1. **CONSERVATION IN NATIONAL PARKS AND RESERVES**
	1. **Introduction**

National parks and reserves are important as instruments of conservation. In these areas alone the conservation of species supposedly takes precedence over all other uses of the land. But one may ask what national parks and/or reserves are for? That question is trite and it leads to the equally trite answer that parks and reserves are to conserve nature. When the question is refined to “what are the precise objectives of *this* park,” the answer must be more concrete. However, even the general question is not as trite as it might seem.

* 1. **Protected areas and community conservation areas**
		1. **Advantages and disadvantages of protected areas and community conservation areas**

Debate over whether protected areas, such as national parks, or community conservation areas are best for conservation is probably unnecessary because both have their advantages and disadvantages, as described below

***Advantages of protected areas***

1. Will protect fragile habitats (swamps, tundra, islands, endangered species).
2. Will protect large species that cannot coexist with humans, for example large carnivores and herbivores.
3. Can act as ecological baselines or benchmarks to monitor human disturbance outside

***Disadvantages of protected areas***

1. They do not represent all ecosystems or communities, often being selected for other reasons.
2. They are often too small to maintain viable populations, particularly of species that are adapted to live in large groups or that migrate across international borders (e.g. migrating caribou, bison, saiga antelope (*Saiga tatarica*), shorebirds (Charadriidae)).
3. Can alienate local indigenous peoples excluded by central governments.

***Advantages of community conservation areas***

1. Can represent species not included in protected areas, for example non-charismatic species (lower animals, microbes, fungi).

In general, protected areas cover no more than about 10% of the terrestrial global surface, that only about 50% of the world’s species are included. At least half of our terrestrial biota must be conserved in human-dominated systems in community conservation areas.

1. Can co-opt support of local peoples if benefits accrue to them.

***Disadvantages of community conservation areas***

1. Tend to protect only species of direct benefit to humans, and ignore the rest, which is the vast majority.
2. Excludes species that are detrimental to humans.
3. Tend to discount the future due to (i) increasing human population demands on the ecosystem and (ii) accelerating economic expectations from the system even with stationary human populations. This result in species loss and ecosystem decline.
	1. **Purposes of national parks and reserves**

It is instructive to follow the history of ideas about the function of reserves, of which national parks can serve as the type example. Here are summaries of those changes in the past. The national park idea has two quite separate philosophical springs whose streams did not converge until about 1950.

The first is American, exemplified by the US Act of 1872 proclaiming Yellowstone as the world’s first national park. The intent was to preserve scenery rather than animals or plants. Public hunting and fishing were at first entirely acceptable.

The second spring is “British colonial,” with the Crown asserting ownership over game animals and setting aside large tracts of land for their preservation. The great national parks of Africa grew out of these game reserves, some physically and the others philosophically. Wildlife was the primary concern and scenery came second.

The first was Kruger National Park established in 1926 on a game reserve proclaimed in 1898. Serengeti, in Tanzania, was gazetted in 1947 following from a reserve established in 1927. Kenya’s first was established in 1946 on the Nairobi common.

All national parks established for 40 years or more have had their objectives and their management modified several times. The more influential fashions in park theory, listed here roughly in order of appearance over the last 100 years, are not mutually exclusive. They tend to be added to rather than replacing the previous ones.

1. The most important objective is to conserve scenery and “nice” animals. The aim translated into restricting roads and railways and attempting to exterminate the carnivores. Banff National Park, Canada, has such a history.
2. The most important objective is the conservation of soil and plants. This aim was a direct consequence of the rise of the discipline of range management in the USA during the 1930s. To implement this, ‘extra’ herbivores were to be shot each year to hold the pressure of grazing and browsing at the “correct” level. An ecosystem could not manage itself. If left to its own devices it would do the wrong thing.
3. The most important objective is the conservation of the physical and biological state of the park
4. The fashion shifted to the conservation of representative examples of plant and animal associations.
5. The most important objective is the conservation of “biological diversity” (or biodiversity). Particularly, species diversity and habitat diversity. Within park management the idea translated as “the more species the better.” and the more diverse a set of plant associations the better the national park.
6. The most important objective is the conservation of “genetic variability.” The phrase can be defined tightly and usefully, but within the theory and practice of park management it lacked focus. It was tossed around with little or no attempt to define or understand what it means, whether the variability sought was in heterozygosity, in allelic frequency, or in phenotypic polymorphism. In practice it again translated into “the more species the better.”
7. The most recent objective differs in kind from the six previous objectives: the purpose of a nature reserve is to maintain, hopefully in perpetuity, a highly complex set of ecological, genetic, behavioral, evolutionary and physical processes and the coevolved, compatible populations which participate in these processes. When it puts it more plainly: “The resource is wildness.”

The first six objectives listed above identify *biological states* as the things to be conserved. The seventh identifies *biological processes* as the appropriate target of conservation. populations are not states in the sense that plant associations are states. A plant association has a species composition. Its component populations must have a ratio of densities one to the other that remains within defined limits. If those limits are breached the plant association has changed into another kind of plant association. A population, however, is not defined by ratios. The management of a national park will be determined by whether the aim is to conserve biological and physical states by suppressing processes or whether it is to preserve processes without worrying too much about the resultant states. There are three options:

1. If the aim is to conserve specified animal and plant associations that may be modified or eliminated by wildfire, grazing, or predation, then intervene to reduce the intensity of wildfire, grazing, or predation.
2. If the aim is to give full rein to the processes of the system and to accept the resultant, often transient, states that those processes produce, then do not intervene.
3. A combination of both: if the aim is to allow the processes of the system to proceed unhindered unless they produce “unacceptable” states, then intervene only when unacceptable outcomes appear likely.
	1. **Effects of corridors**

Corridors between reserves provide the benefit of increasing the size of populations and thereby decreasing the chance of demographic malfunction. However, the overall benefit of corridors is not at all clear cut and must be decided upon case by case.

The factors that might influence the use of corridors include:

1. The biology, ecology, and life history of the species
2. Habitat suitability, including the degree of original vegetation integrity, length, and width
3. Location of corridors in the landscape
4. The type of disturbance in the matrix surrounding fragments and corridors
5. Suitability of the matrix habitat

There is a conceptual problem with corridors. By definition these are strips of habitat that are too small for the species of interest to live in permanently (e.g. too close to the edge of forest for interior forest birds, or too narrow to support a territory). Such strips may be suitable for wide-ranging species, such as rodents, that would benefit from the cover provided by forest or shrubs to allow safer movement relative to movement over fields. However, such species would probably traverse these open habitats if corridors did not exist. In contrast, sedentary species such as interior forest birds (the New Zealand kokako (*Callaeas cinerea*) is a good example of a highly territorial bird that flies poorly and moves little through dense forest) are unlikely to venture into corridors because they are unsuitable habitat. Thus, species that would benefit most from corridors, the reluctant travelers, are the ones least likely to use them, and vice versa. Corridors could also act as sinks, trapping animals in them but preventing successful breeding.

A good example of the effect of corridors is the Narrow strips of eucalypt woodland act as corridors, or more accurately as stepping stones, to connect isolated fragments of original eucalypt woodland in Western Australia. These corridors result in higher species richness of birds, so that the closer the corridors to a patch the higher the species number.

The efficacy of corridors needs to be assessed on a case-by-case basis. Thus, Researchers used the Seychelles islands of the Indian Ocean to make the point that corridors are not always beneficial. The Seychelles contained 14 endemic land birds when Europeans arrived in 1770. Land clearing, fires, and the introduction of rats and cats devastated the archipelago over the subsequent two centuries but resulted in the extinction of only two of those species. Losses were limited partly because no corridors (isthmuses) linked the islands. Introduced predators and fires were unable to reach all the islands.

**Table 7.3.** Potential advantages and disadvantages of conservation corridors



* 1. **Criteria for selecting an area for conservation**

Parks are chosen for a number of reasons: great scenery, many species, a cherished plant association, or a set of interesting landforms. Sometimes the area chooses itself, being deemed good for little else.

Most national parks established since 1960 (the majority) have been chosen with some care. They are designed to conserve the plant and animal communities and/or their associated ecological processes in a particular climatic zone. Therefore, the first step in the selection of an area for conservation is deciding the climatic zone. Having decided upon the zone the next step is to choose an area within that zone which samples or epitomizes that zone. The decision is determined first by what land is available for conversion to a park. It is then determined by whether a piece of available land is large enough, or can be made large enough by accretion of adjacent areas, to serve as a national park. Finally a choice is made between the various areas of land that meet the above criteria.

It seems a good idea to take high habitat diversity and species diversity as criteria of choice. If the choice of land is determined mainly by the criteria that the area contains the greatest internal diversity of habitats and also by which contains the largest number of species, the following negative consequences may follow.

These two criteria of choice have an effect upon extinction rates within the reserve. First, they ensure that the park will have an over diversity of species and habitats. If an area contains a diversity of habitats it will on average contain little of each. *A species dependent on a single habitat will therefore be represented on average by a small population within such a reserve.* Secondly, if the area contains a diversity of species, several of those species will be near the edge of their ranges and so will be living outside their environmental optima. Such species will be at low density within the reserve. If the reserve becomes an ecological island the number of species it contains will be much higher than that predicted by the species–area curve and *it can therefore be expected to lose species*. The consequence of choosing a diversity of habitats is that the main habitat of interest (e.g. rainforest, savanna, taiga) tends to be sampled near the edge of its distribution to allow other habitats to integrate with it. If the climate changes then *the habitat of interest is likely to be lost.* Those are effects of sampling a region by an area containing most of the characteristics of the whole region.

To summarize, to select an area suitable for conservation, one should:

1. choose an area containing a moderate rather than a high number of species
2. include only a moderate number of habitats within the same reserve
3. position a reserve as close as possible to the center of distribution of the habitat of greatest interest.
4. **CONSERVATION IN NATIONAL PARKS AND RESERVES**
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National parks and reserves are pre-eminently important as instruments of conservation. In these areas alone the conservation of species supposedly takes precedence over all other uses of the land. But one may ask what national parks and/or reserves are for? That question is trite and it leads to the equally trite answer that parks and reserves are to conserve nature. When the question is refined to “what are the precise objectives of *this* park,” the answer must be more concrete. However, even the general question is not as trite as it might seem. This unit describes advantages and disadvantages of protected areas and community conservation areas, history of protected areas and their changing objectives, effects of area of National Parks, advantages and disadvantages of corridors.

* 1. **Protected areas and community conservation areas**
		1. **Advantages and disadvantages of protected areas and community conservation areas**

Debate over whether protected areas, such as national parks, or community conservation areas are best for conservation is probably unnecessary because both have their advantages and disadvantages, as described below

Advantages and disadvantages of protected areas such as national parks compared with community conservation areas

***Advantages of protected areas***

1. Will protect fragile habitats (swamps, tundra, islands, endangered species). For example, the only breeding grounds of the whooping crane (*Grus americana*) occur within the Wood Buffalo National Park, Canada, and the only known location of the Madagascan tomato frog (*Dyscophus antongilii* ) is in a single pond in the north of Madagascar.
2. Will protect large species that cannot coexist with humans, for example large carnivores and herbivores.
3. Can act as ecological baselines or benchmarks to monitor human disturbance outside

***Disadvantages of protected areas***

1. They do not represent all ecosystems or communities, often being selected for other reasons.
2. They are often too small to maintain viable populations, particularly of species that are adapted to live in large groups or that migrate across international borders (e.g. migrating caribou, bison, saiga antelope (*Saiga tatarica*), shorebirds (Charadriidae)).
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1. Can represent species not included in protected areas, for example non-charismatic species (lower animals, microbes, fungi).
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1. Tend to protect only species of direct benefit to humans, and ignore the rest, which is the vast majority.
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	* 1. ***Are processes or states that should be conserved?***

The first six objectives listed above identify biological states as the things to be conserved. The seventh identifies biological processes as the appropriate target of conservation. At first glance Frankel’s and Soulé’s purpose of a nature reserve appears also to require the maintenance of states because it refers to the conservation of populations. However, populations are not states in the sense that plant associations are states. A plant association has a species composition. Its component populations must have a ratio of densities one to the other that remains within defined limits. If those limits are breached the plant association has changed into another kind of plant association. A population, however, is not defined by ratios. The ratio of numbers in one age class relative to those in another, or the ratio of males to females, has no bearing on its status as a population. The management of a national park will be determined by whether the aim is to conserve biological and physical states by suppressing processes or whether it is to preserve processes without worrying too much about the resultant states. There are three options:

1. If the aim is to conserve specified animal and plant associations that may be modified or eliminated by wildfire, grazing, or predation, then intervene to reduce the intensity of wildfire, grazing, or predation.
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3. A combination of both: if the aim is to allow the processes of the system to proceed unhindered unless they produce “unacceptable” states, then intervene only when unacceptable outcomes appear likely.
	1. **Effects of area**

Within any group of islands (e.g. the Antilles, Indonesia, Micronesia) big islands tend to contain more species than do small islands. Size as such is not the only influence on the number of species – distance to the mainland, for example, plays a part – but area alone provides a close prediction. The relationship between the number of species and the size of the area within which they were surveyed is known as a species–area curve.

Algebraically it takes the form:

***S* = *CAz***

Where, Sis the number of species of a given taxon (e.g. lizards, forest birds, vascular plants)

 *A* is the area

*C* is the expected number of species on one unit of area (usually 1 km2) and

*z* indexes the slope of the curve relating the number of species to the number of square

 Kilometers.

The table able below shows the relationship between species number and land area for Tasmania and the islands between it and the Australian mainland. These were all linked to each other and to the Australian mainland up to about 10,000 years ago, the subsequent fragmentation reflecting rise of sea level at the end of the Pleistocene. The number of marsupial herbivores that they carry therefore reflects differential extinction without reciprocal immigration over the last 10 millennia. The estimated *z* = 0.18 is low for islands, being closer to that expected for areas within continents, and it probably reflects the recent continental nature of those islands.

**Table 7.1.** Relationship between the number of species of herbivorous marsupials and area of

 land on Tasmania and the islands between it and the Australian mainland.\* The

 “expected” number is calculated as *S* = 1.70*A*0.18.



Table 7.2. shows how *C* and *z* are calculated from these data. The expected number of species on one unit of area, *C*, varies according to latitude, elevation, ecological zone, taxonomic group, and the units in which *A* is measured. In contrast, *z* tends to be quite stable. For most taxa and groups

**Table 7.2.** Estimating the constants of a species–area curve.

of islands, it lies between 0.2 and 0.4. At the midpoint, 0.3, an increase or decrease of area by a factor of 10 results in a doubling or halving respectively of the number of species (by virtue of 100.3 = 2). Thus, when *A* = 1, *S* = *C* irrespective of the value of *z*; and when *A* = 10 and *z* = 0.3, *S* = 2*C*.

The relationship is the same if we count the number of species on nested areas of progressively larger size on a continent. Here the value of *z* tends to be lower, usually around 0.15. It implies that a reduction of area by a factor of 10 reduces the number of species by a factor of only 1.4 (100.15 = 1.41). The difference between that exponent of 0.3 for islands and 0.15 for continents probably reflects the easier dispersal between contiguous areas of land against between islands. These relationships are particularly important for determining optimum sizes of reserves.

* + 1. ***Is one big national park better than two small national parks?***

Suppose we have the money necessary to acquire 100 km2 of land for conversion into national parks. If the aim were to conserve the maximum number of species for a long time, should we go for one park of 100 km2 or two each of 50 km2? Obviously a number of factors would influence our choice, but let us assume that the main aim is to maximize the number of species of ammals within the single large reserve or the alternative two smaller reserves. Let us assume that 1 km2 will on average contain 20 species in this region (i.e. *C* = 20). Further, we know that *z* = 0.15 for mammals in this region. Thus, a national park of 100 km2 would contain about 40 species of mammals (*S* = *CAz* = 20 × 1000.15 = 40) whereas a park of 50 km2 would hold about 36 mammals (*S* = 20 × 500.15 = 36). Whether we favor one park of 100 km2 or two of 50 km2 each comes down to how many species are held in common by the two smaller parks. That will depend on the extent to which they differ in habitat and on the distance between them. The efficacy with which a reserve system conserves species and communities thus depends on the size of the reserves and, more importantly, on where they are – their dispersion relative to the distribution patterns of species. Margules *et al*. (1982) warn against using data-free geometric design strategies (big is better than small, three is better than two, linked is better than unlinked, grouped is better than linear).

* 1. **Effects of corridors**

Corridors between reserves provide the benefit of increasing the size of populations and thereby decreasing the chance of demographic malfunction. However, the overall benefit of corridors is not at all clear cut and must be decided upon case by case.

The factors that might influence the use of corridors include:

1. The biology, ecology, and life history of the species
2. Habitat suitability, including the degree of original vegetation integrity, length, and width
3. Location of corridors in the landscape
4. The type of disturbance in the matrix surrounding fragments and corridors
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There is a conceptual problem with corridors. By definition these are strips of habitat that are too small for the species of interest to live in permanently (e.g. too close to the edge of forest for interior forest birds, or too narrow to support a territory). Such strips may be suitable for wide-ranging species, such as rodents, that would benefit from the cover provided by forest or shrubs to allow safer movement relative to movement over fields. However, such species would probably traverse these open habitats if corridors did not exist. In contrast, sedentary species such as interior forest birds (the New Zealand kokako (*Callaeas cinerea*) is a good example of a highly territorial bird that flies poorly and moves little through dense forest) are unlikely to venture into corridors because they are unsuitable habitat. Thus, species that would benefit most from corridors, the reluctant travelers, are the ones least likely to use them, and vice versa. Corridors could also act as sinks, trapping animals in them but preventing successful breeding.

A good example of the effect of corridors is the Narrow strips of eucalypt woodland act as corridors, or more accurately as stepping stones, to connect isolated fragments of original eucalypt woodland in Western Australia. These corridors result in higher species richness of birds, so that the closer the corridors to a patch the higher the species number.

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**Table 7.3.** Potential advantages and disadvantages of conservation corridors



determined first by what land is available for conversion to a park. It is then determined by whether a piece of available land is large enough, or can be made large enough by accretion of adjacent areas, to serve as a national park. Finally a choice is made between the various areas of land that meet the above criteria.

At this stage the choice of land is determined mainly by which area contains the greatest internal diversity of habitats and also by which contains the largest number of species. The two tend to be correlated. These two criteria of choice have an effect upon extinction rates within the reserve. They ensure that the park will have an over diversity of species and habitats. If an area contains a diversity of habitats it will on average contain little of each. A species dependent on a single habitat will therefore be represented on average by a small population within such a reserve.

If the area contains a diversity of species, several of those species will be near the edge of their ranges and so will be living outside their environmental optima. Such species will be at low density within the reserve. If the reserve becomes an ecological island the number of species it contains will be much higher than that predicted by the species–area curve and it can therefore be expected to lose species. Those are effects of sampling a region by an area containing most of the characteristics of the whole region.

Another consequence of choosing a diversity of habitats is that the main habitat of interest (e.g. rainforest, savanna, taiga) tends to be sampled near the edge of its distribution to allow other habitats to integrate with it. If the climate changes then the habitat of interest is likely to be lost.

To summarize, to select an area suitable for conservation, one should:

1. choose an area containing a moderate rather than a high number of species
2. include only a moderate number of habitats within the same reserve
3. position a reserve as close as possible to the center of distribution of the habitat of greatest interest.
	1. **Community conservation outside national parks and reserves**

The principles of conservation discussed above with reference to parks and reserves hold also for conservation outside those reserves. There are, however, a few important differences. In general, protected areas cover no more than about 10% of the terrestrial global surface, that only about 50% of the world’s species are included. Thus, at least half of our terrestrial biota must be conserved in human-dominated systems.

Some species or associations of species occur only rarely in reserves because parks and reserves do not capture a representative sample of the biota. In Australia, for example, few reserves contain forest types that grow on sites of high fertility. Most such sites were incorporated into state forests or alienated from common ownership before the reserve system was established. The koala (*Phascolarctos cinereus*) is dependent on such sites and so almost all attempts to conserve koalas must be made outside the reserve network where the manager does not have the same control over land use practices.

Legislation is the main means by which conservation is advanced outside reserves. Various practices, such as the killing of nominated species, are banned. Less commonly, there are controls over land clearing, thereby protecting the habitat of species that dwell in forest and woodland. Activities on land owned by the people as a whole, even though that land is not designated as a conservation reserve, may be subject to environmental impact assessment (EIA). Laws governing conservation outside reserves should take legal precedence over forestry and mining law.

* 1. **International Conservations**

Conservation is the responsibility of sovereign nations unless the issue is subject to international treaty (polar bears, ivory trade, migratory birds) or unless the problem occurs on the high seas (whales and pelagic fish stocks), on essentially unclaimed land (Antarctica) or on land under disputed sovereignty (parts of the high Arctic).

***IUCN Red Data Books***

The International Union of Nature and Natural Resources (IUCN) issues “Red Data Books” listing threatened species. Four categories are recognized, their exact wording varying according to the taxon. What follows is generalized.

**Extinct (Ex)**

Species not definitely located in the wild during the last 50 years.

**Endangered (E)**

Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating. Included are taxa whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction. Also included are taxa that are possibly already extinct but have definitely been seen in the wild in the past 50 years.

**Vulnerable (V)**

Taxa believed likely to move into the “endangered” category in the near future if the causal factors continue to operate. Included are taxa of which most or all populations are decreasing because of overexploitation, extensive destruction of habitat, or other environmental disturbance; taxa with populations that have been seriously depleted and whose ultimate security has not yet been assured; and taxa with populations which are still abundant but under threat from severe adverse factors throughout their range.

**Rare (R)**

Taxa with small world populations that are not at present “endangered” or “vulnerable,” but are at risk. These taxa are usually localized within restricted geographical areas or habitats or are thinly scattered over a more extensive range.

**Indeterminate (I)**

Taxa known to be “endangered,” “vulnerable,” or “rare” but where there is not enough information to say which of the three categories is appropriate.

Of these categories the “endangered” and “vulnerable” are the most important and there is widespread agreement on what the terms mean. “Rare” is not a particularly useful category of extinction risk and probably should not be used as such. If rarity itself is the cause of the risk, in the sense that the population size is at a level low enough to place it in danger of demographic or genetic malfunction, then it should be placed in one of the categories of threat.

**The role of CITES**

CITES is the acronym for “Convention on International Trade in Endangered Species of Wild Fauna and Flora.” The convention regulates trade in species of wildlife that are perceived to be at risk from commercial exploitation. There are 99 countries that are party to the convention.

The teeth of the convention are contained in its appendices listing the species covered by CITES. *Article II* of the convention decrees that:

1. Appendix I shall include all species threatened with extinction which are or may be affected by trade. Trade in specimens of these species must be subject to particularly strict regulation in order not to endanger further their survival and must only be authorized in exceptional circumstances
2. Appendix II shall include:

(a) all species which although not necessarily now threatened with extinction may become so unless trade in specimens of such species is subject to strict regulation in order to avoid utilization incompatible with their survival; and

(b) other species which must be subject to regulation in order that trade in specimens of certain species referred to in the above sub-paragraph may be brought under effective control.

1. Appendix III shall include all species, which any Party identifies as being subject to regulation within its jurisdiction for the purposes of preventing or restricting exploitation, and as needing the cooperation of other parties in the control of trade
2. The Parties shall not allow trade in specimens of species included in Appendices I, II, and III, except in accordance with the provisions of the present Convention.

The following table gives the number of species covered by Appendices I and II of CITES as

of 2004.

**Table 7.4.** *Number of species covered by Appendices I and II of the Convention on International*

 *Trade in Endangered Species of Wild Fauna and Flora (CITES) as at 2004. This can be*

 *updated at* [*http://www.cites.org/*](http://www.cites.org/) *eng/disc/species.shtml. Roughly 5000 species of*

 *animals and 28,000 species of plants are protected by CITES against overexploitation*

 *through international trade.*

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