	38
Europe	9,325	603,601	65
Pacific	152	13,113	86
Caribbean	579	108,637	188
Australia/New Zealand	5,882	1,109,024	189
Central America	384	86,049	224
South Asia	719	212,924	296
South-East Asia	1,524	518,864	340
North America	6,711	4,083,806	609
East Asia	1,078	883,681	820
North Eurasia	648	657,935	1,015
South America	1,437	1,838,826	1,280
Africa (Eastern/Southern)	927	1,318,615	1,422
North Africa/Middle East	542	1,037,576	1,914
Africa (Western/Central)	343	755,836	2,204

Management objectives

The distribution of protected areas with respect to IUCN management categories is summarised in Table 5. The total area protected within respective regions is shown for each category in Figure 6. Some of the salient points arising from these analyses are as follows:

- Two-thirds of the protected areas network in North Africa/Middle East is represented by Category VI, although there are numerous smaller sites in Categories IV and V. Category Ib is poorly represented, with only three wilderness sites.
- Over half of Europe's protected areas network comprises Category V, reflecting the landscapes that have developed as a result of the interaction of people with nature over many centuries. More extensive representation of Categories Ib and VI is desirable but opportunities are limited in many countries.

- There is a very real and challenging opportunity to promote Category Ib in the Antarctic, following the recent ratification of the Environmental Protection Protocol to the Antarctic Treaty.
- Category VI is particularly applicable to the Pacific but many of the other categories are poorly represented. Not surprisingly, Category Ib is completely unrepresented. Application of a wider range of categories to this region needs careful consideration.
- By contrast to the Pacific, the categories are more widely applied in the Caribbean region.
- In North America, Australia/New Zealand and East Asia, the categories are fairly widely applied.
- However, in North Eurasia, South-East Asia, South Asia, Central and South America and tropical Africa there is very limited application of Category Ib and, in most cases, Category V.

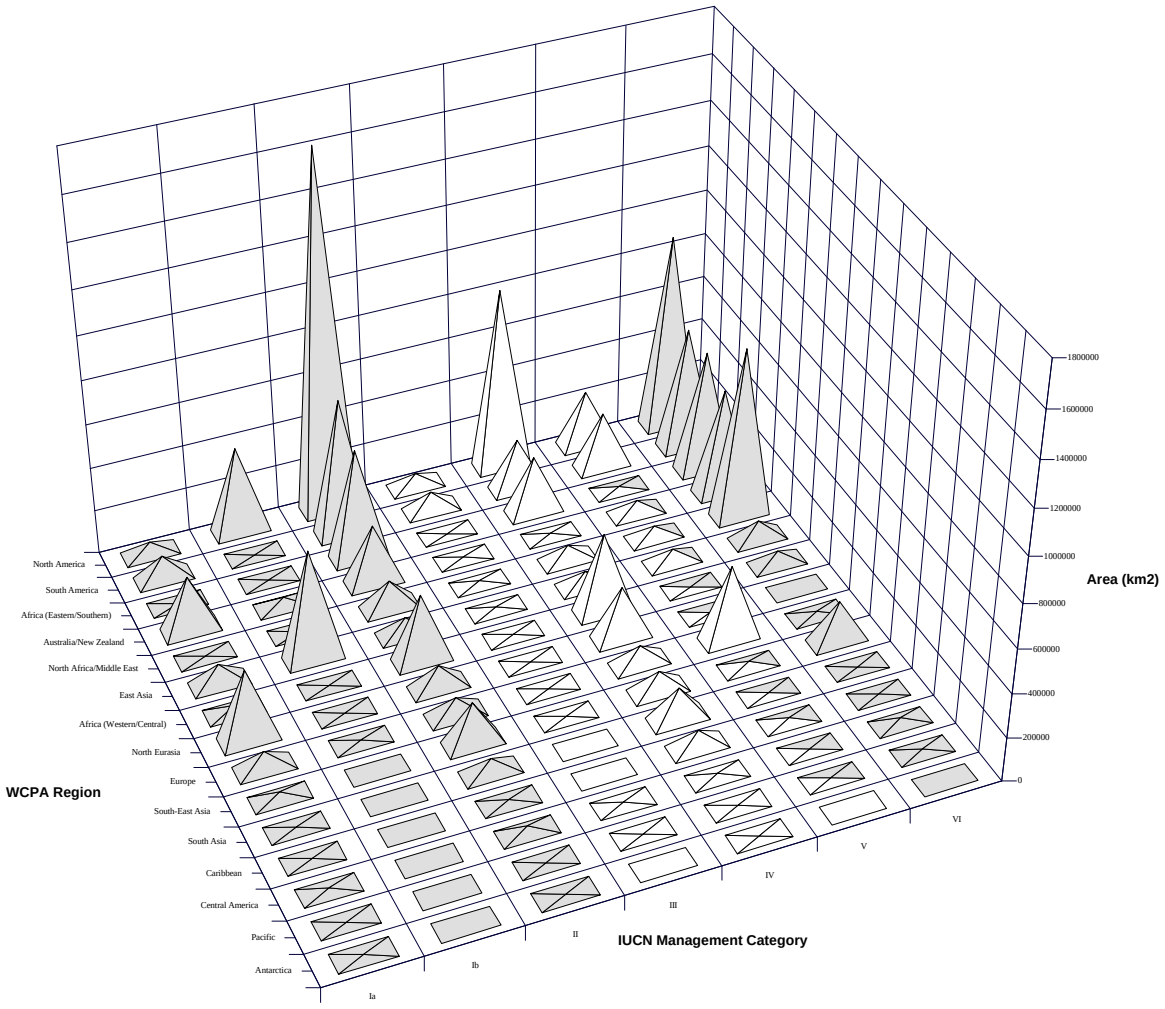


Figure 6 Extent of protected areas within WCPA regions, classified by IUCN management category

3.3 Marine regions

There has been a major increase in the awareness of the need for establishing a global representative system of marine protected areas. One of the most important catalysts for this has been the explicit recognition in the Convention on Biological Diversity and its explanatory documents of the benefits conferred by marine protected areas.

Increasingly, it is recognised that, while the contributions of marine protected areas to biodiversity are vitally important, they can also increase the sustainable catch of fisheries and provide a foundation for sustainable tourism. The opportunity to enlist the support of the tourism and fishery sectors in establishing community support for marine protected areas is being taken in many parts of the world, with consequent reduction in conflict and acceleration of WCPA's program for marine protected areas.

The 18 WCPA regional marine protected area working groups vary in their progress. Some, such as East Asian Seas, are making very significant advances and integrating their work with the terrestrial protected areas program. Others are linking with intergovernment organisations, resulting in co-operative programs producing coherent regional programs. Examples include:

- the Arctic where co-operation with the Program for the Conservation of Arctic Flora and Fauna (CAFF) has produced a scientifically based, multi-national marine protected areas program as part of the Arctic Environmental Protection Strategy (AEPS);
- the Baltic where the Helsinki Commission has committed itself to developing a representative system of marine protected areas for this sea, as discussed in Section 4;
- the Caribbean where a conference to develop a marine protected areas network in the wider Caribbean is to be held under the aegis of UNEP in December 1997;
- the South Pacific where marine protected area proposals in individual countries form part of the International Waters Strategic Action Plan for the Pacific Islands being developed by the South Pacific Regional Environment Programme (SPREP); and
- the Antarctic where the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) is now considering the merit of marine protected areas within the ambit of the Antarctic Treaty.

The World Bank has funded a GEF project for IUCN to develop proposals for three pilot, demonstration marine protected areas in three regions: the South Pacific (Samoa), Asia (Vietnam) and East Africa (Tanzania). These projects will exemplify the community involvement policies which have been shown to be necessary to achieve successful, self-sufficient marine protected areas. Lessons learned from them will be used to expand the program throughout these regions and beyond.

A 19th working group has been set up to deal with the high seas. This reflects growing international recognition that there are resources outside Exclusive Economic Zones that theoretically can be protected only through marine protected areas.

The global program to establish marine protected areas is accelerating. This is accompanied by general agreement regarding the approaches which are likely to be most successful in establishing financially sustainable marine protected areas. They are consistent with the approaches that underlie Integrated Coastal Management and, consequently, the trend is toward larger, multiple-use marine protected areas rather than small, highly protected sites in an unregulated sea.

4. INTERNATIONALLY DESIGNATED AREAS

There are a number of global and regional legal instruments and other initiatives under which protected areas are designated as being of international importance. Provisions for such protected areas are outlined in Box 2, and the number and total area of sites designated under each initiative are summarised in Table 7.

While such initiatives provide valuable mechanisms for recognising the international importance of key sites that meet certain criteria and for promoting their conservation, penalties for parties which do not meet their obligations are limited. In the case of the World Heritage Convention, for

example, threatened sites may be registered on the List of World Heritage in Danger. Provisions for biosphere reserves were strengthened in 1995 under a new Statutory Framework for the World Network of Biosphere Reserves, whereby sites are reviewed every ten years and if they do not fulfil certain criteria they may no longer be referred to as biosphere reserves.

By contrast, sites designated under either of the EC Directives carry the full weight of European Community legislation, with the ultimate prospect of Member States being taken to the European Court of Justice should they fail to meet their obligations.

These various initiatives are gaining considerable momentum. As shown in Maps 4-7, the three global initiatives have been applied by many countries, and their respective networks of internationally designated sites are extensive. At the European level, Natura 2000 already comprises 1,470 Special Protection Areas and candidate lists of Special Areas for Conservation are being drawn up by Member States.

Table 7 Number and extent of internationally designated protected areas

Instrument/Programme	Date	Internationally designated protected areas	
		No. sites	Extent (km²)
Global			
Ramsar Convention - Ramsar Wetlands	September 1997	891	628,474
UNESCO MAB Programme - Biosphere Reserves	November 1997	352	> 2.2 million
World Heritage Convention - Natural - Mixed natural/cultural sites	December 1997	114 20	1,297,776 (included in above total)
Regional – Europe			
EC Birds Directive - Special Protection Areas	December 1996	1,470	82,953
EC Habitats Directive - Special Areas for Conservation	December 1997	pending	0
Helsinki Convention - Baltic Sea Protected Areas	December 1997	3[1]	891
Barcelona Convention - Mediterranean Sea Specially Protected Areas	December 1997	212	10,677
Council of Europe - Biogenetic Reserves	December 1997	341	38,322
Regional - elsewhere			
ASEAN Agreement - ASEAN Heritage Parks and Reserves	December 1997	11	57,494
Antarctic Treaty[2] - Specially Protected Areas	December 1996	20	184

[1] A total of 63 Baltic Sea Protected Areas have been established but currently only three of these have been officially recognised at national levels.

[2] The entire continent and its dependent marine ecosystems have recently been designated as a natural reserve under the Environmental Protocol of this Treaty.

Box 2 Provisions under international instruments and other initiatives for the designation of protected areas

Ramsar Convention (1971)

The Convention on Wetlands of International Importance especially as Waterfowl Habitat (*Ramsar Convention*) was the first global treaty concerning the conservation and wise use of natural resources. Specifically, the *Ramsar Convention* provides a framework for international co-operation on the conservation and wise use of wetland biomes.

World Heritage Convention (1972)

The primary mission of the Convention concerning the protection of the World Cultural and Natural Heritage (*World Heritage Convention*) is to define and conserve the world's cultural and natural heritage. Natural heritage is defined as either:

> *"Natural features consisting of physical and biological formations or groups of such formations, which are of outstanding universal value from the aesthetic or scientific point of view;*
>
> *Geological and physiographical formations and precisely delineated areas which constitute the habitat of threatened species of animals and plants of outstanding universal value from the point of view of science or conservation;* and/or
>
> *Natural sites or precisely delineated natural areas of outstanding universal value from the point of view of science, conservation or natural beauty".*

UNESCO Man and Biosphere Programme (1976)

This interdisciplinary programme of research and training within the natural and social sciences is intended to promote the wise use and conservation of the resources of the biosphere, and improve the global relationship between people and the environment. It is based on the creation and management of a biogeographically representative network of Biosphere Reserves where, through appropriate zoning and management mechanisms, the conservation of ecosystems and their biodiversity is integrated with the sustainable use of natural resources for the benefit of local communities, including relevant research, monitoring, education and training activities.

Birds Directive (1979)

This Directive of the European Commission imposes legal obligations on Member States of the European Union to maintain populations of naturally occurring wild birds at levels corresponding to their ecological requirements. Provisions include the designation of Special Protection Areas to conserve the habitat of migratory and certain listed threatened bird species.

Habitats Directive (1992)

The aim of this European Commission Directive is to ensure that biodiversity is maintained through the conservation of natural habitats and of wild fauna. It provides for the establishment, by the year 2000 at the latest, of a network of protected areas throughout the European Community. Commonly referred to as Natura 2000, this network is designed to maintain the distribution and abundance of threatened species and habitats, both terrestrial and marine. Natura 2000 comprises Special Areas for Conservation, including Special Protection Areas as designated under the *EC Birds Directive*. A Special Area for Conservation is a site of Community importance designated by the Member State through a statutory, administrative and/or contractual act where the necessary conservation measures are applied for the maintenance or restoration of the natural habitats and/or the populations of the species for which the site was designated. Member States are obliged to contribute to Natura 2000 in proportion to the representation of the natural habitat types and species listed in two separate annexes within their territories. No SACs have officially been established yet but some countries have provided candidate lists to the European Commission Directorate General XI.

Helsinki Convention (1974)

The Convention on the Protection of the Marine Environment of the Baltic Sea Area (*Helsinki Convention*) was signed in 1974 by the coastal states of the Baltic Sea at that time. In 1992, a new *Helsinki Convention* was signed by all countries bordering on the Baltic Sea and by the European Economic Community (EEC). The 1992 version includes provisions for nature conservation, and contracting parties are obliged to gradually establish a system of Coastal and Marine Baltic Sea Protected Areas.

Barcelona Convention (1976)

The initial purpose of the *Barcelona Convention* was to combat pollution of the Mediterranean Sea. In 1982 a third protocol was adopted concerning Mediterranean Sea Specially Protected Areas but this is in the process of being replaced by a new protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean, approved in 1995. The objectives of Specially Protected Areas are to preserve:

a) representative types of coastal and marine ecosystems of adequate size to ensure their long-term viability and to maintain their biological diversity;

b) habitats which are in danger of disappearing in their natural area of distribution in the Mediterranean or which have a reduced natural area of distribution as a consequence of their regression or on account of their intrinsically restricted area;

c) habitats critical to the survival, reproduction and recovery of endangered, threatened or endemic species of flora and fauna; and

d) sites of particular importance because of their scientific, aesthetic, cultural or educational interest.

European Network of Biogenetic Reserves (1973)

The Council of Europe launched the concept of a European Network of Biogenetic Reserves in 1973. Member States agreed to co-operate in the creation of a programme for the conservation of representative examples of the natural habitats that are especially valuable for nature conservation in Europe. The network is one of the key methods for direct application of the Convention on the Conservation of European Wildlife and Natural Habitats (*Bern Convention*). A Biogenetic Reserve is defined as a protected area enjoying legal status and characterised by one or more typical, unique, endangered or rare habitats, biocenoses or ecosystems.

ASEAN Agreement on the Conservation of Nature and Natural Resources (1984)

Under this agreement between members of the Association of South-East Asian Nations (ASEAN), protected areas of outstanding international value may be declared as Heritage Parks and Reserves. The agreement provides for regional assistance in support of national efforts via the ASEAN Group on Nature Conservation. It also promotes the formulation of master plans for each Heritage site.

Antarctic Treaty (1956)

Under this treaty were adopted the Agreed Measures for Conservation of Antarctic Fauna and Flora in 1964. These stipulate that the Antarctic Treaty Area should be considered a Special Conservation Area, and they also provide for the establishment of Specially Protected Areas. The latter are intended to preserve unique or outstanding natural ecological systems, unique assemblages of species and important breeding colonies of birds and mammals.

An Environmental Protection Protocol to the Antarctic Treaty was ratified by the 26 member nations in December 1997. Under this Protocol, mining is banned for at least 50 years and the entire continent and its dependent marine ecosystems are designated a “natural reserve devoted to peace and science”.

5. DISCUSSION AND CONCLUSIONS

Managing data and compiling information on the world's protected areas, in order to be able to monitor its growth and assess its status, is a major challenge that requires resources, expertise and collaboration. Considerable progress has been made in managing such information since the *1992 World Parks Congress*. The number of records of designated and proposed areas in WCMC's Protected Areas Database has doubled to some 60,000, of which approximately half meet the IUCN definition of a protected area. Notable improvements include much more comprehensive data for:

- Europe, following the establishment of the *Common Database of Designated Areas in Europe* in partnership with the Council of Europe and European Environment Agency;
- Latin America, as a result of a World Bank-funded review of critical natural habitats;
- China, due to collaboration with the Kunming Institute of Zoology;
- Russian Federation and the Newly Independent States, due to two Russians joining WCMC; and
- marine protected areas, following the incorporation of data from the World Bank-funded marine protected areas review within the WCMC Protected Areas Database.

Despite such improvements, however, there remain significant gaps in the data which constrain the present assessment of the world's protected areas. As has been demonstrated in this paper, a crucial gap is the present lack of spatial data for approximately 75% of the 30,350 known protected areas.

The available data on protected areas shows that the global network is extensive and continuing to grow. Only in a few regions (Eastern/Southern Africa, North America, Caribbean and the Pacific) is there any sign of declining growth rates. Clearly, there remains considerable scope for expanding the network further, both through conservation of natural areas or traditionally maintained land/seascapes and through restoration of biologically degraded land/seascapes.

Analysis of these data reveals some major gaps in the protected areas network at global, regional and national levels. These include:

- a very limited marine component, in comparison to the terrestrial component;
- a preponderance of small rather than large protected areas, jeopardising their integrity and long-term ecological viability;
- a lack of application of the full range of IUCN management categories in some regions, limiting benefits from the full spectrum of services for which protected areas are intended;
- unmet targets in the representation of major biomes within the global network, particularly with respect to temperate grasslands and lake systems; and
- a majority (66%) of countries and dependent territories with less than 10% of their total land area represented in protected areas, and 20% with less than 1% represented.

While useful in providing a crude overview of the status of the world's protected areas, such analyses need to be complemented by more refined regional and national assessments. Several regions have been the subject of *gap analyses* since the *1992 World Parks Congress*, including Latin America (Dinerstein, *et al*., 1995), Indo-Malaya (ABC and WCMC, 1997) and the tropics (Green, *et al*., 1996; Murray, *et al.*, 1997). Particular ecosystems have also been assessed, for example, marine (Kelleher, *et al*., 1995) and forest ecosystems (Iremonger, *et al*.,

1997). At the national level, studies are too numerous to consider here.

As the 21st Century unfolds, the further development of the global network of protected areas will need to focus on four areas:

- consolidation of the existing network by addressing major gaps, including those identified in this paper;
- physically linking protected areas to each other so that they may function effectively as a network;
- expansion of the networks by forming or strengthening links with other sectors, notably the private sector; and
- improving the effectiveness with which protected areas are managed.

Each of these focal areas is considered in turn.

5.1 Consolidation

In order to consolidate the global network of protected areas, it is necessary to ensure that it is fully representative of the world's biological diversity and that it provides a full range of services, from strict protection to sustainable use of natural resources. Gaps in the global network have already been identified and discussed earlier in this paper; they will not be considered further.

5.2 From islands to networks

As shown previously in Figure 3, the majority of the world's protected areas are small (<100ha). Many of these, as well as larger protected areas, are islands within a sea of developed landscapes. Unless buffered from development pressures and linked via corridors to other protected areas, to allow for genetic exchanges between populations, their long-term viability is in jeopardy.

Major initiatives are underway to establish corridors to link protected areas. Examples include the 2,400 km Meso-American Biological Corridor that is planned to run from Panama to Guatemala and Belize (CCAD, 1997). Within Europe, as part of the Pan-European Biological Diversity and Landscape Strategy, it is planned to establish an ecological network (ECONET) of core protected areas, corridors or stepping stones, buffer zones and restoration areas (CoE/UNEP/ECNC, 1996).

As already discussed in Section 2.2, transfrontier protected areas contribute significantly to linking protected areas across international borders. A recent global study shows that there are 136 known transfrontier protected areas complexes, comprising a total of 406 adjacent protected areas (Zbicz and Green, in press). While collaborative management has yet to be established in most of these complexes, the physical link between protected areas either side of international borders represents a vitally important contribution to globally networking protected areas.

5.3 Private and other sectors

A pilot study by WCMC indicates that private initiatives contribute significantly to *in situ* biodiversity conservation in many parts of the world (Watkins *et al*., 1996; Watkins and Green, 1998). This particular study was limited to countries in Eastern/Southern Africa, where private protected areas in Kenya, Namibia, South Africa and Zimbabwe contribute from 1% to 7% of total land area, and are marginally more extensive than legally designated protected areas managed by government agencies.

The extent of private protected areas in other parts of the world is presently unquantified, but it is likely to be significant, particularly in the Americas and Europe. WCMC is planning to extend its Protected Areas Database to include the private sector in order to obtain a comprehensive cross-sectoral picture of the global network.

It is also timely to link up with the military sector, given the significant, often extensive training and other areas of importance for biodiversity that are occupied by the military. Zones demilitarised following the end of the Cold War, for example, provide rare opportunities for extending protected areas networks in often environmentally sensitive or fragile areas (IUCN, 1996). A recent study by IUCN (Wolff, 1997) shows that, while biodiversity conservation is receiving increasing recognition within military circles, there is tremendous scope for creating or strengthening alliances between the two sectors. At a more general level the US Navy, for example, is working with WCMC to build environmental considerations into planning NATO naval training exercises in the Black Sea.

5.4 Management effectiveness

Monitoring the growth in the world's protected areas, their distribution and their management objectives are vital, but it is equally important to know about the conditions and status of this global network and how effectively it is managed. Many protected areas exist in law (on paper), but there may be little to show for them on the ground due to various forms of encroachment (e.g. poaching, livestock grazing, cultivation, settlement, roads and urban development). As protected areas are established, and opportunities for national networks to expand further diminish, so it becomes increasingly important to focus resources on ensuring their effective management.

WCPA has established a Task Force on Management Effectiveness to address this issue, often referred to as the *paper park syndrome*. A framework for evaluating management effectiveness has been designed for different scales (i.e. site, agency, national and global) and different levels of monitoring, that depend on a site's or system's conservation value, use, threats and the potentially available resources (Hockings, 1997). This framework will be piloted at site and agency level in different parts of the world over the next year or so, prior to its adoption by WCPA for application globally. It will provide the basis for monitoring management effectiveness at the global level, working in collaboration with WCMC. Thus, for example, it is anticipated that future editions of the *United Nations List of Protected Areas* will include indicators of management effectiveness, at least at agency level.

It the meantime, available information on levels of funding and staffing for protected areas indicates that such resources are inadequate for management to be effective in many parts of the world. A global survey by WCMC (James *et al*., 1997) shows that in 1993 the mean investment by management agencies was US $ 776 km^{-2} of area protected, varying widely between regions from US $ 57 km^{-2} in South America to US $ 11,552 km^{-2} in East Asia (excluding China). On average management agencies in developed countries outspent those in less developed countries, where biodiversity tends to be higher, by an order of magnitude: US $ 1,687 km^{-2} compared to US $ 161 km^{-2}. In terms of staffing levels the variation was much less extreme (27.3 staff 1,000 km^{-2} in developed countries, compared with 22.6 staff 1,000 km^{-2} in developing countries), but under-investment in capital expenditure over a long period of time has resulted in inadequate protected areas structure and poorly equipped personnel in many countries. In the case of all developing regions, the study showed that budgets were well below actual requirements, based on self-assessment by the agencies concerned (Table 8).

Table 8 Financial requirements for protected areas in developing regions (Source: James, *et al*., 1997)

Region	Actual Budget US $ km^{-2}	Shortfall in budget US $ km^{-2}	Required budget US $ km^{-2}
Lower Cost Areas			
South America	57	85	142
Sub Saharan Africa	143	50	193
North America (Mexico)	36	221	257
Central America	101	235	336
Higher Cost Areas			
Pacific	243	500	743
North Africa and Middle East	126	674	800
South and Southeast Asia	390	569	959
Very High Cost Areas			
Europe (Eastern)	928	650	1,578
Caribbean	1,012	1,179	2,190
Insufficient Data			
East Asia	NA	500	NA
North Eurasia	NA	500	NA
Mean	**161**	**275**	**436**

5.5 Monitoring the world's protected areas in the 21st Century

Managing information on the world's protected areas is a continuous process that, in reality, has only just begun. Much data have been accessed, mostly through direct acquisition, since the early 1980s and an extensive database and GIS has been developed by WCMC in close collaboration with WCPA. The usefulness, as well as the limitations, of these datasets have been demonstrated in this paper. Moreover, the next milestones of filling the gaps in information and, importantly, mapping the boundaries of all the world's protected areas on a GIS have been clearly identified.

It remains to consider the direction in which protected areas information management needs to develop during the course of the next century. Past practices of acquiring data and compiling them in centralised repositories, such as the WCMC Protected Areas Database, are labour intensive, limited to the ability or willingness of agencies to respond, and constrained in so far as direct access to that information is concerned.

With the revolution in information technology and the birth of the Internet, it is now possible to network databases, using common interfaces, and provide direct access to all who need such information. A major advantage of decentralising information management, through a distributed network of national or agency-level databases, is that responsibility for maintaining the information is distributed among the data holders.

Clearly, WCMC's role will change increasingly towards facilitating information exchange. This will result in moving away from gathering data and focusing more on:

- establishing common standards for information exchange;
- promoting and facilitating the networking of data;
- strengthening or building the capacities of protected area agencies to manage information; and
- compiling policy-relevant information from networked data.

Steps are already underway to network protected areas information and make it readily accessible to all. WCPA and WCMC are in the process of establishing Protected Area Resource Centres (PARCs) at international, regional and even national levels. Much of WCMC's ongoing protected areas work will provide the basis for establishing PARC International at WCMC. Meanwhile, parallel initiatives are underway to establish a regional PARC in the South Pacific and a national PARC in Russia. This initiative is set to gain considerable momentum as the 21st Century unfolds.

ACKNOWLEDGEMENTS

This paper has benefited from input by Adrian Phillips, Pedro Rosabal Gonzales, Graeme Kelleher and John Cooper. Particular thanks are also due to Victoria Freeman, Simon Blyth, and Javier Beltrán and Oliver Jarratt who helped with producing the graphics, maps and statistics, respectively.

REFERENCES

ABC and WCMC. 1997. *Protected Areas Systems Review of the Indo-Malayan Realm*. Ed. J. MacKinnon. The Asian Bureau for Conservation in collaboration with The World Conservation Monitoring Centre, Canterbury, England. 198 pp.

CCAD. 1997. *Buscando respuestas: nuevos arreglors para la gestión de áreas protegidas y del corredor biológico en Centroamérica.* Comisión centroamericana de ambiente y desarollo.

Council of Europe, UNEP and European Centre for Nature Conservation. 1996. The Pan-European Biological and Landscape Diversity Strategy. 50 pp.

Dinerstein, E., Olson, D. M., Graham., D. J., Webster, A. L., Primm, S. A., Bookbinder, M. P. and Ledec, G. 1995. A Conservation Assessment of the Terrestrial Ecoregions of Latin America and the Caribbean. The World Bank, Washington, USA. 129 pp.

Green, M. J. B., Murray, M. G, Bunting, G. C. and Paine, J. R. 1997. Priorities for Biodiversity Conservation in the Tropics. WCMC Biodiversity Bulletin No. 1. 20 pp.

Hockings, M. 1997. Evaluating Management Effectiveness: A Framework for Evaluating Management of Protected Areas. IUCN World Commission on Protected Areas, Working Group on Management Effectiveness. 78 pp.

Iremonger, S., Ravilious, C. and Quinton, T. (Eds). 1997. A global overview of forest conservation. CD-ROM. WCMC and CIFOR, Cambridge, UK.

IUCN. 1998. *1997 United Nations List of Protected Areas.* Prepared by WCMC and WCPA. IUCN, Gland, Switzerland and Cambridge, UK. lxii + 412 pp.

IUCN. 1996. *Tanks and Thyme - Biodiversity in Former Soviet Military Areas in Central Europe*. IUCN, Gland, Switzerland and Cambridge, UK. viii +136 pp.

IUCN. 1994. *1993 United Nations List of National Parks and Protected Areas*. Prepared by WCMC and CNPPA. IUCN, Gland, Switzerland and Cambridge, UK. xlvi + 315 pp.

IUCN. 1993. *Parks for Life. Report of the IVth World Congress on National Parks and Protected Areas.* IUCN, Gland, Switzerland. viii+260 pp.

James, A. N., Green, M. J. B., and Paine, J. R. 1997. Financial indicators and targets for protected areas. Background paper for GBF6: dialogue on biodiversity indicators and targets, UN Headquarters, New York, April 3-4, 1997. 16 pp.

Kelleher, G., Bleakly, C., and Wells, S., 1995. *A Global Representative System of Marine Protected Areas*. 4 Volumes, World Bank, Washington D.C.

Leader-Williams, N., Harrison J., and Green, M.J.B. 1990. Designing protected areas to conserve natural resources. *Science Progress* 74: 189-204.

Ledec, G., Pellegrini, M. Beltrán, J. Andreoli, G. Bunting., G., Luigi, B. and Green., M. (in press). Critical Natural Habitats in Latin America and the Caribbean. Volume 1: Southern Cone (Argentina, Chile, Paraguay and Uruguay). Prepared in collaboration with Agriconsulting S.p.A. and the World Conservation Monitoring Centre.

MacKinnon, J., MacKinnon, K., Child, G. and Thorsell, J., 1986. *Managing Protected Areas in the Tropics*. IUCN, Gland, Switzerland. 295 pp.

McNeely and Miller 1984. *National Parks, Conservation and Development: The role of protected areas in sustaining society*. Proceedings of the World Congress on National Parks held on 11–22 October 1982 in Bali, Indonesia. Smithsonian Institution Press, Washington DC.

Murray, M. G., Green, M. J. B., Bunting, G. C. and Paine, J. R. 1997. Biodiversity Conservation in the Tropics: Gaps in Habitat protection and funding priorities. *WCMC Biodiversity Series* No. 6. World Conservation Press, Cambridge, UK. 88 pp.

Soule, M.E. 1983. Applications of genetics and population biology: the what, where and how of nature reserves. In *Conservation, science and society*. UNESCO-UNEP. Pp. 252-264.

Watkins, C. W., Barrett, A. M., Smith, R. and Paine, J. R. 1996. A Preliminary Study of Private Initiatives to Conserve Biodiversity in Selected African Countries. Prepared by the World Conservation Monitoring Centre. 27 pp.

Watkins, C.W. and Green, M. J. B. 1998. The contribution of private initiatives in conserving biological diversity: a pilot study. *Environments* (in press).

Wilcox, B. A. 1984. *In situ* conservation of genetic resources: determinants of minimum area requirements. In *National parks, conservation and development: the role of protected areas in sustaining society*, eds. McNeely, J.A. and Miller, K.A. Smithsonian Institution Press, Washington, DC. Pp. 639-647.

Wolff, E. 1997. Study on Military Lands in Europe: Rehabilitation and Use for Conservation. Report for the Meeting of IUCN's World Commission on Protected Areas, Rügen, Germany, November 1997. 17 pp.

Zbicz, D. C. and Green, M. J. B. (in press). Status of the World's Transfrontier Protected Areas. Paper presented at the International Conference on Transboundary Protected Areas as a Vehicle for International Co-operation, 16-18 September 1997, Somerset West, South Africa. 22 pp.

Map 1 WCPA Regions

Map 2 WCPA Marine Regions

Map 3 Levels of protection within countries

Map 4 States Party to the World Heritage Convention and the location of inscribed natural sites

Map 5 States Party to the Ramsar (Wetlands) Convention and the location of wetlands of international importance: Global

Map 6 States Party to the Ramsar (Wetlands) Convention and the location of wetlands of international importance: Europe

Map 7 States participating in the UNESCO MAB Programme and the location of biosphere reserves