

IS THERE A NEED FOR STRICT CONTROL OF NATURE RESERVES?

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The question has been posed as to whether there is need for strict control of nature reserves. A first reaction might well consider the answer to be an unequivocal 'yes', but further reflection and the fact that the question has been asked suggests that the answer is a less obvious one requiring a more rigorous analysis.

In considering the question it seems clear that the word 'control' refers to the management and conduct of nature reserves. Although some disagreement exists, the need for action by man in directing the course of events that take place biologically in a nature reserve is generally accepted today. At the extreme end of the scale of man's control of events in a reserve, is that where he simply ensures that no intervention takes place. Normally, experience has shown that at least some manipulatory management and control of the ecosystems present is necessary in order to satisfy conservation objectives. The word 'strict' is really the essence of the question posed – what degree and kind of control should be allowed and is there a need for stringent control? Since nature reserves are the objects being controlled, it is necessary to consider some features of these reserves in the Republic of South Africa (RSA), namely, (i) what is broadly being conserved, (ii) control in relation to the purpose of the reserve and (iii) the main controlling agents.

Main kinds of conserved landscape according to human impact

The meaning of 'nature reserve' would appear to be reasonably clear – an area reserved for plant and animal life and its associated environment. Such areas may, however, be either man-made creations in the sense of a plantation of introduced foreign trees and other plants, or be areas with partly disturbed or even completely undisturbed indigenous biotic communities in their natural habitat.

Westhoff (1971) has pointed out four main kinds of landscape in conserved areas. With some modification and extension to include local conditions, these landscapes, that may be termed natural, sub-natural,

semi-natural and cultivated, have arisen as a result of different levels of human impact on the biotic communities present.

Natural landscapes have a native spontaneous flora, fauna, biotic communities and habitats undisturbed by man. Primitive human societies of the hunting and food-gathering type may here be considered as part of the natural ecosystem, but where (often due to modern land use restrictions) they adopt a settled pattern and make intensive use of fire, their landscapes are best considered in the following category.

Sub-natural landscapes also have a native and spontaneous flora and fauna, although there may be minor exceptions. The structure and appearance of the vegetation has to some extent been influenced by man and his domestic animals. It is closely related to the potential natural vegetation, has a similar physiognomy and belongs to the same formation type as occurred in the original natural landscape. The structure of the animal population may also be modified as a result of human activities and, in fact, is usually the first of the biotic components to be changed because of the hunting activities of man. Much of the landscape of South African nature reserves falls into this category.

Semi-natural landscapes have a flora and fauna that is largely native and spontaneous, but the structure of the vegetation has been changed by human influence to another formation type quite different from that of the potential natural vegetation, and the structure of the animal populations is also drastically changed from that of the original. Domestic animals will usually constitute the dominant herbivores and carnivores and larger predators will be noticeably lacking.

Cultivated landscapes, in which the composition of the flora and fauna and the character of the vegetation, animal communities and physical habitat are determined and controlled by man, are not as such commonly the objects of nature conservation in this country. They usually appear as relics of past land use in areas proclaimed for nature conservation, or as areas such as tree plantations that are set aside for outdoor recreation rather than for primarily nature conservation reasons.

During the Middle Ages and until the end of the 19th century, semi-natural landscapes were predominant in western and central Europe and today are the form of landscape that is chiefly conserved (Westhoff 1971). In the RSA, however, the sub-natural type of landscape was predominant at the beginning of the present century and in many of our nature reserves, especially the older ones, is prevalent. Many of the newer reserves that are being created include semi-natural communities and habitats that have arisen as a result of considerable human disturbance. Although the trend is a normal one to be expected from the increasing intensification of land use and the use of modern farming methods in a young recently settled country, it does indicate, firstly, the urgency for acquiring land representative of the indigenous natural ecosystems in their original or near-original condition and,

secondly, the important need to consider carefully the form of control and real management objectives of reserves with semi-natural landscapes. In contrast to Europe, however, an important feature of the semi-natural landscapes of the RSA is that they are of very recent origin and are not commonly stabilized in accordance with practices dating back many hundreds of years. Within the last 100 years there have been well documented drastic changes in the vegetation and animal communities.

The form and degree of control in nature reserves must, therefore, consider also that the biotic communities and habitats are of different kinds according to their history of human influence:

- a few in which there has been no human influence;
- a large number in which human influence has played a relatively minor though significant role;
- an increasingly larger number of reserves in which the biotic communities are as yet unstable responses to human interference or already stabilized responses to human interference; and
- a small, essentially insignificant number of areas with artificial and exotic human controlled biotic communities and habitats.

Control in relation to purpose of reserve

Of obvious importance also in considering the form and degree of control in nature reserves is the purpose of the reserve. Nature reserves may be proclaimed for the purpose of conserving an adequate genetic stock of a particular species of plant or animal, to conserve a particular vegetation or plant community and its physical habitat, or to conserve a natural unique kind of landscape. In all these instances the basic objective of control and management is really to maintain the special ecosystems present. Failure to do so will defeat the purpose of the reserve.

Nature reserves may also be established to serve a special use, such as scientific study or, more commonly, outdoor recreation and tourism. Because of public demand and monetary considerations the use objectives are combined with the pure conservation objectives to provide the practical justification for proclaiming and maintaining a reserve. Although the use objective will usually coincide in principle with the pure conservation objective in that they both require maintenance of the ecosystems that are of common interest, conflict does arise because of user demand, which ultimately leads to more elaborate and eventually to strict control if the pure conservation objectives are to be satisfied. That is, there must develop a limit to which physical human entry into the natural ecosystem can be permitted without causing a disruptive functioning of the ecosystem.

Furthermore, the conservation objective has come to include an

aesthetic element which dictates that the unspoiled and natural, that is, non-man-made and non-man-associated, character of the landscape be preserved. The need for careful and rigorous control of a nature reserve therefore becomes even greater because of the number of restrictions that are necessary in both the development and in the management of a reserve.

Because of the increasing complexity arising from trying to balance and serve the different objectives associated with nature reserves, there has developed a trend towards designating reserves for specialized purposes, thus to some extent simplifying the form of control. At the one extreme, human entry has been limited to the manager and a selected and strictly limited number of pedestrians whose movements are severely controlled. Human interference and human impact by the public is therefore controlled and limited and, as has come to be appreciated, such wilderness areas cater for a select kind of public user. In certain nature reserves where rare plant or animal species are at a critical level of existence, human entry has had to be limited to a very few people charged with the study and re-establishment of the species.

In other nature reserves vehicular traffic is allowed. But the number of vehicles allowed entry at any one time and the number of roads, resting places and camps has also had to be restricted and controlled in order to preserve aesthetic character and attain conservation objectives. Even the largest reserves have had to curtail the development that would be needed to cater for the tourist demand.

Because of such restrictions on the number of public allowed entry, there has recently developed a number of relatively small reserves, usually privately owned, which cater specifically for the visitor need to see animals, roaming at large but not necessarily within a natural ecosystem nor in their natural habitats. So-called game farms also cater for a public interest by allowing controlled hunting but in an otherwise natural environment. When properly conducted, controlled hunting by the public has been considered to be merely a different way of carrying out necessary control and management procedure. Practical implementation of the procedure in nature reserves dictates that it be strictly controlled so that aesthetic character is preserved, ethical conditions are fulfilled and biological requirements are met.

Public need is also catered for in large botanic gardens, such as those of the National Botanic Gardens of the RSA where a feeling of naturalness is preserved and blended with cultivation of the indigenous flora. Similarly to the small game parks previously mentioned, emphasis here is on the plant component, rather than upon the animal and upon conservation of the whole ecosystem.

Brief and broad consideration of nature reserve control in relation to their purpose, purpose having also been determined in response to the problems of control, suggests three main elements that have to be considered in control and management:

conservation of species and the whole ecosystem;
preservation of the natural aesthetic character; and
public user requirements.

Public user requirements tend to be antagonistic to species and ecosystem conservation and to preservation of natural aesthetic character since only a limited amount of human intrusion into the natural ecosystem can be tolerated without disturbing and changing it. Strict control, though it may be of different forms catering to different kinds of person, of the public user is necessary if the conservation and aesthetic objectives are to be fulfilled.

Controlling conservation agencies

Edwards (1974) in a national survey to determine conservation adequacy in relation to vegetation types, considered only so-called 'permanent conservation areas' on the basis that they "may be considered reasonably permanent areas managed specifically for conservation". This implies a certain standard of control and management. As shown in a national register by the National Committee for Nature Conservation (NACOR) (1974), the controlling bodies for permanent conservation areas in the RSA are the National Parks Board of Trustees; the provincial conservation departments and boards of the Cape Province, Transvaal, Natal and Orange Free State; the Department of Forestry; the Sea Fisheries Branch of the Department of Commerce and Industries; the Department of Transport; the National Botanic Gardens of South Africa; and various municipal and divisional councils in the Cape Province. The reserves are broadly grouped into three categories, reflecting different main forms of control and conservation objectives, namely, National Parks, Provincial and equivalent Nature Reserves; Garden and Game Farm Reserves; and State Forest Reserves. In addition, the Department of Forestry has recently proclaimed parts of the State Forest Reserves into a number of extensive Wilderness Areas.

As shown in the broad grouping by the NACOR register and as may be expected, there are differences in the individual approaches to control and management by the different conservation agencies. For instance, most provincial agencies will, unless the reserve is a flora one, reintroduce indigenous animal populations into a newly proclaimed reserve, whereas in the State Forest Reserves the existing animal populations are accepted but there have hitherto been little, if any, attempts to deliberately recreate a nature reserve with the original animal population structure. Emphasis is also placed upon the function of State Forest Reserves as water and soil conservation areas in addition to nature conservation – a multiple use approach. Other instances of different control and management objectives in respect of Game Farms and Botanic Gardens have already been alluded to above.

In addition to these permanent conservation areas there are a large number of privately owned nature reserves. Control and management may be similar to that of the permanent conservation areas, differing only in the unfixed future status that will depend upon the attitude of the future landowner, but varies through various intensities of control to a laxity that can barely be considered nature conservation oriented.

Nature reserve control as a dynamic problem

So far nature reserve control has been considered from the viewpoints of the purpose of nature reserves, the various controlling agency and the main kinds of human influenced landscapes that are being conserved. Nature reserve control for ecosystem conservation is, however, a continuing process dealing with living biological phenomena that are in constant change. Even if in a state of so-called 'stability', this does not presuppose a static condition of either the living components or the physical habitat. It would seem that most, if not all problems of nature reserve control can be related to four main situations into which the ecosystems present will fall. As outlined by Westhoff (1971), these are for:

- (a) reserves with stable ecosystems;
- (b) reserves with dynamic successional systems;
- (c) reserves where change is induced by influences external to the reserve; and
- (d) reserves where change is induced by internal control and management practice.

The first two categories of stable and dynamic systems refer to problems of control due to the inherent character of the ecosystems that are present in the reserve, whereas the last two categories refer to the externally or internally man-induced problems of nature reserve control. In essence the categories refer to the form and degree of control necessary to maintain the ecosystems present in a nature reserve.

Nature reserves with stable ecosystems

Nature reserves with ecosystems where there are no obvious signs of short term successional change over a period of at least several centuries may be referred to as stable, or at least relatively stable. According to Westhoff (1971), this "situation is much more widespread than was formerly supposed, when, apart from the climax succession was thought to be a universal and omnipresent phenomenon". On a physiographically stable site with a constant balance between primary and secondary production the pattern of vegetation is relatively stable. This is also the case for many sub-natural and semi-natural communities that present non-climatic climax communities.

For management, recognition of the relative stability of many ecosystems that, in terms of Clementsian mono-climax theory, represent successional stages, is important. Firstly, because over-emphasis on the theoretical mono-climax relationship creates the farcical objective of endeavouring to control and manage development towards a tenuous impossible long-term stage, for example, on certain soils a mono-climax relationship is really suggested and not a developmental stage. Secondly, management control is then endeavouring to change what is really a long-term balanced situation. A third reason is that such mono-climax "seral stages" are an inherent part of the whole landscape complex of ecosystems, a diversity which it is desirable to maintain so that stability of the ecological diversity of biotic components can be achieved. Incorrectly assigned manipulatory control may thus, for instance, upset an animal population adapted to a diversity of vegetation structures to set in motion a destructive set of compensatory adjustments.

Such relatively stable ecosystems, must therefore be identified and the consequent management control policy strictly defined. Since the systems are stable, a departure in control policy from the *status quo* can be expected to destabilize the ecosystems, such as providing new watering points in a dry area.

Nature reserves with dynamic successional systems

Dynamic successional systems may be grouped into three types: those characterized by cyclic successions; those termed 'proceeding' by Westhoff (1971), where new bare areas are continually being formed as the previously bare areas develop; and those that Westhoff calls 'terminating', in which the communities develop to the terminal climax.

The classical works of Watt (1947, 1964) on pattern and process in vegetation, which showed that cyclic community successions are more frequent than formerly supposed, have been much overlooked in this country. They are important in nature reserve management since failure to recognize them will mean the creation of a uniformity at the expense of a stable natural diversity. Situations where such cyclical successions appear to operate are in the Drakensberg summit vegetation (Edwards 1967), in estuaries (*cf.* Steinke and Ward 1973; Breen and Hill 1969), and in certain savannas and scrub types (*cf.* Western and van Praet 1973).

The case of certain so-called scrub encroachment phenomena is one where investigation is needed to establish whether they are not really phases of a cyclic succession in certain areas, involving wet and dry climatic periods, fire and animal interactions. The appropriate form of control would then be indicated to the reserve manager, faced with developing a control policy in the *fait accompli* of a physically circumscribed reserve. If cyclical successions are present they should be recognized and disturbing control prevented, so that at any one time all

stages will be present but through time there will be a spatial shift in the communities. Control is then to maintain the plant and animal species typical of the pioneer, building, mature and degenerating phases of the cycle of communities and not prevent the cycle. Important is understanding of actual processes that are involved and not simply application of a blanket treatment to reduce all to a monotonous uniformity.

In the case of the proceeding type of succession where new stages are created as the old stages develop, the chief problem that may arise is that earlier stages of particular conservation interest may eventually become lost to the reserve whose boundaries are fixed. This suggests that such situations should be recognized when the reserve is established and due allowance made. The alternative of endeavouring to maintain early successional stages by deliberate manipulation of the physical environment and autogenic processes of development would, generally speaking, be a hazardous operation involving great skill and monetary expenditure.

In the case of the terminating succession, which is here used in a polyclimax sense, the problem of maintaining the diversity of seral stages may also be difficult and only resolved by the presence of a rejuvenating factor. In many sub-natural landscapes fire and grazing provide the rejuvenating factors preventing successional development to forest. If they are not used in the reserve management, successional development occurs and the communities of conservation interest and value will be lost eventually. Such situations have occurred in a number of reserves, though not irretrievably since the trends were recognized after a number of years and fire was re-introduced to provide the vital factor for the fire adapted flora. Another example is that of swamp vegetation where large animals such as the elephant and hippopotamus appear as the factor necessary to maintain open water and to prevent the general raising of the soil surface by maintaining a fine mosaic swamp community patterning.

Nature reserve change due to external factors

The problem of nature reserves in which disturbance and change occurs as a consequence of outside influences is increasing. Notable examples are changing water tables, eutrophication of oligotrophic aquatic and terrestrial systems, pesticide control of animals and plants, and invasion by alien plant and animal species. Such external influences create change either by altering the course of successional development, or by developing new undesirable kinds of community at the expense of the indigenous conserved communities. Prevention of the external cause at its source is the obvious means of preventing such change, but is often exceedingly difficult to achieve because of outside economic interests.

It is clear that where exotic invasions occur at the expense of the indigenous flora, fauna and habitats that are being conserved, the

strictest forms of control are necessary and eradication must be attempted. However, the form of control that is permissible is sometimes more contentious, chiefly because most control and eradictory measures can seldom be applied without disturbance of the indigenous ecosystems and species that are present. Wholesale destructive or sterilization measures can rarely be justified, and certainly not if rare species and ecosystems are involved. But there seems to be no rational alternative to applying a method of control or eradication even if it does have undesirable temporary side effects on conservation. It may well be argued that unless strict control of aliens is exercised, conservation objectives will not, in any event, be achieved. Careful consideration of the control measures to be adopted will, however, always need to be made, especially of the aesthetic effects.

Nature reserve change due to internal control and management practice

Although in Europe semi-natural ecosystems constitute one of the main problems of conservation management since the disturbance that starts as soon as the former age-old management practice is stopped or changed causes a succession that leads to homogenization and loss of diversity (Westhoff, 1971), the problem is not at this stage entirely similar in the RSA. As pointed out previously, most of our semi-natural ecosystems are of very recent origin without having reached the equilibrium and diversity found in the older man-controlled systems of Europe. Semi-natural systems are, however, being included more and more into the newer reserves and the question of the objectives and form of reserve control of such systems is consequently becoming more important. Many of the reserves contain secondary communities that have developed in response to fire and grazing management in which important indigenous animal components are lacking.

The general aim appears to be to manage for re-establishment of the original communities. Since these systems have in most instances not achieved the anthropogenically induced diversity of species and unique interest of the European types, the aim would appear justifiable. Practical realization of the aim is, however, not always easy and in arid areas and certain secondary communities re-establishment may be an exceedingly long process.

The question of whether indigenous animals should be introduced can only be justified on biological, aesthetic and conservation ethical grounds if the animals were formerly present and a part of the local natural ecosystems. In both the natural and sub-natural ecosystems it is then essentially a matter of re-introducing former components. Introducing indigenous animals formerly of the area but into what is now a semi-natural ecosystem structured by human activity can, however, lead to considerable problems of habitat management and animal establishment. The vegetation habitat may, in fact, no longer be suited to the

particular species of animal, or be such that it will change because of the animal population to a degraded type. Careful prior consideration thus needs to be given to the consequences of the introduction and to the subsequent management objectives and form of manipulation that may be needed.

The degree of control that may be allowed in a nature reserve may be illustrated also by watering point development. The creation of watering points can well be expected to create change in ecological systems adapted to a particular natural level and kind of animal population. The justification that the physical circumscription of a nature reserve in itself creates an artificial system requiring control is valid, but only to the extent that conservation and aesthetic interests are not infringed. If conservation and aesthetic objectives in a nature reserve include all components of the ecological systems, priorities for favouring only a particular element can only be allocated to that element in such cases as when the total existence of a species is threatened. Culling, for example, is necessary in order to preserve a suitable habitat for all the species and to maintain the character of the whole ecosystem. But if the degree of control is such that for the sake of some non-conservation interest the whole ecosystem is altered, then it is unethical and the purpose of the reserve to conserve is changed.

Ecological changes in a nature reserve resulting from internal control and management are therefore justifiable when the purpose of control is deliberately to change a system to another one that is necessary for sound biologically based conservation reasons, but not if the reasons are to serve sectional public or other interests. It is necessary to know the controlling ecological factors present in the ecosystems of a reserve so that the kind and degree of control exercised is appropriate to maintain the system.

Knowledge of the structure and functioning of ecosystems that is appropriate to their proper control must also take into account recent work on biogeography, diversity and stability. Diamond (1975), for example, points out that a system of natural reserves each surrounded by changed habitats resembles a system of islands. Different species require different minimum areas to have a reasonable chance of survival. The number of species that a reserve can hold at equilibrium is a function both of its area and its isolation, a rough rule of thumb being that a tenfold increase in island area means a two-fold increase in the number of species. The fraction of the habitat area preserved in a reserve means that it will initially contain more species than it can hold at equilibrium. The excess will gradually go extinct and the smaller the reserve the higher will be the extinction rate.

Summary and conclusions

That control of nature reserves is necessary is generally accepted by conservation authorities in the RSA, but there are different ways in

which control is carried out by the different conservation agencies and according to the purpose of the nature reserves. While the need for control is evident, the form and degree to which control should be applied is more complex. Strictness is necessary in that the form and degree of control needs to be clearly defined and appropriate and in that the real purpose of control must be strictly adhered to. Strictness does not, however, imply that the controlling policies and measures are inflexibly applied to the detriment of the real objectives of control.

The kind and degree of control necessary depends on the three main purposes of nature reserves: to conserve species and ecosystems; to preserve the natural aesthetic character of the landscape; and to satisfy certain needs of what may broadly be termed the public. Public needs tend to be antagonistic to the conservation and aesthetic objectives since only a limited amount of human intrusion can be allowed without upsetting the functioning of the natural ecosystems and destroying the natural aesthetic character of the landscape.

Natural aesthetic character is obviously maximal if no man-made features are allowed, but when human entry is permitted certain facilities need to be provided. Such facilities must not intrude upon the character of the landscape. Intrusiveness can be controlled by the form and character of buildings, etc., but there is ultimately a limit that can be allowed to the amount of artefact. Power line and other engineering constructions are flagrant desecrations of landscape aesthetics.

Control to serve the conservation objective is an ecological problem that depends upon the character of the ecosystems present in a reserve; upon external factors that may influence these ecosystems; and upon the human control internal to the reserve. It is essentially a problem of controlling the dynamics of ecosystems.

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