

uses diary returns or the age-ratios calculated from pre-season trapping.

Finally, there is evidence that fluctuations synchronous with those in Central Otago occur in other parts of the South Island—even in such districts as Canterbury and Nelson where climate and habitat are different from each other and from Central Otago. Fluctuations occurring in the central North Island are *not* in phase with those in the South Island.

The whole study is being continued and widened in scope, and possible connections with climatic factors (c.f. Williams 1954), predators, parasites, and physiological and other natural phenomena are being sought. Three important facts have to be accounted for:

- (i) The decline in reproductive success and numbers always extends over at least two years,
- (ii) In Central Otago, at least, the fall in the proportion of young becomes more marked as population density decreases over the last two years of the cycle,
- (iii) The cycle probably extends synchronously throughout the South Island and so includes different habitats and climates. It does not extend to the central North Island.

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The Seasonal Change of Bird Populations in a Modified South Island Habitat

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Since September, 1958, a study of bird populations has been made in Dunedin in order to determine the pattern of ecological distribution and the population structure of native and introduced species of birds in a modified South Island habitat.

Acknowledgement is made to the Botanic Gardens authority in Dunedin for making accessible to me the upper part of the Gardens in which this work was undertaken, and to the staff of the Botany Department of Otago University for help with the identification of the plants.

The following is the result of the reconnaissance work by which the assessment of an avian habitat of modified conditions was made. The study area was 12 acres in size and consisted of regenerating woodland mixed with a few introduced trees and

patches of flower gardens and lawn. This area was visited 97 times during a period of 12 months for estimating the size of the population, recording the nesting and feeding activities of every species, and ringing nestlings and adults of the key species. The early morning counts of the total population were made weekly in the area and they showed the highest number of 229 in spring and the lowest of 43 in winter with a total of 63 pairs in the breeding season and an average of 73.2 individuals in winter. The house sparrow was excluded from the above counts.

Higher counts obtained in spring and autumn were mainly due to the inclusion of flocking white-eyes which were attracted to the flowers and/or fruits of *Edwardsia microphylla*, *Fuchsia excorticata*, *Carpodatus serratus*, *Griselinia littoralis*, *Plagianthus betu-*

| | No. pairs bred | No. nests found | | | No. young fledged (% of adults) |
|---|----------------|------------------------|---------------|---------------|---------------------------------|
| | | Total (nests per pair) | Successful | Unsuccessful | |
| Song Thrush (<i>Turdus ericetorum</i>) | 16 | 39 (2.4) | 13 (32.8%) | 26 (67.2%) | 36 (112%) |
| Blackbird (<i>Turdus merula</i>) | 15 | 24 (1.6) | 10 (41.7%) | 14 (58.3%) | 23 (77%) |
| White-eye (<i>Zosterops lateralis</i>) | 12 | 22 | 19 (86.4%) | 3 (13.6%) | 51 (212%) |
| Bellbird (<i>Anthornis melanura</i>) | 6 | 8 | 5 (62.5%) | 3 (37.5%) | 12 (100%) |
| Dunnock (<i>Prunella modularis</i>) | 5 | 5 | 3 (60%) | 2 (40%) | 7 (70%) |
| Goldfinch (<i>Carduelis carduelis</i>) | 3 | 3 | 2 | 1 | 8 |
| Grey Warbler (<i>Gerygone igata</i>) | 2 | 2 | 2 | 0 | 4 |
| Chaffinch (<i>Fringilla coelebs</i>) | 2 | 2 | 0 | 2 | 0 |
| Greenfinch (<i>Chloris chloris</i>) | 1 | 1 | 1 | 0 | 2 |
| Redpoll (<i>Carduelis flammea</i>) | 1 | 1 | 0 | 1 | 0 |

TABLE 1.—Nesting Success and Productivity of Birds in the Upper Part of the Botanic Gardens, Dunedin.

linus, *Melicytus ramiflorus*, *Pseudopanax crassifolium*, *Suttonia australis*, *Hoheria augustifolia*, *Coprosma* spp. in the area.

Out of 20 species recorded, kingfisher (*Halcyon sanctus*) and rifleman (*Acanthisitta chloris*) were recorded once; 1 pair of mallards (*Anas platyrhynchos*) and 1 shining cuckoo (*Chalcites lucidus*) were present for a month in spring; greenfinches, goldfinches and redpolls were more or less summer visitors to the area; pigeons (*Hemiphaga novaeseelandiae*), fantails (*Rhipidura fuliginosa*), and brown creepers (*Finschia novaeseelandiae*) were absent from the area for 1-3 months of the breeding season; tuis (*Prothemadera novaeseelandiae*) occurred in association with flowering *Edwardsia microphylla* except for 2 accidental records (1 in January and 1 in June); and the others were resident. The starling (*Sturnus vulgaris*) never exceeded 9 in number. House

sparrows (*Passer domesticus*) were numerous, nesting on *Pinus* spp., *Eucalyptus* spp., *Leptospermum ericoides*, etc., and fledglings were often seen in the woodland part of the area.

The nesting success and the productivity of each species bred in this area are summarized in Table 1. Some nests were probably never found and the average number of nests made by a pair was probably larger than this record. However, if the mortality is considered in the successful nests of blackbirds and song thrushes, the breeding successes were similar to those for the same species obtained at Mangere by Bull (1946). As the song thrush had a higher average of nests per pair and a larger mean number of young leaving the nests than the blackbird, it produced more fledglings than the blackbird in spite of its lower nesting success. The nesting success of blackbirds was very

| | | | | |
|--|--|--|---|---|
| <i>Locality</i> | Botanic Gardens (Dunedin) | Hook Bush (Waimate) | Pyke Junction (Hollyford) | Spey River (Lake Manapouri) |
| <i>Season</i> | 1958 - 1959 | December, 1958 | January, 1959 | February, 1959 |
| <i>Habitat</i> | Garden & Regener- ating Forest | Regenerating Forest | Beech-Kamahi- rimu | Beech |
| <i>Census Area</i> (in acres) | 12 | 6 | 17 | 50 |
| <i>No. Species</i> (Introduced spp.) | 10 (7) | 11 (4) | 10 (2) | 14 (4) |
| <i>No. pairs per</i> <i>100 acres</i> | 525 | 450 | 164 | 144 |
| <i>Dominant Species</i> | <i>Turdus ericetorum</i> <i>Turdus merula</i> <i>Zosterops lateralis</i> | <i>Finschia</i> <i>novaeseelandiae</i> <i>Turdus merula</i> <i>Anthornismelanura</i> | <i>Prothemadera</i> <i>novaeseelandiae</i> <i>Petroica</i> <i>macrocephala</i> <i>Turdus merula</i> | <i>Petroica</i> <i>macrocephala</i> <i>Acanthisitta</i> <i>chloris</i> |
| <i>Locality</i> | Deep Cove (Doubtful Sound) | Lake McKerrow | Kapiti (A) | Kapiti (B) |
| <i>Season</i> | February, 1959 | January, 1959 | December, 1958 | December, 1958 |
| <i>Habitat</i> | Beech-kamahi-rimu | Beech-kamahi | Regenerating forest | Rata-tawa |
| <i>Census Area</i> (in acres) | 50 | 150 | 6 | 2.5 |
| <i>No. Species</i> (Introduced spp.) | 12 (2) | 14 (5) | 5 | 5 |
| <i>No. pairs per</i> <i>100 acres</i> | 92 | 70 | 416 | 440 |
| <i>Dominant Species</i> | <i>Petroica macrocephala</i> <i>Acanthisitta chloris</i> | <i>Zosterops lateralis</i> <i>Fringilla coelebs</i> <i>Hemiphaga</i> <i>novaeseelandiae</i> | <i>Petroica australis</i> <i>Mohoua ochrocephala</i> | <i>Prothemadera</i> <i>novaeseelandiae</i> |

TABLE 2.—Comparison of Breeding Bird Populations in Different Localities in New Zealand.

similar to that obtained in Britain as a whole (Snow, 1955), but lower than in a garden habitat at Oxford (Snow, 1958). The productivity of blackbird nests was similar to the previous record obtained in Dunedin by Gurr (1954).

The total breeding population of 63 pairs in this area is much higher in density than the estimation made in native forest of the South Island. The higher density in this modified habitat is due to the garden element which supports larger populations of introduced species such as the blackbird and the song thrush. Although bellbirds and grey warblers are successfully adapted to this habitat, the regenerating patches of native forest are not large enough to support tomtits, riflemen and fantails which are common in native habitat near Dunedin.

The only comparable figures of high density so far obtained from the native habitat

are in rather exceptional conditions of some of the offshore islands of the North Island where certain native species maintain higher densities. (Turbott, 1947; Kikkawa, in press.)

Further investigations are required for the assessment of productivity of the area and of each species in different habitats.

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