WWF

IUCN
The World Conservation Union

arborvitæ

Supplement

October 2001

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Design by Helen Miller, HMD UK.

WWF's Forests for Life's Protected Areas Initiative is working towards the establishment and maintenance of viable, representative networks of protected areas in the world's threatened and most biologically significant forest regions.

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Forest Protected Areas:
Why Should We Worry About Systematic Planning?

By Nigel Dudley and Bob Pressey

Nigel Dudley

Protected area systems need to be carefully designed if they are to be effective at conserving biodiversity. Unfortunately, many protected areas are inadequately planned or their size and location are constrained by political considerations, resulting in reserves that are isolated from other suitable habitat, too small, missing key components, or simply in the wrong place.

As a result, the world's protected areas contain a biased and incomplete sample of biodiversity, and there is an urgent need for systematic planning to help address this problem.

The following arborvitae special describes some of the current design constraints as they relate to forest protected areas, and introduces a WWF project that is aiming to address these shortcomings through development of a guide for systematic conservation planning.

What are protected areas for?

The basic role of protected areas is to separate natural values (like biodiversity, scenery and naturally functioning catchments) from processes that threaten their existence. The extent to which protected areas fill this role for biodiversity depends on how well they meet two broad objectives:

- **Representativeness:** a long-established goal referring to the need for reserves to represent, or sample, the full variety of biodiversity, ideally at all levels of organisation.

- **Persistence:** reserves, once established, should promote the long-term survival of the species and other elements of biodiversity they contain by maintaining natural processes and viable populations and by excluding threats.

In principle this means that protected area systems need to contain adequate samples of the full range of existing ecosystems, configured so that populations of all their species (and preferably subspecies and populations) persist in the wild over very long periods. Although protected areas are likely to fall short of this ideal, conservation planners are attempting to approach this goal as closely as possible. This means that conservation planning must deal not only with the ***location*** of protected areas in relation to natural physical and biological patterns but also with the ***design*** of protected areas, which includes variables such as size, connectivity, replication, and alignment of boundaries, for example, with watersheds. Once correctly designed, protected areas also need to be effectively managed to ensure persistence.

The world now has over 10 per cent of its forests in protected areas – according to data from the World Conservation Monitoring Centre: thus meeting a major target of WWF's 1995-2000 forest campaign. Unfortunately, this does not mean that natural forests are now adequately protected. Many protected areas are badly managed, or not managed at all, and are in consequence losing the values that they were set up to preserve. Just as importantly, many protected area *systems* have not been designed carefully enough to do their job properly. Even when statistics on national or regional protected area systems appear favourable, they often conceal major inadequacies at the finer scales of forest types or ecosystems. Even if all the world's existing protected areas were managed perfectly, they would still be failing, in part due to inadequacies in the way that many have been located and designed.

Some important problems

Key problems in the location and design of existing protected areas include:

- **Bias in selection of protected areas:** that tends to under-represent many of the landscapes useful for people and over-represent landscapes that are remote or unsuitable for commercial or subsistence activities.

- **Design shortcomings in individual protected areas:** which are often too small, too isolated or the wrong shape and are thus more easily affected by external disturbances.

Discrepancy in amount of protection between different forest types
Although attention tends to focus on problems in the tropical moist forests of the world, analysis by the World Conservation Monitoring Centre[1] suggests that temperate broadleaved forests are actually the most under-represented forest type in the world's protected areas system.

Forest 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%
Total	62,413,347	10,163	4,017,072	Av: 6.64%

Note: This analysis under-represents the protection of biomes by about 30 per cent because only 16,636 (55 per cent) of the 30,350 protected areas have been classified. Their total area is nearly 9.5 million km^2, which represents just over 70 per cent of the global protected areas system.

- **Threshold issues:** threats to biodiversity as a result of species falling below threshold population sizes for long-term survival, so that they decline even within protected areas.

Bias in selection of protected areas

Putting aside land for conservation generally involves costs in terms of acquisition and lost opportunities for activities such as logging, grazing and agriculture. In fact, the adverse effects of these activities on biodiversity are often the reasons for dedicating protected areas. Other costs can be felt by individuals, especially those without legal rights or political influence. When protected areas are established, these people lose access to resources, opportunities to benefit from development projects, and sometimes even their homes.

A tendency to protect mainly residual landscapes
To minimise the social and economic costs of protection, and the political opposition that often accompanies them, while at the same time appearing to support nature conservation, governments have tended to bias the process of locating protected areas. Protected areas tend to be established in places that are remote and/or without valuable commercial resources and are either uninhabited or are occupied by people who are politically weak. The world has many huge national parks and wilderness reserves in deserts, ice caps, mountains and tundra – for example the 972,000 km^2 national park on the Greenland ice cap and the 640,000 km^2 Ar-Rub'ai-Khali wildlife management area in the deserts of Saudi Arabia. These areas are important for their wilderness

Pyhä-Häkki reserve is only 1200 ha in size, but now represents the largest area of ancient forest in southern Finland, whereas very large areas have been protected in the less commercially valuable taiga forest in the north.

and cultural values and for some wildlife species, but they can give a false impression of the adequacy of protected areas. It is far more difficult to establish protected areas in productive locations, such as timber-rich forests or fertile plains where land can command high prices, or on coasts where people would have to forgo profitable tourism activities.

In Sweden and Finland, for example, although around 3-4 per cent of forest is in protected areas, much of this is on mountainous areas or north of the Arctic Circle where timber is of little value and few people live. Less than 1 per cent of Sweden's and Finland's southern forest is protected although this is where most biodiversity and threatened species are listed. Pyhä-Häkki National Park, covering just 1200 ha, is now the largest area of old-growth forest in southern Finland and there are fears for the long-term survival of some of its species because populations may not be viable.

The world's least protected forest ecosystems

Despite the fact that there are more tropical forests in protected areas than temperate forests, the coverage of different types of tropical forests is very uneven. Most of the least protected forests are also in the tropics. Research by the World Conservation Monitoring Centre[2], undertaken for WWF's Forests for Life campaign, found that the following forest areas had the least protection:

- South Pacific islands including American Samoa (0.2 per cent protection)
- Nagu Manapuri Chin Hills in Southeast Asia (0.8 per cent)
- Solomons/Vanuatu/Bismarck moist forests in the Southwest Pacific (1 per cent)
- Cameroon Highlands in Central and West Africa (1 per cent)
- Gulf of Guinea mangroves in Northwest Africa (1.1 per cent)
- Madagascar mangroves (1.3 per cent)
- Palawan moist forests of the Philippines (1.4 per cent)
- Philippine moist forests (1.8 per cent)
- Southern Mexican dry forest (2.1 per cent)
- East African mangroves (2.2 per cent)

Badly sited protected areas can miss most of the biodiversity
When Hawaii's system of nature reserves was established, a prime motivation was to protect the rare and endemic birds that live on the island. But research has shown that many of the most threatened birds actually live outside the protected areas. This is far from unusual. In Sichuan province, China, over half the highly endangered giant pandas still live outside panda reserves. In the USA, many endangered species are 'missed' by the protected area system. There is an all-too-common mismatch between areas with biodiversity that needs protection and areas set aside to protect biodiversity.

Over half the world's remaining giant pandas live outside reserves and the Government of China is currently trying to increase the number of panda reserves.

Design shortcomings in individual protected areas

Even if the correct habitats are selected, protected areas will only achieve their purposes if the design of individual reserves is adequate.

Small reserves are likely to be of only limited value if they are isolated from other suitable habitat
Whilst even quite tiny nature reserves can be important for the protection of some species, they are seldom a long-term solution for the majority of threatened biodiversity. The species they contain are likely to be present as populations that are too small to survive indefinitely, either because there are not enough individuals for the species to be genetically viable or because an unusual event (e.g. outbreak of disease, wildfire, extreme climatic conditions) can wipe out the small number that remain.

Evidence is accumulating that suggests small protected areas may be losing their species. In Java, Indonesia, the Bogor 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, but the diversity of birds has suffered a steep decline. 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 had declined substantially, even though the immediate habitat remained reasonably intact[3].

Small reserves can work well if they are connected with other reserves or other suitable habitat. But in an increasing number of cases, protected areas are surrounded by land that has undergone dramatic conversion to farmland, tree plantations or urban areas, isolating all but the most adaptable species. Furthermore, research suggests that most of the world's protected areas are small. Analysis by the World Conservation Monitoring Centre in 1997 found that 17,892 (59 per cent) of protected areas are less than 1,000 ha in size, accounting for a total area of 28,713 km^2, which is only 0.2 per cent of the global protected areas system. Just 1,673 (6 per cent) protected areas exceed 1,000 km^2, but they comprise 11.56 million km^2 or 87 per cent of the global system[4].

The fact that protected areas often cannot protect everything is not, of course, an argument for doing nothing. Loss of species is now unfortunately sometimes almost inevitable, as in the case of the last fragments of temperate Atlantic forest in Brazil. Although the fragments that have been protected are losing some of their larger species, many smaller and distinctive species are likely to survive there, with the possibility of increasing their habitats in the future through restoration, thereby justifying conservation action. But when there is any choice, large size and connectedness are goals to be achieved either by retaining or restoring native habitat.

Choices about reserves are also influenced by timing and urgency. Sometimes small or fragmentary patches of habitat in highly threatened locations are more urgently in need of protection than large tracts of pristine forest, to buy time for species before restoration efforts begin, as in the Brazilian case mentioned above. An important element in designing an effective protected areas system is therefore scheduling the establishment of individual protected areas. ***Scheduling*** is essential so that the most important areas for biodiversity are protected first and long-term options for conservation are not foreclosed by loss and alteration of forests.

The shape of protected areas is also critical to their success
Protected areas that are made up of fragmented habitat, or those without a large 'core' area that is remote from disturbance, or protected areas that contain barriers such as roads, have a higher risk of losing their values.

Protected areas with large and remote 'core areas' are much more secure from human interference from poaching, land invasion and edge effects such as pollution[5]. In Serengeti National Park and World Heritage Site in Tanzania, it is estimated that poachers take 200,000 animals every year, with by far the largest effects occurring at the edges of the 14,763 km^2 protected area, where teams of porters carry meat out by hand in a large and well-organised operation[6]. Animals living further inside the reserve are more secure. Long, narrow national parks in East Africa have suffered disproportionate losses from poaching.

Some insect and mammal species will seldom if ever cross roads; therefore a road in a protected area can isolate populations. In Victoria, Australia, a road through a ski resort in Mt Higginbotham isolated males of the mountain pygmy possum from females, which normally live at higher elevations, thus inhibiting breeding. In this case a corridor – known locally as the 'tunnel of love' – helped to address this frustration. In this and other regions, many species are restricted to core habitat distant from forest edges. It follows that protected areas with more irregular and less compact shapes have smaller proportions of core habitat, smaller populations of core habitat specialists, and less chance of retaining these species in the long-term.

Roads can also isolate populations of larger animals. In Sabah, in the Malaysian part of the island of Borneo, the Kinabatangan River provides an extremely important corridor of natural forest through an area of oil palm plantations. However a single road breaks the biological corridor, isolating the group of a hundred forest elephants from the more extensive forest areas in the uplands.

The Kinabatangan River in Sabah, Malaysia provides a biological corridor through an area of oil palm. But a road crossing the river isolates populations of elephants and orang utan from the forested mountains further inland.

Protected areas that lack a key habitat may be unable to protect all their biodiversity
Another design problem is that protected areas can sometimes be established without a particular habitat important for one or more of the species that they contain. This is particularly likely in the case of migratory species, where liaison between protected area agencies in a number of different countries is sometimes needed. It can also occur when key resources in the same region remain unprotected, such as seasonal food sources or breeding habitats for birds, bats or fish.

One omission from many protected areas that is becoming of increasing concern is the flexibility to adapt to changing conditions – including climate change. Many do not include climatic gradients that will allow species to shift their ranges upwards or downwards if average temperature or rainfall changes. Similarly, a coastal salt-marsh reserve can only be protected against possible rise in sea level by having space to retreat to on higher land, but many protected areas do not contain these 'insurance zones'. For example, Vadehavet is an important reserve on the Wadden Sea in Denmark. The sea and its associated system of mudflats and salt marshes provide habitat for 6-9 million migratory birds and nursery grounds for commercially important fish. Vadehavet is one of many areas where salt marshes are threatened with inundation; however dykes built behind will hamper any natural sedimentation and creation of new marsh areas[7].

Threshold issues

These design issues together add up to a more fundamental problem: even if protected areas do contain populations of species now, there is no guarantee that these will persist into the future if the size, shape and connectivity of the protected area is not improved. The example from Java quoted above shows that species can decline even if their immediate habitat seems adequate. The level below which a species is unlikely to persist in the long term is known as the ***threshold*** value. Even after the initial losses of species, the process of extinction could continue for a century or more. The number of species that are predicted to become extinct due to past adverse environmental changes is called the extinction debt. Inadequately designed reserve systems can contain small populations of species that give ecologists and policy-makers a false sense of security, but which will decline and disappear because the individual isolated populations are not large enough to persist.

Although the importance of threshold values is increasingly recognised, and there is a growing literature detailing their calculation, they remain unknown for the majority of species. For example, half of the world's known populations of mountain gorillas – some 350 individuals – live in Bwindi Impenetrable Forest National Park in Uganda, near the borders of Rwanda and the Democratic Republic of Congo. The population is probably as large as the 32,092 ha protected area can support. Currently there is no room for the protected area to expand, or even be linked by corridors to other forest nearby. Whether or not this population is large enough to survive in the long term is still a matter of guesswork.

Many protected areas, like Bwindi Impenetrable Forest Reserve in Uganda, now have land converted right up to their borders. The long-term survival of the mountain gorilla probably depends on expanding the available habitat, although currently external pressures on land make this extremely difficult.

Protected areas can only ever contain a small portion of biodiversity. Therefore the management of forest landscapes outside protected areas will also be essential for safeguarding the world's biodiversity.

An artificial nest for the endangered peregrine falcon on a cliff top in a nature reserve in Ontario, Canada. WWF Canada has carried out groundbreaking work in systematic conservation planning through use of gap analysis methodologies to identify natural areas missing from the existing protected areas system. Through its Endangered Spaces Campaign, WWF has been lobbying for these gaps to be filled, to create a comprehensive system of protected areas for the country.

References

1 **Green, J B and J Paine** (1997); *State of the World's Protected Areas at the end of the Twentieth Century*, paper presented at the IUCN World Commission on Protected Areas Symposium on 'Protected Areas in the 21st Century: From Islands to Networks', Albany, Australia 24-29 November 1997

2 **WWF** (2001); *The World's Top Ten Most Vulnerable Forest Ecoregions*, WWF International, Gland, Switzerland

3 **Bennett, Andrew** (1999); *Linkages in the Landscape*, IUCN The World Conservation Union, Gland, Switzerland

4 **Green and Paine** (1997); *op cit*

5 **Bruner, Aaron G, Raymond E Gullison, Richard E Rice and Gustavo A B da Fonseca** (2001); Effectiveness of parks in protecting tropical biodiversity, *Science* **291**, 125-129

6 **Personal communication from Justin Hando, chief warden of Serengeti,** July 2001

7 **Loh, Jonathan** (1997); *Climate Change and Protected Areas*, WWF International, Gland

A new synthesis

Conservation organisations are increasingly changing their focus from site-based to more broad-scale approaches in response to the shortcomings outlined here. But planning protected area systems is never easy: not only do we have to get the conservation science right but we are faced with huge negotiation tasks with local communities and others with an interest in using the land.

The basis of an effective system of protected areas is good planning. The WWF *Forests for Life* campaign is therefore sponsoring the development of a comprehensive guide for systematic conservation planning. This guide will integrate four lines of work and thinking that have tended to remain separate:

1. Single-species conservation biology;
2. Quantitative methods for computer-based planning;
3. Approaches that use expert workshops to identify priority conservation areas; and
4. Experience and lessons from implementation of conservation action on the ground.

The guide will focus on planning that is systematic, i.e. based on explicit conservation targets, identifying new protected areas in ways that are transparent and defensible, and scheduling conservation on the ground in a way that minimises losses of biodiversity to ongoing threats.

Systematic conservation planning

The methodology being developed for WWF is based around nine stages and will usually be applied at the level of an ecoregion:

- Stage 1. *Scoping and costing the planning process.* Defining the boundaries of the planning region, assembling the team, and deciding on how subsequent stages will be approached.

- Stage 2. *Identifying and involving key stakeholders.* Deciding which stakeholders should be part of the planning process and developing strategies for involving them.

- Stage 3. *Identifying broad goals.* Developing a broad, idealized 50-100 year goal or vision for conservation within the ecoregion.

- Stage 4. *Assembling and evaluating data.* Reviewing existing data on biodiversity and deciding which can be used as 'surrogates' for biodiversity. Collecting new data if possible and necessary, including information on distribution of rare or endangered species in the region. Assembling data on threats to biodiversity.

- Stage 5. *Formulating conservation targets (conservation targets are shaped by the goals - Stage 1 - and the available data - Stage 2).* Setting quantitative conservation targets for species, vegetation types and other features as well as for minimum size, connectivity and other design criteria. Setting qualitative targets for desired features in those protected areas (e.g. favour areas with less disturbance).

- Stage 6. *Reviewing the effectiveness of existing protected areas.* Measuring the extent to which quantitative targets have been met by the existing protected area system and assessing the effectiveness of the system in excluding threatening processes and facilitating management.

- Stage 7. *Selecting additional protected areas.* Using existing protected areas as focal points, identifying potential new protected areas (for example by using decision support software to apply expert judgements on how to balance the need for new protected areas with constraints such as budgets and opportunity costs).

- Stage 8. *Implementing conservation action on the ground.* Reviewing proposed protected areas and deciding on scheduling of conservation action and the most feasible and appropriate forms of protection for individual areas.

- Stage 9. *Maintaining and monitoring established protected areas.* Setting conservation goals in individual protected areas, implementing management actions and monitoring key indicators of success, with modifications to management as necessary.

Each of the main stages will be broken down into a number of more detailed steps. In turn, each of the steps will:

(i) review the main ideas and principles, with references for further reading;
(ii) provide examples and illustrations from around the world;
(iii) recommend actions, acknowledging the need for adaptation; and
(iv) list gaps in knowledge and issues for further work.

The guide will draw on existing work from many countries. Its development will also involve trial applications of the proposed planning framework. One of these is underway in the forests of the upper Yangtze valley in southwest China. The intended audience is broad, including governments, protected area departments, non-governmental organisations and students.

Many of these ideas are not new to WWF. WWF national organisations and programme offices have already implemented parts of the systematic conservation planning methodology. Examples are the gap analysis used in WWF Canada's *Endangered Spaces* campaign and the ecoregion process followed by WWF-US in Klamath-Siskyou. The guide will draw on and expand on these and other experiences.

WWF recognises that a planning guide alone will not solve all the problems of poor location and design of protected areas. All the same, recent experience has shown that explicit, comprehensive and defensible conservation plans across whole regions have many advantages. They can alert conservationists and others to the real requirements of protecting and restoring regional biodiversity. In doing so, they are a basis for informed negotiation with communities, governments and other organisations about how to blend biodiversity conservation with socio-economic values and expectations.