

SOME OBSERVATIONS ON THE ECOLOGY OF THE RAINBOW LORIKEET *Trichoglossus haematodus* IN OATLEY, SOUTH SYDNEY

R. D. WATERHOUSE

4/1–5 Ada Street, Oatley, New South Wales 2223

Received: 12 December, 1995

The Rainbow Lorikeet was a familiar bird during the early days of settlement of Sydney. It became less common by the 1920s, but is now common again throughout Sydney.

A weekly survey conducted during 1993 and 1994 in Oatley, along the Georges River in southern Sydney established that the birds feed, roost and breed in the area.

Major sources of food varied according to season but pollen and nectar was taken from a mix of native and exotic species. The introduced Coral Tree provide a major and reliable source of food, especially during the winter months and while the birds were breeding. Fruit of the Small-leaved Fig was the only major fruit observed to be taken. Sunflower and other seeds were provided by local residents and were an additional source of food for the birds.

Rainbow Lorikeets also seem to compete successfully for breeding hollows with other suburban bird species, including native and introduced species such as Southern Boobook, Sulphur-crested Cockatoos, Eastern Rosellas, Galahs, Dollarbirds, Common Mynahs. Suitable nesting hollows were found in Blackbutts and Rusty Gums growing in some small local bushland reserves.

INTRODUCTION

The Rainbow Lorikeet *Trichoglossus haematodus* was one of the first birds recorded in what is now Sydney by the Cook expedition in May 1770 (Hindwood 1962). It was regarded as a familiar bird in the Sydney district until the last decade of last century (North 1901–1913, in Crome and Shields 1992). Its disappearance by the early part of this century was attributed to widespread clearing of the natural vegetation and trapping for the cage bird trade (North 1901–1913, in Crome and Shields 1992).

In pre-settlement days, the natural vegetation of southern Sydney (i.e. the area between Port Jackson and Port Hacking) consisted mostly of sclerophyll forest with considerable tracts of heathland and swamp forest (Benson and Howell 1990). Suitable food species for Rainbow Lorikeet, which were then common, but are now reduced to remnant stands, included Banksias

Banksia spp., Paperbarks *Melaleuca* spp., She Oaks *Casuarina* spp., Swamp Mahoganies *Eucalyptus robusta* and various other eucalypts.

Today, most of southern Sydney is intensively settled and within living memory, bushland and rural areas have disappeared to become an integral part of the urban sprawl. Despite this, there are many 'leafy suburbs' and a large number of trees planted decades ago have now grown tall enough to provide copious supplies of pollen and nectar, but not yet old enough to develop many hollows in trunks and limbs.

By the 1920s and 1930s, Rainbow Lorikeets and other species of lorikeets had become nomadic visitors to southern Sydney appearing in scattered flocks only in good seasons (Lendon 1973). In the last 15 years or so, the Rainbow Lorikeet has made a spectacular comeback throughout southern Sydney, after having already established itself on the north shore of the city some decades ago.

Although it cannot be seen in such large flocks as occur in coastal Queensland and northern New South Wales, this species is not uncommonly encountered in flocks of 10 to 20 birds. However, these may gather into larger flocks of 60 or more birds where seed is provided for them and other birds in gardens. Roosting birds may gather in considerable numbers, at least in northern Sydney. The tall Norfolk Island Pines *Araucaria heterophylla* along the Manly waterfront provide a well known roosting spot which attracts hundreds of birds each evening.

In seeking the reasons for the Rainbow Lorikeet's recolonization of its old haunts in southern Sydney after decades of absence, it is easy to postulate simplified explanations, as many older Sydney residents are prone to do. Some of the most common explanations include: the replanting and maturation of eucalypts in parks and gardens, the provision of artificial feeding stations for the birds and the planting of certain exotic trees, which provide pollen and nectar.

This study sought to examine the following questions for a selected suburb in southern Sydney:

1. To what extent are planted eucalypts important sources of food for recolonizing Rainbow Lorikeets?
2. How important is the practice of 'backyard' feeding for providing food resources for Rainbow Lorikeets?
3. What contribution does the nectar and pollen of exotic trees make to the diet of Rainbow Lorikeets and which species are important?
4. Are there year round supplies of food for the birds or must they wander away from the district or depend on backyard feeding?
5. Do Rainbow Lorikeets roost locally in southern Sydney or fly long distances to a few large communal roosting places?
6. Are they able to breed locally or must they leave the area to find suitable nesting holes?
7. Can they compete successfully with other, well-established suburban birds?

METHODS

Regular walks were made each week during 1993 and 1994 in the suburb of Oatley, which may be considered typical of the garden suburbs which flank the Georges River in southern Sydney. Rainbow Lorikeets have distinctive noisy calls while feeding and in flight, and an attuned ear can quickly detect even odd pairs in a suburban tree. A flock soon draws the observer's attention to a rich food source or an evening flight path. It is therefore easy to locate birds when walking in suburbia or adjoining bushland patches, even if they are not always visible at first.

Once a flock has demonstrated its interest in a particular type of tree as a source of food, it is often a matter of checking areas where the species occurs in the same or another suburb, to ascertain if Rainbow Lorikeets are regularly availing themselves of that particular food source elsewhere.

When Rainbow Lorikeets were located, the tree species in which they were feeding was recorded. The part of the growth being fed upon by the birds was identified as either blossom, fruits or seeds. Qualitative estimates were made of the availability of each food tree. Species that were commonly found growing in Oatley and which were frequently fed upon by Rainbow Lorikeets were classified as major food sources. Those that were less commonly grown or were not at the peak of their flowering or fruiting were classified as minor food sources.

Bushland remnants in Oatley and neighbouring suburbs were surveyed for large trees with hollows which may be used in the breeding season by Rainbow Lorikeets and other species.

RESULTS AND DISCUSSION

Food resources from plants

Eucalypts were of some importance in August, November, December and January, but were by no means the only source of pollen and nectar in any one month (Table 1). In the newer suburbs which have replaced the eucalypt forests in the last century, it appears that eucalypt blossom is of minor importance for the survival of the birds in suburbia. Certain eucalypts not mentioned in Table 1, in particular Tallow Wood *Eucalyptus microcorys*, have commonly been planted on streetside verges in Oatley and some other suburbs, but do not appear to be used as a source of food by Rainbow Lorikeets.

The season with the least number of available food sources was winter (Table 1). The lack of variety was made up for by the large quantities of Coral Tree *Erythrina variegata* blossoms which supplied copious amounts of nectar and blossom throughout the cooler months. The trees were not common in gardens or street sides but have been

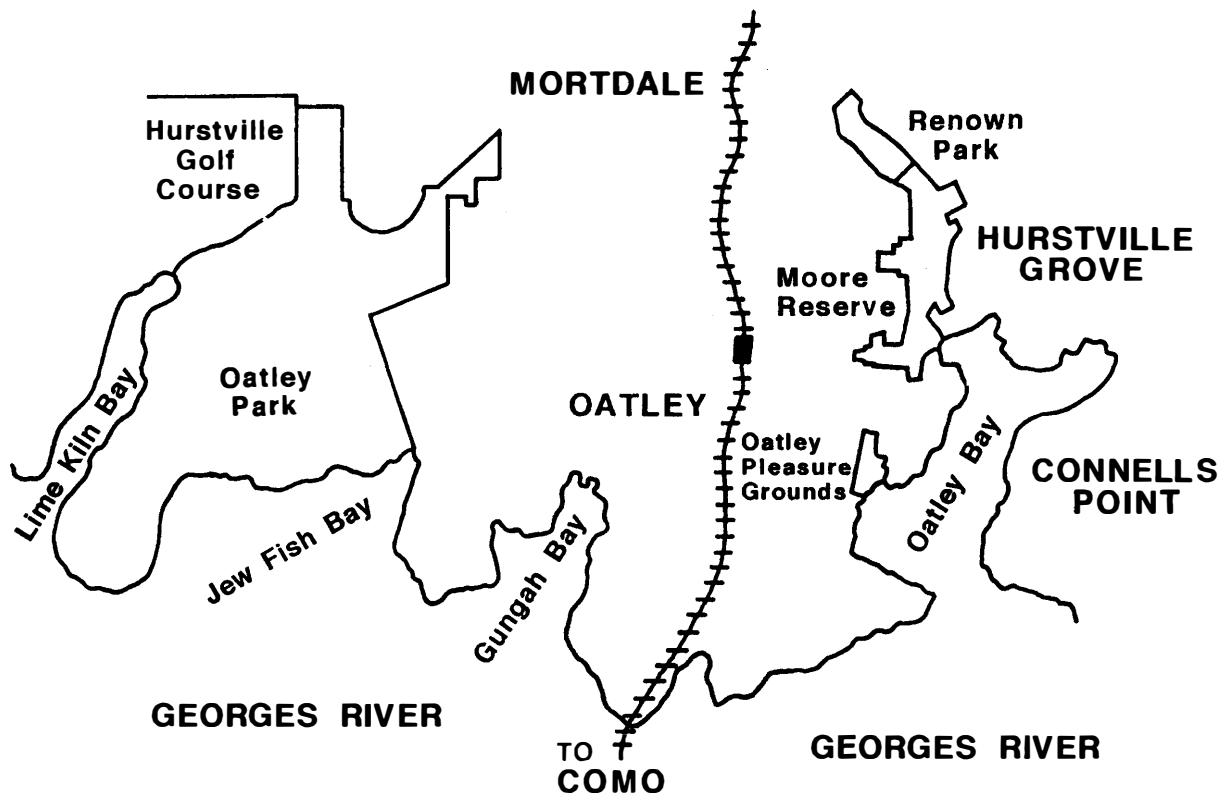


Figure 1. Map of Oatley and surrounding suburbs of southern Sydney showing the location of parks and reserves with bushland remnants.

planted in large numbers in parks and reserves throughout Sydney. In winter, the flowers of this tree attracted roving flocks of Rainbow Lorikeets and other nectar feeding birds.

There is no doubt that planted exotics now provide the bulk of the birds' food intake in all seasons, although local native species are still utilized (Table 1). The phenology and exploitation of individual species are considered below.

The Coral Tree was a reliable and major source of pollen and nectar for Rainbow Lorikeets throughout the winter months, from May to early October. The nectar was commonly fed to the first and second broods of young.

Although native to Queensland rainforests, Umbrella Trees *Schefflera actinophylla* are commonly planted in Sydney gardens, with one tree to every five or six households in many places. The blooms provided a long-lasting source of both pollen and nectar in summer with a few flowers persisting all through the autumn. Their importance was probably equal to the blooming of Coral Trees in the cooler months.

Queen's Palms *Syagrus romzoffianum* are not infrequently planted in gardens of houses and there is a locally important group of 21 trees in the Memorial Park opposite Oatley Railway Station. They provided a major food source for Rainbow Lorikeets in February and were a minor food source in March, April and May.

TABLE 1

Seasonal feeding pattern of the Rainbow Lorikeet *Trichoglossus haematodus* in the Sydney suburb of Oatley 1993–1994. b = blooms (nectar/pollen), f = fruits, s = seeds. Major Food Sources refer to trees which are common in the Oatley district and in which Rainbow Lorikeets have been observed feeding throughout the month. Minor Food Sources refer to trees which were uncommon in the Oatley district or produced fewer blooms than during the month shown in the 'Major Food Source' column.

| Month | Major Food Source | Minor Food Source |
|---------------|--|---|
| Spring | | |
| Sep. | Coral Tree <i>Erythrina variegata</i> b Spotted Gum <i>Eucalyptus maculata</i> b | |
| Oct. | Coral Tree <i>Erythrina variegata</i> b Silky Oak <i>Grevillea robusta</i> b | Spotted Gum <i>Eucalyptus maculata</i> b Cockscomb Coral Tree <i>Erythrina crista-galli</i> b She-Oak <i>Casuarina</i> spp. s Blackbutt <i>Eucalyptus pilularis</i> b Bottlebrush <i>Callistemon</i> spp. b |
| Nov. | Silky Oak <i>G. robusta</i> b Blackbutt <i>Eucalyptus pilularis</i> b | Cockscomb Coral Tree <i>E. crista-galli</i> b Flame Tree <i>Brachychiton acerifolium</i> b Giant Crane Flower <i>Strelizia giganteum</i> b Rusty Gum <i>Angophora costata</i> b |
| Summer | | |
| Dec. | Old Man Banksia <i>Banksia serrata</i> b Blackbutt <i>Eucalyptus pilularis</i> b | She-Oak <i>Casuarina</i> spp. s Black Bean <i>Castanospermum australe</i> b Red-flowering Gum <i>Eucalyptus ficifolia</i> b Cheese Tree <i>Glochidion ferdinandi</i> f |
| Jan. | Old Man Banksia <i>B. serrata</i> b Umbrella Tree <i>Schefflera actinophylla</i> b Small-leaved Fig <i>Ficus microcarpa hillii</i> f Blackbutt <i>Eucalyptus pilularis</i> b | Spotted Gum <i>E. maculata</i> b She-Oak <i>Casuarina</i> spp. s Cheese Tree <i>Glochidion ferdinandi</i> f |
| Feb. | Umbrella Tree <i>Schefflera actinophylla</i> b Small-leaved Fig <i>F. microcarpa hillii</i> f Queen's Palm <i>Syragus romzoffianum</i> b | She-Oak <i>Casuarina</i> spp. s Pepper Tree <i>Schinus molle</i> f |
| Autumn | | |
| Mar. | Umbrella Tree <i>Schefflera actinophylla</i> b Small-leaved Fig <i>F. microcarpa hillii</i> f Coast Honeysuckle <i>Banksia integrifolia</i> b Broad-leaved Paperbark <i>Melaleuca quinquenervia</i> b | Queen's Palm <i>Syragus romzoffianum</i> b |
| Apr. | Coast Honeysuckle <i>B. integrifolia</i> b Broad-leaved Paperbark <i>M. quinquenervia</i> b | Queen's Palm <i>Syragus romzoffianum</i> b Umbrella Tree <i>Schefflera actinophylla</i> b Spotted Gum <i>Eucalyptus maculata</i> b |
| May | Coral Tree <i>Erythrina variegata</i> b | Queen's Palm <i>Syragus romzoffianum</i> b Wheel-of-fire Tree <i>Stenocarpus sinuatus</i> b Umbrella Tree <i>Schefflera actinophylla</i> b |
| Winter | | |
| Jun. | Coral Tree <i>Erythrina variegata</i> b | Mugga Ironbark <i>Eucalyptus sideroxylon</i> b Umbrella Tree <i>Schefflera actinophylla</i> b |
| Jul. | Coral Tree <i>Erythrina variegata</i> b | She-Oak <i>Casuarina</i> spp. s |
| Aug. | Coral Tree <i>Erythrina variegata</i> b Spotted Gum <i>Eucalyptus maculata</i> b | |

Fruits of the Small-leaved Fig *Ficus microcarpa hillii* were the only major fruit observed to be taken by Rainbow Lorikeets during this study. Nevertheless, two crops can be produced in a year (pers. obs.) and the fruits were locally important to the birds.

Broad-leaved Paperbarks *Melaleuca quinquenervia* are commonly planted as a park or street tree and their blooms provided a major food source in March and April. Although species of bottlebrush *Callistemon* spp. are commonly seen in local gardens, they did not appear to be much sought after by Rainbow Lorikeets, and the birds were only seen to be feeding on the blooms on two occasions (both in October 1993). Rainbow Lorikeets were observed to feed on both planted specimens of Old Man Banksia *Banksia serrata* in gardens as well as remnant stands in bushland.

Rainbow Lorikeets were observed feeding in She-oaks at various times of year (both on planted and remnant native specimens). Outside Oatley, where remnant stands of swamp forest still occur, for example at Ramsgate in Scarborough Park and Carss Park near Blakehurst, the birds often sought out the seed of Swamp Oaks *Casuarina glauca*. No doubt they did so last century when this type of habitat was more widespread. When feeding on *Casuarina* seeds, Rainbow Lorikeets deftly removed the tiny seeds from their cones without breaking the capsules from the twigs. Most other parrots which feed on *Casuarina* seeds, such as Eastern and Crimson Rosellas and various black cockatoos, invariably snap the capsules off and extract the seeds while grasping a cone in a claw. Rainbow Lorikeets also have the strange habit of chewing the tips of *Casuarina*, or at least, passing the ends of the phyllodes through their bills (Barker and Vestjens 1989; pers. obs.).

Spotted Gums *E. maculata* have been frequently planted in backyards in parts of Sydney suburbia but the species is not native to the Oatley district and can be regarded as a local exotic. It flowered mostly in September but its flowering was irregular with some blossoms observed in January and April.

Blackbutt *E. pilularis* trees are plentiful in some Southern Sydney bushland reserves and the nectar was a major food source to lorikeets in years of profuse blossoming. The blossom of

Swamp Mahogany *E. robusta* was also much sought after by the birds in some winters at Scarborough Park and Carss Park (pers. obs. over several years outside the study period), but as with Spotted Gum, it does not occur in the Oatley district, except as odd street tree plantings.

Although Rusty Gums *Angophora costata* are also plentiful in all Oatley bushland reserves, a Rainbow Lorikeet was seen to feed at the blossom of one of these trees on only a single occasion. On present evidence therefore, it does not appear that this species is a favoured food tree. However, mature trees provide numerous nesting cavities for several local parrot species, including Rainbow Lorikeets (see 'Breeding' below).

Backyard feeding

In Oatley, as in some other suburbs, a few local residents fed Rainbow Lorikeets and other suburban birds in their gardens, or from house and apartment balconies. Investigations made during this study show that the food provided consisted mostly of sunflower or other seed and not nectar substitutes. Usually seed is only provided at certain times of day. The birds soon learn these feeding times and gather in the street trees around the house concerned at the appropriate time. At one such suburban feeding site in Rosa Street, Oatley, 60 or more Rainbow Lorikeets (as well as other seed-eaters) were attracted. Other local feeding stations attracted smaller numbers of birds.

Although captive Rainbow Lorikeets can survive on a diet of seed, they are said not to thrive on a nectar-free diet and it is possible that wild swift-flying birds might need the high energy provided by pollen and nectar for health and successful breeding.

Roosting

Even if studies show conclusively that the modern-day suburban mosaic of exotic and native trees can provide a year-round food supply, there is still the need to ascertain whether the birds roost and breed locally if they are to be regarded as sedentary south Sydney residents as opposed to regular visitors to suburbia from outside the district.

The fact that lorikeets could be heard screeching just on dawn in Oatley indicated that some birds, at least, must roost either in the local area or within a very short distance of it as they do not appear to fly in the dark. Evening observations of Rainbow Lorikeets in Oatley revealed that pairs and small flocks habitually flew high and straight in a north-westerly direction, usually almost half an hour before sunset in all seasons.

One evening on dusk, a few of the birds could be heard screeching above the din of a flock of Common Mynahs *Acridotheres tristis* in an ornamental street fig tree on the intersection of Dardanelles and Park Streets, in Mortdale, an adjacent suburb of Oatley. The tree in question was not very tall, but had a compact, thick crown which could shelter many birds.

Subsequent observation revealed that between 20 and 35 Rainbow Lorikeets regularly gathered in backyard trees on dusk, before flying into the ample cover provided by the fig tree's foliage. There were far more mynahs than lorikeets roosting in the tree, but after much noise from both species, they settled down and became virtually silent by nightfall.

Local residents stated that the lorikeets had been regularly using the fig tree as a roost for the past two years. Towards dusk on any evening, small flocks or pairs of lorikeets intermittently flew over the roost towards the north-west, suggesting the presence of other, perhaps larger roosts in or beyond the district.

Another roost was later located in a pair of palms in a backyard in Rosa Street, Oatley. In this case, a few Rainbow Lorikeets, far outnumbered by Common Mynahs, settled in the deep cover provided by spaces between the leaf bases and tree trunks.

Breeding

No cases of Rainbow Lorikeets nesting in street or garden trees were observed. This is not surprising because few planted trees have developed suitable hollows. However, they were observed to utilize hollows in old smooth-barked trees which persist in the bushland reserves such as at the Moore Reserve and Oatley Pleasure Grounds (Table 2). This was also the case in other southern suburbs such as Carss Park near Blakehurst. The chosen nest sites were usually in

the limbs of old Blackbutts *Eucalyptus pilularis* and Smooth-barked Apples or Rusty Gums *Angophora costata* (Table 2).

The largest bushland remnant in Oatley, known as Oatley Park, contains few large, old trees with hollows suitable for tree hole-nesting birds, but some of the smaller reserves still retain large, old trees, most growing on the steeper slopes. Some of these trees contained a large number of cavities, not all of which were visible or obvious to an observer on the ground. Such hollows provide nesting sites for a range of suburban birds including Southern Boobook *Ninox novaeseelandiae*, Sulphur-crested Cockatoos *Cacatua galerita*, Eastern Rosellas *Platycercus eximius*, Galahs *Cacatua roseicapilla*, Dollarbirds *Eurystomus orientalis*, and Common Mynahs, as well as Rainbow Lorikeets (Table 2). Some hollows were also used by bee colonies. Despite this, Rainbow Lorikeets seemed to compete very successfully with other potential occupants of suitable nest holes, because pairs of the species occupied more holes than any other species of bird surveyed in suburban reserves. Sometimes, several pairs nested in the same tree, alongside a pair of Galahs or Sulphur-crested Cockatoos (in bigger hollows) or a swarm of bees (Table 2).

The usual practice of preparing nest hollows commenced at the end of March. The first broods of chicks therefore hatched at the start of the long flowering period of the Coral Trees in May. In some cases the adults were observed flying into their nest hollows after having fed at Coral Tree blossom less than 100 m from the nest site.

Because they start breeding early and produce several successive broods in some instances, Rainbow Lorikeets do not have to compete with other hollow nesting bird species, until spring. In the spring of 1994, an Eastern Rosella was seen to investigate a tree hollow occupied by a pair of Rainbow Lorikeets in the owners' absence. On the return of the original occupants, one of the pair flew to the hollow's entrance and vigorously attacked the usurper with much shrieking until the rosella, half dragged from the hollow, was evicted.

Pairs of Rainbow Lorikeets were also seen to be unintimidated by Common Mynahs (potential nest hollow competitors) and Pied Currawongs *Strepera graculina* which are potential egg or nestling predators. Both species were chased away from nesting hollows on several occasions.

TABLE 2

Occupation of hollows in different species of tree by different bird species in parks and reserves in the Oatley area. n = number of hollows occupied.

| Bird Species | Tree Species | n | Notes |
|---|--------------------------------|---|---|
| Oatley Pleasure Grounds | | | |
| Rainbow Lorikeet <i>Trichoglossus haematodus</i> | Blackbutt ¹ | 8 | 3 hollows in same tree. All 8 hollows within a 50 m radius. |
| Crimson Rosella <i>Platycercus elegans</i> | Blackbutt ¹ | 1 | In same tree as Southern Boobook hollow. |
| Eastern Rosella <i>Platycercus eximius</i> | Rusty Gum ² | 1 | |
| Galah <i>Cacatua roseicapilla</i> | Blackbutt ¹ | 1 | In same tree as 3 pairs of nesting Rainbow Lorikeets. |
| Southern Boobook <i>Ninox novaeseelandiae</i> | Blackbutt ¹ | 1 | |
| Dollarbird <i>Eurostomus orientalis</i> | Blackbutt ¹ | 1 | |
| Moore Reserve, Oatley | | | |
| Rainbow Lorikeet <i>Trichoglossus haematodus</i> | Rusty Gum ² | 2 | Bees occupied other hollows in both trees. |
| Sulphur-crested Cockatoo <i>Cacatua galerita</i> | Rusty Gum ² | 1 | Bees occupied nest hollow of previous year. |
| Common Mynah <i>Acridotheres tristis</i> | Rusty Gum ² | 1 | |
| Oatley Park | | | |
| Rainbow Lorikeet <i>Trichoglossus haematodus</i> | Blackbutt ¹ | 1 | |
| Rainbow Lorikeet <i>Trichoglossus haematodus</i> | Rusty Gum ² | 1 | |
| Eastern Rosella <i>Platycercus eximius</i> | Unknown dead tree | 1 | |
| Sulphur-crested Cockatoo <i>Cacatua galerita</i> | Rusty Gum ² | 1 | |
| Myles Dunphy Reserve, Oatley | | | |
| Rainbow Lorikeet <i>Trichoglossus haematodus</i> | Blackbutt ¹ | 1 | |
| Eastern Rosella <i>Platycercus eximius</i> | Blackbutt ¹ | 1 | |
| Laughing Kookaburra <i>Dacelo gigas</i> | Blackbutt ¹ | 1 | |
| Carrs Park Reserve, near Blakehurst | | | |
| Rainbow Lorikeet <i>Trichoglossus haematodus</i> | Blackbutt ¹ | 4 | |
| Sulphur-crested Cockatoo <i>Cacatua galerita</i> | Blackbutt ¹ | 1 | Bees occupied another hollow in the same tree. |
| Yelambah Lagoon Bushland, Georges River N.P. | | | |
| Rainbow Lorikeet <i>Trichoglossus haematodus</i> | Rusty Gum ² | 3 | |
| Sulphur-crested Cockatoo <i>Cacatua galerita</i> | Blackbutt ¹ | 1 | |
| Crimson Rosella <i>Platycercus elegans</i> | Sydney Peppermint ³ | 1 | |
| Dollarbird <i>Eurostomus orientalis</i> | Blackbutt ¹ | 1 | |

¹Blackbutt = *Eucalyptus pilularis*

²Rusty Gum = *Angophora costata*

³Sydney Peppermint = *Eucalyptus piperita*

With the approach of dusk, breeding pairs roosted in their nest hollows and did not join the evening flocks of non-breeding birds flying to their communal roosts.

Conclusion

It appears that at least some Rainbow Lorikeets in Oatley and the surrounding district have become fully suburbanized and do not need to move long distances between feeding, roosting and breeding sites. They are also quite capable of successfully competing with other suburban bird species, both native and introduced. Rainbow Lorikeets have reclaimed their ancestral territory in Oatley and throughout much of southern Sydney by utilising a wide range of newly available food sources throughout the year.

REFERENCES

- Barker, R. D. and Vestjens, W. J. M. (1989). 'The Food of Australian Birds — 1 Non-Passerines.' (CSIRO Division of Wildlife and Ecology: Canberra.)
- Benson, D. and Howell, J. (1990). 'Taken for Granted: The Bushlands of Sydney and its Suburbs.' (Kangaroo Press: Sydney.)
- Crome F. and Shields, J. (1992) 'Parrots and Pigeons of Australia.' (Angus and Robertson: Sydney.)
- Hindwood, K. A. (1962). The Birds of Sydney. In 'The Natural History of Sydney'. Pp. 32. (Second edition, Australian Museum: Sydney.)
- Lendon, A. H. (1973). 'Australian Parrots in Field and Aviary.' (Angus and Robertson: Sydney.)
- North, A. J. (1901–1913). 'Nests and Eggs of Birds Found Nesting in Australia and Tasmania.' (Australian Museum: Sydney.)

BOOK REVIEW

The Penguins — Ecology and Management P. Dann, I. Norman and P. Reilly, 1995. ISBN 0 949324 58 2. Surrey Beatty & Sons Pty Limited, 45 Rickard Road, Chipping Norton, New South Wales 2170, Australia. 475 pp., numerous figures and b/w photographs, and 8 colour plates; 150 × 210 mm; hard cover. Available from leading Natural History Bookshops and publishers, RRP Aud\$85.00 plus postage.

This book contains some of the papers presented at the Second International Penguin Conference held at Cowes, Phillip Island, Victoria, Australia in August 1992. The papers are divided into four groups: A — Breeding Biology, B — Foraging Ecology and Energetics, C — Sexual and Geographic Variations, D — Management of Penguins and their Environment.

The eight contributions under Breeding Biology reflect a wide range of topics from census to overall effects on populations of occasional severe annual losses, from synchrony to asynchrony, from cost of reproduction to using such costs to appraise marine resources, the influences of behaviour on reproduction, and the factors controlling behaviour. The increasingly broad approach, made possible by the rapid advances in newer technologies, is apparent also in the section on Foraging Ecology and Energetics. The paper by R. Bannasch entitled 'Hydrodynamics of Penguins — an experimental approach' is a 'must' to read and, together with the contribution of B. Culik on 'Energy Expenditure of Adelie Penguins', sets the basis for appreciating the other papers on partitioning of resources and foraging using satellite telemetry and data loggers. A paper of 'Consumption of Southern Ocean marine resources by penguins' indicates an increasing interest in the role of penguins in biomass studies of this vast ecosystem. Sexual dimorphism of the bill is a feature of many species and an interesting hypothesis is presented for this evolution, and

a taxonomic approach applies this feature to assert that Macaroni and Royal Penguins should be regarded as separate species. The five papers on management are concerned with problems at colony site: the presence of people, changes in the physical attributes of the colony site, predators. One on heavy metal and organochlorine concentrations in tissues shows the increasing pollution of foraging areas.

It is inevitable that such a volume does not cover all the topics discussed at the Conference. It does indicate the great differences in approach that are possible nowadays because of the advance in technologies. They also demonstrate the importance of critical long-term studies in appraising changes in abundance. For the reviewer, it is the variety of studies that makes the book interesting to read. The book should be read by anyone interested in seabirds and others to appreciate the scope of the quantitative studies that are now possible with this group. Increasingly, those who study penguins know more about the marine environment than those who claim an expertise.

The quality of the colour and b/w photographs selected is variable. Some are excellent and clearly illustrate and enhance the topic to which they refer. Others are poor, and even out of focus. Some appear to have little relevance to the text and others are placed with little relevance to the text. This is a pity because so much can be told by appropriate photographs. There is not a single photograph depicting a Little Penguin of the host country or its habitat, even though five of the papers are about this bird and it is probably the most managed of all penguins — remarkable!

M. D. Murray
Pymble, New South Wales