The Use of Remnant Vegetation by Nectarivorous Birds: Biodiversity as a Model for Management in the Wheatbelt of Western Australia

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INTRODUCTION

The successful management of remnant vegetation depends upon the formulation of clearly defined management goals. Broad objectives, such as "management to maintain biodiversity", have been identified, but the implications for managers of such statements have not been specified.

Honeyeaters in the central Wheatbelt provide a model for understanding the functional significance of biodiversity, and for assessing the implications of a reduction in regional biodiversity. This understanding, in turn, can provide a framework for approaching the daunting task of "managing for biodiversity".

Biodiversity encompasses the variation that occurs between individuals, species, communities, landscapes, and broad biogeographical regions. The relationship between honeyeaters and their food plants provides an opportunity to explore the consequences of diversity at all of these levels and to examine the functional significance of this diversity. As pollinators, honeyeaters play an important role in the maintenance of local floral diversity. A decline in honeyeater numbers can affect plant communities by reducing the distance and frequency of gene flow between discontinuous populations (Lamont *et al.* 1993), a problem that is exacerbated in fragmented environments. Changes in floral diversity may, in turn, affect the persistence probabilities of other species associated with, or dependent upon, that flora. By considering these relationships between plants and animals, we can identify the importance of variety at various organisational levels in both plant and animal communities.

PLANT DIVERSITY

Individual Differences

Although most members of a plant species in one area flower synchronously, individual differences result in some plants flowering earlier in the season, while others commence later. These phenological differences may result from variation in microenvironments as well as from genetic differences between individuals. These individual differences result in an increase in the amount of time that nectar is available for honeyeaters.

Species Differences

Differences in the flowering phenology of different species also broaden the range of opportunities for honeyeaters in a given habitat. An array of species which flower synchronously in different locations increases the range of habitats that honeyeaters can utilise.

Community Differences

Edaphic, evolutionary, disturbance and other factors have resulted in Wheatbelt plants forming clear associations in a pronounced vegetation mosaic. The constituent species within these associations have particular flowering characteristics which result in different patches producing nectar at different times of the year. Provided the configuration of these resources is favourable, honeyeaters can move from one patch type to another at different times of the year, further increasing their resource options.

Landscape Diversity

The same vegetation communities at different positions in the landscape often have different phenologies as a result of regional variation in environmental conditions, again expanding the resource base for honeyeater species that can range widely across the landscape.

Regional Diversity

Unfavourable climatic conditions in a particular region may result in poor flowering and hence temporary shortages of nectar over substantial areas. At such times, mobile species are able to move to adjoining regions where a different suite of plant species may provide the necessary resources. The persistence of a species in its preferred habitat may depend upon access to resources in adjoining areas at times when local resources are depleted. For example, white-fronted honeyeaters (*Phylidonyris albifrons*), pied honeyeaters (*Certhionyx variegatus*) and black honeyeaters (*C. niger*) irrupt sporadically into the central Wheatbelt at times of low rainfall in the more arid interior. Nectar-producing plant species in the Wheatbelt may provide a critical resource for these birds at these times.

HONEYEATER DIVERSITY

Not only is a variety of plants important for the persistence of pollinators, but similarly a variety of pollinators is essential for the maintenance of plant diversity. The impact of fragmentation on plant–pollinator relationships will depend upon the capacity of pollinators to deal with the modified landscape. A range of pollinators which respond to the landscape in different ways will enhance the prospect of plant population processes being maintained. The functional significance of honeyeater diversity is expressed primarily at the species level, but individual differences may also influence patterns of pollen dispersal.

Individual Differences

Within some species, some individuals establish territories in which they remain for extended periods of time. Other younger, or less dominant, individuals are unable to establish or maintain territories. They are more mobile, and this results in different patterns of pollen dispersal.

Species Differences

Differences exist between species in the way they move around the landscape. Some species, such as white-eared honeyeaters *(Lichenostomus leucotis)*, are relatively sedentary and tend to remain in territories within remnants. Singing honeyeaters *(L. viriscens)* commonly move back and forth between remnants and adjoining road-verge vegetation. Brown honeyeaters *(Lichmera indistincta)* move widely around the landscape, commonly moving between remnants, and white-fronted, pied and black honeyeaters invade from more arid regions to the north and east. Some species remain in close proximity to vegetation, while others, such as yellow-throated miners *(Manorina flavigula)*, routinely make extended flights over open paddocks. This array of different strategies for exploiting resources provides various opportunities and scales for pollen transfer throughout the landscape.

IMPLICATIONS OF REDUCED DIVERSITY

The value of greater biodiversity lies in the increased numbers of species that mediate important processes, thereby increasing the area and time over which a given process proceeds. Species which play equivalent roles can be viewed as functional analogues. The functional significance of a species in a system is inversely related to the number of its functional analogues. Loss of biotic diversity reduces the number of alternative, functional pathways and hence reduces the probability that a process will occur. Species that have no functional analogues but make a major contribution to a given function may become "keystone" species, and their loss could have serious implications for other associated organisms.

The acorn banksia *(Banksia prionotes)* flowers in early autumn in the central Wheatbelt. No other nectar-producing plants flower in the Durokoppin area at this time — it has no functional analogues. It is heavily exploited by honeyeaters and, because it appears to be a limiting resource, it may influence total honeyeater numbers in the region for the remainder of the year. For these reasons, this species is a keystone species. It does not play the same role in other parts of its range where other species (for example, *B. menziesii*) flower at the same time.

MANAGEMENT IMPLICATIONS

Honeyeaters have been used here to explore the functional significance of biodiversity. This model may hold for a wide range of species and communities, although the scale and number of participants may vary. Several implications flow from this perspective.

Management for Function and Representation

Representation of biodiversity is a necessary objective for the management of native biota, but it alone is not sufficient. It is also essential to consider how different levels of representation contribute to ecosystem function. The greater the functional contribution of a species or community, the more widely should it be represented. Honeyeaters are not a high priority for conservation in their own right, but may be essential for the achievement of other objectives. Consequently, they must be well represented in the landscape. For species that contribute less to community processes, representation in a few locations may be adequate.

The Importance of Scale and Configuration

Management must be planned at an appropriate scale for the species and processes being managed. Because biodiversity encompasses all scales, from individuals to landscapes, it is necessary to have strategies that reflect this diversity. While large-scale, regional assessments of conservation value must be made, these must then be combined with local strategies which identify those actions that need to be implemented at particular locations. Attempts to achieve an objective within a single remnant will fail if that objective is dependent upon processes that operate at a scale greater than that of the remnant. Management of remnants must be guided by their role in landscape processes and in achieving regional conservation objectives.

The Importance of Objectives

The above point presupposes that regional conservation objectives and strategies exist. Conservation objectives must be identified at catchment, regional and national levels, with local actions targeted towards those objectives which are relevant for the area being managed. For example, some areas may not encompass species or communities that are recognised as regional or national priorities. This cannot be taken to mean that nature conservation is not an important issue for such an area. It simply means that specific objectives have to be identified which address those values that do remain in that region.

Objectives, at any scale, will not be achieved in a short period of time. It is therefore necessary to identify a sequence of actions that will achieve nominated objectives. It is also important to identify those objectives that need most urgent attention, and actions that will provide maximum conservation value for minimum effort.

BIODIVERSITY AS A MODEL FOR SOCIAL MANAGEMENT

If a regional conservation strategy is developed, its implementation will require a coordinated effort by a wide range of individuals and organisations. Diversity at different levels within the human community must also be recognised, and the functional significance of each cultural group identified in order to develop an effective social process for achieving biodiversity conservation. In terms of the biodiversity model presented above, important components of diversity in the human community are as follows:

- ❖ Individual differences: Different individuals will have different capacities to contribute towards management of the native biota in a region, depending upon inclination, financial resources, other commitments, etc. Local farm plans or community projects should be designed to recognise these differences, and should enable all individuals to feel that their contribution, no matter how large or small, is an integral part of a larger conservation effort.

- ❖ Species differences: Sometimes it appears that the various groups with vested interests in regions are indeed different "species". These "species" comprise the land-holders, and the wide array of government and non-government agencies that are involved. The different perspectives and aspirations of these groups must be acknowledged and incorporated into planning. The functional role of each group must be clearly identified and their efforts coordinated so as to maximise conservation return.

- ❖ Community differences: Different areas may have different conservation priorities, depending upon their particular problems. If regional targets can be identified, local communities, together with other groups with appropriate information and expertise, must work jointly towards identifying how those targets can best be achieved in a manner which maximises both conservation return and primary productivity.

The use of "biodiversity" as a metaphor for social organisation will clearly have its limitations if taken to extremes. For example, while a range of functional analogues performing similar roles in a natural ecosystem may enhance the stability of that system, the presence of a number of government agencies all fulfilling equivalent functions will simply result in unnecessary duplication and conflict. Given that government agencies rarely "become extinct", the need for functional equivalents is clearly not desirable.

In contrast, at the level of individuals who are implementing recommendations, it is important to ensure that multiple representation exists. Given the magnitude of the problems in agricultural landscapes, management actions will need to be implemented over a large proportion of the landscape. This requires a clear statement of objectives, identification of the actions to be taken, and the involvement of many individuals in implementing these actions. In the absence of an integrated management strategy, there will be only small localised responses which will generate limited benefit at a landscape scale.

The comparison of social organisational structures with biodiversity may be more appropriate when considering the functional roles of these organisations. The value of the analogy lies in the recognition that a complex system comprising a number of interdependent components needs to retain all of the essential functions if that system is to persist. In order to achieve sustainable agriculture and maintain biological diversity, it will be necessary to integrate social, agricultural, land conservation and nature conservation objectives.

Only by recognising the diversity within the community and the different contributions that different sectors can make will nature conservation succeed in what is predominantly a freehold landscape. Ownership of, and responsibility for, local conservation must be devolved to the community, with government organisations managing specifically identified, high-priority targets which are beyond the material and knowledge resources of local communities.

REFERENCES

Lamont, B.B., Klinkhamer, P.G.L., and Witkowski, E.T.F., 1993. Population fragmentation may reduce fertility to zero in *Banksia goodii* — a demonstration of the Allee effect. *Oecologia* **94**: 446–450.

Note that Robert Lambeck's work on honeyeaters, referred to extensively, has not yet been published.

REMNANT NATIVE VEGETATION
TEN YEARS ON

A DECADE OF RESEARCH
AND MANAGEMENT

PROCEEDINGS OF THE
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