6-4-4

Forest Ecology and Management, 7 (1983/1984) 57—66
Elsevier Science Publishers B.V., Amsterdam — Printed in The Netherlands

POSITIVE MANAGEMENT FOR STRICT NATURAL RESERVES: REVIEWING EFFECTIVENESS

JOHN B. HALL

Division of Forestry, University of Dar es Salaam, P.O. Box Sub-Post Office Chuo Kikuu, Morogoro (Tanzania)

(Accepted 21 February 1983)

ABSTRACT

Hall, J.B., 1983. Positive management for strict natural reserves: reviewing effectiveness: reviewing effectiveness. *For. Ecol. Manage.*, 7: 57—66.

Current interest in creating networks of strict natural reserves is not reflected in active management for conservation in the field. The absence of any practical guidelines is considered responsible for this situation. The first step is to ascertain the effectiveness of the strict natural reserve. Accordingly, proposals are made for collecting appropriate information through routine patrolling followed by formal interference assessment surveys. For both phases of activity attention centres on the individual threats to which strict natural reserves are exposed and a classification of the threats is given. Organizational change may be needed to promote positive management: it is argued that strict natural reserves would benefit if they were separated administratively and financially from other parts of the forest estate.

INTRODUCTION

In the last 2 decades considerable attention has been given to the importance, in conservation and research, of areas set aside as strict natural reserves: examples of the community in its un-modified state. The increased publicity given latterly to strict natural reserves leaves no doubt, however, that preoccupation is with their creation and their legal status (Roche, 1975a). Comments which look beyond the establishment phase are less frequent: reference is made most often to the desirability of biological monitoring programmes. The exceptions, though valuable, are concerned more with highlighting points to consider than outlining procedures for considering them. Brune and Melchior (1976), for example, urge theft control but do not indicate criteria for deciding if theft is a problem serious enough to demand control action, nor what such action should be. Positive guidance for management is not given.

Two principal management issues arise with strict natural reserves —

0378-1127/83/$03.00

stability and effectiveness. Stability depends upon questions of succession (Roche, 1975b) and on reserve size and shape (Ashton, 1976; Roche, 1979) and management approaches to problems of instability will vary with the composition of the community. In contrast, the concern of management with effectiveness can be expressed in universally applicable practical measures and here, therefore, attention centres on this issue.

The approach outlined here has recently been adopted in connection with the management of the University of Dar es Salaam's strict natural reserve at Mazumbai Forest in Tanzania's West Usambara Mountains. It is, however, likely to be widely applicable and hopefully will provide a stimulus for more positive future management elsewhere.

OBSTACLES TO EFFECTIVENESS

Implicit in the recognition of most strict natural reserves is the understanding that they should enjoy inviolate status. Nevertheless, as Roche (1975a) points out, full legal support for such a status is rare. Even when present it will not in itself guarantee full protection. In practice, abuse of inviolate status is rife. Sometimes legal wrangles render the forest services powerless to halt undesirable activity and combinations of inadequate legal protection and unsympathetic local attitudes have frequently dashed hopes of maintaining a strict natural reserve (Ola-Adams and Iyamabo, 1977). In fact, even where abuses are not reported the status of reserves remains in doubt: first hand impressions and conversations about strict natural reserves reveal that after creation reserves are officially largely ignored. This situation arises from the lack of any appropriate set management routine.

Most strict natural reserves are parts of national forest estates. It is assumed for them that existing management practices and schedules embraced in Government forest policy are adequate and appropriate. Strict natural reserves, despite this assumption, are not readily managed within these schedules: where there is a general aim of preserving a sample of the natural vegetation in perpetuity (Ola-Adams and Iyamabo, 1977), it is obvious that management in accordance with a standard plan (e.g. Bourne, 1934) presupposes too much interference. The initial course of management action is, however, clear. The threats that may weaken its inviolate status must be determined and the severity of each assessed.

POSSIBLE THREATS

There are three basic categories of threat: intrusions, external events and unpredictable effects. Intrusions refer to events instigated within the strict natural reserve as deliberate removals or introductions of material or as ecosystem modifications. External events are considered as threats when their influence penetrates the reserve and leads to change in the faunal population balance or the habitat within it. Unpredictable effects describe the unaided,

TABLE I

Classification of the main threats to the effectiveness of strict natural reserves

Basic categories	Sub-divisions	Individual threats
Intrusion	removals	of poached animals
		of animals for food
		of animals for bait
		of animal trophies
		of commercial specimens of animals
		of logs
		of poles
		of plant material for food
		of plant material to feed animals
		of medicinal plant material
		of plant material for building and craftwork
		of commercial specimens of plants
		of fuelwood
		of other organic debris
		of stone
		of soil
		of water
	introductions	of livestock
		of crops
		of waste stone
		of waste soil
		of waste rubble
		of domestic rubbish
		of polluted water
	ecosystem modifications	path making
		camp making
		application of fire
External events	disruption of the faunal population balance	through loss of species from reserve
		through depressing population density
		through repelling animals from boundary area
		through attracting animals to boundary area
		through raising population density
		through attraction of new species to reserve
	ecosystem modifications	through changed microclimate
		through incursions of fire
		through sedimentation
		through soil erosion
		through water contamination

Continued overleaf

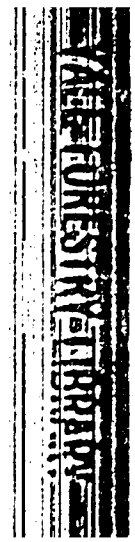

Table I continued

Basic categories	Sub-divisions	Individual threats
Unpredictable effects	arrival of exotics	cash crop species
		agricultural crop species
		forestry plantation species
		horticultural species
		ornamental species
		amenity species
		fungal diseases
		invertebrate pests
	arrival of local invaders	woody species
		non-woody species
		fungal diseases
		invertebrate pests

or at least unintentional, establishment of alien (exotic or locally derived) organisms dispersed into the reserve from man-modified communities near-by. During patrol and assessment work, specific threats within the broad categories must be considered individually. In Table I the main threats are listed, by categories.

PROBLEM DETECTION: PATROL ACTIVITY

The consistent small size (generally below 500 ha) of strict natural reserves is significant for two reasons. Firstly, it is universally important to watch closely boundary situations — most of the area is close to a boundary. Secondly, a single man, if necessary, easily can review the situation in a reserve thoroughly and frequently.

Earlier, the lack of official activity in strict natural reserves was mentioned. How important activity proves to be will vary with circumstances but it is needed both to confirm the intended status and to check that it is respected. A problem detection survey of the reserve by patrol staff should be carried out at least once a year in the most secure cases and much more frequently in those that are highly vulnerable. There must be positive control over patrolling activity. The staff involved must be specially instructed in procedures applicable for this task and they should submit two kinds of report after a patrol — an annotated base map and a completed proforma.

The map allows recording of where any relevant observation is made. To facilitate this the reserve is divided into units of constant area, each with reference coding: if the total extent does not exceed 500 ha, square 4 h

units are convenient. Note is made of evidence of poaching, tree cutting, the dumping or removal of material and habitat modification by fire and path or camp making. The map must also indicate sensitive points (rights of way, boundaries and watercourses) — special care is taken to check these during patrols. A fresh map, dated appropriately, is used on each occasion.

Proformas complement observations expressed in map form

Specifically, they enable encounters with indicator animal species (either species that are principal objects of conservation or newly arrived aliens) to be recorded. The proforma is to be preferred to the map for this purpose as negative reports are more easily noted. Provision must be made for patrol staff to develop competence in detecting and recognizing the animal species and also for the list to be reviewed from time to time as circumstances warrant. Proformas should accommodate entries enabling cross-reference to the base map.

PLANNING ASSESSMENTS

General considerations

Where review of status is concerned, patrol staff should not be expected to do more than locate and report incidences of abuse and encounters with indicator species: formal assessments should be undertaken by more appropriately trained personnel. What the returns from patrolling exercises will provide, however, are indications of where, initially, more intensive attention should be directed.

Assessment of the effectiveness of strict natural reserve status involves direct observations on plants or habitat features but for animal information indirect approaches are more convenient. Additions to the fauna may leave distinctive traces in the reserve: inference relates these to an overall level of activity and an estimate of numbers. Poaching and other removals of animals require more elaborate procedures for estimates of their impact. The density of bases used for these activities can be established by direct observation. The period of use and the frequency with which new bases are set up and old ones abandoned must be determined through periodic re-assessment. The significance of bases is gauged after interviews with people that engage in the activity — either caught offenders or those willing to discuss their craft who live outside the reserve but in the general area.

Assessment activity should not, however, be limited to observations within a reserve. Information collected from communities in the vicinity is vital where attention focusses on threats posed by external events. Trends of increasing or diminishing interference in parts of reserves near boundaries may prove correlated with particular activities outside. It is most important to be aware of such correlations as they may help in formulating accurate predictions of the consequences if certain developments outside take place.

Practical considerations

When organizing assessments four practical considerations arise: the policy governing sampling, the form of data to be collected, the frequency and the need for standards with which results can be compared.

Sampling

Assessments in routine management should be simple and time-efficient and, in the case of strict natural reserves, associated interference should be minimized. These points favour adoption of systematic sampling designs. The additional advantage is that when a reasonable base map is available the samples can be located accurately and, if applicable, referred to appropriate strata where several strata are recognized.

Data

There will be marked variation in the data collected on different parameters. Frequency data, with respect to the number of samples evaluated, are the simplest. With animal signs, habitat modifications, fire incidence or removals of any items or materials that do not leave readily countable or measurable traces, more elaborate procedures are impracticable. The sample in such cases must have a defined area -- either as a transect width or plots of fixed extent centred on pre-determined positions — to enable the frequencies to be interpreted.

When, in contrast, the incidence of damage to countable individuals is assessed a quantitative approach is possible even at the scale of a single sample and is desirable. Note that recording the number of individuals affected conveys little unless it is related to the population more generally: it is this relationship that reveals the intensity of interference. Samples defined as areas or as numbers of inspected individuals are both appropriate. The latter have advantages in being quicker to carry out and are unaffected by structural anomalies in the vegetation. If the area supporting the sample can be measured or estimated, findings can be expressed in absolute as well as relative terms, as with a fixed area sample. In practice, a choice between a fixed or variable area plot is likely to depend on the sizes of the individuals inspected: if these are small (e.g. woody plants less than 10 cm in diameter at breast height) a fixed plot area of 100 m^2 to 625 m^2 is appropriate. For larger individuals, inspection of the 10, 20 or 30 nearest a centre point is more convenient.

The sample size or area will also depend on the nature of the observations being made — it is much faster to detect and record stumps left after cutting than removal of bark for medicinal purposes, for example. If the survey is purely to reveal levels of interference, no more than 30 min should be needed to assess a sample and move to the next. Where inspection must be

ıeticulate (e.g. bark removal incidence) small sample sizes or extents are ppropriate. Less demanding parameters can be assessed through larger amples and it may then be logical to incorporate observations into an nventory of more general applicability and allow more time (up to 1 h) per ample.

If vegetation is species-rich, without strong dominance, it is unrealistic to estrict work of this kind to individuals of particular species — it is more ɔracticable to review the situation as it affects each after pooling data from he whole survey. If there are dominant, or otherwise strongly represented, ɜpecies of interest in the community other species can be ignored when inspection is undertaken.

Frequency

Survey frequency should be considered for two reasons. One is so that trends of increasing or decreasing interference with a seasonal explanation can be detected. The second is to establish reliably the intensity of interference when it is indicated by signs that change in appearance over time, particularly when they become less conspicuous on ageing (e.g. trunk damage). In this second case the aim is to determine how damage appears at known intervals from its infliction so that surveys can then restrict attention to "recent" damage — damage within a defined period leading up to the length of time damage remains conspicuous and then to organize surveys accordingly.

Standards for comparisons

Surveys to assess interference levels and relative security in strict natural reserves have negligible value unless results can be compared with those from standard situations. For this reason parallel surveys are needed in adjacent areas of the same community not theoretically afforded such a high level of protection.

Unless interference in the strict natural reserve is nil or lower than outside it clearly is not serving its purpose. If interference is lower, then it remains to be determined if it stays constant or is increasing or decreasing. Under effective management it should continually decrease until it is negligible — at least as far as offences classifiable as intrusion are concerned.

AFTER ASSESSMENT – SUBSEQUENT ACTION

Reaction to what assessment surveys reveal has to be realistic. In theory, problems of intrusion which clearly flout the law should be vigorously tackled, examples being made of caught offenders to deter others. If it becomes clear that the law cannot be broken with impunity the need for more caution on the part of potential culprits will itself reduce the impact

of their activity even if trespassing continues. This, however, assumes the full support of local authorities. To ensure this in practice may require skilful extension work: forestry must not shirk this responsibility. Where legal ambiguities complicate a situation it is important that this difficulty be recognized early and action initiated to strengthen reserve status: tactful extension activity coupled with effective presentation of the case for re-classification at the highest level will encourage progress.

In forestry practice, however, there is all too often a situation where manpower is limited. Patrol and assessment needs can be taken as essential if a strict natural reserve is to exist in anything more than name but if a level of abuse, though detectable, is negligible it may not be worth releasing staff from other duties to pursue extension work.

How low an intensity of damage is "negligible"? No poaching of animals given full protection in national schedules can be considered acceptable but for unlisted species losses of less than 1% are unlikely to be important. On the plant side, annual timber removals estimated at less than 0.5% of the standing crop of a species will be both well below normal commercial exploitation rates and well below the normal turnover of the natural vegetation and do not signify a need for remedial action. It will be apparent that application of these criteria will not be possible until inventory provides a satisfactory picture of the populations present: the biological monitoring urged by various authors. For trees, as indicated earlier, this can be obtained during interference level assessments if these take a suitable form. For animal populations, special arrangements will be needed for population study.

Management faces more difficult problems when external events cause concern — a circumstance most likely where there is an interface with a different community. Habitat change reflected in a locally modified micro-climate must obviously be accepted. Change due to other influences should be countered by positive steps from the forestry side. Along a vulnerable boundary a fire break must be set up and provision made for labour to maintain it adequately. Fires which affect the reserve despite a satisfactory fire-break indicate intrusion — offenders can be traced and dealt with accordingly. Externally initiated water-related problems also merit direct action. To prevent sediment being transported into the reserve a trap should be constructed at the boundary and emptied of sediment as necessary. Erosion must be tackled with suitable preventive measures applied on reserve land. In most cases national laws place watercourses under the control, at least partly, of the water authorities — even outside boundaries it should be possible to arrange implementation of anti-erosion action at appropriate points. Contamination of water is a more serious difficulty. The circumstance of pollution must be ascertained and responsible parties persuaded to amend their practices. Warning of the need to comply with water laws may be a useful approach to adopt in the face of reluctance to take action.

Solving problems due to external events is likely to be most difficult

solving those due to unpredictable effects is likely to be most contraversial. To what extent are alien organisms to be allowed to establish freely in the reserve? As this clearly relates to the other major issue in strict natural reserves — stability — it is not appropriate to treat it in detail here. However, stability is closely linked with reserve effectiveness where the boundary partly or wholly constitutes an interface with a contrasting community. Under such conditions the reserve, if small (as is likely), is already only doubtfully self-sustaining. When the intention is to preserve its character, intervention by management may be unavoidable — emphasis being on the suppression of aggressive and persistent aliens. Differing criteria are likely to be proposed for taking such drastic action. Here it is suggested that alien plants be removed if it becomes clear that pioneer individuals are producing offspring establishing successfully in the strict natural reserve. Faunal problems are likely to be more complex and each should be considered separately. Most larger animals are relatively habitat-specific: if measures to prevent the vegetation changing succeed, large alien animal species are unlikely to constitute problems serious enough to call for remedial action.

DISCUSSION

The intention of this account is to alert management to its unacceptably low level of activity in strict natural reserves and its failure to express in any definite terms the effectiveness of a reserve. Endorsing an earlier plea (Roche, 1975b) for dynamic conservation measures, an attempt has been made to specify in what way appropriate management should begin.

Today's typical strict natural reserves remain as initially conceived by the forest services half a century ago — the cores of extensive tracts of communities managed as parts of national forest estates. The parts of the communities surrounding the cores constitute protective buffer zones. Just as most strict natural resrves have lacked distinctive legal status, they have lacked also full administrative independence from their buffer zones. This independence, however, is needed for smooth implementation of active conservation. Responsibility for strict natural reserves should be allocated to a unit quite different from that carrying out traditional forestry activities. There is a strong case for incorporating such units in forestry research organizations. A departure from established practice is implied but forestry's long tradition of efficient administration should enable it readily to accommodate this innovation. Funds to maintain active conservation in a strict natural reserve will thus not be drawn directly from the votes financing routine traditional forestry activity. Funding both needs from the same pool invites conflict over priorities — with strict natural reserves representing the less familiar role of forest, an outcome in their favour would be unlikely.

Actual funding requirements will be dependent on buffer zone effectiveness. Where a buffer zone is lacking, or has undergone extensive change since the establishment of the strict natural reserve, formal assess-

ment of interference levels will be required most often. Assessments can be costed in terms of the expertise that must be committed for them. In a typically small strict natural reserve a single assessment will involve a research officer supported by a technician and take a month, part of this period being in the field and entailing payment of touring allowances. As positive strict natural reserve management materializes and more respect develops for reserve status it is to be hoped that expenditure will be limited more and more to the cost of basic patrolling. This is estimated at 600 man-days per annum for a reserve up to 500 ha. Extra labour at this rate is applicable for every additional 500 ha. The usual strength of a national forest service and the small number of strict natural reserves mean that this calls for no more than a nominal addition to expenditure. The burden of extra cost is not a convincing argument against the adoption of positive management for strict natural reserves.

ACKNOWLEDGEMENTS

The present paper is a consequence of work towards management documents for catchment forest supported with funds allocated by the University of Dar es Salaam Research and Publications Committee.

REFERENCES

Ashton, P.S., 1976. Factors affecting the development and conservation of tree genetic resources in South-east Asia. In: J. Burley and B.T. Styles (Editors), Tropical Trees — Variation, Breeding and Conservation. Academic Press, London, pp. 189—198.

Bourne, R., 1934. Working plan headings. Emp. For. J., 13: 239—243.

Brune, A. and Melchior, G.H., 1976. Ecological and genetical factors affecting exploitation and conservation of forests in Brazil and Venezuela. In: J. Burley and B.T. Styles (Editors), Tropical Trees — Variation, Breeding and Conservation. Academic Press, London, pp. 203—215.

Ola-Adams, B.A. and Iyamabo, D.E., 1977. Conservation of natural vegetation in Nigeria. Environ. Conserv., 3: 217—226.

Roche, L., 1975a. Case study: tropical hardwoods. In: The Methodology of Conservation of Forest Genetic Resources. FAO, Rome, pp. 65—78.

Roche, L., 1975b. Guidelines for the methodology of conservation of forest genetic resources. In: The Methodology of Conservation of Forest Genetic Resources. FAO, Rome, pp. 107—113.

Roche, L., 1979. Forestry and the conservation of plants and animals in the tropics. For. Ecol. Manag., 2: 103—122.

Forest Ecology and Management, 7 (1983/1984) 67–68
Elsevier Science Publishers B.V., Amsterdam — Printed in The Netherlands

Book Review

CONSTITUENTS AND PROPERTIES OF SOILS

Constituents and Properties of Soils. M. Bonneau and B. Souchier (Editors), Translation: V.C. Farmer. Academic Press, London, 1982. 496 pp., £36.20/US$74.50. ISBN 0-12-114550-6.

This edition has been translated from the original French by members of the Macaulay Institute for Soil Research, Aberdeen, under the editorship of Victor Farmer. It is Volume II of a wider treatise, *Pedologie*, edited by P.L. Duchaufour and B. Souchier. Volume I, *Pedogenesis and Classification*, is also to be published in an English translation, by Allen and Unwin, London. Both volumes should however stand in their own right, although there are a number of allusions in the volume under review to *Pedogenesis and Classification*.

As Victor Farmer points out in his preface, "The present translation . . . provides both an excellent overview of French soil research, and also an entry to primary research publications through its very complete and up-to-date bibliographies". I agree. For readers of *Forest Ecology and Management*, many of the examples amplifying the text are drawn from forest soils, and forestry.

The book is a compendium — almost a vade-mecum — of undoubted value to those, such as postgraduate students, wishing to gain a quick insight into pedology. The coverage is very broad, and divided for convenience into two parts: Soil Constituents, and Physico-Chemical Properties of Soils. The former comprises ten chapters prepared by various authors on such diverse topics as mineral constituents and weathering, humus and organo-metallic complexes and soil biology. As is unavoidable in such multi-authored works, treatment is somewhat uneven, both in terms of scale and detail, e.g. Chapters 1–5 on the mineral fabric are well covered in about 100 pages; soil biology from soil organisms to microbial processes is dismissed in a single chapter of a mere 34 pages; the treatment of the humus/organic matter components covering three chapters contains a most succinct and useful exposition of this diffuse subject, including a summary of the methods for determining these organic complexes, in about 75 pages. There is some overlap in treatment of soil organic matter in the chapters on humus and soil biology, but this reinforcement is not disadvantageous in a reference of this nature.

Part two does not work quite as well as part one. Three chapters cover physical organisation, including a useful summary on micromorphology. The chapters on soil water and solute movement, and that on ion exchange, are reasonably detailed but the latter hardly deals with anion exchange and makes only passing reference to the problems of variable-charge soils;