CHAPTER 12

THE ROLE OF PROTECTED AREAS IN NATURE CONSERVATION

CHAPTER OUTLINE

12.1 AN OVERVIEW OF PROTECTED AREAS

12.1.1 What are protected areas?

Protected areas are ***areas 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*** (IUCN, 1994). Not all protected areas are preservation areas: some allow for extraction of certain renewable resources such as timber, while others allow for multiple use by a whole range of user groups. But whatever the details of management, the main purposes of management of protected areas generally include one or more of the following (IUCN, 1994):

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

There are several categories that are widely recognised internationally, such as National Park, Game Reserve and Forest Reserve. But the management objectives of these areas can differ from country to country. In some countries, a Forest Reserve is managed only for timber production with no allowance for use by local people, while in others the same name might refer to an area specifically established for use by locals.

To get around this problem of nomenclature, IUCN has devised a set of international categories, into which all national categories can be fitted. Box 12.1 lists these in order of decreasing emphasis on preservation of nature (Makombe, 1994). Note that the basis of categorisation is by primary management objective: other activities may also be compatible with the primary objective. Under this classification, most natural Forest Reserves in Uganda are theoretically managed according to the principles under Category VI: *Managed Resource Protected Area*, whereas National Parks fit in Category II and Game Reserves probably fit in Category IV. But the strict nature reserves within some Forest Reserves fit into Category I.

12.1.2 Biosphere reserves and buffer zones

It is now widely recognised that conservation goes hand-in-hand with sustainable development: both processes should benefit from each other. A logical conclusion of this is that, if we want protected areas to work for nature conservation, then they should also be seen to be providing benefits for society. In many parts of the world, including Uganda, the future of many conservation areas depends on the attitudes of people living near to these areas. Alienating them from the protected area may make the conservation situation worse, not better.

Box 12.1
IUCN Protected Area categories (Makombe, 1994)

Category I: Strict Nature Reserve/Wilderness Area: protected areas managed mainly for science or wilderness protection. Either (1a) areas 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 (strict nature reserves); or (1b) large areas of unmodified or slightly modified land, and/or sea, retaining their natural character and influence, without permanent or significant habitation, which are protected and managed so as to preserve their natural condition (wilderness areas).

Objectives: Strict Nature Reserve

- to preserve habitats, ecosystems and species in as undisturbed a state as possible;
- to maintain genetic resources in a dynamic and evolutionary state;
- to maintain established ecological processes;
- to safeguard structural landscape features or rock exposures;
- to secure examples of the natural environment for scientific studies, environmental monitoring and education, including baseline areas from which all avoidable access is excluded;
- to minimise disturbance by careful planning and execution of research and other approved activities;
- to limit public access.

Objectives: Wilderness Area

- to ensure that future generations have the opportunity to experience understanding and enjoyment of areas that have been largely undisturbed by human action over a long period of time;
- to maintain the essential natural attributes and qualities of the environment over the long term;
- to provide for public access at levels and of a type which will serve best the physical and spiritual well-being of visitors and maintain the wilderness qualities of the area for present and future generations;
- to enable indigenous human communities living at low density and in balance with the available resources to maintain their lifestyle.

Category II: National Park: protected areas managed mainly for ecosystem conservation and recreation. Natural areas of land and/or sea, designated to (a) protect the ecological integrity of one or more ecosystems for this 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.

Objectives

- to protect natural and scenic areas of national and international significance for spiritual, scientific, educational, recreational or tourist potential;
- to perpetuate, in as natural a state as possible, representative examples of physiographic regions, biotic communities, genetic resources, and species, to provide ecological stability and diversity;
- to manage visitor use for inspirational, educational, cultural and recreational purposes at a level which will maintain the area in a natural or near natural state;
- to eliminate and thereafter prevent exploitation or occupation inimical to the purposes of designation;
- to maintain respect for the ecological, geomorphologic, sacred or aesthetic attributes which warranted designation;
- to take into account the needs of indigenous people, including subsistence resource use, in so far as these will not adversely affect the other objectives of management.

Category III: Natural Monument: protected areas managed mainly for conservation of specific features. Areas 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.

Objectives

- to protect or preserve in perpetuity specific outstanding natural features because of their natural significance, unique or representational quality, and/or spiritual connotations;
- consistent with the foregoing, to provide opportunities for research, education, interpretation and public appreciation;
- to eliminate and thereafter prevent exploitation or occupation inimical to the purpose of designation;
- to deliver to any resident population such benefits as are consistent with the other objectives of management.

Box 12.1 continued

Category IV: Habitat/Species Management Area: protected areas managed mainly for conservation through management intervention. Areas 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.

Objectives

- to secure and maintain the habitat conditions necessary to protect significant species, groups of species, biotic communities or physical features of the environment where these require specific human manipulation for optimum management;
- to facilitate scientific research and environmental monitoring as primary activities associated with sustainable resource management;
- to develop limited areas for public education and appreciation of the characteristics of the habitats concerned and of the work of wildlife management;
- to eliminate and thereafter prevent exploitation or occupation inimical to the purposes of designation;
- to deliver such benefits to people living within the designated area as are consistent with the other objectives of management.

Category V: Protected Landscape/Seascape: protected areas managed mainly for landscape/seascape conservation and recreation. Areas 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, cultural and/or ecological 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.

Objectives

- to maintain the harmonious interaction of nature and culture through the protection of landscape and/or seascape and the continuation of traditional land uses, building practices and social and cultural manifestations;
- to support lifestyles and economic activities which are in harmony with nature and the preservation of the social and cultural fabric of the communities concerned;
- to maintain the diversity of landscape and habitat, and of associated species and ecosystems;
- to eliminate where necessary, and thereafter prevent, land uses and activities which are inappropriate in scale and/or character;
- to provide opportunities for public enjoyment through recreation and tourism appropriate in type and scale to the essential qualities of the areas;
- to encourage scientific and educational activities which will contribute to the long term well-being of resident populations and to the development of public support for the environmental protection of such areas;
- to bring benefits to, and contribute to the welfare of, the local community through the provision of natural products (such as forest and fisheries products) and services (such as clean water or income derived from sustainable forms of tourism).

Category VI: Managed Resource Protected Area: protected areas managed mainly for the sustainable use of natural ecosystems. Areas 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.

Objectives

- to protect and maintain the biological diversity and other natural values of the area in the long term;
- to promote sound management practices for sustainable production purposes;
- to protect the natural resource base from being alienated for other land-use purposes that would be detrimental to the area's biological diversity;
- to contribute to regional and national development.

On the other hand, many species cannot tolerate much human disturbance, even if the level of disturbance is low. If they are to survive, they must have areas free of any disturbance. So allowing people increasing access to and use of a protected area tends to make them more inclined to accept the presence and protected status of that area, but at the same time, increasing human use can degrade the ecosystem, even if it only affects a few species at first. How do we resolve this apparent dilemma?

One solution is to develop protected areas according to the model of **biosphere reserves**. These are protected areas recognised as being internationally important under the UNESCO Man and Biosphere Programme (UNESCO/UNEP, 1984). Inclusion of a protected area on the UNESCO list gives it international recognition, but even for areas that will never make the list, the concept of a biosphere reserve is useful. In fact, in Uganda, only Queen Elizabeth National Park is officially designated as a UNESCO biosphere reserve.

Biosphere reserves ideally consist of a strictly protected **core** zone comprising a relatively intact natural ecosystem, surrounded by a **buffer** area (Sayer, 1991). The use of the word "buffer" has led to some confusion. In a UNESCO biosphere reserve, the buffer can be *outside* the main protected area, in which case the buffer can contain settlements and agricultural activities. In other cases, the buffer consists of a zone *within* the overall protected area, in which case such activities would not normally be permitted, but certain others might be. In either case, the idea is to surround a core preservation area with one or more zones where sustainable development will be encouraged, involving various activities that are compatible with preservation of the core area. Those activities that are most compatible with preservation should be permitted in the zone nearest the core area, while those that are less compatible should be permitted, if at all, in a zone a bit further from the core area.

Figure 12.1 illustrates the conceptual arrangement of zones that could make up a biosphere reserve. We will go on to consider how this might be adapted to natural Forest Reserves with a high nature conservation value in Chapter 15.

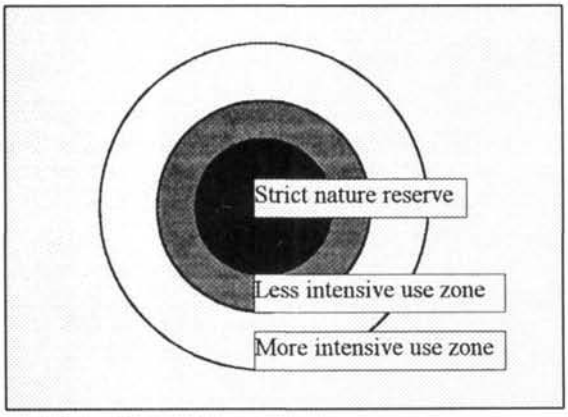

Figure 12.1. Possible management zones in a biosphere reserve. After Howard (1991).

12.1.3 The growth of the protected areas network

Many cultures worldwide have traditionally given some sort of protection to certain areas, particularly forests, often for cultural or religious reasons. But the formal designation of protected areas did not really begin until the last century. In Uganda, the first Forest Reserves were designated in the 1930s, and other protected area categories have followed since. No new areas have been designated recently. Globally, the protected areas network continues to expand, as Figure12.2 shows. However, certain ecosystems seem to have been getting rather better protection than others.

Within Africa, savannah ecosystems have received far more attention, because they support some very obvious and "charismatic" species of wildlife. Africa's forests have generally fared far worse, as Figure 12.3 demonstrates. By 1990, about 7% of Africa's savannah lands had been gazetted as protected areas, but only 3% of the natural forests (Sayer et al., 1992). This makes Uganda's Forest Reserve network all the more important.

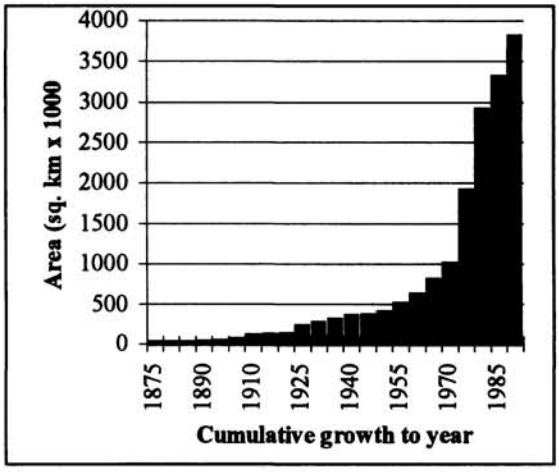

Figure 12.2. The growth of the world's protected areas network. After WCMC (1992).

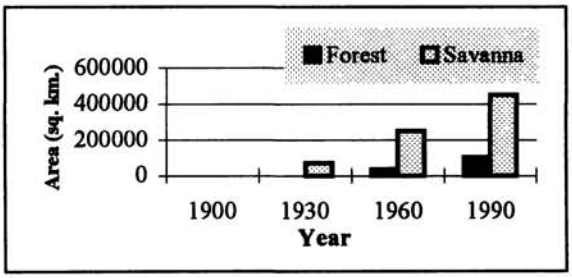

Figure 12.3. The uneven growth of the protected areas network in Africa. After Sayer et al. (1992).

12.2 PROTECTED AREAS IN UGANDA

The main categories of protected area in Uganda are Forest Reserve, National Park, Game Reserve, Game Sanctuary and Controlled Hunting Area. Table 12.1 gives some information on their functions.

It has proved difficult (and in some cases impossible) to get definitive figures for the size or even the number of Uganda's protected areas. This is partly because some are known by more than one name, have recently changed status, or have dual status, or partial dual status. Consulting different publications gives different answers.

The list of Forest Reserves of Uganda, given in Appendix 1, is complete as far as is known. Protected areas in the other categories are summarised in Box 12.2. Figure 12.4 attempts to show the location of all the protected areas in Uganda.

To date, just over 15% of Uganda's land area is gazetted as either Forest Reserve, National Park or Game Reserve, as Figure 12.5 demonstrates. Forest Reserves still make up the largest part of the protected areas network, both in area, in the diversity of ecosystems represented, and in the number of sites.

Since these reserves include many of Uganda's most important areas for nature conservation, this makes the Forest Department the primary custodian of Uganda's extraordinary wealth of plant and animal life. Despite this, the network in Uganda is still incomplete. According to NEAP (1992), some 40% of the vegetation types of Uganda recognised by Langdale-Brown et al.(1964), particularly various woodlands, scrublands and wetlands, are still not well represented in the protected areas network.

Table 12.1. The main categories of protected area in Uganda and their functions

Category	Authority	Management objectives	Permitted activities	Prohibited activities
Forest Reserve	Forest Department	• Ensure sustained yield of forest products for the nation, including local people • Protect plants and animals, including endangered ones	• Licensed cutting, taking, working and removal of forest produce • Collection of non-timber forest products by local people for personal use • Tourism with approved guide • Research • Educational use	• Human settlement • Cultivation • Grazing • Construction of roads or buildings • Hunting
National Park	National Parks	• Protect natural and scenic areas of international importance • Provide for recreational, educational and scientific use	• Controlled tourism • Research • Educational use • Some local use by license-holders in some parks	• Uncontrolled access • Human settlement • Cultivation • Grazing • Hunting
Game Reserve	Game Department	• Protect animals from hunting and encroachment of their habitat • Buffer National Parks from encroachment	• Tourism • Research • Licensed hunting	• Uncontrolled access • Human settlement • Cultivation • Grazing • Unlicensed hunting
Game Sanctuary	Game Department	• Protect endangered species of animals	• Human settlement • Cultivation • Grazing • Licensed hunting	• Unlicensed hunting
Controlled Hunting Area	Game Department	• Protect animals from hunting	• Human settlement • Cultivation • Grazing • Licensed hunting	• Unlicensed hunting

Box 12.2
Protected areas in Uganda (other than Forest Reserves). Data mostly from NEAP (1992). Figures in brackets refer to area in square kilometres

National Parks	Game Reserves	Game Sanctuaries	Controlled Hunting Areas
Bwindi/Impenetr. (321)	Ajai (158)	Dufile (10)	Buhuka (228)
Kibale (560)	Bokora Corridor (2034)	Entebbe (51)	East Madi (900)
Kidepo Valley (1400)	Bugungu (748)	Jinja (33)	Kaiso-Tonya (830)
Lake Mburo (264)	Karuma (713)	Kazinga (22)	Karamoja (18773)
Mgahinga Gorilla (25)	Katonga (207)	Malawa (8)	Karuma (18)
Mount Elgon (1145)	Kibale F. Corridor (339)	Mount Kei (452)	Katonga (2269)
Murchison Falls (3900)	Kigezi (328)	Otze Forest (204)	Lipan (241)
Queen Elizabeth (1978)	Kyambura (165)		Napak (?)
Rwenzori (997)	Matheniko (2587)		Sebei (?)
Semliki (212)	Pian Upe (2287)		Semliki (504)
	Toro (549)		Teso (227)
			West Madi (1752)

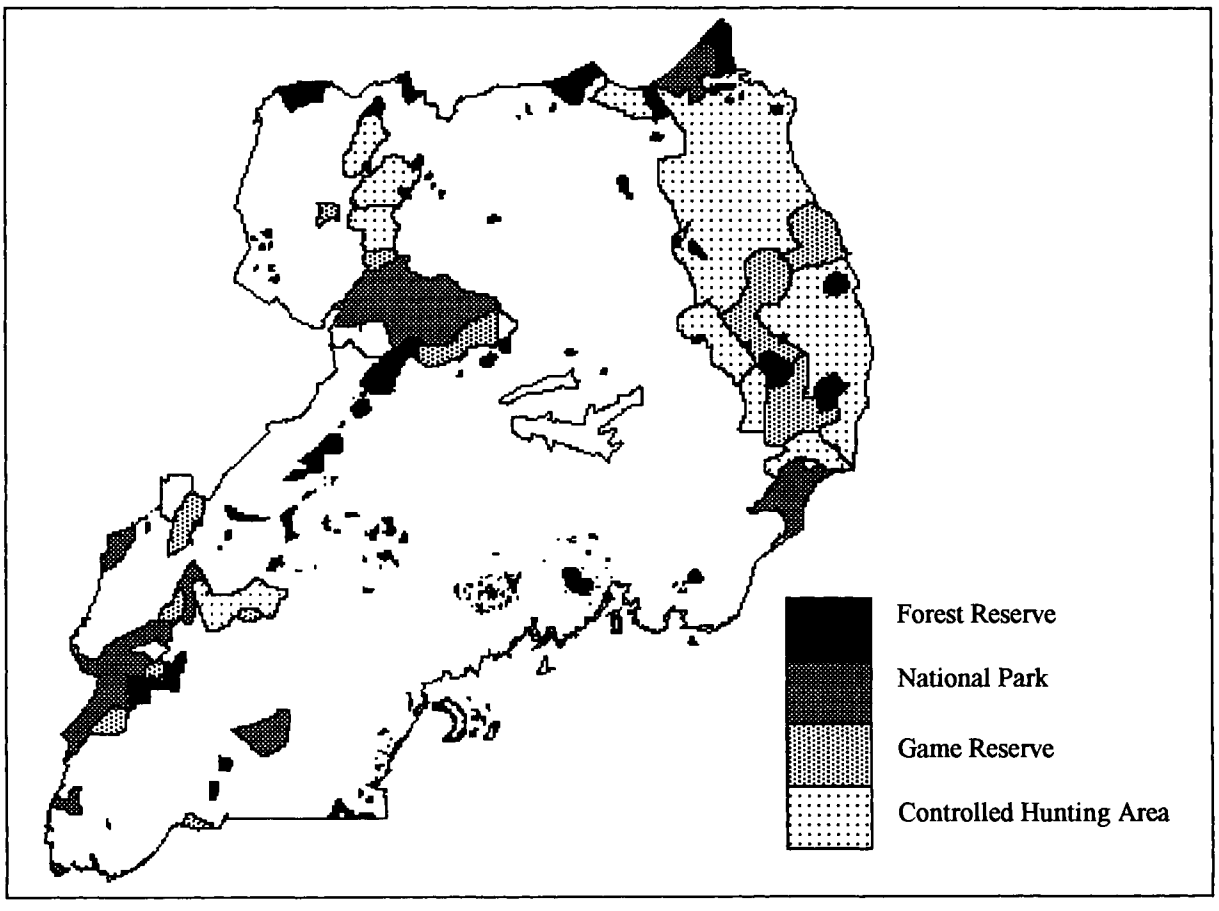

Figure 12.4. The protected areas of Uganda. Note that some areas have dual status, although on the map Forest Reserves within National Parks, or Game Reserves within Forest Reserves, are not depicted. Partly after Kamugisha (1993).

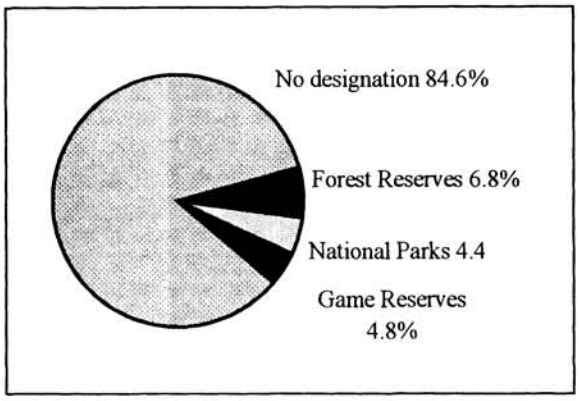

Figure 12.5. Protected areas in Uganda as a proportion of the total land area. Game Sanctuaries and Controlled Hunting Areas have been excluded, because in practice they receive virtually no protection. From various sources.

Some people might argue that "locking up" so much land is unethical in a country with high population growth like Uganda, especially since so many people are dependent on the land for their survival. However, quite apart from the argument that protected areas are more valuable as they are than if they were converted (see Chapter 9), it should also be clear that, with population growth at nearly three per cent per year, it would not take many years for the "extra" land within protected areas to be completely settled. In fact, the effect would be so short-lived that after less than seven years, the human population would have grown by more than enough to replace completely all the protected areas with cultivation, and then Uganda would be back to where it was, except with more people and none of the benefits of the protected areas that exist today.

12.3 ISLAND BIOGEOGRAPHY AND THE DESIGN OF PROTECTED AREAS

12.3.1 The theory of island biogeography

Protected areas are the fundamental units of nature conservation. The main question that concerns us here is, how can we make sure that protected areas are designed to achieve the best results for conservation while minimising conflict with other potential legitimate land-uses?

When considering these questions, it is useful to bare in mind the ideas that make up the theory of **island biogeography** (MacArthur and Wilson, 1967). In brief, the theory states that ***the number of species able to survive long-term in a given area is a function of the balance or equilibrium between the rate at which species can colonise the area in question and the rate at which species become extinct in that area***. The reference to islands stems from the original analyses that looked at differences in species richness on oceanic islands of different sizes and distances from the mainland (the presumed source of colonising species). It was found that:

- smaller islands have fewer species than larger ones, regardless of the distance from the mainland;
- more distant islands have fewer species than nearer ones, regardless of size.

This is because an increase in distance from source of colonists lowers the immigration rate (because few species can colonise over long distances), while an increase in island area lowers the extinction rate (because more species can coexist).

12.3.2 Species-area curves and the effects of ecosystem loss or fragmentation

The observation that small islands have fewer species than larger ones has been found to be true for very many ecosystems, and not just for oceanic islands. In theory, any ecosystem that is surrounded by a different sort of ecosystem or ecosystems can be considered to function a bit like an island. Something like a forested mountain-top surrounded by lowland savannah is an obvious example.

The concept can even be extended to isolated patches of forest in an "ocean" of agricultural land. The general relationship takes the form of a curve, referred to as a *species-area curve*. Figure 12.6 is an example of a species-area curve, based on the cumulative number of tree species recorded in mixed forest in Budongo. Note that the larger the area sampled, the more species there appear to be, but that after a while further sampling hardly leads to the recording of any further species. In general, the larger the area of a given ecosystem, the more species it is likely to support, but beyond a certain size it does not make much difference how large the area is. In practice, protected areas are seldom big enough for species-area curves to be completely levelling off to a plateau for all groups of plants and animals.

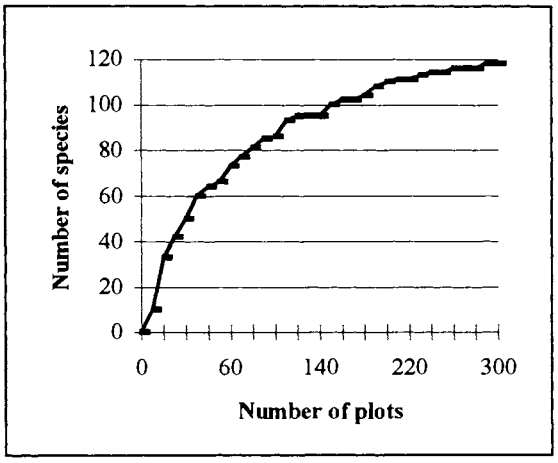

Figure 12.6. A species-area curve for tree species in mixed forest in Budongo Forest, Uganda. Redrawn from Plumptre et al. (1994).

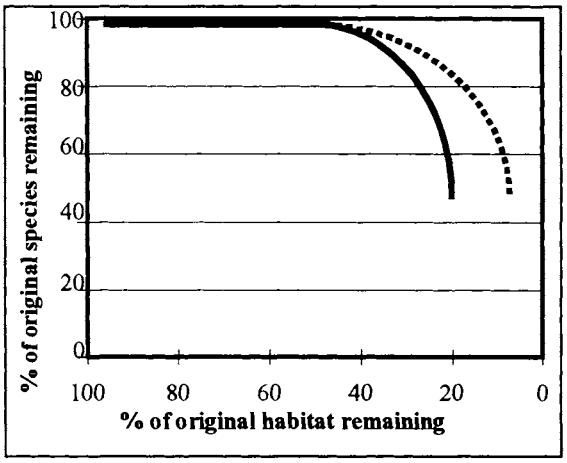

Figure 12.7. The effect of ecosystem loss or fragmentation on the number of species able to survive long-term. The vertical axis shows the proportion of the original species pool remaining. Two extremes are plotted: one for a group of species that requires a large area and has poor powers of dispersal (solid line) and a second for a group that requires smaller areas and has better powers of dispersal. After Wilcove et al. (1986).

The theory makes another important prediction for nature conservation: if the area of an ecosystem is reduced artificially (for example, deforestation, or the expansion of logging into undisturbed forest), or if the ecosystem becomes progressively more isolated from other fragments of the same ecosystem type (e.g. forest fragmentation) then the number of species that can continue to exist in that area will decline. Species will start to go extinct, one by one, until a new equilibrium point is reached as dictated by the size and degree of isolation of the remaining ecosystem fragment. This is like drawing the species-area curve on its side (Figure 12.7). Several studies have now shown this prediction to be observable. The general relationship is that "specialist" species, with narrow ecological niches and/or poor powers of dispersal, go extinct first, followed eventually by the "generalist" species that have broad ecological niches and/or good powers of dispersal.

Forest Reserves and other forested protected areas in Uganda represent a small fraction of the original natural forest cover in the country (see Chapter 1). This means that, if the predictions of island biogeography are correct, we will have already lost and will continue to lose species from the forest. Two examples that seem to bare this out are elephants and chimpanzees. Elephants used to occur over the whole of Uganda, but they require such large areas that there are few forests that still support them. As elephants die out, so too will species dependent on them for dispersal (including several tree species: see Section 5.6.32), and then the species dependent on those species, and so on. Chimpanzees probably once occurred throughout the forests of western Uganda, but are now confined to a handful of the larger reserves.

As ecosystems have a certain amount of in-built inertia, they take time to respond to changes, so even if the area of forest does not decline further we should still expect to lose more species from past declines.

The reason that species go extinct is related to how much habitat individuals of that species require for their survival. But on top of this, current thinking is that it is no use reserving enough habitat for just a few individuals of a species, because sooner or later the population will become in-bred or will become extinct due to chance events, disease and so on. We really need to look at the concept of ***minimum viable populations***. For most species, a working figure of 500 breeding individuals, or 250 breeding pairs, is seen as a minimum population size to ensure long-term survival in any one area. Some examples of estimates of minimum areas needed to support minimum viable populations of certain species are given below:

- Tropical forest trees (natural population density 1/ha): 5 km^2;
- Leaf beetles (natural population density 1/m^2): 0.0005 km^2;
- Chimpanzees (natural population density 1-2/km^2): 125-250 km^2;
- Northern spotted owl (USA) (natural population density 1 pair/9 km^2): 2,250 km^2;
- Brown hyena (Namibia) (natural population density 1 pair/250 km^2): 62,500 km^2.

Thus most forest reserves or nature reserves are large enough to ensure the survival of most tropical forest trees and leaf beetles in Uganda (assuming they are managed well), but few will be able to support chimpanzees in the long term. Leopards are likely to require even larger reserves than the Northern spotted owl (a bird confined to old-growth forest fragments in the NW USA), which means that perhaps none of Uganda's forest reserves or other protected areas are large enough for the long-term survival of this species. Leopards do currently exist in a number of forests, but their future is uncertain, unless they can also effectively occupy the land that lies between the forests, alongside humans. Figure 12.8 is a schematic representation of how the fragmentation process may affect a forest as human population pressure increases.

Soulé et al. (1979) carried out a study of several national parks in East Africa, and predicted that each of them would suffer a "***faunal collapse***" amongst the large mammals as they become more and more isolated in a sea of farmland. The collapse is partly attributed to the interdependence of species, such that if one goes extinct, others will automatically follow. The study predicted that a park such as Murchison Falls would lose 50% to 65% of its currently extant large mammal species over the next 3,000 years or so, and would not reach equilibrium until perhaps 5,000 years from now, by which time up to 75% of the original species would have gone extinct.

Since the study, at least one species (the white rhino) has gone extinct there. There is no reason to suppose that other species will not also go extinct there, or that forest reserves will be immune to the same effects. Indeed, recent studies by Dranzoa (Howard, pers. comm. 1994a) suggest that some of the bird species found in Zika Forest (a small patch of remnant forest on the Entebbe peninsula) in the 1960s are no longer present, probably because the forest is now too small to support them in the long term.

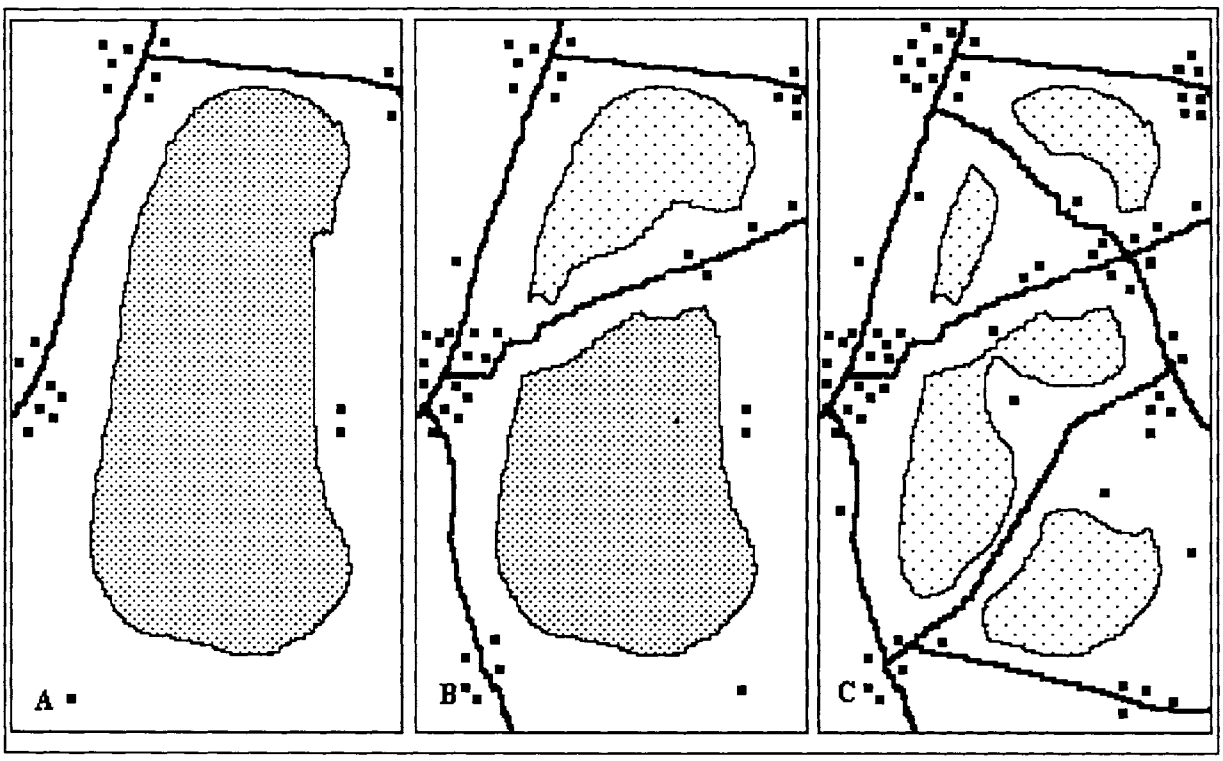

Figure 12.8. Schematic representation of the fragmentation process on a forest over time. The sequence is from left (A) to right (C). The darker shading indicates the forest areas that are large enough to support a viable population of a hypothetical species, while lighter shading indicates those fragments that are no longer large enough to support viable populations of that species. Thick lines indicate roads, black squares represent houses, and white is agricultural land. Note that, as fragmentation proceeds, the species is progressively limited to smaller and smaller areas until none of the forest fragments are large enough and the species goes extinct.

12.3.3 Applying these ideas to the design of protected areas

It has already been stated that some species survive better in smaller fragments than others. Likewise, many species can survive in forests modified by human activities (such as logging) but others cannot. As human activity intensifies, the number of original species than can survive in the long term decreases, although new, opportunistic species may colonise to take advantage of the new conditions (see Section 8.4). These ideas all support the design of protected areas along the lines of biosphere reserves, a concept which has been adopted by the Forest Department in the zoning of Forest Reserves. Reserves of importance for nature conservation will contain one or more strict nature reserves, where as many forest species as possible will be able to survive without interference. In theory, around these nature reserves, zones of low-intensity management will be established, where most (but not all) of the species found in the undisturbed forest will be able to survive. Beyond this zone may be areas of the forest that will be set aside primarily for intensive production forestry: in these zones, fewer forest species will be expected to survive, but for some species these outer zones will be important in that they increase the effective size of the nature reserve, ensuring that the Forest Reserve as a whole can support minimum viable populations.

When establishing nature reserves, such as those within Forest Reserves, an understanding of ecology and island biogeography leads us to the set of guidelines given in Figure 12.9. Note that there is a caveat that says "all things being equal". Often, there are other considerations to bear in mind, such as economic or political arguments, or the need to use clearly-defined natural boundaries such as streams or ridges. Also, some of the guidelines are potentially conflicting. At the end of the day, they are only guidelines, and the final design of any nature reserve will depend on local conditions and the skills and knowledge of the implementers.

12.4 SUMMARY

This chapter has reviewed the rationale for different sorts of protected areas and their role in nature conservation. The following points emerge as being particularly important:

- A range of activities may take place in protected areas. It helps to decide upon which activities can and cannot take place in any particular protected area and designate it accordingly. Internationally accepted categories make this process easier.
- Increasingly, managers of protected areas are adopting the concept of biosphere reserves, to cater for nature preservation as well as wise use of the natural resource.
- The global protected areas network is still growing, but tropical forests are relatively poorly represented, especially in Africa.
- Uganda's protected areas system is, on paper, one of the more comprehensive in Africa, although some key ecosystems are still poorly represented, and some protected areas exist in name only.
- The theory of island biogeography, and the idea of minimum viable populations, provide us with a sound basis for designing protected areas that will function well, and at the same time help to explain why forest fragmentation and degradation can be so harmful for nature conservation.

12.5 FURTHER READING

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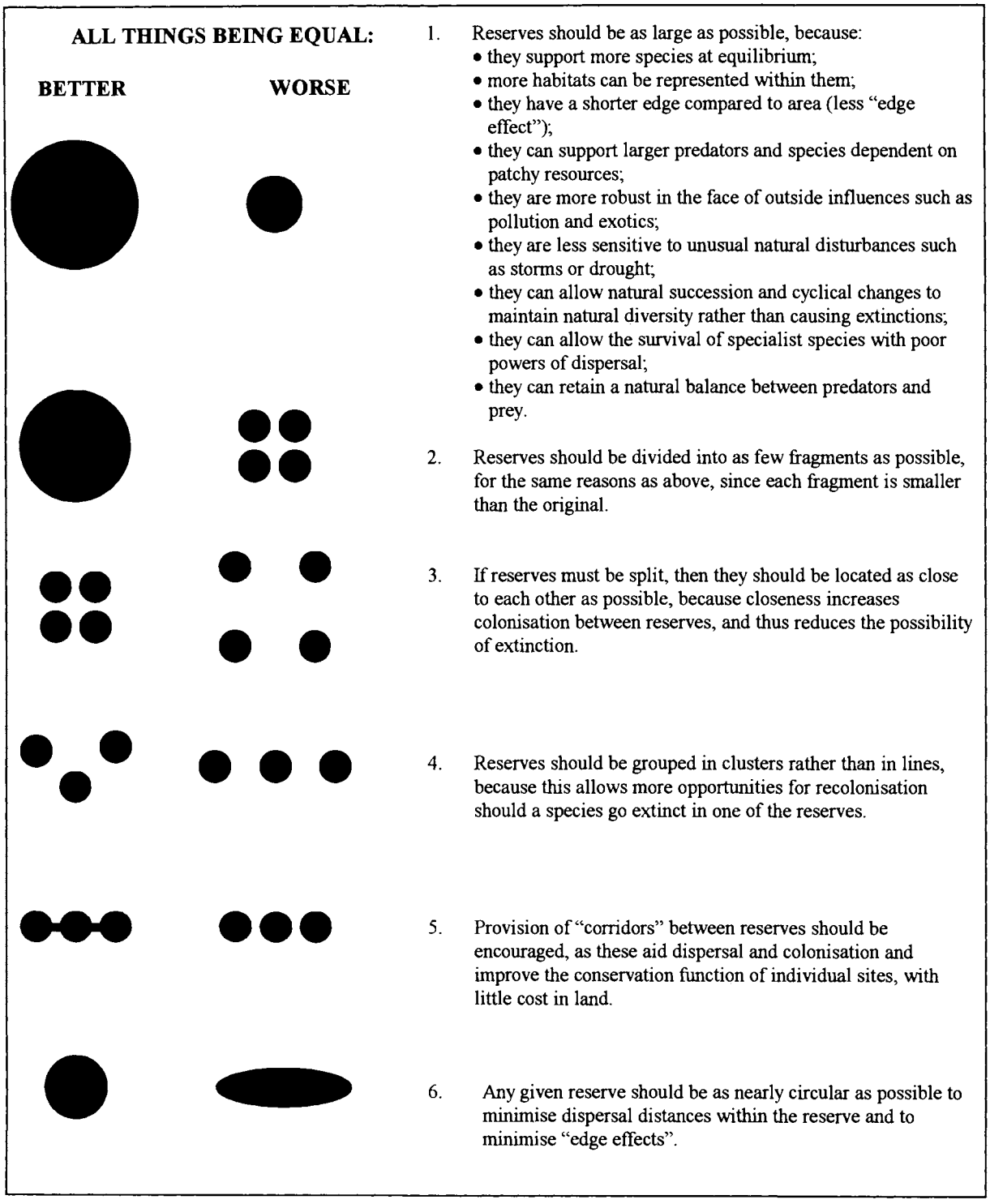

Figure 12.9. Guidelines for designing protected areas. After Diamond (1975) and Beeby (1993).