

PLANT FOOD RESOURCES OF BIRDS IN COASTAL DUNE COMMUNITIES IN NEW SOUTH WALES

CARL R. GOSPER

Australian Flora and Fauna Research Centre, Department of Biological Sciences, University of Wollongong, Northfields Avenue, Wollongong, New South Wales 2522

Received: 24 April 1998

The plant food resources of birds, namely nectar, flower parts, leaves, exudates, seeds, elaiosomes and fruits, were recorded in coastal dune communities at several locations along the New South Wales coastline. This paper lists all the observed plant food types (73 in total) used by 53 bird species, from 58 plant species. Notes are included on the more unusual and interesting food items and foraging techniques. The majority of observations add to the current range of specifically known bird foods. Of particular interest was the diversity of the diet of many species, particularly in the previously unknown use of nectar and fleshy fruit resources.

INTRODUCTION

Many species of birds rely directly on plants for food, consuming nectar, parts of flowers, leaves, exudates, seeds and fruits. Similarly, some plants depend on birds to achieve pollination, or seed dispersal, or both. Extensive lists of the food sources of Australian birds (particularly plant foods) have been published by several authors, most notably several chapters in Ford and Paton (1986), Floyd (1989), Barker and Vestjens (1989 and 1990) and Lepschi (1993 and 1997). These accounts cover broad geographic areas and a variety of habitat types by collating either a range of published sources or opportunistic personal records. More intensive studies of herbivory in birds in a defined region or habitat type include Crome (1975), Paton and Ford (1977), Holmes (1987), French (1990) and Green (1993).

Overall, there is still much to learn about the diets of many species, particularly in assessing the food sources of suites of birds in particular localities. In particular, the diet of birds in coastal vegetation communities have been only opportunistically recorded. How strictly some Australian species of bird are insectivorous, nectarivorous or frugivorous is also poorly defined. This paper aims to document plant foods utilized by birds in coastal dune communities in New South Wales. For the purposes of this study, coastal dune communities include all vegetation on foredunes and hind-dunes.

METHODS

Information on plant food types was obtained through opportunistic, direct observation of feeding birds and analysis of pellets over the period March 1995 to July 1997. Pellet records were confined to those species whose pellets could be readily recognized, namely Pied Currawongs *Strepera graculina* and Ravens *Corvus* spp. Particular attention was placed on birds feeding at flowers to determine if insects, nectar, or both, were taken.

As a consequence of the non-systematic sampling, the observations may be biased towards easily-observed bird species, common plant species, plant species that flowered or fruited regularly over the study period, and to situations in which I suspected particular birds to be foraging on particular plant foods. Also, greater attention was allocated to Bitou Bush *Chrysanthemoides monilifera* subsp. *rotundata* and Monotoca *Monotoca elliptica*, species in which I had a particular research interest.

STUDY SITES

Data on birds' diets were collected from widely separated locations along the New South Wales coastline, from Lennox Head in the north to Eurobodalla National Park (Moruya Heads) in the south. The bulk of the observations originate from four sites at which extensive surveys were completed, namely Myall Lakes National Park (NP) (32°32'S, 152°18'E), Perkins Beach Recreation Reserve, Primbee (34°31'S, 150°53'E), Eurobodalla NP (35°56'S, 150°10'E) and Yuraygir NP/Bundjalung NP/Iluka Nature Reserve (29°24'S, 153°21'E). The remaining sites (Killalea State Recreation Area/Bass Point 34°36'S, 150°52'E; Botany Bay NP, Kurnell 34°02'S, 151°13'E; Seven-mile Beach NP 34°49'S, 150°45'E; Stuart Park, North Wollongong 34°25'S, 150°55'E; Dunbogan 31°39'S, 152°49'E; and Flat Rock, Lennox Head 28°50'S, 153°36'E) were visited sporadically and on few occasions.

Bitou Bush infestation of dune communities characterized all sites, although each area also had sections of the coastline free from this weed species. The natural vegetation consisted of Hairy Spinifex *Spinifex sericeus* grassland on the foredune, coastal scrub (usually a mix of Coastal Wattle *Acacia sophorae*, Coastal Beard-heath *Leucopogon parviflorus* and Coastal Tea-tree *Leptospermum laevigatum*) grading into either sclerophyll forest (dominated by either Swamp Mahogany *Eucalyptus robusta*, Bangalay *E. botryoides* or Blackbutt *E. pilularis*), littoral rainforest, heath or *Banksia/Leptospermum* scrub. Carolin and Clarke (1991) provide a more detailed description of typical coastal dune vegetation in eastern Australia. New South Wales Agriculture conducted Bitou Bush control works at the main study sites (see Toth *et al.* 1993 for a description of New South Wales Agriculture Bitou Bush control techniques).

RESULTS AND DISCUSSION

In coastal dune environments in New South Wales, 53 species of birds were observed using a total of 73 plant foods (from 58 plant species). The plant foods used by each bird species are shown in the accompanying tables with fruit, seed and elaiosome foods presented in Table 1 and nectar, flower, sap and leaf foods in Table 2. The number of bird species observed foraging on each plant food type is shown in Table 3. Bird species have been arranged in commonly accepted foraging guilds in these tables, rather than in taxonomic order, to allow an easier assessment of the variety of foods utilized by species that are thought to require somewhat similar resources. Table 3 details the number of plant species of each food type (nectar, fruit etc) utilized by each bird species. Botanical nomenclature follows Harden (1990-93), with common names for plants added where appropriate. Notes on interesting and unusual observations of food type and

TABLE 2
Food sources of birds in coastal New South Wales — nectar, flower parts, leaf and sap.

Plant Species #	Frugivores ^	Green Catbird	Regent Bowerbird	Satin Bowerbird	Granivores	Crimson Rosella	Eastern Rosella	Frugivore/gleaner	*Red-whiskered Bulbul	Generalist	Lewin's Honeyeater	Silvereye	Nectarivore	Rainbow Lorikeet	Scaly-breasted Lorikeet	Musk Lorikeet	Little Lorikeet	Swift Parrot	Red Wattlebird	Little Wattlebird	Noisy Friarbird	Little Friarbird	Nectarivore/gleaner	Blue-faced Honeyeater	Noisy Miner	Yellow-faced Honeyeater	Brown-headed Honeyeater	White-naped Honeyeater	Brown Honeyeater	New Holland Honeyeater	White-checked Honeyeater	Eastern Spinebill	Scarlet Honeyeater	Insectivores	White-throated Treecreeper	Variagated Fairy-wren	Brown Thornbill	Spangled Drongo	*Common Myna	Omnivore	Pied Currawong	Forest Raven	Number of bird species		
Thymelaeaceae																																													
<i>Pimelea linifolia N</i>																															P												1		
Rosaceae																																													
* <i>Rubus sp. N</i>																														P														1	
Proteaceae																																													
<i>Persoonia stradbrogensis N</i>																														Y	Y													2	
<i>P. lanceolata N</i>											P																																	1	
<i>Banksia integrifolia N</i>		M	M							MEY	PME		EY	MY				E	MEY					Y		E	E	PE	Y	PME	MY	PME	M					E	E			S	M	21	
<i>B. integrifolia Fl</i>						E	E																																			M		3	
<i>B. serrata N</i>										M			E	M				PE	ME	ME				M	M	ME				PM	M	ME												12	
<i>B. aemula N</i>													Y	Y																														2	
Myrtaceae																																													
<i>Eucalyptus gummiifera N</i>											P																					P												2	
<i>E. botryoides L</i>						E																																						1	
<i>E. botryoides N</i>																																P												1	
<i>E. robusta N</i>								P		M	PM		M	M	M	P	M	PM	M	M				M	PM	M				PM	M	PM	M	M		P				PM	P		21		
<i>E. tereticornis N</i>																									M																			1	
<i>E. pilularis N</i>										M	P																		P		P		P	M										7	
<i>Leptospermum laevigatum N</i>										M	M									M						M				PM	M													6	
<i>Callistemon citrinus N</i>																																												1	
<i>Melaleuca quinquenervia N</i>										Y				Y	D				Y		Y					M			M		Y	M	Y											10	
Rutaceae																																													
<i>Correa alba var. alba N</i>																															M		M											2	
Sapindaceae																																													
<i>Cupaniopsis anacardioides N</i>										M										M														M										3	
Fabaceae																																													
<i>Acacia sophorae Ex</i>												P																				P												2	
* <i>Erythrina X syksii N</i>										S	P								M	MB	M			M	M				W	B													9		
<i>Kennedia rubicunda N</i>											M																			PM	M													3	
<i>K. rubicunda Fl</i>		M																																										1	
<i>Hardenbergia violacea N</i>																																		M										1	
Loranthaceae																																													
<i>Muellerina celastroides N</i>																															M		M											2	
Pittosporaceae																																													
<i>Billardiera scandens N</i>																																		S										1	
Solanaceae																																													
<i>Duboisia myoporoides N</i>																															P													1	
Epacridaceae																																													
<i>Styphelia viridis N</i>																																	M											1	
<i>Leucopogon parviflorus L</i>						E																																						1	
<i>L. parviflorus N</i>										M																																		1	
<i>L. parviflorus Fl</i>						E																																						1	
Goodeniaceae																																													
<i>Scaevola calendulacea Fl</i>																																										M		1	
Verbenaceae																																													
* <i>Lantana camara N</i>																																	PKS												1

Codes following plant species: Fl - Whole flower or parts thereof; N - nectar; Ex - stem exudate; L - leaves. * Introduced taxa. ^ Codes for locations of observations: P - Perkins Beach RR; M - Myall Lakes NP; E - Eurobodalla NP; Y - Yuraygir NP/Bundjalung NP; B - Botany Bay NP; K - Killalea SRA/Bass Point; S - Seven-mile Beach NP; W - Wollongong; and D - Dunbogan. Scientific names for birds in Table 3.

TABLE 3
Observed food types for each bird species in coastal New South Wales.

Bird Species	F#	Sd	A	E1	N	Fl	Ex	L	Total
Brown Quail <i>Coturnix ypsilophora</i>	1								1
White-headed Pigeon <i>Columba leucomela</i>	1								1
Bar-shouldered Dove <i>Geopelia humeralis</i>		1							1
Yellow-tailed Black-Cockatoo <i>Calyptorhynchus funereus</i>		2							2
Galah <i>Cacatua roseicapilla</i>		1							1
Rainbow Lorikeet <i>Trichoglossus haematodus</i>	1	2			5				8
Scaly-breasted Lorikeet <i>T. chlorolepidotus</i>	1	1			5				7
Musk Lorikeet <i>Glossopsitta concinna</i>					1				1
Little Lorikeet <i>G. pusilla</i>					1				1
Crimson Rosella <i>Platycercus elegans</i>	2	3				1		1	7
Eastern Rosella <i>P. eximius</i>	1	1				1			3
Swift Parrot <i>Lathamus discolor</i>					1				1
White-throated Treecreeper <i>Cormobates leucophaeus</i>					1				1
Superb Fairy-wren <i>Malurus cyaneus</i>	1	1							2
Variiegated Fairy-wren <i>M. lamberti</i>	1				1				2
Brown Thornbill <i>Acanthiza pusilla</i>	1			1	1				3
Striated Thornbill <i>A. lineata</i>				1					1
Red Wattlebird <i>Anthochaera carunculata</i>	2	1			4				7
Little Wattlebird <i>A. chrysoptera</i>	2				8				10
Noisy Friarbird <i>Philemon corniculatus</i>	1				3				4
Little Friarbird <i>P. citreogularis</i>	1				1				2
Blue-faced Honeyeater <i>Entomyzon cyanotis</i>					3				3
Noisy Miner <i>Manorina melanocephala</i>					3				3
Lewin's Honeyeater <i>Meliphaga lewinii</i>	11	1	2		9				23
Yellow-faced Honeyeater <i>Lichenostomus chrysops</i>	3	1			7				11
Brown-headed Honeyeater <i>Melithreptus brevirostris</i>					2				2
White-naped Honeyeater <i>M. lunatus</i>					2				2
Brown Honeyeater <i>Lichmera indistincta</i>					3				3
New Holland Honeyeater <i>Phylidonyris novaehollandiae</i>	1				13		1		15
White-cheeked Honeyeater <i>P. nigra</i>					6				6
Eastern Spinebill <i>Acanthorhynchus tenuirostris</i>					14				14
Scarlet Honeyeater <i>Myzomela sanguinolenta</i>					5				5
Golden Whistler <i>Pachycephala pectoralis</i>	1								1
Grey Shrike-thrush <i>Colluricincla harmonica</i>		1							1
Spangled Drongo <i>Dicrurus bracteatus</i>					1				1
Black-faced Cuckoo-shrike <i>Coracina novaehollandiae</i>	2		1						3
Olive-backed Oriole <i>Oriolus sagittatus</i>	3		1						4
Figbird <i>Sphecothebes viridis</i>	4								4
Australian Magpie <i>Gymnorhina tibicen</i>		1							1
Pied Currawong <i>Strepera graculina</i>	4	1			1	1			7
Australian Raven <i>Corvus coronoides</i>	3	1							4
Forest Raven <i>C. tasmanicus</i>	2				1	1			4
Green Catbird <i>Ailuroedus crassirostris</i>						1			1
Regent Bowerbird <i>Sericulus chrysocephalus</i>	3				1				4
Satin Bowerbird <i>Ptilonorhynchus violaceus</i>	2				1				3
*House Sparrow <i>Passer domesticus</i>	1	2							3
Red-browed Finch <i>Neochmia temporalis</i>		3							3
*European Goldfinch <i>Carduelis carduelis</i>		2							2
Mistletoebird <i>Dicaeum hirundinaceum</i>	3								3
*Red-whiskered Bulbul <i>Pycnonotus jocosus</i>	3	1	2		1				7
Silvereye <i>Zosterops lateralis</i>	7	3	2		8		1		21
*Common Starling <i>Sturnus vulgaris</i>	1								1
*Common Myna <i>Acridotheres tristis</i>					1				1

*Introduced species. #F – fruit; Sd – seed; A – arillate seed; EL – elaiosome; N – nectar; Fl – whole flower or parts thereof; Ex – exudate; L – leaves.

foraging technique are included below in individual species accounts. For many species of bird for which food types were recorded, no atypical behaviour or food usage was observed.

Brown Quail *Coturnix ypsilophora*

Brown Quail fed on the fruit of the Coastal Fan-flower *Scaevola calendulacea* (purple to white, 9-12 mm diameter) by pecking the flesh off the fruit when it was still on the plant or when fallen to the ground.

Yellow-tailed Black Cockatoo *Calyptorhynchus funereus*

Feeding of Black Cockatoos *Calyptorhynchus* spp. on *Banksia* cones has been attributed to searching for both seeds (Barker and Vestjens 1990) and insect larvae (Scott and Black 1981). My observations in coastal environments were insufficiently detailed to determine which food was the main object of Cockatoos crunching up *Banksia* cones, or whether they were eating both. However, further inland a group of Cockatoos was observed feeding on Saw *Banksia B. serrata* cones in a recently burnt area. The follicles were opening and releasing the seeds, allowing easy access to seed predators such as the Cockatoos. Presumably, any insect larvae present would have been killed during the fire.

Rainbow Lorikeet *Trichoglossus haematodus*

In addition to the expected use of nectar, Rainbow Lorikeets utilized a variety of native fruit and seed types in dune communities across a range of sites. Similarly, Gosper and Gosper (1996) illustrated the flexibility of Rainbow Lorikeets in being able to exploit locally abundant, exotic fruits.

Rainbow Lorikeets foraged for Coastal She-Oak *Casuarina equisetifolia* subsp. *incana* seeds in small to medium sized flocks (2-20 birds), often mixed with Scaly-breasted Lorikeets *T. chlorolepidotus*. The She-Oak cones were in the process of opening and releasing their seeds, facilitating access. Lorikeets used their bills and tongues to pick the seeds from the open cones, similar to the method used to extract the seeds of Slash Pine *Pinus elliotii* in northern NSW (Gosper and Gosper 1996). Feeding on Coastal She-Oak seeds has been noted previously (Bourke and Austin 1947; Lepschi 1993).

Over the summer of 1996/97, Coastal Wattle and Coastal Beard-heath fruited prolifically at Eurobodalla NP, attracting a range of fruit-eating and seed-eating birds. Groups of between two to four Rainbow Lorikeets foraged on the fruits or seeds of each species, by perching on the canopy of the low (0.5-1.5 m) shrubs. Coastal Wattle seeds were taken from the open legume and swallowed whole. In contrast, the slightly larger Coastal Beard-heath seeds were discarded after the flesh and juice were nibbled off the fruit. Scaly-breasted Lorikeets utilize a similar foraging technique on hard-seeded fruits (see below and Gosper and Gosper 1996). Forde (1986) recorded Coastal Beard-heath in the diet of Rainbow Lorikeets.

Scaly-breasted Lorikeet *T. chlorolepidotus*

Scaly-breasted Lorikeets were observed utilising a similar range of food sources and types as Rainbow Lorikeets. As

for Rainbow Lorikeets the occurrence of several native fruit and seed types in the diet suggests an ability to utilize abundant non-nectar food sources (see Gosper and Gosper 1996). Scaly-breasted Lorikeets extracted seeds from Coastal She-Oak cones in the same fashion as did Rainbow Lorikeets (described above). This food source was also documented by Bourke and Austin (1947).

Monotoca fruits were regularly taken by Scaly-breasted Lorikeets at Myall Lakes NP in late spring/early summer 1996/97. Small flocks of up to 10 birds would frequently gather in groves of fruiting shrubs to feed. Birds would select a Monotoca fruit (orange, 3-4 mm diameter), crush it with their bill and drop the seed out of one side. The juice, with or without the pericarp, was swallowed. On several occasions, birds were observed with several seeds and pericarps hanging from the sides of their bill and caught on throat feathers. Wiping of the bill and face on nearby branches was common during feeding. Fruits were only worked on for a few seconds before moving to the next. Rainbow Lorikeets fed on a similar fruit (Coastal Beard-heath) in an almost identical fashion (see above), and Scaly-breasted Lorikeets likewise obtain juice and flesh from the substantially larger Camphor Laurel *Cinnamomum camphora* fruit with a similar technique (Gosper and Gosper 1996).

Crimson Rosella *Platycercus elegans*

Crimson Rosellas fed destructively on both Coastal *Banksia B. integrifolia* and Coastal Beard-heath flowers, eating the flowers parts themselves. Crimson Rosellas fed in a manner similar to that of Rainbow Lorikeets on Coastal Beard-heath fruit, chewing on the fruit for several seconds before dropping the seed out the side of the mouth. Seeds would often be caught on feathers beneath the bill. In contrast to the lorikeets, green fruits were taken predominantly. Crimson Rosellas often fed on Coastal Beard-heath fruit, flowers and leaves from the one shrub. Unlike other species feeding on Coastal Wattle seeds, Crimson Rosellas could gain access to unexposed seeds by stripping open the legume with their bill.

Swift Parrot *Lathamus discolor*

Swift Parrots are a threatened species (Schedule 2 on the New South Wales *Threatened Species Conservation Act, 1995*), and Swamp Mahogany nectar appears to be an important food source in coastal New South Wales where small numbers of the parrots spend the cooler months. Records in flowering Swamp Mahogany woodland over the survey period were in hind-dune depressions at Myall Lakes NP in autumn 1997 and 1998, and at Perkins Beach in autumn 1996 and 1998.

White-throated Treecreeper *Cormobates leucophaeus*

A White-throated Treecreeper was observed to probe several flowers of a Swamp Mahogany while in a vertically perched position on the trunk of the same tree. The flowers hung quite close to the trunk. Although the taking of insects from the flowers cannot be discounted as the motive for the foraging, the deep probing motion was consistent with the taking of nectar rather than for pecking at insects. White-throated Treecreepers have not been previously recorded feeding on nectar (Barker and Vestjens 1990).

Superb Fairy-wren *Malurus cyaneus*

Few records exist of fairy-wrens feeding on either nectar or fleshy fruit. Baker and Clarke (1996) recorded Superb Fairy-wrens consuming nectar from garden grevilleas *Grevillea* spp. in Wollongong. During the course of this work, Superb Fairy-wrens were often seen foraging around Coastal Banksia inflorescences, but were only seen to take insects, with shallow pecks around the flowers.

Superb Fairy-wrens have been previously noted taking *Acacia* seeds (Forde 1986). At Perkins Beach several seeds were taken from an open legume (seeds exposed) on a low branch. French (1990) and Forde (1986) note several fleshy fruit and seed types utilised by Superb Fairy-wrens.

Variiegated Fairy-wren *M. lamberti*

Unlike Superb Fairy-wrens, Variiegated Fairy-wrens were observed to take nectar. At Eurobodalla NP, Variiegated Fairy-wrens fed at *Banksia* inflorescences with a prolonged probing action into the bottom of the flowers. Accompanying this, and on separate occasions, Variiegated Fairy-wrens took insects from around Banksia inflorescences with shallow pecks. Variiegated Fairy-wrens regularly fed around Banksia inflorescences, usually in small parties, often in the company of Superb Fairy-wrens and Brown Thornbills *Acanthiza pusilla*.

Variiegated Fairy-wrens were only observed taking *Monotoca* fruits on a single occasion, at Myall Lakes NP. Five Variiegated Fairy-wrens formed part of a loose, mixed foraging flock consisting of Silvereyes *Zosterops lateralis*, a Golden Whistler *Pachycephala pectoralis* and Brown Thornbills (all of which consumed *Monotoca* fruit — see below). Forde (1986) includes notes on fruit in the diet of Variiegated Fairy-wrens.

Brown Thornbill *A. pusilla*

There are few records of the primarily insectivorous Brown Thornbill taking nectar, seeds or fruit. Barker and Vestjens (1990) contains references to instances of Brown Thornbills taking the nectar of Grass Trees *Xanthorrhoea* spp. and unidentified seeds. Forde (1986) and French (1990) recorded the seeds of *Rubus* spp. in Brown Thornbill faecal samples. Brown Thornbills regularly foraged at Coastal Banksia inflorescences at Eurobodalla NP, often in loose association with Variiegated and Superb Fairy-wrens. Birds took both insects from around inflorescences and probed flowers. Like other relatively short-billed species such as White-naped Honeyeaters *Melithreptus lunatus* and Silvereyes, Brown Thornbills gained access to nectar at the base of *Banksia* inflorescences by probing from beneath the inflorescence into the basal flowers. As the pollen presenters of the flowers were rarely contacted during such foraging bouts, these bird species may not be effective pollinators of Coastal Banksia.

Brown Thornbills utilized an unusual foraging technique when taking Coastal Wattle seeds. Birds picked the seeds out of open legumes, and from a perch held the seed under their feet and picked off and consumed the elaiosome. The seed was then discarded. O'Dowd and Gill (1986) described an observation by N. Reid in which Chestnut-rumped

Thornbills *A. uropygialis* similarly consumed the elaiosome of a wattle (*Acacia ligulata*) but discarded the seed beneath the parent plant.

In contrast, *Monotoca* fruits were swallowed whole. At Myall Lakes NP and Eurobodalla NP, *Monotoca* was a commonly observed food used by Brown Thornbills in late spring to early summer.

Striated Thornbill *Acanthiza lineata*

This species adopted an identical foraging strategy to that of Brown Thornbills in removing and consuming the elaiosome of Coastal Wattle seeds. Over several consecutive days, three to four birds of this primarily insectivorous species foraged on insects and the elaiosomes of Coastal Wattle in low scrub at Eurobodalla NP. Faeces of Striated Thornbills contained fleshy fruit seeds in the studies of Forde (1986) and French (1990).

Red Wattlebird *Anthochaera carunculata*

Of note is the variety and importance of fleshy fruits and seeds in the diet of Red Wattlebirds at Eurobodalla NP. Throughout summer 1996/97 Coastal Beard-heath fruits and Coastal Wattle seeds, both swallowed whole, formed the bulk of observed foraging bouts.

Little Wattlebird *A. chrysoptera*

The small, fleshy fruits of the Epacridaceae (*Monotoca* and *Leucopogon*) formed an important food source for Little Wattlebirds in dune vegetation at several localities. The amount of fruit consumed by this species may have been underestimated in previous works (see Barker and Vestjens 1990; Rose 1999).

Noisy Friarbird *Philemon corniculatus* and Little Friarbird *P. citreogularis*

Both species utilised fruit in addition to nectar, swallowing the fruits of Epacridaceae species whole.

Lewin's Honeyeater *Meliphaga lewinii*

The greatest number of individual plant foods (23) were recorded for this species, which utilised a variety of fruit, seed, arillate seed (a seed with a partial or complete fleshy envelope around the seed) and nectar sources.

Yellow-faced Honeyeater *Lichenostomus chrysops*

Fleshy fruit of the Epacridaceae and seeds of Coastal Wattle constituted the bulk of the observed foraging bouts of Yellow-faced Honeyeaters over the summer months. Forde (1986) and Barker and Vestjens (1990) previously document *Leucopogon* sp. (seed in the gut of a specimen) and Coastal Wattle seeds respectively as food of this species.

New Holland Honeyeater *Phylidonyris novaehollandiae*

In addition to a wide variety of nectar sources, New Holland Honeyeaters utilised both an exudate and fleshy fruit as food. The only reference to New Holland Honeyeaters consuming fruit is an unspecified fruit food in Barker and Vestjens (1990) and birds feeding on two exotic

fruit types in Forde (1986). The taking of *Monotoca* fruit at two widely separate locations is therefore quite significant.

Paton (1980, 1982) noted the importance of exudates in the diet of New Holland Honeyeaters, including an observation of birds feeding on exuding sap of *Acacia pycnantha* (Paton 1980). At Perkins Beach, a New Holland Honeyeater was observed feeding at a gash (about 15 cm long, 3 cm wide) in the trunk of a Coastal Wattle about 50 cm above the ground. The bird licked the mix of exudate and water (rain fell the previous evening and all surfaces were wet) seeping below the scar and the pooled liquid at the base of the scar for approximately 1 minute. On the next visit to the site, four days later, a New Holland Honeyeater flew directly to the wound and began feeding, on this occasion for approximately four minutes. A bird returned briefly to forage on several further occasions. As much of the sap had dried, the bird probed more deeply under the bark to obtain the exudate.

Eastern Spinebill *Acanthorhynchus tenuirostris*

The diverse range of nectar sources utilized by Eastern Spinebills included several plants not visited by other nectar-feeding birds. These were Lantana *Lantana camara* and Riceflower *Pimelea linifolia*, both of which have small flowers with long, thin floral tubes.

Golden Whistler *Pachycephala pectoralis*

Buckingham (1986), Paton *et al.* (1988), French (1990), Barker and Vestjens (1990) and Green (1993) detail instances of Golden Whistlers feeding on fleshy fruit or seeds. In spring 1996 at Myall Lakes NP, a female Golden Whistler was observed foraging amongst a mixed species flock in a *Monotoca* shrub. The bird took and swallowed whole ripe *Monotoca* fruits taken both from a perched position and a sallying/hovering flight.

Grey Shrike-thrush *Colluricincla harmonica*

Only one plant food was noted in the current study, but this is significant given the paucity of previous records of plant foods for this species. French (1990) and Barker and Vestjens (1990) recorded Grey Shrike-thrush taking fleshy fruits and seeds respectively. A bird was observed picking the seeds out of two recently opened Coastal Banksia cones. The seeds were on the verge of being shed and only loosely held in the cones. Occasionally, however, the Grey Shrike-thrush would vigorously work on the valves of the cone with its bill to widen the opening. Once extracted, the seeds were typically held in the bill and hit against a branch in a similar fashion to that utilized to kill animals.

Australian Magpie *Gymnorhina tibicen*

An Australian Magpie was observed to pick at least 20 Coastal Wattle seeds from open legumes hanging at ground level. O'Dowd and Gill (1986) note Australian Magpies dispersing the seeds of several *Acacia* species.

Pied Currawong *Strepera graculina*

Pied Currawongs foraged at *Banksia* inflorescences using two techniques. One involved probing the bill into the inflorescence without causing obvious damage to flowers,

while the other consisted of ripping out flower parts with the bill and eating them. No notes were taken on the stage of the inflorescence, therefore it cannot be determined if age of the inflorescence determined the foraging technique adopted. Several fruit, arillate seed and seed sources were also utilized.

Australian Raven *Corvus coronoides*

Pellets of Australian Ravens in late spring and summer at Perkins Beach consisted almost entirely of Coastal Wattle seeds (intact, but with elaiosome removed), with minor components of Bitou Bush seed (flesh removed), insect and vertebrate remains. Individual pellets often held in excess of 50 seeds.

Coastal Beard-heath, Coastal Wattle and Coastal Fan-flower seeds were noted in corvid pellets (species unknown) at Myall Lakes NP.

Forest Raven *Corvus tasmanicus*

Forest Ravens fed on Coastal Banksia nectar by probing open inflorescences, with neither invertebrates or flower parts seemingly being taken. In contrast, whole Coastal Fan-flower flowers were picked and swallowed. Barker and Vestjens (1990) did not list any flower parts or nectar foods of Forest Ravens.

Green Catbird *Ailuroedus crassirostris*

Green Catbirds took and swallowed entire Dusky Coral Pea *Kennedia rubicunda* flowers. The inclusion of flowers (including nectar and flower parts) in the diet of Green Catbirds was not noted in Barker and Vestjens (1990), however, Innis and McEvoy (1992) recorded that flower parts constituted 4 per cent of the diet of this species at one particular locality.

Regent Bowerbird *Sericulus chrysocephalus*

A Regent Bowerbird probed Coastal Banksia inflorescences at Myall Lakes NP, a food type (nectar) not listed in Barker and Vestjens (1990). Several fruit types were also taken.

Satin Bowerbird *Ptilonorhynchus violaceus*

Although Barker and Vestjens (1990) documented the inclusion of whole flowers in the diet of Satin Bowerbirds, no records are listed of foraging on nectar. Satin Bowerbirds took nectar from Coastal Banksia flowers at Myall Lakes, and also several fruits.

Mistletoebird *Dicaeum hirundinaceum*

Bitou Bush and Coastal Beard-heath fruit comprised the bulk of observed foraging bouts of Mistletoebirds in dune environments along the New South Wales coast. This further illustrates the wide range of fruits utilised by this species in addition to Mistletoe berries.

Red-whiskered Bulbul *Pycnonotus jocosus*

Barker and Vestjens (1990) document only a single food source (the seed of Sweet Pittosporum *Pittosporum undulatum*) of Red-whiskered Bulebuls in Australia. The

observations here suggest that Red-whiskered Bulbuls utilize a wide range of native and introduced fruit and seed sources in coastal New South Wales close to urban settlements. The largest fruit food observed (Wild Quince *Alectryon subcinereus*) was not consumed whole; rather the flesh (aril) was stripped from the fruit with the seed still held on the plant. Bulbuls also consumed Swamp Mahogany nectar. Baker and Clarke (1996) reported Red-whiskered Bulbuls feeding on nectar of garden *Grevillea* spp. in nearby suburban Wollongong.

Silvereye *Zosterops lateralis*

A broad range of fruit, seed and nectar food sources was utilized by what is typically the most abundant bird species in dune environments of New South Wales (Gosper, unpubl. data). Observations include both the mainland (race *familiaris*) and migratory Tasmanian (race *lateralis*) populations. Larger fruits, namely Wild Quince, were not taken whole but pieces of the aril ripped off by foraging birds. *Breynia oblongifolia* and Black Nightshade *Solanum nigrum* may represent the upper limit of fruit size that Silvereyes can swallow whole (7–9 mm diameter). For both these plant species Silvereyes tended to manipulate fruit shape to facilitate swallowing by 'bashing' the fruit on branches and breaking the pericarp. On other occasions fruits were dropped after unsuccessful swallowing attempts.

A Silvereye fed on Coastal Wattle exudate on the same shrub as the New Holland Honeyeater discussed above. The bird licked at the frothy mixture of sap and water (following a storm the previous evening) on the surface of the wound in the Wattle trunk. Three days later, a bird was again observed foraging at the same exudate site.

Common Myna *Acridotheres tristis*

Barker and Vestjens (1990) do not document any nectar foods of Common Mynas. However, the observation here, combined with several records of nectar foraging on garden plants in Wollongong (Gosper, unpubl. data), suggest that nectar is a readily used food by this species.

Although undoubtedly influenced by the abundance of plant species and flowering and fruiting phenology, the most widely used nectar sources were: Coastal Banksia (used by 21 species of birds), Swamp Mahogany (21 species, even though absent from Eurobodalla) and Saw Banksia (12 species); and the most utilized fruit or seed types: Bitou Bush (17 species), Coastal Beard-heath (15 species, although absent Perkins Beach) and Monotoca (13 species) (Tables 1 and 2). Several species not noted for usually utilizing nectar resources, such as the bowerbirds and Forest Raven, were able to access this food type from Coastal Banksia flowers. Visitation does not necessarily result in pollination, however (see Brown Thornbill and Rosella species accounts for examples of species feeding at flowers but presumably not always effecting pollination).

Interestingly, Epacrid fruit (Monotoca and Coastal Beard-heath) formed a frequently used food resource for several of the larger honeyeaters (wattlebirds and friarbirds) and lorikeets, groups typically regarded as being mostly reliant on nectar. The small seed size of these plant species also allowed typically insectivorous species such as the Golden

Whistler, Brown Thornbill and Variegated Fairy-wren to take fruit.

Ten bird species fed on Coastal Wattle seeds, most acting in a manner consistent with seed dispersal (except Crimson Rosella — a seed predator; and the thornbills, which although they do not damage the seed, do not transport it beyond the canopy of the parent plant). Ants disperse the seeds of many species of *Acacia*, especially those with white to light brown elaiosomes (O'Dowd and Gill 1986). O'Dowd and Gill (1986) suggested that bird-dispersed *Acacia* species typically have brightly coloured elaiosomes, often yellow to red, which contrast with the black seed. The elaiosome colour of Coastal Wattle is pale brown to white; however, O'Dowd and Gill (1986) regarded the mode of seed presentation (retained and displayed in the canopy) and diaspore characteristics (mass, length and contortion of elaiosome, percentage lipid content and elaiosome investment) as likely to favour bird dispersal over ants. In contrast, French and Westoby (1996) classify Coastal Wattle as being ant-dispersed. Although no measure was made of ant dispersal, the number of bird species involved in dispersal, the fate of the taken seeds and the amount of seed removed supports the assertion by O'Dowd and Gill (1986) that Coastal Wattle can be bird-dispersed.

CONCLUSION

The results of this study support others (such as Forde 1986; French 1990; French *et al.* 1992; Baker and Clarke 1996) that suggest that, when readily available, nectar, fruit and seeds are taken by many species of birds that are not widely recognized as utilizing that food type. At times of high nectar, fruit or seed abundance, these foods constitute an easily obtained source of energy. The more widely used and abundant plant food sources in coastal dune communities in New South Wales could be utilized by unspecialized feeding birds. Thus, most bird species utilized a range of plant species for food, and similarly most plant species (for either or both pollination and seed dispersal) were visited by several bird species. Paton and Ford (1977) and Brown and Hopkins (1996) reached similar conclusions in the utilization of flower resources by birds in South Australia and Papua New Guinea respectively.

ACKNOWLEDGMENTS

This research was conducted while in receipt of an APA(I) postgraduate award supported by the University of Wollongong, Department of Public Works (NSW) and NSW Agriculture. Larry Monaghan (Wollongong City Council); and Mellea Schroder (Raymond Terrace), Neale Watson (Narooma) and Jeff Thomas (Grafton) of NSW National Parks and Wildlife Service granted permission to use the study areas. Paul Milham and John Toth of NSW Agriculture provided advice and undertook the Bitou Bush control program. I also thank Rob Whelan and Kris French (University of Wollongong); Dennis Gosper, Annette Cam and two anonymous referees for helpful comments on the manuscript, Samantha Lloyd for distraction, and Justine Cox for many things.

REFERENCES

- Baker, J. and Clarke, J. (1996). Nectar-feeding Fairy-wrens. *Wingspan* 6: 37.
 Barker, R. D. and Vestjens, W. J. M. (1989). 'The food of Australian birds. 1. Non-passerines'. (CSIRO: Melbourne.)

- Barker, R. D. and Vestjens, W. J. M. (1990). 'The food of Australian birds. 2. Passerines'. (CSIRO: Melbourne.)
- Bourke, P. A. and Austin, A. F. (1947). The Atherton Tableland and its avifauna. *Emu* 47: 87-116.
- Brown, E. D. and Hopkins, M. J. G. (1986). How New Guinea flower resources vary in time and space: Implications for nectarivorous birds. *Aust. J. Ecol.* 21: 363-378.
- Buckingham, R. (1986). Juvenile Golden Whistler and juvenile Pied Currawong eating native fruits. *Aust. Bird Watcher* 11: 274.
- Carolin, R. C. and Clarke, P. (1991). 'Beach plants of south eastern Australia'. (Sainty and Associates: Sydney.)
- Crome, F. H. J. (1975). The ecology of fruit pigeons in tropical northern Queensland. *Aust. Wildl. Res.* 2: 155-185.
- Floyd, A. G. (1989). 'Rainforest Trees of mainland south-eastern Australia'. (Inkata Press: Melbourne.)
- Ford, H. A. and Paton, D. C. (1986). 'The dynamic partnership. The birds and plants of southern Australia'. (Govt. Printer: South Australia.)
- Forde, N. (1986). Relationships between birds and fruits in temperate Australia. In 'The Dynamic Partnership. The birds and plants of southern Australia' (Eds H. A. Ford and D. C. Paton). Pp. 42-58. (Govt. Printer: South Australia.)
- French, K. (1990). Evidence for frugivory by birds in montane and lowland forests in south-eastern Australia. *Emu* 90: 185-189.
- French, K., O'Dowd, D. J. and Lill, A. (1992). Fruit removal of *Coprosma quadrifida* (Rubiaceae) by birds in south-eastern Australia. *Aust. J. Ecol.* 17: 35-42.
- French, K. and Westoby, M. (1996). Vertebrate-dispersed species in a fire-prone environment. *Aust. J. Ecol.* 21: 379-385.
- Gosper, D. G. and Gosper, C. R. (1996). Exotic fruits and seeds in the diet of Lorikeets in northern New South Wales. *Aust. Bird Watcher* 16: 255-259.
- Green, R. J. (1993). Avian seed dispersal in and near subtropical rainforests. *Wildl. Res.* 20: 535-557.
- Harden, G. J. (ed) (1990-1993). 'Flora of New South Wales. Volume 1-4'. (New South Wales University Press: Kensington.)
- Holmes, G. (1987). 'Avifauna of the Big Scrub region'. (NSW National Parks and Wildlife Service: Sydney.)
- Innis, G. J. and McEvoy, J. (1992). Feeding ecology of Green Catbirds (*Ailuroedus crassirostris*) in subtropical rainforests of south-eastern Queensland. *Wildl. Res.* 19: 317-329.
- Lepschi, B. J. (1993). Food of some birds in eastern New South Wales: Additions to Barker and Vestjens. *Emu* 93: 195-199.
- Lepschi, B. J. (1997). Food of some birds in southern Australia: Additions to Barker and Vestjens, Part 2. *Emu* 97: 84-87.
- O'Dowd, D. J. and Gill, A. M. (1986). Seed dispersal syndromes in Australian *Acacia*. In 'Seed Dispersal' (Ed D. R. Murray). Pp. 87-121. (Academic Press: Australia.)
- Paton, D. C. (1980). The importance of manna, honeydew and lerp in the diets of honeyeaters. *Emu* 80: 212-226.
- Paton, D. C. (1982). The diet of the New Holland Honeyeater, *Phylidonyris novaehollandiae*. *Aust. J. Ecol.* 7: 279-298.
- Paton, D. C. and Ford, H. A. (1977). Pollination by birds of native plants in South Australia. *Emu* 77: 73-85.
- Paton, D. C., Tucker, J. R., Paton, J. B. and Paton, P. A. (1988). Avian vectors of the seeds of the European Olive *Olea europea*. *Sth. Aust. Ornithol.* 30: 158-159.
- Rose, A. B. (1999). Notes on non-nectar foods of some honeyeaters in eastern New South Wales. *Aust. Bird Watcher* 18: 26-34.
- Scott, J. K. and Black, R. (1981). Selective predation by White-tailed Black Cockatoos on fruit of *Banksia attenuata* containing the seed-eating weevil *Alphitopis nivea*. *Aust. Wildl. Res.* 8: 421-430.
- Toth, J., Milham, P. and Nazer, C. (1993). 'Aerially applied herbicides selectively control Bitou Bush growing in communities of indigenous plants on sand dunes'. (Proc. 14th Asian Pacific Weeds Conf., Vol. 2, P 1-5.)

BOOK REVIEW

Hooded Plover Report No. 2. 1996-1999.

Supplement to Western Australian Bird Notes, Issue 90, June 1999.

Marcus Singor, 1999. Birds Australia (WA Group).

This report is the second on Hooded Plovers produced by the Western Australian group of Birds Australia and provides an overview of results from their ongoing research into the important foraging and breeding sites of this species in Western Australia. In particular it summarizes the results of two surveys conducted in 1998 that investigated the dispersal patterns of this species in both summer and winter and then relates the distributional data to rainfall patterns.

The first section of the report provides a brief overview of the Hooded Plover project, the previous report published in 1996 and the priorities of the research programme. The next two sections detail the two surveys conducted in 1998; one, conducted in February, that covered sites in south-western Western Australia where it was likely that Hooded Plovers would be present; and the second, conducted in September, that investigated the breeding distribution of the species, with a particular concentration of effort in the area to the north of Esperance. The summer survey highlighted the movement of individuals to coastal areas. Of particular note was the discovery of a large number of birds at Yalgorup National Park, making this a new area of international importance for this species. The later survey indicated that significant numbers of individuals had moved to inland lake systems.

The results section of the report also includes a review of all observations of this species in south-western Western Australia since 1994, providing insight into its distributional patterns and how they change through the year. As with the 1998 surveys, these data show that the species is primarily coastal over summer, with movements inland in autumn. There are inland records through until mid-spring, at which time the inland lakes dry out and the birds move back to the coast. In addition, the results section includes all records of breeding found during the two 1998 surveys and comments on any threats to populations evident during the surveys; such threats included dogs, cats, foxes and off-road vehicles. It also includes comments on the possible

importance of food, in particular *Coxiella* gastropods, in determining suitable habitat for Hooded Plovers.

The final section of the report includes a discussion of the distributional data in relation to rainfall. The large scale movement inland was concluded to be a response to the first good autumn rains, usually occurring in April. A proportion of the birds remain at these inland sites throughout summer, although in drought years, when all the inland lakes dry out, all the birds move to the coast; it is suggested that such years provide a good time to conduct a thorough census of the population. There is also discussion of the characteristics of the inland sites at which the birds congregate as well as of Yalgorup National Park, an important reserve for Hooded Plovers.

Such a compilation of up-to-date distributional data for this species provides a good basis for further work. It also highlights the gaps in current knowledge, such as a paucity of data on the winter distribution of this species. This report provides a list of recommendations for future work, such as the need for a banding/flagging programme to help reveal precise movement patterns, an examination of the importance of *Coxiella* as a factor controlling the distribution of Hooded Plovers and the need for an action plan for the management of this species and to increase awareness of its management needs. The information contained in this report will greatly assist such research.

It would have been useful if the author had included a map of south-western Western Australia that contained the place names mentioned in the text. Some of the formatting of figures could also have been better. However, overall this is a well written report which clearly presents the latest knowledge on the distribution of this species in Western Australia.

Copies of this report can be obtained by contacting the Birds Australia (WA Group) at 71 Oceanic Drive, Floreat, Western Australia 6014 or birdswa@starwon.com.au.

James Nicholls
'Wisewood', Lute Street, Gundaroo, New South Wales 2620