THE FUTURE OF BIRDS IN THE MOUNT LOFTY RANGES

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Accepted May, 1979

INTRODUCTION

Biologists have known for many years that small remote islands support fewer species of birds (or of any other group of organisms) than larger, less isolated islands. In 1967 MacArthur and Wilson published a book entitled *The Theory of Island Biogeography*, which proposed a general model to explain this pattern. They reasoned that the rate at which new species arrive on an island must at some point be balanced by the rate at which species already present go extinct. In other words, the number of species eventually reaches a stable equilibrium, if the immigration and extinction rates are not altered. The main factor determining immigration rate is distance from a "source" area, and that determining extinction rate is size of the island. Habitat quality and diversity, shape of the island, elevation and diversity of plants can also be significant influences. According to the MacArthur-Wilson theory, if the area of an island is reduced the rate of extinction will increase (owing to reduction in diversity of habitat and flora, smaller population sizes, etc.), while the immigration rate will remain more or less the same. The number of species will therefore gradually decline until a new equilibrium is reached. Recently Willis and Wilson (1975), Diamond (1975a) and others have applied this concept to "islands" of natural vegetation in a "sea" of agricultural or urban land. Since this is (or will be) the status of most nature reserves and national parks, it is important to consider the predictions of MacArthur and Wilson's model.

The Mt. Lofty Ranges were covered in dry sclerophyll forest for several thousand years, isolated from similar areas in south-eastern Australia. For those species of birds which are restricted to forest, the region was effectively a habitat "island". With the settlement of Europeans this forest was cleared until today only about 10% of its original area remains. If the theory of island biogeography applies, then fewer species of birds will be able to maintain viable populations in this reduced area of forest. In other words, species now present in the Mt. Lofty Ranges will be lost in the next few years, decades and centuries. The time required to reach a new equilibrium is difficult to predict. In this paper we shall examine the number of species of birds occupying different-sized forests in eastern Australia, and attempt to estimate the number of species that will survive under present conditions in the Mt. Lofty Ranges.

METHODS AND RESULTS

In the following analysis and discussion we shall consider only land-birds (i.e. button-quails, quails, raptors, owls, nightjars, kingfishers, parrots, pigeons, cuckoos and passerines). Dry sclerophyll forest in the Mt. Lofty Ranges lies mainly within the 500 mm isohyet and is interpreted broadly to include low *Eucalyptus baxteri* scrub and open forest with *E. leucoxylon* and *E. camaldulensis* as well as strict dry sclerophyll forest (*E. obliqua* etc.) but not *E. odorata* and *Casuarina stricta* woodland. The total area was about 500,000 ha (5,000 sq. km) before clearing. Some 115 species of land birds were resident or regular breeding visitors to the Mt. Lofty Ranges (from Condon 1968). The number of species of birds in forest areas of New South Wales and south-eastern New South Wales (from Slater 1970 and 1974), in some National Parks in the Mt. Lofty Ranges (S. Aust. Orn. Assoc. Nat. Parks Scheme) and in small "islands" of forest in New South Wales (Howe, unpublished) were used to illustrate the relationship between area of forest and number of bird species (Table 1). When these data are plotted on a graph (the logarithm of area against logarithm of species, Fig. 1), the points lie close to a straight line with a slope of 0.166 (correlation coefficient $= 0.92$, $p < 0.001$). From this line the expected number of species in a patch of forest of any area can be estimated.

THE PREDICTION

At present only about 8,000 ha of forest habitat is included in National Parks in the Mt. Lofty Ranges. This area can be considered safely conserved although small patches have been altered (e.g Belair Recreation Park), and several parks receive large numbers of visitors (e.g. Belair and Para Wirra Recreation Parks). A further 10,000 ha of forest remains in State Forest and reserves around reservoirs. This land is at present more "natural" than some of the

National Parks, but its future is less secure. Other smaller patches of forest remain in private hands, but the total area of these is probably small. Thus at most let us assume 50,000 ha, or about 10% of the original area of forest remain, and only 8,000 ha, or just over 1% of it is safely conserved. From Fig. 1 we can see that these areas would be expected to support only about 80 and 65 species respectively. In other words between 35 and 50 species of birds breeding in the Mt. Lofty Ranges at the time of European settlement can be expected to go extinct locally.

ASSUMPTIONS AND ERRORS

The above prediction relies on the assumption that area alone determines the number of species on an island or a patch of forest. There are a number of reasons why this estimate may be either optimistic or pessimistic.

Estimate optimistic

Even more species may be lost because:

(i) The figures used for National Parks and smaller islands are those for species now present. It is likely that the bird communities of all these regions are not in equilibrium, and thus are overestimates of the number that can be supported in the long term. If equilibrium figures were used the slope in Fig. 1 would be even steeper and this would give an even lower ultimate number of birds in the Mt. Lofty Ranges.

(ii) Remaining areas of natural vegetation in the Mt. Lofty Ranges consist of several moderate-sized patches and many smaller ones. These may have fewer species than one large island of similar total area (see Diamond 1975a) (see pessimistic estimate (iii) for an alternative possibility).

(iii) The remaining native vegetation has been degraded, and will continue to be, by introduced plants and animals, grazing, trail-bikes etc. It is probably now less suitable for native birds than before.

(iv) The estimate predicts that there will be 65-80 species, but not necessarily 65-80 of the original species. At least three native species (Galah, Little Corella and Crested Pigeon) have invaded the area since European settlement and eight exotic species are now present (though not all in native forest). Thus more than 35 to 50 species may be lost from the original avifauna.

(v) The forests of south-eastern South Australia and Victoria have been extensively cleared; thus the source area from which immigration may occur has been reduced, probably reducing the immigration rate and eventual equilibrium number of species.

Estimate pessimistic

The predicted losses may have been over-estimated because:

(i) The equilibrium may take a very long time to eventuate. Diamond (1975b) believes that some islands off New Guinea still have more species than islands of similar size and isolation elsewhere, even though they have been separated from New Guinea for several thousand years. He suggests that this is because the equilibrium has still not been reached.

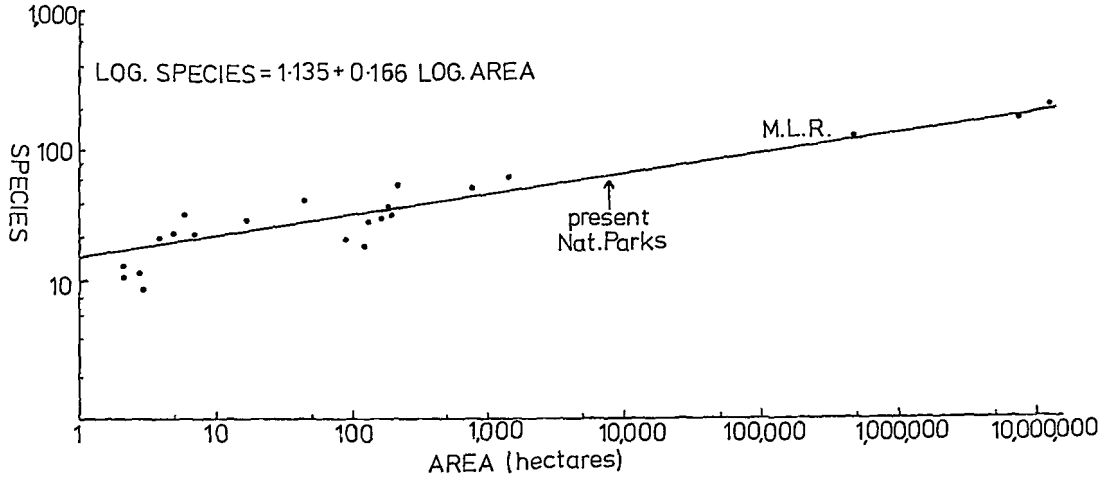

FIGURE 1. *The relationship between the number of bird species and area in forests of South Australia and New South Wales (logarithmic scale). The point for the Mt. Lofty Ranges is marked (MLR) as is the present area of National Parks.*

(ii) Some, perhaps many, of the species can use or even breed in habitats which are not included as native forest. The most important of these are suburban areas (e.g. for Musk and Rainbow Lorikeets), pine forests (e.g. for White's Thrushes) and grazed woodland.

(iii) There is some evidence (Howe unpublished) that groups of small islands may actually contain more species of birds than one larger island of the same total area, because the former include a wider range of habitats. The present national parks and reserves probably represent a more diverse collection of areas than an average selection of the original area. This would increase the diversity of species of birds.

(iv) We hope that conservationists will learn more about the species which are vulnerable to extinction, and manage the forests to maintain the present diversity.

(v) The relationship between area and number of species shown on Fig. 1 is not an exactly straight line (logarithmic scale), especially when a wide range of areas are used. In general, the loss of species tends to be proportionately greater in small areas. This would indicate that the loss of species from the Mt. Lofty Ranges would be less severe than predicted.

WHICH SPECIES COULD BE LOST

At present only a handful of species of birds are designated endangered in the Mt. Lofty Ranges. Which 35 to 50 species, then, are likely to be lost if the prediction is correct? The theory of island biogeography involves a balance between the rate of extinction and the rate of immigration. The chance of extinction will depend upon the size of the population and the degree to which it fluctuates. There are no data on population sizes of birds in the Mt. Lofty Ranges; but an idea of the abundance of a species may be gained from the Bird Atlas of the Adelaide Region (1977). We have arbitrarily taken as rare all species recorded in 10 or less of the 60 10 x 10 km squares in the Mt. Lofty Ranges which include forest. The chance of recolonisation after extinction will depend on the distance from the nearest population and also the mobility of the bird. In Table 2 we have listed the species which are either rare (less than 10 squares in the Mt. Lofty Ranges) or are isolated from other populations of that species. We have also given the location of the nearest large populations for isolated species. Forty-four species appear on the list. Nine of these are both rare and isolated. Four are probably already extinct. It is hard to believe that some of the isolated species, e.g. Scarlet Robin, Striated and Brown Thornbills and Crescent Honeyeater, could be endangered, because their populations are thriving in the Mt. Lofty Ranges. Hence, if the predictions of the theory prove correct, some species which are neither rare nor isolated will go extinct.

MANAGEMENT

Although the loss of 35-50 species of birds in the Mt. Lofty Ranges may seem unbelievable to many ornithologists, it seems likely that some species will be gradually lost over the next few decades. The full depletion, on the other hand, might take thousands of years. Whatever the case, there are several things which can be done to prevent or at least slow down this loss.

Firstly the area of conserved land could be increased. At present only National Parks can be considered safely conserved. If natural forest in State Forests and around reservoirs could be retained in its present condition the potential loss of species of birds could be significantly reduced. The guardians of this land should be made aware of its importance. In addition owners of forest on private land should be encouraged to conserve it. Probably the area of new National Parks in the near future will be small in comparison with the above areas. Emphasis should be placed on providing corridors between existing parks or in buying land containing particularly rich or unusual habitats which will need to be specially managed. Large-scale planting of native forest for timber or recreation in areas where farming is at present marginal is perhaps the only realistic way in which the total area of forest in the Mt. Lofty Ranges could be increased.

Even if the area of forest is not greatly increased there are still many things that could be done. Two approaches are to reduce the chance of extinction and to increase the chance of immigration. To start with we must learn the approximate sizes of the populations of the vulnerable species, in addition to their specific habitat and nesting requirements. This type of work could be undertaken by individuals or groups in the S.A.O.A. Given such information, natural habitats could be managed to provide conditions favourable for vulnerable species and, in addition, "unnatural" habitats such as grazed woodland, pine forests or suburban areas could be made more attractive to them. All this would effectively increase population sizes and reduce the chance of extinction. Immigration between patches of forest could be encouraged by planting corridors, and species might in certain circumstances be artificially reintroduced to parts of their range where they have already gone extinct. On a larger scale species would be

reintroduced from outside the Mt. Lofty Ranges (i.e. only after they have gone extinct). All this requires knowledge of the species' ability to survive for short periods in captivity.

We believe that the S.A.O.A. should plan a research programme on the vulnerable species in the Mt. Lofty Ranges, with the ultimate aim of ensuring their survival. Such a programme could start by determining the exact distribution of the five species which are both rare and isolated: Swamp Quail, Spotted Quail-thrush, White-throated Warbler, Southern Emu-wren, and Black-chinned Honeyeater. Estimates of population size could be made and all information on their ecological requirements pooled. Have they been bred in captivity? If so, with what success? If not, is someone willing to try? All members could contribute to this programme with one or a group collating the information for each species. For a start HF should like to collect all the information we have, particularly in ornithologists' notebooks, on the Black-chinned Honeyeater.

The ornithologists of South Australia have a choice. Either to sit back and watch the progressive loss of species of birds in the Mt. Lofty Ranges, or to find out more about their ecology and make positive plans to conserve them.

ACKNOWLEDGEMENTS

We thank Jane Needle for providing details of the birds in National Parks in the Mount Lofty Ranges, and Nick Reid, Shane Parker, Kath Shurcliff, David Close and Brian Gepp for comments on the manuscript.

REFERENCES

A Bird Atlas of the Adelaide Region. 1977. Adelaide, S.A.O.A.

Condon, H. T. 1968. A Handlist of the Birds of South Australia. Adelaide, S.A.O.A.

Diamond, J. M. 1975a. The island dilemma: lessons of modern biogeographic studies for the design of nature reserves. Biol. Cons. 7: 129-146.

Diamond, J. M. 1975b. Assembly of species communities. In Cody, M. L. and Diamond, J. M. Ecology and Evolution of Communities. Belknap Press, Cambridge, Mass.

MacArthur, R. H. and Wilson, E. O. 1967. The theory of island biogeography. Princeton Univ. Press.

Slater, P. 1970. A Field Guide to Australian Birds. I. Non-passerines.

Slater, P. 1974. A Field Guide to Australian Birds. II. Passerines.

Wilson, E. O. and Willis, E. O. 1975. Applied Biogeography. In M. L. Cody and J. M. Diamond, eds. Ecology and Evolution of Communities. Belknap Press, Cambridge, Mass.

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TABLE 1. Regions used in compiling Figure 1, with their areas and number of species of birds which are residents or breeding visitors.

REGION	AREA (ha)	NO. OF BIRD SPECIES
Eastern N.S.W.	16 m	206
South-eastern N.S.W.	8 m	173
Mount Lofty Ranges	500,000	115
Para Wirra R.P.	1,450	60
Cleland R.P.	790	50
Eastwood State Forest (N.S.W.)	220	53
Spring Mount C.P.	200	30
Hale C.P.	190	34
Myponga C.P.	170	29
Horsnell Gully C.P.	140	27
Sturt Gorge C.P.	130	18
Shepherd's Hill C.P.	90	20
Cromer C.P.	44	40
Near Walcha (N.S.W.)	17	29
" " (N.S.W.)	7	22
" " (N.S.W.)	6	32
" " (N.S.W.)	5.1	23
" " (N.S.W.)	4	21
" " (N.S.W.)	3	9
" " (N.S.W.)	2.8	12
" " (N.S.W.)	2.2	11
" " (N.S.W.)	2.1	13

TABLE 2. Species of land-birds in the Mount Lofty Ranges which could be expected to go extinct before equilibrium is reached.

SPECIES	RARE (less than 10 squares in atlas)	ISOLATED (with nearest population)
Collared Sparrowhawk *Accipiter cirrhocephalus*	Yes	No
Peregrine Falcon *Falco peregrinus*	Yes	No
Brown Quail *Coturnix australis*	Yes	Yes?
King Quail *C. chinensis*	Yes (extinct?)	Yes?
Painted Button-quail *Turnix varia*	Yes	No
Peaceful Dove *Geopelia placida*	Yes	No
Glossy Black Cockatoo *Calyptorhynchus lathami*	Yes (rare non-breeding visitor from Kangaroo Island)	Yes (Kangaroo Island)
Yellow-tailed Black Cockatoo *Calyptorhynchus funereus*	No	Yes (Kangaroo Island)
Rainbow Lorikeet *Trichoglossus haematodus*	No	Yes
Musk Lorikeet *Glossopsitta concinna*	No	Northern MLR otherwise SE
Budgerygah *Melopsittacus undulatus*	Yes	No
Swamp Parrot *Pezoporus wallicus*	Yes (extinct)	Yes (Victoria)
Black-eared Cuckoo *Chrysococcyx osculans*	Yes	No
Owlet Nightjar *Aegotheles cristatus*	Yes (under-recorded?)	No
Spotted Nightjar *Caprimulgus guttatus*	Yes	No
Azure Kingfisher *Ceyx azureus*	Yes (extinct?)	Yes (lower SE)
White-winged Triller *Lalage sueurii*	Yes	No
White's Thrush *Zoothera dauma*	No	Yes (Kangaroo Island)
Spotted Quail-thrush *Cinclosoma punctatum*	Yes	Yes (Victoria)
Golden-headed Cisticola *Cisticola exilis*	Yes	No
Rufous Songlark *Cinclorhamphus mathewsi*	Yes	No
White-throated Warbler *Gerygone olivacea*	Yes	Yes (South-East)
Western Warbler *Gerygone fusca*	Yes (occasional breeder)	Yes (Eyre Peninsula)
Striated Thornbill *Acanthiza lineata*	No	Yes (Kangaroo Island)
Buff-rumped Thornbill *A. reguloides*	No	Yes (upper SE)
Brown Thornbill *A. pusilla*	No	Yes (Kangaroo Island)
White-browed Scrubwren *Sericornis frontalis*	No	Yes (upper SE)
Chestnut-rumped Hylacola *S. pyrrhopygius*	No (12 squares only)	Yes (Tothill Ra, southern Flinders Ra.)
Fieldwren *S. fuliginosus*	Yes (extinct?)	Yes (SE)
Southern Emu-wren *Stipiturus malachurus*	Yes	Yes (Kangaroo Island)
Scarlet Robin *Petroica multicolor*	No	Yes (Kangaroo Island)
Red-capped Robin *P. goodenovii*	Yes	No
Crested Shrike-tit *Falcunculus frontatus*	No	Yes (SE)
White-throated Treecreeper *Climacteris leucophaea*	No	Yes (SE)
Spotted Pardalote *Pardalotus punctatus*	No	Yes (SE)
Yellow-faced Honeyeater *Lichenostomus chrysops*	No	Yes (SE)
White-naped Honeyeater *Melithreptus lunatus*	No	Yes (SE)
Black-chinned Honeyeater *M. gularis*	Yes	Yes (lower SE)
Crescent Honeyeater *Phylidonyris pyrrhoptera*	No	Yes (Kangaroo Island)
Tawny-crowned Honeyeater *P. melanops*	Yes	No
Regent Honeyeater *Xanthomyza phrygia*	Yes (rare visitor)	Yes (Victoria)
Eastern Spinebill *Acanthorhynchus tenuirostris*	No	Yes (Kangaroo Island)
Little Wattlebird *Anthochaera chrysoptera*	No	Yes (Kangaroo Island)
Red-browed Firetail *Emblema temporalis*	No	Yes (Kangaroo Island)
Beautiful Firetail *E. bella*	No	Yes (Kangaroo Island)
Olive-backed Oriole *Oriolus sagittatus*	Yes (occasional breeder)	Yes (Victoria)
Grey Butcherbird *Cracticus torquatus*	Yes	No