

OBSERVATIONS ON THE DIET OF THE TOPKNOT PIGEON *Lopholaimus antarcticus* IN THE ILLAWARRA RAINFOREST, NEW SOUTH WALES

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Observations were made on the feeding behaviour of Topknot Pigeons *Lopholaimus antarcticus* from March 1988 to December 1992 near Mt Keira, Wollongong, New South Wales. The species of plants that contributed fruit to the diet were recorded for each month of the year. The seasonality, quantity and duration of fruiting by food species varied considerably over the study period. Topknot Pigeons were found to consume the fruits of 13 rainforest species and those that contributed most to the presence of the birds in the study area were the Cabbage Tree Palm *Livistona australis*, Moreton Bay Fig *Ficus macrophylla*, Brown Beech *Pennantia cunninghamii*, Jackwood *Cryptocarya glaucescens*, White Cherry *Schizomeria ovata*, Peppervine *Piper novaehollandiae* and Lillypilly *Acmena smithii*. These are recommended for rainforest revegetation schemes in the Wollongong area.

INTRODUCTION

The Topknot Pigeon *Lopholaimus antarcticus* is a monotypic Australian endemic which formerly ranged in large flocks, mainly in rainforests along the east coast and tablelands from Cape York to southern New South Wales (Morris *et al.* 1981; Pizzey and Knight 1997).

Although at one time reported in flocks of three to five thousand birds (Crome and Shields 1992), such concentrations no longer occur. It is thought that this is largely due to habitat destruction and shooting. In the case of the Illawarra rainforest near Wollongong, New South Wales, the methodical clearing was particularly severe commencing early 1800s, with only remnant stands surviving by the end of that century (Angel *et al.* 1985; Strom 1977). These scattered remnants probably amount to five per cent or less of the original Illawarra tract. Although the Topknot Pigeon has been occasionally recorded on the far south coast of New South Wales, with vagrants reaching Victoria and even Tasmania, the southern limit of seasonally occurring flocks of a hundred or more is the Illawarra district (Pizzey and Knight 1997).

Other studies of Topknights indicate that there is a wide range of fruit which contributes to their diet (e.g. Frith 1957; Crome 1975; Barker and Vestjens 1989; Innis 1989; Recher *et al.* 1995) although fruit availability varies from region to region through the year.

The Illawarra is depauperate in rainforest plant species compared with the subtropical rainforests of northern New South Wales and Queensland and a more limited range of fruit is available.

The aims of the study were:

1. to observe over several years, the feeding habits of Topknot Pigeons in a representative section of the remnant Illawarra rainforest in order to ascertain the seasonal and relative importance of the various fruits consumed;
2. to determine the rainforest plant species suitable for propagation by Wollongong City Council and private landholders; and

3. to identify 'key' species that could supplement the natural food supplies available locally to Topknot Pigeons as well as other rainforest birds.

Topknot Pigeons were formerly very wary in the region due to being hunted extensively until the 1930s. Even today, some illegal shooting takes place in the Illawarra district (D. Rosso, pers. comm.) but no longer occurs in the vicinity of the Mount Keira Scout Camp (D. Stone, Camp Superintendent, pers. comm.) where the study was done.

A secondary aim was to make some assessment of the sensitivity of Topknot Pigeons to human activity in close proximity as this could determine the usefulness of habitat restoration near built up areas.

METHODS

The study area was a remnant tract of mixed sub-tropical and warm temperate rainforest around the Mount Keira Scout Camp at the foot of the Illawarra escarpment and immediately west of the city of Wollongong (150°50'E, 34°25'S).

The method of locating Topknights involved searching the study area first from the Mount Robertson Lookout above the escarpment from where the whole district between Mts. Keira and Kembla could be observed. After a few minutes' observation with binoculars a flock was usually located, either feeding in the canopy or flying between food sources. The flock size was estimated by counting. The flock was then promptly located from below using emergent Moreton Bay Figs *Ficus macrophylla* as reference points relative to a system of walking tracks in the vicinity of the Camp. A car was used to reach it within a few minutes. The numbers of birds present in the flock was checked and the plant species they were feeding on, confirmed.

Observations were made over the period February 1988 to December 1992. Whenever possible, observations were made on a fortnightly basis and on Sundays in the late afternoon or early evening period when human disturbance in the study area was minimal. On some occasions however, this was not possible and observations had to be made during varying amounts of human activity.

RESULTS

Food species

The fruits of thirteen species of rainforest plants were utilized as food by Topknot Pigeons (Table 1).

These species of trees form part of the canopy or are emergents as in the case of the figs. The Peppervine *Piper*

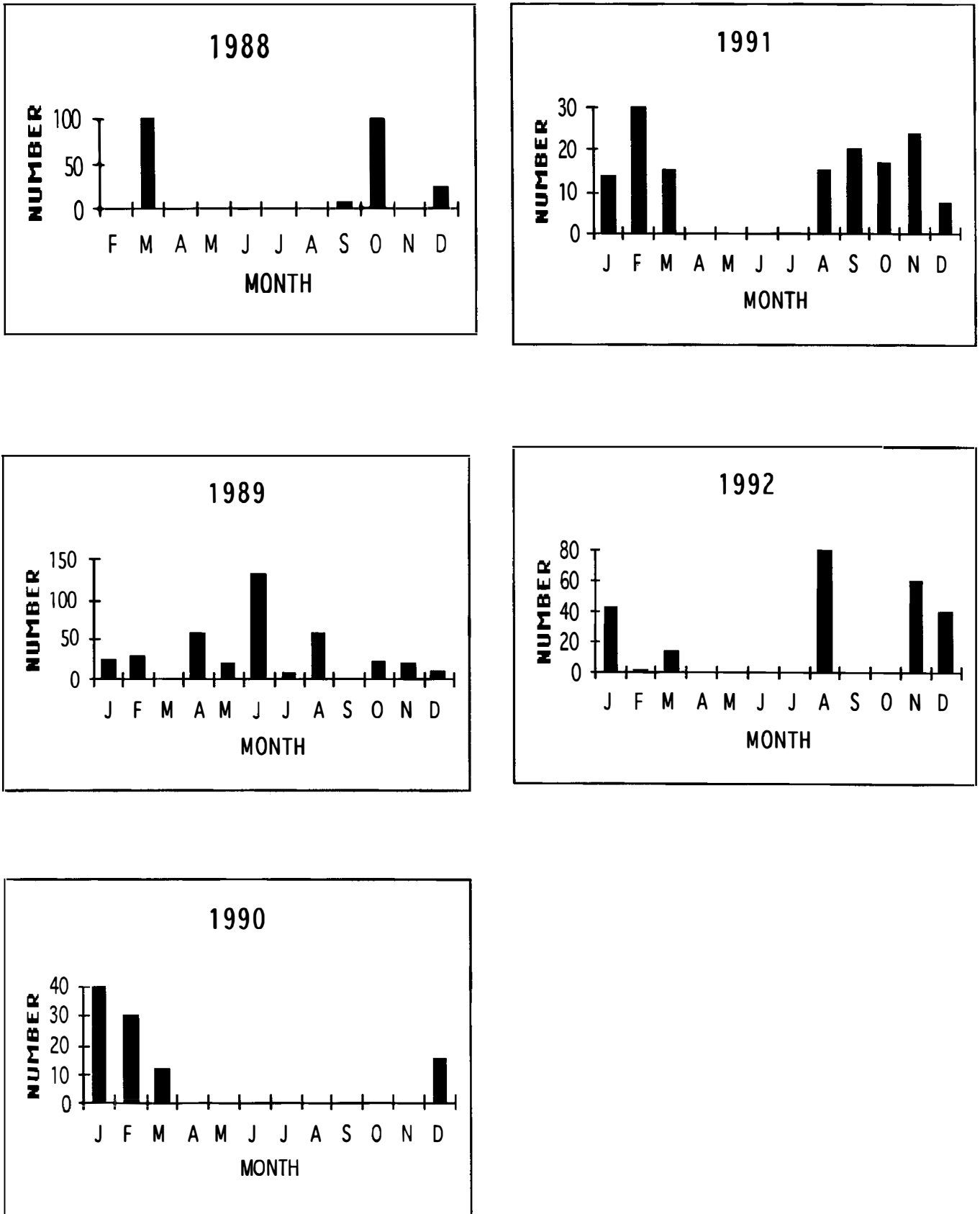


Figure 1. The greatest number of Topknot Pigeons observed feeding each month, in the Illawarra rainforest study area over the five years duration of the study. Refer also to Appendix 1.

TABLE 1
The fruiting periods of Mount Keira rainforest plants utilized as food by Topknot Pigeons.

Tree/vine species		J	F	M	A	M	J	J	A	S	O	N	D
Native Tamarind <i>Diploglottis australis</i>	1988												
	89	■											
	90	■											
	91	■											
White Cherry <i>Schizomeria ovata</i>	1988		■	■	■	■	■						
	89		■	■	■	■	■						
	90		■	■	■	■	■						
	91		■	■	■	■	■						
Moreton Bay Fig <i>Ficus macrophylla</i>	1988		■	■	■	■	■						
	89	■	■	■	■	■	■						
	90	■	■	■	■	■	■						
	91	■	■	■	■	■	■						
Jackwood <i>Cryptocarya glaucescens</i>	1988					■	■						
	89			■	■	■	■						
	90			■	■	■	■						
	91			■	■	■	■						
Lillypilly <i>Acmena smithii</i>	1988							■	■	■			
	89							■	■	■			
	90							■	■	■			
	91							■	■	■			
Cabbage Tree Palm <i>Livistona australis</i>	1988						■	■	■	■	■	■	■
	89						■	■	■	■	■	■	■
	90						■	■	■	■	■	■	■
	91						■	■	■	■	■	■	■
Brown Beech <i>Penamntia cumminghamii</i>	1988								■	■	■	■	■
	89								■	■	■	■	■
	90								■	■	■	■	■
	91								■	■	■	■	■
Churnwood <i>Citronella moorei</i>	1988	■	■	■	■	■							
	89	■	■	■	■	■							
	90	■	■	■	■	■							
	91	■	■	■	■	■							
White Quandong <i>Elaeocarpus kirtonii</i>	1988												■
	89												■
	90												■
	91												■
Peppervine <i>Piper novaehollandiae</i>	1988												■
	89												■
	90												■
	91												■
Small-leaved Fig <i>Ficus obliqua</i>	1988								■	■	■		
	89								■	■	■		
	90								■	■	■		
	91								■	■	■		
Murrogun <i>Cryptocarya microneura</i>	1988												
	89												
	90												
	91												
Bollygum <i>Litsea reticulata</i>	1988												
	89												
	90												
	91												



novaehollandiae is a climber which grows high into the canopy and so can be regarded as part of it. Even though it can provide some fruits well below canopy level, these rarely attracted pigeons to feed at lower levels when other frugivorous birds readily did so.

With the exception of the Cabbage Tree Palm *Livistona australis*, other frugivorous bird species also fed on fruit of these trees and the vine. At night, mammals such as possums and fruit bats fed upon certain fruits, particularly figs and fruits of the Lillypilly *Acmena smithii*. Both Topknot Pigeons and Brown Cuckoo-Doves *Macropygia amboinensis* were observed foraging regularly on the fruit of the Brown Beech *Pennantia cunninghamii* but the latter birds usually fed in the lower levels of the trees or in smaller trees growing on the edge of clearings. The Bollygum *Litsea reticulata* was the only tree species which had White-headed Pigeons *Columba leucomela* as well as Topknots feeding on the fruits.

Topknots were not observed eating fruits produced by sub-canopy trees and shrubs. These were eaten by other bird species including the Brown Cuckoo-Dove, which would also take some fruit from the ground and herb layer. Other common fruit-bearing species of vine including Water Vine *Celastrus subspicatus* and Morinda *Morinda jasminoides* were not recorded as food of Topknots although small flocks were sometimes seen resting in the vicinity of Water Vines (both in the study area and below the Bulli Lookout) and could have been feeding on the fruits unobserved during the survey.

Fruit of the Water Vine and Staff Vine were frequently observed with other birds feeding on them and on one occasion, a Brown Cuckoo-Dove was seen to pluck and eat a Morinda berry.

Species of sub-canopy trees and vines recorded as fruiting and eaten by other bird species in the study area were as follows: *Polyscias murrayi*, *Ehretia acuminata*, *Diospyros australis*, *Polyosoma cunninghamii*, *Claoxylon australe*, *Omolanthus populifolius*, *Eupomatia laurina*, *Ficus coronata*, *Sloanea australis*, *Rapanea howittiana*, *Notolaea longifolia*, *Pittosporum undulatum*, *Alectryon subcinereus*, *Guioa semiglauc*, *Trema aspera*, *Dendrocnide excelsa*, *Sterculia acerifolium*, *Cissus hypoglauc*, *Cissus antarctica*, *Celastrus subspicatus*, *Morinda jasminoides*, *Palmeria scandens* and *Breynia oblongifolia*.

During extensive observations of other frugivorous birds in the study area contemporary with this study, Topknot Pigeons were never observed to feed on the fruits of any of these species.

Seasonality and abundance of fruit

Not all the thirteen plant species produced fruit each year (Tables 1 to 3). Some, such as the White Quandong *Elaeocarpus kirtonii* and the Bollygum *Litsea reticulata*, fruited in only one season out of five (Table 2).

Of the species which did fruit each year, the crop varied from sparse to copious, depending on the numbers of individuals fruiting and the amount of fruit produced by each tree. For example, the White Cherry *Schizomeria*

TABLE 2
Relative importance of fruiting plant species as food sources for Topknot Pigeons.

Species of tree or vine	Length of fruiting period in months	Number of good crop seasons	Index of fruiting reliability*
Native Tamarind			
<i>Diploglottis australis</i>	1-2	1	2
White Cherry			
<i>Schizomeria ovata</i>	2-3	1	5
Moreton Bay Fig			
<i>Ficus macrophylla</i>	3	1	5
Jackwood			
<i>Cryptocarya glaucescens</i>	1-2	1	5
Lillypilly			
<i>Acmena smithii</i>	1-2	2	5
Cabbage Tree Palm			
<i>Livistona australis</i>	6	2	4
Brown Beech			
<i>Pennantia cunninghamii</i>	2-4	2	4
Churnwood			
<i>Citronella moorei</i>	2	2	4
White Quandong			
<i>Elaeocarpus kirtonii</i>	1	1	1
Peppervine			
<i>Piper novaehollandiae</i>	1-2	3	4
Small-leaved Fig			
<i>Ficus obliqua</i>	2	1	3
Murrogan			
<i>Cryptocarya microneura</i>	1-2	1	1
Bollygum			
<i>Litsea reticulata</i>	2-3	1	1

*Refers to number of years in the five year period when each species bore at least some fruit.

ovata fruited each year in late summer and early autumn and produced a prodigious amount of fruit in 1988 and a smaller crop in 1992. In 1989, only a few trees produced a few fruit.

Other trees which produced at least some fruit each year included the Moreton Bay Fig *Ficus macrophylla*, Jackwood *Cryptocarya glaucescens* and Churnwood *Citronella moorei* as well as Lillypilly and Cabbage Tree Palm. The Peppervine produced fruit, usually in abundance, in mid-summer. The Brown Beech *Pennantia cunninghamii* provided at least some fruit for Topknots in most years in spring and early summer.

Within the timeframe of the study, the greatest variety of fruit was available in summer and the least available in winter (Table 3). Most trees produced fruit for two or three months (Table 2). The Cabbage Tree Palm had at least some fruit available for half the year which was a longer time than for the other species (Table 2). It was also a reliable fruiter, bearing some fruit in four years out of five, with good crops produced in two of those years.

The Moreton Bay Fig is another reliable food source (Tables 1 and 2). This species and the older Cabbage Tree Palms are emergents of the local rainforest but the fig is less common and is represented by only half a dozen or so well grown individuals in the vicinity of the Scout Camp. A few others are scattered along the escarpment foot and slope to Mount Kembla and beyond. These emergent figs produce an abundance of fruit during a good season

TABLE 3
Seasonal availability of fruits as food sources for Topknot Pigeons.

Year	Number of species producing fruit			
	Summer (D J F)	Autumn (M A M)	Winter (J J A)	Spring (S O N)
1988	7	3	4	3
1989	8	3	3	1
1990	13	4	1	2
1991	12	2	2	1
1992	6	5	2	2
Average	9.2	3.4	2.4	1.8

(autumn 1988 and summer 1989). Jackwood could also prove to be a reliable food source as it produces at least some fruit each autumn (Tables 1 and 2).

The only species consistently producing fruit in the colder months was the Lillypilly. In 1990, the species produced the only available fruit during the winter (Table 1). In some years, the Cabbage Tree Palm may produce some ripe fruit at the end of winter before the main spring crop (Table 1).

Chronology of fruiting events and presence of topknots

1988

On March 2, 1988 soon after the study commenced, a flock of between 80 and 100 Topknots were seen from the Robertson Lookout. A Grey Goshawk *Accipiter novaehollandiae* put to flight all of the large flock that had previously been feeding in one of the Moreton Bay Figs. The flock soon flew into another fruiting fig close to the Scout Camp clearing whereupon one of the birds was struck by the raptor and later found dead at the base of the tree. During autumn 1988, good crops of Moreton Bay Figs and White Cherries attracted Topknots.

Topknots were not recorded again in the vicinity until September 1988 (Appendix 1) when eight birds were observed feeding in one of the few Small-leaved Figs *Ficus obliqua* in the study area. Despite the profuse fruit produced by this tree, it appeared to attract few birds compared with the Moreton Bay Figs.

By mid-October of 1988, the Cabbage Tree Palms and Brown Beeches, both represented by scores of trees in the study area, were producing copious amounts of fruit that attracted a large flock of Topknots. An exact count was impossible, either from the Lookout or at ground level, but there were more than one hundred birds present during October. By November, numbers had declined and only a few birds were still feeding on the remaining fruits by early December. By mid-December, the birds had switched to feed alternately on the fruits of the Native Tamarind *Diploglottis australis* and Peppervine. The former was not as common as Brown Beech or White Cherry and did not produce as much fruit even in a good year. The vine was common in the area close to the Scout camp and it covered some of the larger trees in some places.

1989

By mid-January 1989, both the Native Tamarind and Peppervine had finished fruiting and fruits of the

Churnwood and Moreton Bay Fig started to become available lasting until March. Like the Native Tamarind, the Churnwood was not common in the study area and does not bear large amounts of fruit. Consequently, the Native Tamarind and the Churnwood only attracted small numbers of Topknots.

In contrast, the Jackwoods *Cryptocarya glaucescens* produced a bumper crop from March until mid-June and attracted considerably more Topknots than the above two tree species, with between 120 and 130 birds recorded on June 10. This was the largest flock recorded since the simultaneous fruiting of the Cabbage Tree Palm and the Brown Beech in the previous year (Appendix).

Topknots were not recorded in the study area after the Jackwoods ceased fruiting in mid-June until late July when the Lillypilly trees fruited well and Topknots began foraging on the crop. This was the only year in which the Lillypilly was recorded as a winter fruit source. (Although 1991 was a good fruiting year for Lillypilly there were no flocks present in the area.)

Although the Cabbage Tree Palm began fruiting in July in 1989 and some fruit was still available until the end of the year, the crop was poor and attracted only small flocks or single birds. By December, a few Topknots were seen in one of the large Moreton Bay Figs where they appeared to be eating mostly unripe fruit. In the middle of that month, Topknots were starting to feed on fruit of the White Quandong *Elaeocarpus kirtonii* which only fruited for one season (from December 1989 to January 1990) during the study period.

1990

For the first two months of 1990, the birds continued to feed in small groups on White Quandong fruits but larger numbers were recorded feeding on Moreton Bay Figs until well into March (Appendix).

Unusually, the Peppervine did not attain its peak fruiting until February in 1990, and the Churnwood until March when flocks were seen foraging on them. Virtually no Topknots were recorded throughout the autumn and winter of 1990 in the study area (Appendix). It was not until December of that year that a few birds re-appeared to feed on the fruit of the Brown Beech. Jackwoods produced a poor crop in 1990 and no birds were seen feeding on them.

1991

The fruiting and feeding pattern for the first quarter of 1991 was similar to that of the previous year. Topknots were only recorded in small numbers until mid-March when 20–30 birds were seen feeding on Jackwood fruits which produced only a moderate amount of fruit in 1991 compared with the copious amounts produced in 1989. For the remainder of the year, the palms mainly provided the pigeons with food for approximately four months.

1992

During the final year of the survey, a variety of fruits attracted mostly small numbers of Topknots for the first quarter of the year, although the Peppervine fruited well and attracted the most pigeons. 1992 was also the only year

in which the Bollygum *Litsea reticulata* produced any fruit and the few trees present in the study area attracted some Topknots as well as a few White-headed Pigeons. This was the only occasion on which this latter species was recorded in the study area although they are commonly seen near fruiting Camphor Laurel *Cinnamomum camphora* in winter further south around Jamberoo.

The Murrogan *Cryptocarya microneura* does not occur in the study area but a small stand occurs further east in wet sclerophyll forest at the Girl Guide Camp. A large concentration of Topknot Pigeons and Pied Currawongs *Streptera graculina* feeding in these trees was seen from the Robertson Lookout and from the ground. The Brown Beech fruited well again towards the end of this year and attracted a number of Topknot Pigeons.

Sensitivity to human activity

My own presence during feeding observations was as unobtrusive as possible and the birds did not take flight at my approach. Although large and often noisy groups of people occasionally passed close to feeding Topknots, the birds rarely took flight. Sudden, loud noises could scare away a whole flock feeding close by but groups invariably returned within a few minutes (pers. obs.).

Other observers have reported small flocks of Topknots feeding in isolated fig trees in more built up areas of the region, adjacent to hotels and homesteads. These fed for some time on the fruit during human activity on the ground below (D. Rosso and I. Forman, pers. comm.).

DISCUSSION

This study shows that the pattern of fruiting of the rainforest species varies from year to year and that there is considerable variation in the seasonality, quantity and duration of food availability to Topknot Pigeons in the area under study. Most notably, in 1989, when the Lillypilly trees produced a good winter crop, Topknots were present in variable number most of the year. However, in other years, the pigeons may be absent for considerable periods particularly in the cooler months possibly due to the lack of suitable or sufficient food sources.

It is also apparent that of the thirteen food-producing plants utilised by Topknots, one group (including: Native Tamarind, Churnwood, White Quandong, Small-leaved Fig, Murrogun and Bollygum) are either unreliable in their fruiting or so short in their fruiting periods that they cannot be depended upon as regular food supplies. This also appears to be the case on the north coast of New South Wales (Recher, Date and Ford 1995) despite the greater variety of fruit-bearing trees in that region.

In contrast, the second group are relatively reliable fruiters, regular producers of good fruit crops or have a long fruiting period. These species include: Cabbage Tree Palm, Moreton Bay Fig, Brown Beech, Jackwood, White Cherry, Peppervine and Lillypilly; and they can be regarded

as key plants in terms of food sources for Topknot Pigeons in the Illawarra district. Such species should be included in revegetation schemes carried out by local councils and landholders in areas which previously supported rainforest if Topknots are to have a more secure status in the future. The deficiency in winter fruit crops could be at least partially made up by planting other, reliable winter fruiting species favoured by Topknots such as White Cedar *Melia azedarach* which is rare in the study area but occurs more often in certain other remnants of Illawarra rainforests such as Minnamurra Falls.

Studies in northern New South Wales clearly indicate the importance of the widespread Camphor Laurel in the winter diet of Topknot Pigeons (e.g. Recher, Date and Ford 1995). This introduced species is nowhere near as widespread in the Illawarra district as it is on the north coast and is not considered to be of much importance to Topknots as a winter food source.

A programme of rainforest species replantings close to some human habitation may be relevant to Topknot conservation as there are indications that the birds are able to adjust to human activity nearby (comparison with Recher *et al.* 1995). Such observations suggest that a decline in persecution over the past five decades may be causing the birds to be less wary of humans than previously.

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APPENDIX

Topknot Pigeons feeding in Mt Keira study area.

Year	Date	Numbers in flocks	Food Source	Year	Date	Numbers in flocks	Food Source
1988	2/3	80-100	Moreton Bay Fig		22/1	30-40	Moreton Bay Fig
	21/3	27	White Cherry		22/1	2	White Quandong
	21/3	40-50	Moreton Bay Fig		22/1	3	Peppervine
	20/9	8	Small-leaved Fig		29/1	15	Moreton Bay Fig
	6/10	11	Small-leaved Fig		17/2	20-30	Moreton Bay Fig
	15/10	100+	Cabbage Tree Palm		17/2	12	Peppervine
	23/10	100+	Cabbage Tree Palm		25/2	20-30	Moreton Bay Fig
			Brown Beech		10/3	11	Moreton Bay Fig
	23/10	40	Cabbage Tree Palm		10/3	6	Churnwood
			Brown Beech		19/12	10-15	Brown Beech
	11/12	9	Cabbage Tree Palm	1991	18/1	13	Peppervine
			Brown Beech		18/1	1	Brown Beech
	18/12	25	Native Tamarind and Peppervine		27/1	2-3	Churnwood
1989	2/1	10-12	Native Tamarind		27/1	12-14	Moreton Bay Fig
	11/1	20-25	Peppervine		10/3	8-10	Churnwood
	18/1	7	Churnwood		17/3	20-30	Jackwood
	18/1	30	Moreton Bay Fig		18/8	12-15	Cabbage Tree Palm
	5/2	13	Churnwood		7/9	20	Cabbage Tree Palm
	5/2	25-27	Moreton Bay Fig		13/10	17	Cabbage Tree Palm
	12/2	20-30	Moreton Bay Fig		10/11	4	Cabbage Tree Palm
	25/4	60	Jackwood		10/11	7-8	Brown Beech
	7/5	20	Jackwood		28/11	20-24	Cabbage Tree Palm
	10/6	120-130	Jackwood		8/12	7	Cabbage Tree Palm
	22/7	9	Lillypilly	1992	7/1	1	Cabbage Tree Palm
	6/8	40-60	Lillypilly			15-20	Peppervine
	1/10	4	Cabbage Tree Palm		24/1	43	Peppervine
	15/10	22	Cabbage Tree Palm		27/2	1	Crabapple
	21/10	3-4	Cabbage Tree Palm		27/2	2	Churnwood
	4/11	20	Cabbage Tree Palm		8/3	6	Crabapple
	18/11	10	Cabbage Tree Palm		15/3	2	Churnwood
	25/11	12-15	Cabbage Tree Palm		15/3	6	Moreton Bay Fig
2/12	3-4	Moreton Bay Fig		15/3	15	Bollygum	
16/12	3-4	Moreton Bay Fig		29/3	9	Bollygum	
1990	16/12	12	White Quandong		16/8	80+	Murrogan
	8/1	6	Moreton Bay Fig		5/11	58-60	Brown Beech
	8/1	15	White Quandong		10/12	16-20	Brown Beech
	15/1	30	Moreton Bay Fig		12/12	30-40	Brown Beech
	15/1	15-20	White Quandong				