Koala Beach Glossy Black-cockatoo habitat Monitoring Report

Photograph by Guy Shepherd, August 31st 2014.

November 2017

Prepared for

Tweed Shire Council

by

Mark Fitzgerald

Ecological Consultant

P.O. Box 237 Mullumbimby NSW 2482

EXECUTIVE SUMMARY

Monitoring commenced in September 2016, with 1925 chewed cones found under 28 trees in the reserved habitat and its vicinity. A pair of birds was found feeding in a Forest Oak west of Lomandra Avenue and outside the reserved habitat.

Monitoring continued in May and September 2017 with 2060 chewed cones found under 21 trees in the reserved habitat. No birds were observed in the course of 2017 monitoring.

Nine new feed trees have been tagged in the Koala Beach reserved habitat since the 2014 round of monitoring, most were Forest Oak, but included one Swamp Oak.

Monitoring in 2016-2017 also included inspection of six artificial hollows, which have not yet been recorded being used by Glossy Black-cockatoos.

Monitoring provides evidence of the ongoing importance of habitat at Koala Beach for the local Glossy Black-cockatoo population. The condition of Forest Oak stands in the reserved habitat and reservoir stands was similar to that observed in previous monitoring with minimal weed presence and a low rate of senescence of mature trees. Very dry conditions in 2017 had resulted in a dense layer of Forest Oak cladodes on the ground, and most feed trees used by Glossies were located close to gully edges.

No evidence of Glossy Black-cockatoo feeding on Black She-oak was found at Bogangar or Hastings Point in 2017. A pair of birds and feed sign were recorded from Horsetail Oak stands at Kingscliff.

The Koala Beach Glossy Black-cockatoo Plan of Management needs amendment to reflect variations in monitoring technique and timing.

Community sightings support the patterns evident in monitoring, and provide insight into regional movements of Glossy Black-cockatoos in the Tweed Shire.

GLOSSARY

Cladode: foliage of she-oaks (*Casuarina* and *Allocasuarina* species) also termed 'needles' are rod-shaped branchlets with tiny reduced leaves arranged around the branchlet.

Cone crop: The number of cones present on each Forest Oak at the time of survey.

Correlation test: a statistical test performed to test if any numerical relationship exists between two sets of variable or factors.

Feed sign: chewed cones, usually on the ground beneath a feed tree.

Feed tree: she-oak or Forest Oak with feed sign beneath it.

Ibid: in the sample place or reference

Preferred feed tree: feed tree with history of repeated or large-scale use by Glossy Black-cockatoos.

ACKNOWLEDGEMENTS

Thanks to: Marama Hopkins, Lael Osun, Anneliese Simke and Scott Hetherington, for supplying Glossy Black-cockatoo records. Thanks to Guy Shepherd for the cover page photograph of Glossy Black-cockatoos feeding at Koala Beach.

TABLE of CONTENTS

FIGURES

TABLES

APPENDICES

1.0 Introduction

1.1 The Plan of Management

A Plan of Management for reserved Glossy Black-cockatoo habitat at the Koala Beach Estate prescribes monitoring of the reserved habitat and of use of the habitat by Glossy Black-cockatoos *Calyptorhynchus lathami*.

Specific requirements for monitoring in the plan are listed below.

Project: Carry out monitoring of Glossy Black-cockatoo habitat at Koala Beach; provide an annual report of monitoring results; and recommend revisions to the Plan of Management if deemed necessary.

Monitoring is to be undertaken in accordance with the current adopted Glossy Black-cockatoo Plan of Management.

1. Monitor use of the Glossy Black-cockatoo habitat area and adjacent Forest Oak Allocasuarina torulosa habitat between March and September. Monitoring should include 2 surveys comprising one day each in July and August, preferably separated by 20-30 days.

1(a) Search for Glossy Black-cockatoos in the Glossy Black-cockatoo habitat area and adjacent Forest Oak habitat. Mid-morning traverses of the Forest Oak stands listening for sounds of feeding and calling birds, use binoculars to count birds and identify pairs and immatures.

1(b) Search for, quantify and record the location of feed sign (chewed Allocasuarina cones) in the Glossy Black-cockatoo habitat area and adjacent Forest Oak habitat. The area for searches is indicated in Figure 2 in the Plan of Management.

2. Assess the condition of the Glossy Black-cockatoo habitat area and adjacent Forest Oak habitat and provide information including but not restricted to: general tree health and any tree death; recruitment of Forest Oak Allocasuarina torulosa;

and disturbance e.g. tree removal, branch lopping, dumping of garden wastes, fire, and weed development. Report on condition of plantings, if any.

3. Provide an annual report of monitoring results and recommend revisions to the Glossy Black-cockatoo Plan of Management if deemed necessary.

3(a) The report should be provided on disk as a Word document, and as a printed hard copy.

3(b) Copies of the report should be provided to:

- *Koala Beach Wildlife and Habitat Management Committee;*
- *Department of Environment and Conservation (Threatened Species Unit in Coffs Harbour).*

4. Collate and review any sighting records collected by residents and forwarded to the Koala Beach Wildlife and Habitat Management Committee (a standard survey form will be distributed to residents by the committee to report fauna sightings).

1.2 Objective of the Glossy Black-cockatoo Plan of Management

The principal objective of this management plan is;

- to preserve habitat value for Glossy Black-cockatoos by maintaining the reserved Forest Oak *Allocasuarina torulosa* stands, roost trees and potential or actual nest trees at Koala Beach.

Monitoring and collation of local sightings incidentally provide a measure of the local abundance of Glossy Black-cockatoos.

1.3 Installation and monitoring of artificial hollows

Six artificial hollows, based on designs used successfully for Glossy Black-cockatoos on Kangaroo Island, were installed in two clusters of three each at Koala Beach on February 25th 2010. Hollows were constructed and installed by Graeme Lloyd (WildlifeServices, Terranora) after selection of potentially suitable trees on February 15th 2010. Tree selection was determined by descriptions of nest trees in literature (*e.g.* GBC 2010) as being large living or dead eucalypts with diameter at breast height > 40 cm. Tree selection was also influenced by the proximity of trees to the reserved Forest Oak habitat stands, and to a known watering site.

Following the collapse of a tree to which a hollow had been attached in April 2012, this hollow was re-located into the central reserved habitat stand in May 2012.

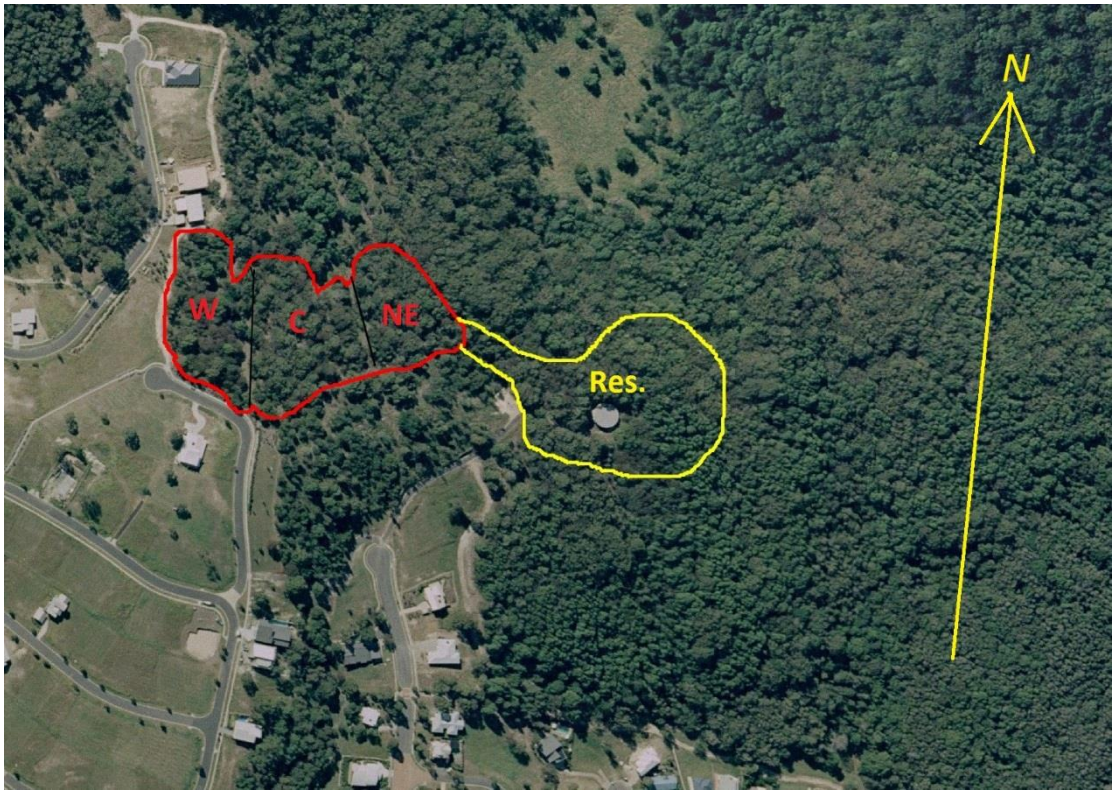
1.4 Reserved Glossy Black-cockatoo habitat at Koala Beach

Reserved Glossy Black-cockatoo habitat at the Koala Beach Estate comprises 2.26 ha of the north-facing slopes of a low ridge (<50 m AHD) of metamorphic geology, which is oriented from southwest to northeast. The ground surface is rocky and sloping, with small patches of grassland. Two small gullies are present which divide the habitat into 3 identifiable stands (west, central, northeastern). Buffers to the reserved habitat extend the area reserved to a total of 6.16 ha. The reserved habitat is contiguous with a large block of forested land to the north which is zoned 7(l) Environmental Protection (Habitat), and with an area to the south-east reserved as habitat for the threatened Common Blossom Bat *Syconycteris australis*.

The dominant vegetation and principal canopy tree in the reserved habitat is Forest Oak, *Allocasuarina torulosa* and the overall stand height is low (<15m). Occasional emergent Northern Grey Ironbark *Eucalyptus siderophloia* and Pink Bloodwood *Corymbia intermedia* are present; taller Swamp Oak *Casuarina glauca* are also present, mainly in the lower slope and around gullies. Coast Banksia *Banksia integrifolia* occurs on the ridge top above the reserved habitat stands.

Forest Oaks are also the dominant and co-dominant canopy species in a similar stand to the near northeast, extending around the water reservoir site (reservoir stand: see Figure 1). Vegetation of the reserved Glossy Black-cockatoo habitat and the reservoir stands thus differs from habitat elsewhere on the Koala Beach Estate, where Forest Oak generally occurs as a minor component of the mid-layer vegetation beneath eucalypt open forest and woodland, where the canopy layer is dominated by taller sclerophyllous species such as Blackbutt *Eucalyptus pilularis*, Northern Grey Ironbark, Grey Gum, *E. propinqua*, White Mahogany *E. acmenoides* and Pink Bloodwood.

Figure 1: Reserved Koala Beach Glossy Black-cockatoo habitat and Reservoir stand



Source GoogleEarth. Scale = ~1: 5 600

2.0 Methods

2.1 Monitoring procedures

Monitoring procedures undertaken during field work for the current report included:

- Checking occupation of artificial hollows;
- Searches of the reserved habitat and vicinity;
- Quantification of feed sign, tree size, cone and crop sizes;
- Identification of trees used;
- Tagging of new feed trees;
- Recording the occurrence of weeds in the reserved habitat, and
- Surveys of sites on the Tweed coast where Glossy Black-cockatoos had been recorded feeding on Black She-oak and Horsetail She-oak.

2.2 Checking occupation of artificial hollows

Six artificial hollows were installed in Koala Beach in February 2010 to augment the available nest hollow resource. Survey of artificial hollows involved use of a pole camera provided by Graeme Lloyd (Wildlife Services, Terranora) in June 2015, and September 2016. In 2016 a fixed motion sensor camera was installed to monitor use of a hollow placed in the reserved habitat. While a possible cockatoo egg was observed in 2015, this hollow was later occupied by a Maned Duck, and no evidence has been found of Glossy-Black-cockatoos using the hollows.

Maned Ducks have been observed nesting in all the artificial hollows, and may have displaced cockatoos from using these as nesting sites.

2.3 Searches of the reserved habitat and vicinity

This search area is determined by the concentration of Forest Oaks and history of feed tree use detected previously, since 1994. Occasional reconnaissance beyond this area has resulted in the discovery of an additional feed tree. Searches involved looking for

and quantifying feed sign beneath trees, as well as looking for and listening for Glossy Black-cockatoos. New feed trees encountered were individually identified by attaching a numbered stainless steel tag to the trunk surface at breast height.

Thorough searches were made of the reserved Glossy Black-cockatoo habitat and nearby areas of Koala Beach where Forest Oaks are found, as specified in the approved Plan of Management.

2.4 Quantification of feed sign, tree size, cone and crop sizes

Feed sign is counted or estimated in order to provide an index of Glossy Black-cockatoo foraging effort. Monitoring enables repeat use of preferred feed trees and groups of trees to be identified. When < 20 chewed cones were present these were counted; where > 20 cones were present the number of chewed cones was estimated. Estimates of cones were re-counted on occasion to check accuracy of estimates, which can be affected by the nature of the groundlayer vegetation beneath the feed trees, the extent of dismemberment of the cones, and the time since feeding. Chewed cones and fragments of cones are more difficult to distinguish from leaf litter under wet conditions. Estimates of the number of chewed cones are considered to be in the order of +/- 10% accuracy.

See Appendix A for feed sign data from the 2016-2017 samples, and definition of categories.

2.5 Identification & tagging of individual trees used

New feed trees encountered were individually identified by the application of a numbered stainless steel tag attached to stainless steel wire and fixed permanently into the trunk surface at breast height. Since 2014 monitoring a total of nine (9) untagged or new feed trees were tagged, resulting in a total of 187 tagged feed trees.

2.6 Recording the occurrence of weeds in the reserved habitat

Weeds were noted as encountered during searches for birds and feed sign.

2.7 Searches outside Koala Beach

Areas known to be used by Glossy Black-cockatoos for foraging were searched at Bogangar, Cudgera Creek and Hastings Point. A watering and feeding site at Kingscliff (Sutherland Point) was also searched.

2.8 Collation of records from local observers

Information on recent local sightings of birds and was provided by Lael Osun, Anneliese Simke, Scott Hetherington, and Marama Hopkins (Tweed Shire Council). See Appendix E.

3.0 Results—2016-2017 Glossy Black-cockatoo monitoring

3.1 Inspection of Artificial Hollows

Glossy Black-cockatoo monitoring included a check of the artificial hollows in June 2015, July and September 2016 and July 2017. A fixed motion sensor camera placed in a tree to monitor use of an artificial hollow in the reserved habitat central stand recorded images of a Maned Duck using the hollow.

No evidence of use of the hollows by Glossy Black-cockatoos was found.

3.2 Searches of the reserved Glossy Black-cockatoo habitat at Koala Beach

The reserved Glossy Black-cockatoo habitat was surveyed in 2016 on September 9th and 12th resulting in a total of 1925 chewed cones found under 28 trees. Two new feed trees were located on 9/9/16: one was a small Swamp Oak *Casuarina glauca* in

the western reserved habitat patch with 80 chewed cones, the other a Forest Oak in the central stand with 200 cones. Two new feed trees were tagged on 12/9/16; one in the northeastern stand, and the other was a large Forest Oak (#182) outside the reserved habitat on the western side of Lomandra Avenue, with a pair of Glossy Black-cockatoos feeding in it, and later found to have 200 chewed cones beneath it.

The reserved Glossy Black-cockatoo habitat was surveyed again on May 17th, when only 2 chewed cones were found.

Searches of the reserved Glossy Black-cockatoo habitat on September 19th 2017 recorded 2060 chewed cones and five (5) new feed trees. No birds were seen.

3.3 Feed sign outside Koala Beach

Areas outside Koala Beach which were inspected during the 2016-2017 monitoring period included Hastings Point Landcare, tracks near Murnane's Fire Trail at Bogangar (which were partly burnt), North Kingscliff Dune Care, and the reserve on Cudgen Creek at Kingscliff (Sutherland Point), and the Pottsville Environmental Park.

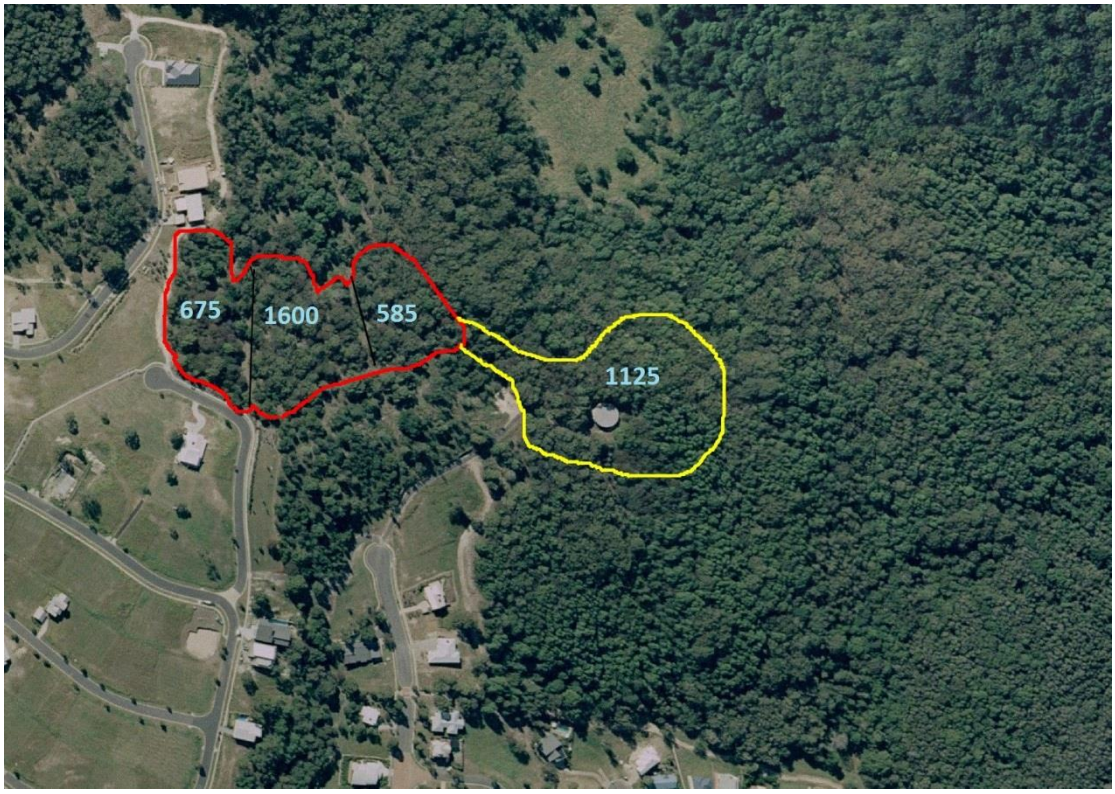
No feed sign was found at Hastings Point or at Bogangar in the monitoring period. Minor amounts of feed sign (25 cones) were found beneath three (3) Horsetail She-oaks *Casuarina equisetifolia* at the Cudgen Creek Headland reserve (Sutherland Point) in May 2017, where a pair of Glossy Black-cockatoos were feeding over the access road. Table 1 summarises the monitoring activity undertaken from 2015-2017.

Table 1: Monitoring activity: 2015-2017

Date	Activity/Area Searched	Feed Sign	New Feed trees	Birds sighted
3/6/15	Hollow check	--	--	--
19/7/16	Hollow check	--	--	--
9/9/16	Feed sign search: Reserved habitat	1135	2	2
12/9/16	Feed sign search: Reserved habitat	790	1	--
12/9/16	Hastings Pt. Landcare	--		
20/9/16	Hollow check	--	--	--
17/5/17	Feed sign search: Reserved habitat	2	--	--
	Murnane's Fire Trail			
	Hastings Pt. Landcare			
31/5/17	Kingscliff Sutherland Point	--	--	2
	Ocean Avenue	25	3*not tagged	--
	Pottsville environmental Park	--	--	--
27/7/17	Hollow check	--	--	--
19/9/17	Feed sign search: Reserved habitat	2060	5	--

Figure 2 shows the distribution of chewed cones across the reserved habitat and reservoir stands at Koala Beach. See Appendix A for details.

Figure 2: Feed sign totals from 2016 & 2017.



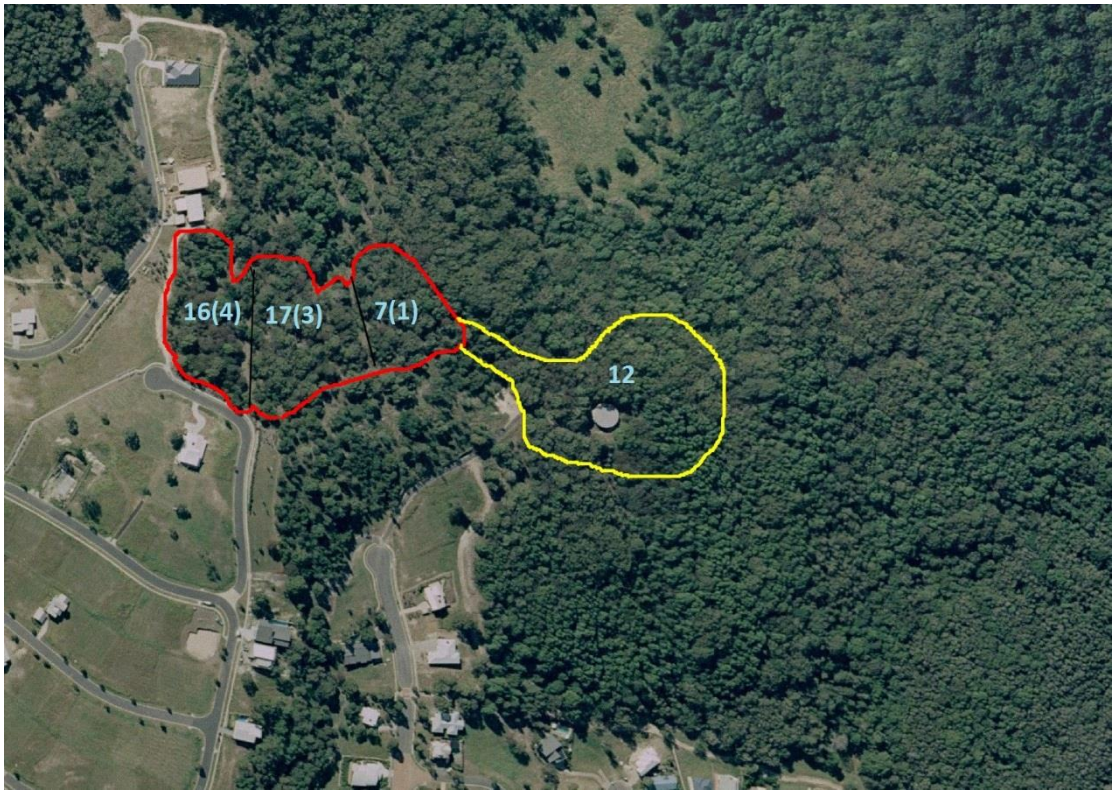
Source GoogleEarth. Scale = ~1: 5 600

Table 2: Combined feed sign counts from 2016 & 2017

Year	West	Central	NE	Res.	Total
2016	175	960	225	565	1925
2017	500	640	360	560	2060
TOTAL	675	1600	585	1125	3985

Figure 3 shows the distribution of feed trees recorded in the current monitoring period, with the number of new feed trees in brackets.

Figure 3: Distribution of feed trees in 2016-& 2017; no. of new feed trees in brackets.



Source GoogleEarth. Scale = ~1: 5 600

Table 3 lists summary data from eight (8) Glossy Black-cockatoo monitoring events at Koala Beach since 1996.

Table 3: Summary: feed sign monitoring results:
1996, 2005, 2007, 2009, 2011, 2014, 2016 & 2017. Nil results in 2013.

Monitoring data	**1996**	**2005**	**2007**	**2009**	**2011**	**2014**	**2016**	**2017**
Total number of chewed cones	1672	2705	4785	4941	1389	2616	1925	2060
Feed trees	38	56	89	69	34	45	29*	21
'New feed trees' tagged	--	--	137	24	3	13	4	5

Monitoring data	1996	2005	2007	2009	2011	2014	2016	2017
Average feed sign per tree (chewed cones)	44	48.3	52.6	51.5	40.9	58.1	73.3	98.2
Feed trees in reserved habitat (& % of total)	32 84.2	39 69.6	56 63	52 75.4	34 100	27 60	20 68.9	18 76
Feed trees in reservoir stand (& % of total)	6 15.8	17 30.3	33 37	17 24.6	0	18 40	9 31.1	12 24

3.4 Occurrence of weeds in the reserved habitat

Weeds still occurring in the reserved habitat include Woody Passionfruit *Passiflora suberosa* (widespread but at low abundance); Lantana *Lantana camara*, (northeast and reservoir stands).

3.5 Conditions at the time of monitoring in 2016-2017

Mean annual rainfall data from the nearest BoM station (Marine Parade Kingscliff), is 1827mm. Annual Rainfall for 2015 was average (1960mm); while 2016 recorded a lower than average rainfall (1333mm). Rainfall for the first 10 months of 2017 (1179mm) was well below the average annual figure. Source: Bureau of Meteorology: Climate online.

3.6 Condition of the reserved habitat

The reserved Glossy Black-cockatoo habitat at Koala Beach is generally in good condition, in terms of weeds and tree health.

Demographics of Forest Oak *Allocasuarina torulosa* in the reserved habitat stands remain largely stable, with the collapse of a known and tagged feed tree (#96) in the central patch in May 2017. Younger trees are bearing cone crops and some of these are being newly exploited as feed trees.

3.7 Records/sightings of Glossy Black-cockatoos on Koala Beach Estate

Glossy Black-cockatoos were detected by the author outside the reserved habitat in September 2016, when a pair was discovered feeding in a Forest Oak west of Lomandra Avenue.

Koala Beach residents Lael Osun, Anneliese Simke , Scott Hetherington, provided observations of Glossy Black-cockatoos feeding at Koala Beach. These records are provided in Appendix E.

3.8 Feed sign quantities

Eight (8) counts of chewed cones in the reserved habitat at Koala Beach since 1996 have ranged from 1389 in 2011, to 4941 in 2009, with an average of 2761.

The totals of chewed cones recorded in 2016 (1925) and in 2017 (2060) are both below average counts. However, average feed sign counts per tree in 2016 (73.13) and 2017 (98.2) are both significantly higher than the overall average feed sign counts from previous monitoring events (55.17: see Table 1).

3.9 Identification of trees used

A total of 187 feed trees have now been tagged at Koala Beach; 130 are located within the reserved Glossy Black-cockatoo habitat and 57 trees are located nearby on the ridge and upper slopes around the reservoir. Figure 3 illustrates the distribution of these Forest Oak *Allocasuarina torulosa* trees among stands.

3.10 'Preferred feed trees'

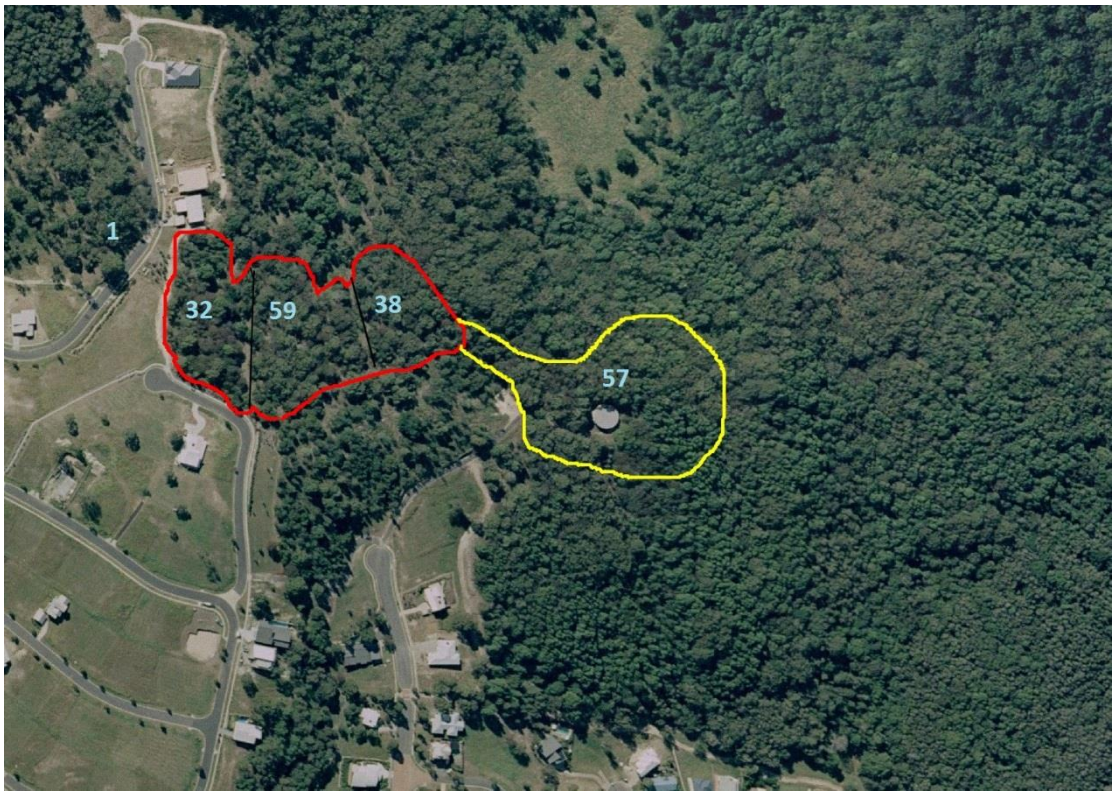
The cumulative feed sign data presented in Appendix C of this report shows the repeated use of particular Forest Oaks by foraging Glossy Black-cockatoos. This supports the contention (*e.g.* Clout 1989) that use of Forest Oaks by Glossy Black-cockatoos involves selection of particular trees.

This selection is described in literature as being based on higher nutrient yields and/or of seed counts in particular cones (GBC 2010) and is supported by the observations over consecutive monitoring samples of trees with cone crops which do not have feed sign beneath them (yet) and the repeated exploitation of certain Forest Oaks which are used more frequently than others. If the nutrient content, productivity and palatability of seeds is heritable, then the repeat use trees should be the source of any future plantings of food trees for Glossy Black-cockatoos at Koala Beach.

Monitoring data overall also indicates a gradual uptake of new feed trees, both as younger Forest Oaks begin to bear large crops of cones, and of the occasional exploitation of mature Forest Oaks which have not been detected as feed trees in previous monitoring samples.

The young Forest Oak shown in Appendix B (vi) has borne heavy crops of large cones over the last five years, but has not yet been recorded as a feed tree. Its exposed position on the ridge above the central stand, and thus vulnerability to predation, may influence this lack of exploitation.

Figure 4: Distribution of feed trees at Koala Beach: 1996-2017



Source GoogleEarth. Scale = ~1: 5 600

3.11 Threatened Species Records at Koala Beach

Twenty-four (24) plants of the Endangered Nodding Greenhood *Geodorum densiflorum* were detected in the central reserved habitat stand on September 12th 2016. None were detected in 2017 surveys.

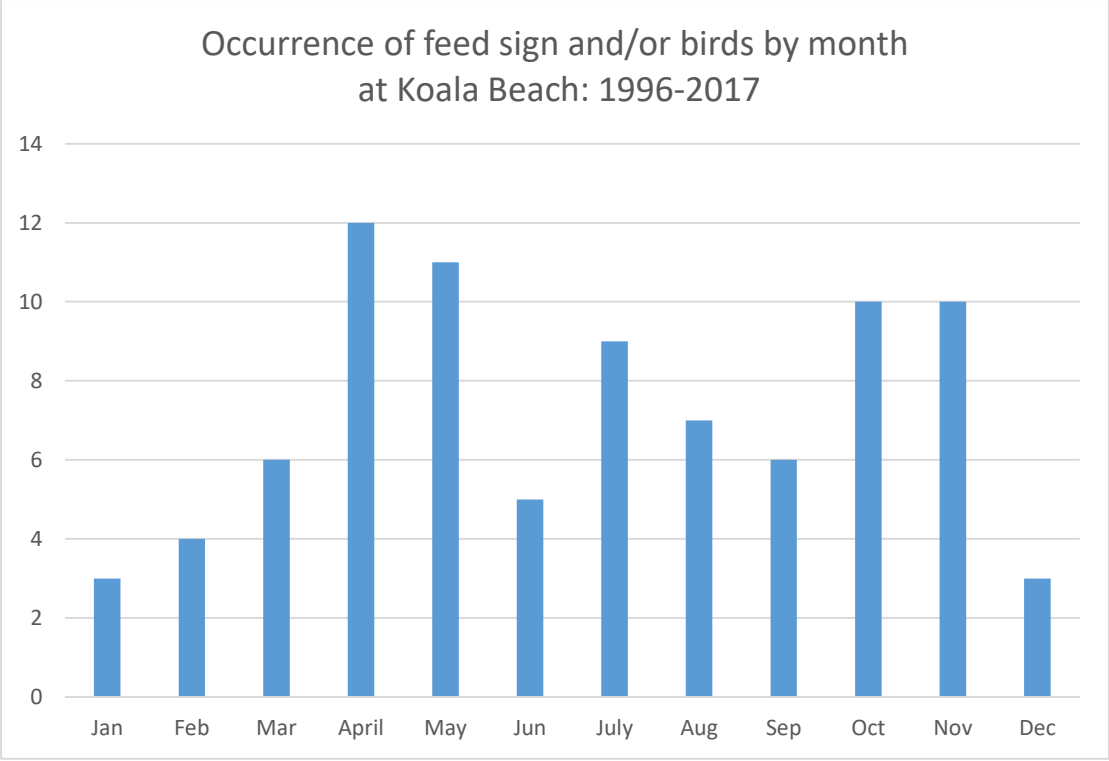
4.0 Discussion—Glossy Black-cockatoo use of the reserved habitat at Koala Beach

The paucity of feed sign in the reserved habitat and reservoir stands at Koala Beach during searches in 2015 resulted in deferring monitoring until the following year. A pattern of presence and absence evident in previous monitoring (see 2014 report) indicates that Glossy Black-cockatoos observed at Koala Beach and in the Tweed Coast are mobile and capable of moving in response to the availability of resources.

The mobility of flocks and the likelihood of dispersal and break up into smaller groups when food resources are scarce, or occur at low density, may explain the absence of records of birds from this period.

The principle of the availability of food resources influencing the movement patterns of birds is well established in the case of nectivorous and frugivorous species (Hawkins 2014, Fitzgerald 2013). It is also evident in the Glossy Black-cockatoo monitoring data to date, and in the patterns evident in the community sightings: see Appendix E. Birds occur in Koala Beach when sufficient cone crops are present and when cones are at a suitable stage of maturity for consumption. Birds and/or feed sign have now been recorded at Koala Beach in every month of the year (since 1996). While earlier samples indicated feeding in winter and spring later samples have recorded feed sign later in the year, with November being the month most frequently with feed sign present. This is not the result of random sampling but results from early reconnaissance searches indicated the likely timing of cones being available at a suitable stage of maturity.

Figure 5: Feed sign and bird sightings at Koala Beach by month



4.1 Artificial hollows

Use of a pole camera, and installation of a fixed motion sensor camera have provided more detailed evidence of use of the artificial hollows with four checks of the hollows in the reporting period. All artificial hollows have been occupied at times by nesting Maned Ducks; a Brush-tailed possum has been found in one hollow.

A single white egg likely to be from a parrot and possibly from a Glossy Black-cockatoo was found in one hollow in June 2015, but this hollow was later observed to have a brooding Maned Duck resident.

Fidelity of Glossy Black-cockatoos to existing nest tree hollows (GBC 2010), and likely low recruitment rates in this population may retard the rate at which they take up use of artificial hollows. However continued annual monitoring of the artificial hollows is recommended. As the breeding season is given as between late January and early June (GBC 2014), monitoring should take place between these dates.

4.2 Significance of other feed trees and stands outside Koala Beach

Results of monitoring in 2016-2017 further confirm the variable temporal and spatial patterns of habitat use by Glossy Black-cockatoos reported in literature (*e.g*. GBC 2010). Seasonal variations of food resources appear to be a major influence in patterns of movement and foraging by the birds.

Monitoring data in 2016-2017 confirm the use of Horsetail She-oaks as feed trees on the Tweed Coast. More detailed information on the extent of use of Horsetail She-oaks would be valuable, considering the extent of this resource in the Tweed Coast.

4.3 Adequacy of the PoM and current monitoring

The Plan of Management has successfully tracked the use of the reserved habitat and reservoir stands since 1996, and the ongoing management of weeds, plantings and some natural recruitment have ensured that this habitat remains in similar condition to that present when monitoring and management began.

The current Glossy Black-cockatoo Plan of Management requires several amendments. The timing and frequency of monitoring needs to be amended to reflect variability in the seasonal use of the site by Glossy Black-cockatoos. The apparent absence of Glossy Black-cockatoos, and scarcity of Forest Oak cones in 2013 & 2015 demonstrates that flexibility in the timing of monitoring is necessary

Proposed amendments to the plan are outlined in the Recommendations section of this report.

5.0 Conclusion

The most important results and conclusions drawn from the 2016-2017 monitoring include:

- Glossy Black-cockatoos continue to feed in the reserved habitat stands, despite their apparent absence from Koala Beach in 2013;

- Mortality and senescence of Forest Oaks within the reserved habitat stands and their vicinity remained at a low and stable rate;

- Tweed Coastal Horsetail She-oak foraging sites are an important component of local Glossy Black-cockatoo habitat and their conservation will contribute to the persistence of the Tweed Coast population;

- Contributions of sightings by the community substantially strengthens the overall understanding of habitat use by Glossy Black-cockatoos on the Tweed coast and elsewhere in Tweed Shire.

6.0 Recommendations

- Recruitment issues / Forest Oak mortality: collect seed and propagate seedlings from the reserved habitat stands (preferably from 'preferred feed trees': listed in Appendix C of this monitoring report).

- Establish approximately 50 Forest Oak plants to approximately 1m height and plant these in gaps and edges of the reserved habitat stands and reservoir stands when large enough.

- Monitor artificial hollows between February and July 2018, using a pole camera.

- Continue feed sign and feed tree monitoring in 2019; according to the approved and amended Glossy Black-cockatoo Plan of Management;

- Continue to control weeds and encourage native species regeneration in accordance with the revised Koala Beach Habitat Restoration Plan. Weeds need to be treated periodically and on an ongoing basis to ensure reduced competition with native plants.

- Modify the current Koala Beach Glossy Black-cockatoo Plan of Management to include the following two phrases:

- *1 (a)Monitor use of the Glossy Black-cockatoo habitat area and adjacent Forest Oak Allocasuarina torulosa habitat between June and December. Monitoring should include 2 surveys approximately 30-60 days apart and*

timing of surveys should be determined by the presence of feed sign and/or birds.

- *1 (c)Use a pole camera or similar telemetry technique to monitor artificial hollows on two occasions between late January and June, preferably 20-30 days apart.*

- Provide a copy of the final monitoring report to the Glossy Black Conservancy.

- Continue collation of community records of Glossy-black Cockatoos at Koala Beach Estate and on the Tweed Coast.

REFERENCES

Beruldsen, G. (1980) "A field Guide to the Nests and Eggs of Australian Birds". Rigby, Adelaide.

Crowley, Gabriel Mary (1986) Ecology of *Allocasuarina littoralis* (Salisb.) L. Johnson and *A. torulosa* (Ait) L. Johnson in North Queensland. PhD thesis, James Cook University.

Fitzgerald M. (2013) Environmental Performance Report, North Byron Parklands. Unpublished report to NSW Department of Planning and Infrastructure. Prepared for North Byron Parklands.

Glossy Black Conservancy (2010) Glossy Black-cockatoo Conservation Guidelines for South-Eastern Queensland and Far North-Eastern New South Wales. Glossy Black Conservancy

Hawkins B. A. (2014) Birds, fruit and nectar: spatio-temporal patterns of regional abundance and food availability in subtropical eastern Australia. Ph.D. thesis. Monash Unversity Faculty of Science School of Biological Sciences. Reference: Monash:120708.

Appendix A: Feed sign data–2016-20017

See below for category definitions

Tree #	Chewed Cones	Conecrop	Conesize	Patch	Date
35	5	0	0	West	9/9/16
151	70	2	1	West	
2	20	1	2	West	
179	80	2	1	West	
86	70	0	0	Central	
10	5	0	0	Central	
169	5	0	0	Central	
88	250	2	1	Central	
141	100	1	1	Central	
91	100	2	1	Central	
140	150	2	1	Central	
142	70	1	1	Central	
93	10	1	1	Central	
180	200	1	2	Central	
159	60	1	2	NE	12/9/16
102	30	1	2	NE	
172	5	1	1	NE	
148	60	2	2	NE	
181	70	2	1	NE	
56	50	2	1	Reservoir	
147	20	2	1	Reservoir	
61	80	1	1	Reservoir	
62	50	2	1	Reservoir	
175	20	2	1	Reservoir	
136	50	1	1	Reservoir	
137	10	0	0	Reservoir	
70	280	2	1	Reservoir	
128	5	0	0	Reservoir	
	1925				**Total 2016**
182	200			Lomandra (outside reserved habitat)	
154	1	2	2	West	17/5/17
2	0	3	1	West	
79	0	1	1	West	
78	1	2	2	West	
75	0	3	1	West	

81	120	3	2	West	19/9/17
3	50	2	3	West	
164	80	2	2	West	
183	80	3	1	West	
184	80	3	1	West	
185	60	3	1	West	
80	30	3	1	West	
75	60	2	2	Central	
23	120	3	2	Central	
86	10	3	1	Central	
186	60	3	2	Central	
140	240	2	2	Central	
142	10	2	1	Central	
187	140	2	2	Central	
93	350	3	1	NE	
41	10	3	1	NE	
56	10	2	1	Reservoir	
62	150	2	2	Reservoir	
70	400	2	1	Reservoir	
	2060				**Total 2017**

Feed sign score is the number of cones beneath the tree; cone size is allocated into categories: 1= small, 2 = moderate, 3 = large, 4 = variable; cone crop size is allocated into categories: 1= light, 2 = moderate, 3 = heavy; and tree size is allocated to categories: 1 = small, 2 = moderate and 3 = large.

Categories are defined below:

Cone size
1 = in the smallest 33% of cone size range
2 = in the median 33% of cone size range
3 = in the upper 33% of cone size range

Cone crop
1 = in the smallest 33% of cone crop sizes
2 = in the median 33% of cone crop sizes
3 = in the upper 33% of cone crop sizes

Appendix B: Site photographs

(i) Chewed cones: Central stand

(ii) Reserved Habitat stand: northeast. Heavy cladode layer September 2017.

(iii) Pink Nodding Orchid *Geodorum densiflorum* May 2017. Central stand; with fruiting Woody Passionfruit *Passiflora suberosa*

(iv) Burned Black She-oak Bogangar. May 2017

(v) Burned Black She-oak Bogangar. May 2017

(vi) Young Forest Oak Koala Beach, not so far recorded being used as a feed tree

Appendix C: Patterns of tree use at Koala Beach 2007-2017

Trees with no data were identified as use trees prior to 2007 and not since.

Tree #	Aug-07	Oct-07	Nov-07	Sep-09	Nov-09	Jul-11	Nov-11	Nov-14	Sep-16	Sep-17	sum
1											0
2	20			30				100	20		170
3	80			5						50	135
4	5										5
5											0
6											0
7											0
8											0
9											0
10								40	5		45
11											0
12	10	10		100	20						140
13											0
14				20	5						25
15							15				15
16											0
17		20		120							140
18		30		20		25					75
19											0
20		20			5						25
21		60		120	80						260
22				40	30			30			100
23		15	100	50	15					120	300
24		80									80
25					20						20
26	50	120						260			430
27											0
28											0
29		20		20	130		150				320
30							20				20
31											0
32		70									70
33											0
34		30		10							40
35			80						5		85
36				50							50
37											0
38											0
39						40					40
40		120									120

41					7		10	50		10	77
42							40				40
43											0
44											0
45											0
46								60			60
47			50					70			120
48											0
49											0
50											0
51											0
52											0
53				80							80
54			20								20
55											0
56			80						50	10	140
57											0
58											0
59								40			40
60		40									40
61		125			50			150	80		405
62		125		90				150	50	150	565
63											0
64											0
65											0
66			10								10
67											0
68											0
69											0
70		250		200				70	280	400	1200
71											0
72			30								30
73		15									15
74		30						20			50
75		40			5	6	30			60	141
76		10				20					30
77		100									100
78		100		50	25						175
79		10		10	20	20					60
80		10			60	16				30	116
81		50		5	2	15				120	192
82		20			120						140
83		20			30						50
84		50									50

85		120		20	20						160
86		80		50			20	150	70	10	380
87		60		20				20			100
88		120		130	100		30	250	250		880
89		15						50			65
90		10									10
91		50		100	10	20		10	100		290
92		10					30				40
93		30	50		70		80		10	350	590
94		60			5	90					155
95		10		5							15
96		60									60
97		120		5	60						185
98		70									70
99		60						10			70
100		120									120
101		25									25
102		50		80	15				30		175
103		60									60
104		20									20
105		30									30
106		10					20				30
107		40		20	300						360
108		10						40			50
109		10									10
110		10									10
111			10								10
112			5								5
113			50								50
114			10								10
115			30		30						60
116			25	100	20			10			155
117			50		5						55
118			10								10
119			100					20			120
120			150								150
121			30								30
122			20								20
123			10								10
124			80					10			90
125			100								100
126			80								80
127			20								20
128			30	70	120			250	5		475

129			60	30	5			20			115
130			50	30	10			20			110
131			60	30				40			130
132			60	180	50			10			300
133			20								20
134			40					10			50
135			10	35							45
136			120					100	50		270
137			70						10		80
138				20							20
139				200							200
140				10	120		120		150	240	640
141				15	120		100		100		335
142				160	10				70	10	250
143				65				50			115
144				110	5						115
145				20							20
146				55							55
147				55	120				20		195
148					100				60		160
149					15	1	200				216
150					80	6					86
151					30				70		100
152					20						20
153					25						25
154					5						5
155					2		20				22
156					30						30
157					10						10
158					10						10
159					5				60		65
160					140						140
161					10		5	60			75
162					5			30			35
163							20				20
164							20			80	100
165							10				10
166								20			20
167								20			20
168								20			20
169								60	5		65
170								20			20
171								100			100
172								60	5		65

173								30			30
174								6			6
175								50	20		70
176								10			10
177								10			10
178								10			10
179									80		80
180									200		200
181									70		70
183										80	80
184										80	80
185										60	60
186										60	60
187										140	140
	165	2850	1720	2635	2306	259	940	2616	1925	2060	17476

Appendix D: Threatened Species Records Koala Beach

Common Name	Scientific Name	Location	Obs.	Date
FLORA				
Pink Nodding Orchid	*Geodorum densiflorum*	Koala Beach	MF	12/9/16
	#24 plants in the reserved habitat			

Appendix E: Tweed Shire Glossy Black-cockatoo Sightings 2016-2017

Observers: LO = Lael Osun; AS = Annaliese Simke; SH = Scott Hetherington; MF = Mark Fitzgerald

Obs.	Count	Date	Mo.	Time	Species Comments
LO	5	29/4/16	4	1705	group roosting in eucalypt
LO	2	23/7/16	7	1715	pair flying speedily
LO	3	5/5/16	5	1600	flying south
LO	3	5/5/16	5	1725	group roosting in eucalypt
LO	2	27/4/16	4	1630	pair calling in eucalypt
LO	2	27/4/16	4	1705	pair flying
LO	3	28/4/16	4	1700	roosting then flying
LO	3	31/5/16	3	1649	in tree
LO	3	10/5/16	5	1700	calling from roost in Casuarina
LO	4	16/8/16	8	1715	two pairs flying post
LO	2	2/5/17	5	1653	pair roosting in eucalypt
LO	6	20/4/16	4	1640	3 pairs in tree then flew south
AS	2	18/4/17	4	1703	Watched fly north towards Hastings point along ridge at koala beach
AS	7	6/12/16	12	820	
AS	2	11/4/16	4	801	Watched GB's fly from Koala Beach to Farrants Hill.
AS	3	9/1/16	1	700	Flying south west over Koala Beach
AS	2	25/10/16	10	800	
SH	4	8/4/16	4	747	
SH	5	25/2/16	2	1858	Flying north over Koala Beach ridge
SH	6	21/3/16	3	745	Flying south east over koala beach ridge.
SH	5	16/3/16	3	706	Flying south along ridge line
SH	3	24/1/16	1	743	
SH	7	10/5/16	5	1720	
SH	6	13/5/16	5	635	In swamp mahogany street tree. Continued flying around the tree, to nearby trees and then across to trees in gully behind sassafras street.
SH	2	10/5/16	5	1725	Roosting
SH	3	11/3/16	3	1902	
SH	18	13/5/16	5	1710	
SH	8	2/5/16	5	656	Flying south over koala beach ridge.
SH	6	10/7/16	7	1725	Flew west from coast, over koala beach and north west towards round mountain. Right on dark.
SH	8	10/6/16	6	1716	
SH	6	12/4/16	4	1725	
SH	2	6/4/16	4	1705	
SH	2	25/10/16	10	801	Flying south east
SH	2	28/1/17	1	745	Flying south over koala beach towards Pottsville

SH	6	20/7/16	7	642	Flew from north east across koala beach. Four of six circled over swamp oak forest in south west then flew north towards round mountain again. 1 adult female observed, others unknown.
SH	6	30/5/16	5	726	Flew south east towards Pottsville Environment Park
SH	8	15/5/16	5	1655	
SH	2	12/4/16	4	1655	
SH	6	18/4/16	4	1745	Flying west above Muskheart Circuit.
SH	4	7/3/16	3	739	
SH	2	7/3/16	3	705	Flying south.
SH	4	24/12/16	12	1520	In flight. Amongst other birds possibly disturbed by collared sparrowhawk.
SH	10	26/5/16	5	725	
SH	8	21/4/16	4	555	Flying east over koala beach.
SH	6	28/3/16	3	738	Flying south
SH	1	20/7/16	7	715	Heard
SH	3	17/4/16	4	600	Flying south over lomandra drive
SH	9	14/5/16	5	620	Grooming in tree behind 9 Hovea
SH	4	6/11/16	11	625	Still at roost in street tree - bottlebrush drive. 2 still roosting. 2 preening each other.
SH	2	7/8/16	8	715	
SH	1	28/8/16	8	1700	
SH	1	30/4/17	4	615	Heard only
SH	2	9/3/16	3	651	Flying south
SH	1	13/3/16	3	925	Flew south over koala beach ridge, observed continuing flight as far as Pottsville town.
SH	5	20/4/16	4	635	4 flew east across koala beach. One calling from sugar glider drive vicinity.
SH	1	9/5/16	5	1640	
MF	2	9/9/16	9	1105	Pair feeding in torulosa west of Lomandra Ave
MF	2	31/5/17	5	1107	Pair feeding in equisetifolia: Sutherland Point