

Feeding ecology of the Green Catbird *Ailuroedus crassirostris* in the Illawarra region, New South Wales

Matthew Mo^{1,3} and David R Waterhouse²

¹NSW Department of Primary Industries, Elizabeth Macarthur Agricultural Institute, Woodbridge Road, Menangle, NSW 2568.

²4/1-5 Ada Street, Oatley, NSW 2223

³Corresponding author. Email: matthew.mo@dpi.nsw.gov.au

Abstract

Feeding ecology in the Green Catbird *Ailuroedus crassirostris*, a primary frugivore of temperate and subtropical rainforests of eastern Australia, was investigated in the Illawarra rainforests over a five-year period. Fruit from 20 species of trees, shrubs and climbers was identified in the diet, which comprised 25% of available fruiting species in the region. Bolwarra *Eupomatia laurina*, Brown Beech *Pennantia cunninghamii* and Featherwood *Polyosma cunninghamii* were the most important feed species. Sandpaper Fig *Ficus coronata* was moderately exploited, although figs were not as important in the local diet as they were in the northern part of the species' range. Seven fruiting plants were new additions to the known diet, as were sections of Lantana *Lantana camara* stems. Knowledge of Green Catbird diet at regional scales improves the assessment of suitable habitat and assists rainforest restoration by identifying priority plant species that benefit catbirds. (*The Victorian Naturalist* 133 (1), 2016, 4–9)

Keywords: bowerbirds, diet, foraging, frugivore, rainforest restoration

Introduction

Frugivores play a keystone role in forest ecosystems as agents of seed dispersal, and aid the reproductive cycles of up to 80 % of subtropical rainforest flora (Snow 1962; Smythe 1970; Leck 1971; Webb and Tracey 1981). At least 26 bird species in eastern Australia are considered primarily frugivorous (Holmes 1987; Green 1993). Fluctuating abundance of fruit resources have an important influence on their ecology, e.g. nomadism and timing of breeding events (Snow and Snow 1964; Crome 1975, 1976). A single fruiting tree may be exploited by a variety of species (French *et al.* 1992; Neilan *et al.* 2006), therefore dietary overlap amongst frugivores is expected to be high (Terborgh and Diamond 1970).

The Green Catbird *Ailuroedus crassirostris* is found along the entire length of the east coast of New South Wales (NSW) and south-eastern Queensland where there is suitable habitat, not extending far beyond the inland slopes of the Great Dividing Range. It inhabits temperate and subtropical rainforests and adjacent eucalypt forests from near sea level to over 1000 m ASL. The Green Catbird is considered a generalist omnivore, primarily frugivorous or herbivorous (Frith and Frith 2004). More than 75 % of the diet consists of fruits (Don-

aghey 1981). Other components include flowers, palm seeds, leaves and invertebrates such as beetles and their larvae, millipedes, cicadas and grasshoppers (Lea and Gray 1936; Gwynne 1937; Donaghey 1981; Chaffer 1984; Frith and Frith 1979, 2004). There are also records of predation on nestling birds (Bell 1960; Donaghey 1981), frogs (Innis and McEvoy 1992) and lizards (Lemckert *et al.* 2007). Captive catbirds also are known to feed on dead mice placed in an aviary for another species (Bell 1960).

The feeding ecology of the Green Catbird has been investigated only in the northern parts of its distribution (Donaghey 1981; Innis and McEvoy 1992; Church 1997). One study in the Jimna and Conondale Ranges, south-eastern Queensland, recorded fruits from more than 100 plant species in the diet at lowland and upland sites (Innis and McEvoy 1992). Less diverse flora would be expected for rainforest areas located further south (Floyd 1982; Keith 2004). It is therefore important to understand the feeding ecology of the Green Catbird in the southern part of its distribution.

Rainforests in the Illawarra region have been identified as an important stronghold for the Green Catbird in the southern part of its range (NSW NPWS 2011; Schulz and Magarey 2012)

but are severely fragmented (Stork *et al.* 2008). This paper reports on a five-year study of Green Catbird feeding ecology, carried out simultaneously with a broader project on fruiting phenology and avian frugivory (Waterhouse 1995; Waterhouse 2001; Mo and Waterhouse 2015). Here we sought to determine the diet of the Green Catbird in the Illawarra rainforests, particularly in comparison with that recorded in northern locations (Donaghey 1981; Innis and McEvoy 1992; Church 1997). In view of reduced flora diversity, it was hypothesised that the diet in the Illawarra rainforests would contain fewer species. Information on diet and feeding techniques provide a basis for assessing optimal habitat areas for catbirds and identifying plant species most suitable for restoring rainforest linkages.

Methods

Study area

The Illawarra region contains the most extensive rainforest area in the Sydney Basin Bioregion (Erskine 1984; NSW NPWS 2002), and one of six major rainforest regions in NSW (Floyd 1982). Generally, subtropical rainforest occurs on the lower slopes of the escarpment, and temperate rainforest on the upper slopes and gullies. Canopy height ranges from 35 to 50 m. Two sections of the Illawarra Escarpment State Conservation Area formed the main study sites: Mount Keira (34° 24' S, 150° 51' E, ~600 ha area) and Bulli Mountain (34° 20' S, 150° 54' E, ~100 ha area). Four additional sites were visited sporadically: Bola Creek in the Royal National Park (34° 9' S, 151° 1' E, ~100 ha area), Minnamurra Falls in Budderoo National Park (34° 38' S, 150° 43' E, ~90 ha area), Foxground (34° 43' S, 150° 46' E, ~60 ha area) and Saddleback Mountain (34° 41' S, 150° 47' E, ~70 ha area).

From 1988 to 1992, mean annual rainfall in the study area was 1726 mm (Australian Bureau of Meteorology, Wollongong University station, 1988–1992). The most rainfall was recorded for the months of February, April and June. Mean daily temperatures ranged from 8°C (August) to 25°C (January).

Data collection

The main study sites, Mount Keira and Bulli Mountain, were subject to one-day visits on

a fortnightly basis between January 1988 and December 1992, giving a total of 132 field days. Mount Keira was surveyed from Robertson's Lookout, Byarong Park, the Mount Keira Ring Track (~5.5 km) and the Dave Walsh's Track (~800 m). Bulli Mountain was surveyed from Bulli Lookout and a walking track that extends to Sublime Point (~2.5 km). The additional sites were visited up to four times per year.

Green Catbirds were located by traversing walking tracks, with particular attention given to listening for calls. When catbirds were sighted, details of their behaviour and food sources were noted. One feeding record is defined as each fruit species consumed by a single catbird for the duration that it was followed. Trees, shrubs and vines that were in fruit were noted so as to determine food availability and to develop a monthly fruiting phenology for the study period. Core fruiting periods for each species were determined as the period of months in which crop production occurred in at least 60 % of years.

Results

Catbirds were difficult to locate and surveys yielded only 77 observations. Most of these observations were made at Mount Keira (n=55) and Bulli Mountain (n=13). Surveys of Bola Creek yielded six observations and surveys of Minnamurra Falls, Foxground and Saddleback Mountain yielded one observation each. The highest rates of encounter occurred in January, September and October (Table 1). Feeding observations were made in all months of the year, but these were scant in at least half the months. When catbirds were disturbed, they often ceased feeding and retired to a lookout position until the observer passed.

Fruit component of the diet

This study identified 80 species of trees, shrubs and climbers that produce fleshy fruit (see Mo and Waterhouse 2015), a quarter of which were included in the Green Catbird diet (Table 2). More than 95 % of fruits consumed were recorded within 42 months of the 60-month study period, indicating that the sampling regime was adequate. Fruiting reliability of 100% was observed only in three species in the diet. There was little difference in the number of

Table 1. Total number of observations of Green Catbirds *Ailuroedus crassirostris* for each month between 1988 and 1992, including the number of feeding observations in the Illawarra region, NSW.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total no. observations	10	4	3	2	2	8	4	8	13	10	9	4
No. feeding observations	8	2	3	2	2	5	3	8	8	8	5	2

Table 2. Fruiting reliability of plants consumed by the Green Catbird *Ailuroedus crassirostris* in the Illawarra rainforests, NSW. Integers indicate the percentage of years fruiting occurred in each month, January to December. Bold and italicised integers indicate those months in which feeding by catbirds was observed.

Species	Month											
	J	F	M	A	M	J	J	A	S	O	N	D
Red Ash <i>Alphitonia excelsa</i>										20		
Staff Vine <i>Celastrus subspicata</i>			60	60	40	60	20					
Kangaroo Vine <i>Cissus antarctica</i>					20	20	100	80	60	20	20	
Water Vine <i>Cissus hypoglauca</i>			40	60	80	60	20	40	20			
Giant Stinging Tree <i>Dendrocnide excelsa</i>					40	60		20				
Black Plum <i>Diospyros australis</i>			20	40	40	80	40	40	20			
Native Tamarind <i>Diploglottis australis</i>	40											20
White Quandong <i>Elaeocarpus kirtonii</i>	20	20									20	20
Bolwarra <i>Eupomatia laurina</i>				40	20	100	60	40	40	20		
Sandpaper Fig <i>Ficus coronata</i>	20	60	80	60					20			
Moreton Bay Fig <i>Ficus macrophylla</i>	60	80	60	20	20	20						40
Small-leaved Fig <i>Ficus oblique</i>	40	20						20	40	20		
Brown Beech <i>Pennantia cunninghamii</i>	20	20							20	20	80	80
Pepper Vine <i>Piper novaehollandiae</i>	80	20										20
Featherwood <i>Polysoma cunninghamii</i>			20	60	40	80	60	60	60			20
Brush Muttonwood <i>Myrsine howittiana</i>	20									20	40	20
Scrub Turpentine <i>Rhodamnia rubescens</i>	20											
Crabapple <i>Schizomeria ovata</i>	20	100	100	40	20							
Lillypilly <i>Syzygium smithii</i>						40	80	60	20			
Tree Heath <i>Trochocarpa laurina</i>							20			20		

fruiting plants in the diet available between seasons (10–11 species per season). Diet diversity was broader in spring and summer (11 and eight species consumed respectively) than in autumn and winter (six and five species consumed respectively); however, feeding observations in the cooler months were fewer.

The most important feed trees were Bolwarra *Eupomatia laurina*, Brown Beech *Pennantia cunninghamii* and Featherwood *Polyosma cunninghamii*, contributing almost 40% of feeding records. Bolwarra fruited from mid-autumn to mid-spring, with a core fruiting period between June and July (60–100% reliability). Featherwood had an extensive fruiting period, mostly reliable in April (60%), June (80%) and from August to September (60%). Brown Beech fruited from September to February, with a core fruiting period between November and December (80% reliability). The Sandpaper Fig *Ficus coronata*, which fruited reliably from February to April (60–80%), was also used moderately (5% of all feeding observations).

In most months, two to four plant species in the diet produced fruit reliably. Reliable fruiting occurred in at least one species in all months, except October. At this time of the year, catbirds were seen pecking off portions of stem from Lantana *Lantana camara*. In four observations, catbirds fed on unripe fruits from Brush Muttonwood *Myrsine howittiana*, Red Ash *Alphitonia excelsa*, Moreton Bay Fig *Ficus macrophylla* and White Quandong *Elaeocarpus kirtonii*. In each case, ripe fruits from other species were available at the time.

Feeding techniques

In most observations, catbirds fed singly (61%) or in pairs (29%). Feeding groups of three and four were seen four and two times respectively. Feeding occurred mostly in the upper and mid-canopy (93% of observations), with only three observations of catbirds recovering fallen Crabapple *Schizomeria ovata*, White Quandong and Lillypilly *Syzygium smithii* fruits on the ground. One catbird also chased a cicada through the canopy in January 1988 and an adult fed a fledgling by turning over leaf litter for insects and millipedes in February 1989.

Fruits were gleaned by various means; catbirds commonly perched next to the clusters

and gleaned sideways. For Lillypilly and Featherwood, catbirds were often positioned below clusters and sprang up to pluck one at a time. Featherwood fruits also were dislodged from branches by catbirds hovering mid-air, one managing to dislodge fruit in a continuous flight. For Bolwarra and Brown Beech, catbirds sometimes hung upside down to glean. Typically, Brown Beech fruits from a single tree were exhausted by a catbird before it moved on.

Some fruits were swallowed whole, e.g. Lillypilly and Brown Beech. At times, feeding was rapid, with up to 12 Lillypilly fruits consumed within periods of six minutes. Fruits also were squashed in the bill before swallowing, or eaten in portions while still attached to the tree. The flesh of Bolwarra fruits came away in sticky strips with seeds adhering. Catbirds were restless when feeding, often changing perches after only a short time. Those feeding on Brush Muttonwood consumed three to four berries from one cluster before changing positions. Catbirds consumed fruits close to where they gleaned, except on two occasions in which clusters of fruits from Featherwood and Giant Stinging Tree *Dendrocnide excelsa* were carried in flight. Both of these observations were made outside the breeding season.

Foraging associations with other frugivores was recorded in 16% of feeding observations, occurring throughout the year. Green Catbirds associated mostly with Satin Bowerbirds *Ptilonorhynchus violaceus*, feeding together on Sandpaper Fig, Brown Beech, Moreton Bay Fig, Brush Muttonwood, Tree Heath *Trochocarpa laurina* and Staff Vine *Celastrus subspicata*. Associations with Lewin's Honeyeaters *Meliphaga lewinii* and Topknot Pigeons *Lopholaimus antarcticus* were restricted to October. Catbirds responded aggressively to Pied Currawongs *Strepera graculina*, mostly displacing them with a single pursuit. In one observation, a catbird persistently chased a currawong that had snatched a catbird nestling; however, the outcome was not observed.

Catbirds probing the hollow stubs of Moreton Bay Figs were recorded twice in June 1988 and 1989. It was not known whether this was feeding behaviour. In one observation, the stub was filled with water and the catbird extracted a dead leaf, which it immediately discarded.

Discussion

The fruit component of the diet recorded in this study was lower in species diversity than that of previous studies further north. A gradual reduction in the diversity of fruiting species that serve as food occurs with decreasing latitude: up to 60 species were identified in lowland and upland sites in the Jimna and Conondale Ranges (Innis and McEvoy 1992); 37 in Lamington National Park, Queensland (Church 1997); and 28 species in the Tooloom Range, northern NSW (Donaghey 1981). The present study identified 20 species in the diet, which was expected due to reduced flora diversity (Keith 2004). As with Innis and McEvoy's (1992) study, fewer than 25 % of plant species in the diet of the Green Catbird produced crops with 100 % reliability in any calendar month. Whilst the Sandpaper Fig was consumed many times, figs were not as important in the diet of the Green Catbird when compared to other studies (cf. Donaghey 1981; Innis and McEvoy 1992; Church 1997). This observation held true despite the availability of three other species of fig *Ficus* sp. in the Illawarra region.

In tropical and subtropical forests, there is a correlation between food abundance and breeding seasons in frugivorous birds (Snow and Snow 1964; Crome 1975, 1976), including the Green Catbird (Donaghey 1981; Innis and McEvoy 1992). The breeding season of the species in NSW is from September to February (Higgins *et al.* 2006), during which only six species in the diet fruited reliably: Kangaroo Vine *Cissus antarctica* and Featherwood in September, Brown Beech in November and December, and Moreton Bay Fig in January and February, Pepper Vine *Piper novaehollandiae* in January, and Sandpaper Fig in February. The remainder of the breeding season diet comprises species at the early or late period of crop season (e.g. Black Plum *Diospyros australis*, Sandpaper Fig, Crabapple) or species that fruit sporadically (e.g. Small-leaved Fig *Ficus obliqua*, Brush Muttonwood, White Quandong).

Although stripping vine stems is a known behaviour (Donaghey 1981), Lantana stems are a previously unreported element of the diet in the Green Catbird. Furthermore, at least one third of the fruits found in the diet have not been identified in other studies: Staff Vine,

Water Vine *Cissus hypoglauca*, Bolwarra, Sandpaper Fig, Brush Muttonwood, Crabapple and Tree Heath. Foraging associations with honey-eaters, pigeons and other bowerbirds has been documented (Gwynne 1937; Chaffer 1984); however, currawongs in the present study were an apparent predator (at least of nestlings) and were not tolerated by catbirds as they were in other studies (Higgins *et al.* 2006).

Knowledge of the Green Catbird diet in the southern part of its distribution improves the assessment of potential catbird habitat. Robinson (1977) introduced the concept of restoring corridors between wilderness areas in the Illawarra region to facilitate wildlife movements. Connectivity of large and small remnants may be necessary to aid animal and seed dispersal (Price *et al.* 1999; Cramer *et al.* 2007; Gomes *et al.* 2008). This study has identified four tree species that appear to be especially important in the Green Catbird diet in the Illawarra region (Bolwarra, Brown Beech, Featherwood and Sandpaper Fig), as well as a number of feed trees used in the breeding season. Use of these species can be prioritised in future replanting programs to encourage the presence of catbirds.

Acknowledgements

Sharman Lugton helped locate relevant literature and useful comments by Rohan Clarke and Anne Morton improved the manuscript.

References

- Bell HL (1960) Observations on the habits of bower-birds in captivity. *Emu* **60**, 8–10.
- Chaffer N (1984) *In Quest of Bowerbirds*. (Rigby Publishers: Sydney)
- Church RJ (1997) Avian frugivory in a subtropical rainforest: eleven years of observations in Lamington National Park. *Sunbird* **27**, 85–97.
- Cramer JM, Mesquita RCG and Williamson GB (2007) Forest fragmentation differentially affects seed dispersal of large and small-seeded tropical trees. *Biological Conservation* **137**, 415–423.
- Crome FHJ (1975) The ecology of fruit pigeons in tropical northern Queensland. *Australian Wildlife Research* **2**, 155–185.
- Crome FHJ (1976) Some observations on the biology of the cassowary in northern Queensland. *Emu* **76**, 8–14.
- Donaghey RH (1981) The ecology of bowerbird mating systems. (Unpublished PhD thesis, Monash University, Melbourne)
- Erschine J (1984) The distributional ecology of rainforest in the Illawarra in relation to fire. (Honours thesis, University of Wollongong, Wollongong NSW)
- Floyd AG (1982) Rainforests of northern Illawarra. Unpublished report to NSW National Parks and Wildlife Service, Sydney.

- French K, O'Dowd DJ and Lill A (1992) Fruit removal of *Coprosma quadrifida* (Rubiaceae) by birds in south-eastern Australia. *Australian Journal of Ecology* **17**, 35–42.
- Frith CB and Frith DW (1979) Leaf-eating by birds-of-paradise and bowerbirds. *Sunbird* **10**, 21–23.
- Frith CB and Frith DW (2004) *The Bowerbirds*. (Oxford University Press: Melbourne)
- Gomes LGL, Oostru V, Nijman V, Cleef AM and Kappelle M (2008) Tolerance of frugivorous birds to habitat disturbance in a tropical cloud forest. *Biological Conservation* **141**, 860–871.
- Green RJ (1993) Avian seed dispersal in and near subtropical rainforests. *Wildlife Research* **20**, 535–557.
- Gwynne AJ (1937) Notes on the green catbird. *Emu* **37**, 76–78.
- Higgins PJ, Peter JM and Cowling SJ (Eds) (2006) *Handbook of Australian, New Zealand and Antarctic Birds. Volume 7: Boatbill to Starlings*. (Oxford University Press: Melbourne)
- Holmes G (1987) *Avifauna of the Big Scrub Region*. (NSW National Parks and Wildlife Service: Sydney)
- Innis GJ and McEvoy J (1992) Feeding ecology of green catbirds (*Ailuroedus crassirostris*) in subtropical rainforests of south-eastern Queensland. *Wildlife Research* **19**, 317–329.
- Keith DA (2004) *Ocean Shores to Desert Dunes: the Native Vegetation of New South Wales and the ACT*. (NSW Department of Environment and Conservation: Hurstville, NSW)
- Lea AH and Gray JT (1936) The food of Australian birds. An analysis of the stomach contents. Part V. *Emu* **35**, 335–347.
- Leck CF (1971) Overlap in the diet of some neotropical birds. *Living Bird* **10**, 89–106.
- Lemckert F, Lemckert G, Lemckert C and Lemckert F (2007) An observation of probable predation of a Northern Leaf-tailed Gecko by a Green Catbird. *Herpetofauna* **37**, 63.
- Mo M and Waterhouse DR (2015) Fruiting phenologies of rainforest plants in the Illawarra Region, New South Wales, 1988–1992. *Proceedings of the Linnean Society of New South Wales* **137**, 17–27.
- Neilan W, Catterall CP, Kanowski J and McKenna S (2006) Do frugivorous birds assist rainforest succession in weed dominated oldfield regrowth of subtropical Australia? *Biological Conservation* **129**, 393–407.
- NSW NPWS (2002) Wollongong LGA Bioregional Assessment (Part I): Native Vegetation of the Illawarra Escarpment and Coastal Plain. NSW National Parks and Wildlife Service, Sydney.
- NSW NPWS (2011) Illawarra Escarpment State Conservation Area: Draft plan of management. NSW National Parks and Wildlife Service, Sydney.
- Price OF, Woinarski JCZ and Robinson D (1999) Very large area requirements for frugivorous birds in monsoon rainforests of the Northern Territory, Australia. *Biological Conservation* **91**, 169–180.
- Robinson NH (1977) The need for joining Illawarra wilderness areas. *Australian Zoologist* **19**, 125–132.
- Schulz M and Magarey E (2012) Vertebrate fauna: a survey of Australia's oldest national park and adjoining reserves. *Proceedings of the Linnean Society of New South Wales* **134**, B215–B247.
- Smythe N (1970) Relationships between fruiting seasons and seed dispersal in a neotropical rainforest. *American Naturalist* **104**, 25–35.
- Snow DW (1962) A field study of the black and white manakin, *Manacus manacus*, in Trinidad, W.I. *Zoologica (N.Y.)* **47**, 65–104.
- Snow DW and Snow BK (1964) Breeding seasons and annual cycles of Trinidad land birds. *Zoologica (N.Y.)* **49**, 1–40.
- Stork NE, Goossem S and Turton SM (2008) Australian rainforests in a global context. In *Living in a Dynamic Tropical Forest Landscape*, pp. 4–20. Eds NE Stork and SM Turton. (Blackwell Publishing: Melbourne)
- Terborgh J and Diamond JM (1970) Niche overlap in feeding assemblages of New Guinea birds. *Wilson Bulletin* **82**, 29–52.
- Waterhouse DR (1995) Observations on the diet of the Lewin's Honeyeater *Meliphaga lewinii* in the Illawarra rainforest, New South Wales. *Corella* **19**, 102–105.
- Waterhouse DR (2001) Observations on the diet of the Top-knot Pigeon *Lopholaimus antarcticus* in the Illawarra rainforest, New South Wales. *Corella* **25**, 32–38.
- Webb LJ and Tracey JG (1981) Australian rainforests: patterns and change. In *Ecological Biogeography of Australia*, pp. 606–694. Ed A Keast (W Junk: The Hague)

Received 30 April 2015; accepted 8 October 2015

One Hundred Years Ago

A SKETCH OF THE KEILOR PLAINS FLORA

BY C.S. SUTTON

Tree Growth

... Before dealing with these groups, reference may be made here to the tree growth of the area. Although ten eucalypts have been noted, only four exist in such numbers that they may be said to belong to the basalt. Of these, the River Red Gum, *E. rostrata*, is undoubtedly predominant, exceeding the others in numbers, distribution, and range. In the eastern part, especially about and between Epping and Woodstock, it forms fine open forests, where trees quite often attain imposing proportions. Perhaps no other of the great genus shows so much individuality as this species, no two trees being quite alike except in that they all bow more or less to the pole in deference to the will of the strong north winds. The varied sweep of their massive, far-reaching, and often strangely contorted branches, and the sober yet rich colouring of bole and limbs, endows them with a picturesqueness quite redeeming the flat country from its monotony. The Red Gum has almost undisputed possession of all the water-courses, often extending in that way right up on to the open plain. Isolated groups exist near Point Cook and on the Werribee Sewage Farm, and the trees, though small, appear to be of considerable age.

From *The Victorian Naturalist* XXXIII, p. 119, December 1916