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Forest reservations: an overview

A R Main

Zoology Department, University of Western Australia, Nedlands WA 6907

Abstract

This paper is placed in the context of the assumptions made when suggesting criteria for selecting areas for reservation. It is suggested that, in the absence of detailed taxonomic knowledge, site selection might be improved by recognising the possibility that relict occurrences of past environments will include equally ancient biotic assemblages. Moreover, the reasons for the persistence of such past environments offer guide-lines for management which will ensure their retention.

Introduction

When I was first asked to provide an overview for this Symposium the proposed title began "Requirements for Reservation....", the latest version is " The design of Reservations". It is easy to see why the title has been changed; to require is to insist upon having. In a biological sense it is broadly known what is required of reservations. But requirement also carries a connotation of asking or claiming by right or authority. So, the latter title is less likely to be misconstrued because design, as a scheme or plan, purpose or intention, is less coloured. The other papers in this issue have embraced these subtleties. In this overview I wish to emphasise the importance of including historically significant biological elements as a requirement of adequate design for reservations, allude to scientific procedures so that non-scientists may understand why interpretations change, and show that historical knowledge of the biota offers a guide for management.

The Commonwealth has proposed a set of criteria for National Forests Conservation Reserves defining forests as woody vegetation with a potential height >5m (Anon 1995:41). In the proposed criteria it is frequently stated that there is a need to emphasise national estate values. Moreover, "*our knowledge of forest species is limited, large numbers of invertebrate species are reasonably presumed to be undiscovered and/or undescribed*" (Anon 1995:24). It is proposed that this deficiency can be overcome by identifying habitats as surrogates for these values. This is in contrast to various studies which suggest that plants and vertebrates are such surrogates, while the Commonwealth position is that consultation and 15% of the original or pre-European extent of forest present will adequately reserve forest communities.

A common approach to the problem is to accept the present as given, then after survey and classification, select areas for reservation *i.e.* assume tomorrow will be like today. Yet other perspectives and procedures on these topics are in terms of whether reserves are adequate, comprehensive and connected. Another possibility is as follows; some of the National Estate values reside in historic elements of the biota which can be readily recognised. Their occurrence is tied to historical/geological events and land forms resulting from them. Their origins go back to the time when there was only one great southern continent, the land mass known as Gondwana. The plants and animals which survived from this time contribute much to the distinctive character of the biota and sets aside the bioregion as being unique *i.e.* having National Estate values. The aquatic and wetland habitats favoured by animals are readily recognised and thus present themselves as potential surrogates when identifying areas for reservation.

Goals

As a minimum we wish to retain replicated, representative areas of natural biodiversity so that those who come after us may know what the present day world was like. While we are interested in retaining biodiversity, usually conceived as species or genetic richness, within reservations, we need to ask the questions: Is this goal reasonable? Can it be achieved? We cannot foresee the future and can only know the present, so does this give a sound basis for choosing areas or expecting success?

A central question which arises with the goal of conserving through reservation is: will tomorrow (the future) be like today (the present)? *i.e.* will what we know and cherish about nature be able to persist tomorrow? Common sense tells us that today is like yesterday or at least not too different and so common sense suggests that tomorrow will be like today. But in science, common sense is not taken as a good guide; rather, it is a conjecture which must then be subject to rigorous tests to show whether these conjectures are true. Only when repeated attempts at refutation have failed can any faith be placed in the conjectures and the interpretations that follow from them.

The world is neither static nor stable and nature persists in a non-equililbrium state *i.e.* selection and genetic composition of populations or the populations composing communities are the result of past selection and temporary assemblages arising from transient circumstances. But this happened in the past also, so we might conclude that tomorrow will be like today. Espe-

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cially so because the same classes of biological interactions will occur, methods of interaction will be similar but rates will be different and the resource base reduced unless we are careful, so tomorrow may not be like today.

The foregoing paints a picture of great uncertainty and is the central issue facing us when selecting areas for reservation and managing them. Management can address uncertainties by adopting a system of adaptive management as advocated. Landscapes rather than reserves might be the management unit. But our concepts of reserve design and adequacy are pitifully incomplete because of the poor and very slowly expanding knowledge base. Additionally, there is the question of whether 15% (or any other arbitrary percentage) of an area can cover the foregoing uncertainties.

Ideally, selection of areas for reservation would follow comprehensive surveys. These are time-consuming, expensive and hindered by inadequate taxonomic expertise. Moreover, the results might not be timely in the sense that for various reasons decisions need to be made before the survey can be completed.

So what is a prudent course of action? The more particular and specific are the goals the greater the likelihood of misjudgement *i.e.* specific goals require detailed knowledge, but this takes an inordinately long time to acquire. However, generality based on understandable principles relating to biological needs of animals of gondwanan origin might be a way of selecting areas. Moreover, the general principles might be confirmed from a knowledge of what happened following changes in the past and might incidentally give guidance for management.

History

Australia is a fragment of a former super continent, Gondwana. Since it broke away some 60 mybp, Australia has traversed 35-40 degrees of latitude and has come from a region with a cool damp climate to the unreliable climate with seasonal drought characteristic of its present low latitude situation. So today is not like yesterday.

The last major sculpting of the western landscape occurred during the Permian glaciation 250 mybp. The subdued landscape that resulted from the glaciation has dominated stream flows and erosion patterns ever since. The current system of salt lakes for example are the relicts of early Tertiary rivers and these in turn may represent Mesozoic drainage channels.

While the drainage channels show their origin they also show the influence of more recent events, such as the sagging of the southern margin of the Western Australian part of the Australian plate as it fragmented from Antarctica and the uplift of the western margin along the Darling Fault and Meckering line. These events changed the direction of streams affected by the tectonic events to either the west or south (Hocking & Cockbain 1990). The nett result was a new cycle of erosion with the head waters of these streams, in some cases, cutting back into the streams of the plateau. More recently, rainfall has become seasonal, and evaporaton higher resulting in the accumulation of cyclic salt in the soil profiles in areas of lower rainfall (Ghassemi *et al.* 1995: 155, 180).

From the taxonomic literature it is possible to identify many invertebrate groups which have Gondwanan affinities occur in South East Australia, New Caledonia, New Zealand, South America or South Africa (Main & Main 1991; Hopper *et al.* 1996; Table 4). A field inspection of the localities from which animals have been reported reveals the easily recognised environmental characteristics where habitat favourable for invertebrate animals with Gondwanan affinities may be found. Such sites are damp or wet, often with impeded drainage and showing little or no signs of salinisation. Such sites can be considered to resemble or be representative of habitats which were more widespread in earlier times. Thus with respect to the sites and habitats identified as containing gondwanic elements today is like yesterday and such sites, even without detailed surveys for reservation are likely to retain significant Gondwanan biota

The present

Surface characteristics, drainage, topography and rainfall combine to determine the quality of any water within a catchment. Under high rainfall conditions, soils accumulate little salt while in low rainfall areas salt accumulates in the soil profile and is released as ground water discharge when the hydrological balance is disturbed *e.g.* following clearing. Saline ground waters are common in the semi-stripped etch plain to the north and east of the forest region and absent in the high rainfall areas to the west and south of the region. Thus three sorts of river water occurs, saline in those streams whose head waters drain the semi-stripped etch plain; streams which are saline in the head waters but fresh in the lower reaches where flow from fresh tributaries dilutes the saline waters from the upper reaches; and those, usually short streams, draining only high rainfall areas.

The erosion by the western and southern streams has resulted in the present etched landscape of high topographic relief so characteristic of the high rainfall areas, particularly along the Darling Scarp and in the vicinity of Manjimup and Pemberton (Finkl & Churchward 1973). This new landscape contrasts markedly with the former subdued Gondwanan topography.

To summarise the changes to the present; the latitude of the continent has changed, climate has altered and become more seasonal, and much of the old surface has been destroyed by erosion. To refer back to the introductory analogy, today is not like yesterday. This would suggest simply that biotic relicts of ancient times will not have survived to the present! Yet collection of biotic material quickly shows that this is not so. *Podocarpus* is an obvious example; it has a long geological history from at least early Tertiary times and still occurs in other fragments of the former Gondwana. But there are countless other plant genera with equally ancient lineages *e.g. Xylomelum, Adenanthos, Banksia* and other Proteacea. Many terrestrial invertebrates show their Gondwanan origins through their affinities and relationships to elements of the other southern continents. So, despite the changes noted above there must be some places which are still like yesterday. Some of the sites can be characterised and thus offer a good guide for

selection of areas having a high likelihood of containing Gondwanan elements and thus capable of retaining this element of biodiversity. Moreover, some of the unique vertebrate elements also occur in similar or the same sites *e.g.* freshwater fish (Hopper *et al.* 1996; Table 4).

The low topography of the old Gondwanan surface and in places on the incipient etch plain results in poor drainage, ill defined water courses, and extensive areas of swamp land which is either permanentely wet or variously referred to as winter-wet or summer-dry swamps. These swamp lands provide one of the modern habitats which retain Gondwana-like characteristics. In drier sites invertebrate elements with gondwanic affinities have adapted by modifiying life histories *e.g.* aestivating or behaviourablly by burrowing. The chain of soil types (the catenas) of the valley sides, even in saline areas often have a series of summer-dry swamps each with its own characteristic fauna and flora. Better drained areas permit the growth of jarrah and karri which provide a closed canopy and thus another Gondwana-like habitat. Thus each land surface has its own hydrological regime and the potential to retain different Gondwanan elements. The retention of whole catenas with perched swamps and impeded ground water flow extending from granite crests to valley floors is important.

Selection of Gondwanan sites

So, what are the characteristics which could be used to identify sites for reservation so that Gondwanan elements might be conserved (Main & Main 1991; Hopper *et al.* 1996)? They are;

1 unaffected by salinisation;

2 high rainfall areas with short summer drought;

3 topographically high south coastal areas subject to frequent mists, cloud and drizzle;

4 areas adjacent to granite rocks from which water is shed;

5 areas of impeded ground water flow so producing winter-wet swamps;

6 streams with extensive fresh head water swamps and year round flow;

7 areas where vegetation can harvest water from fog or cloud by drip from leaves and stem flow *e.g.* tingle forest and south coast dunes and heath;

8 areas with southern or south-western aspect which are thus sheltered from summer insolation *e.g.* valley slopes and wet valley floors; and

9 areas of intact forest canopy under which the characteristic under storey shrubs and herbs occur.

Endemic elements

The foregoing are not the only criteria for selecting elements of the biota for conservation. Numerous plants and animals have evolved since Gondwanan times. Such species will be found in sites whose characteristics have developed more recentlly *i.e.* are drier, better drained or more exposed, eucalypts and acacias are perhaps the most successful of these more recently evolved types. But, any sites where evolution and selection might be expected to produce unique endemic forms because they are different to 'typical' Gondwanan land forms should be considered when surveying for conservation sites *e.g.* the twig-lining habit of the spider *Aganippe raphiduca* (B Y Main 1976). Thus in selecting sites for reservation the following should be considered in addition to those in which old Gondwanan elements may occur;

a. new topographic elements to which Gondwanan forms may have evolved adaptations and thus become unique endemic elements of the biota; and

b. sites where Tertiary and more recent migrants to the south-western part of the continent have evolved to be typical elements of certain communities or ecosystems.

Implications

A goal of retaining Gondwanan elements has implications for management. The fossil record shows a long history of fire in Australia. However, many Gondwanan elements, especially wet-land forms, are more sensitive than later evolved forms to fire and so in site selection and management this factor needs to be considered.

Field inspection of sites from which biotic elements with Gondwanan affinities have been collected suggest that in addition to fire, drainage, harvesting or removal of vegetation cover and salinisation are all inimical so management plans that recognise the need to retain special elements and the dangers to their persistance have the maximum chance of ensuring that tomorrow (the future) will be like today (the present).

Recent developments demonstrate the readiness with which the tourism industry will embrace new reservations as a resource to be exploited. Such use has the potential to destroy the qualities which justified the initial reservation. Such an outcome can only be negated by detailed expensive management, or by having numerous large areas reserved, within which there is an adequate and significant replication of historically important habitats.

Nevertheless it should always be borne in mind that reservations will only be part of a mosaic of land uses whether they be within native forests, plantation forests of eucalypts or conifers, or wheatfields. Their health and persistence will be inextricably linked to the whole matrix of reservations, how isolated the biota of each reservation may be and how the management of the non-reserved portion of the landscape impinges on the long term viability of the reservations *i.e.* the landscape rather than the individual reservation is the management unit. This last point is important because large size or an adequate surrounding buffer when areas are selected for reservation may be the only practical way of ensuring their long term viability.

Conclusions

The common practice when selecting areas for conservation reserves is to interpret the broad patterns of

the current situation without any time dimension. A further assumption is that what is present now will persist in the future despite interference and disturbance *i.e.* the future will be like the present. Elsewhere (Main 1996) I have expressed doubts about ecosystem stability and suggested a dynamic state as being a more realistic assumption. Furthermore, there is a strong possibility that increased amounts of greenhouse gases in the atmosphere will result in climatic changes which may impact on this nature conservation estate (Main 1993). Despite these possibilities, ecosystems are in a dynamic state on a trajectory determined by biological responses to environmental changes set in train as the continent moved from high latitude moist equable climates to warmer drier more seasonal ones. In this process the cool climate moisture dependent elements have been restricted to refugia which are usually small scale, long undisturbed, habitats which are easily overlooked in large scale forest harvesting. When selecting areas for reservation to retain biodiversity we should realize that despite an absence of detailed taxonomic knowledge of the cool temperate Gondwanan elements of the biota we do have a basis for selecting reservations so that the possibility of retaining this element of the biodiversity is maximised.

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