

2 January 2015
Ref No: 2182-1118

The Manager
Jacobs
PO Box 2147
DANGAR NSW 2309

Attention: Rachel Vazey

Dear Rachel,

January 2015 fortnightly Flying-fox monitoring report

This short report details the findings of the January 2015 fortnightly Grey-headed Flying-fox (GHFF) monitoring at the Macksville camp (the site) undertaken between standard monthly monitoring events. The purpose of collecting additional data more frequently is to form a clearer picture of short-term population fluctuations at the camp. For more detailed information on methodology used for this monitoring, refer to the monthly flying-fox monitoring reports.

A traverse of the site was undertaken on 14 January 2015. It was observed that flying-foxes have now returned to the site in low to moderate numbers after an absence since April 2014. Both Grey-headed Flying-fox and Black Flying-fox were observed. Dependent young were also present. The roost footprint was recorded by GPS and is shown in Illustration 1.1. The area of the roost is approximately 0.22 ha.

An exit count was conducted at two vantage points north and south of the site on the evening of 14 January. The results of the count indicated that between 3,000 and 5,000 flying-foxes were roosting at the site. Approximately three-quarters of the flying-foxes were observed to be flying from the site in a westerly direction, with most of the remainder exiting towards the north. A relatively small number of flying-foxes (approximately 500) were also observed to be flying into the site from the north (presumably originating in Nambucca Heads).

Other regional flying-fox camps were visited on 14 January. General observations made at these camps are as follows:

Bellingen Island:

GHFF (>90%) and Black Flying-fox (<10%) were present. The roost area and estimated number of flying-foxes was similar to that recorded in the last monthly monitoring event in December 2014 (approximately 5,000-7,500 individuals). The number of flying-foxes at Bellingen Island has been at low to moderate levels (<10,000) over the last several months. Visual observations indicated that female GHFF were supporting dependent young at the time of the current monitoring event. Flying-foxes continue to be absent from the Camphor Laurel vegetation behind Wheatley Street.

Gordon Park (Nambucca Heads):

GHFF (>90%) and Black Flying-fox (<10%) were present. The roost area is approximately the same as was recorded in December 2014. However, the number of flying-foxes present appears to have undergone a minor decrease recently (estimated 10,000 individuals roosting). As was the case at Bellingen Island, GHFF with dependent young were also observed.

ABN 79 896 839 729
ACN 101 084 557

Return address:
PO Box 119
LENNOX HEAD
NSW 2478

LENNOX HEAD
T 02 6687 7666
F 02 6687 7782

COFFS HARBOUR
T 02 6651 7666
F 02 6651 7733

www.geolink.net.au

Bowraville:

It was estimated that approximately 3,000 to 5,000 flying-foxes were present at the Bowraville roost. This represents a minor decrease in numbers since the December monthly monitoring event when the population estimate was 5,000 to 7,500 flying-foxes. Both GHFF (>95%) and Black Flying-fox (<5%) were observed. Flying-fox numbers have been fluctuated between 3,000 and 15,000 at Bowraville over the last few months. Female GHFF with dependant young were also observed.

Flowering of a number of highly productive nectar source trees for GHFF in the upper North Coast region of NSW in January includes Forest Red Gum (*E. tereticornis*) (high altitude), Grey Ironbark (*E. siderophloia*) (foothills and ranges), Coastal Blackbutt (*E. pilularis*) (foothills and ranges), and a number of *Corymbia* species including Spotted Gum (*Corymbia maculata* and *C. variegata*), Red Bloodwood (*C. gummifera*) and Pink Bloodwood (*C. intermedia*). These highly productive nectar source trees can be considered key diet species for GHFF (Eby 2012; Eby and Law 2008). Observations when travelling between regional flying-fox camps indicated that light flowering of Pink Bloodwood (*C. intermedia*) has begun in the region in the foothills.

If you have any queries regarding this report, please feel free to call on 02 6621 6677.

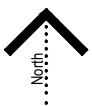
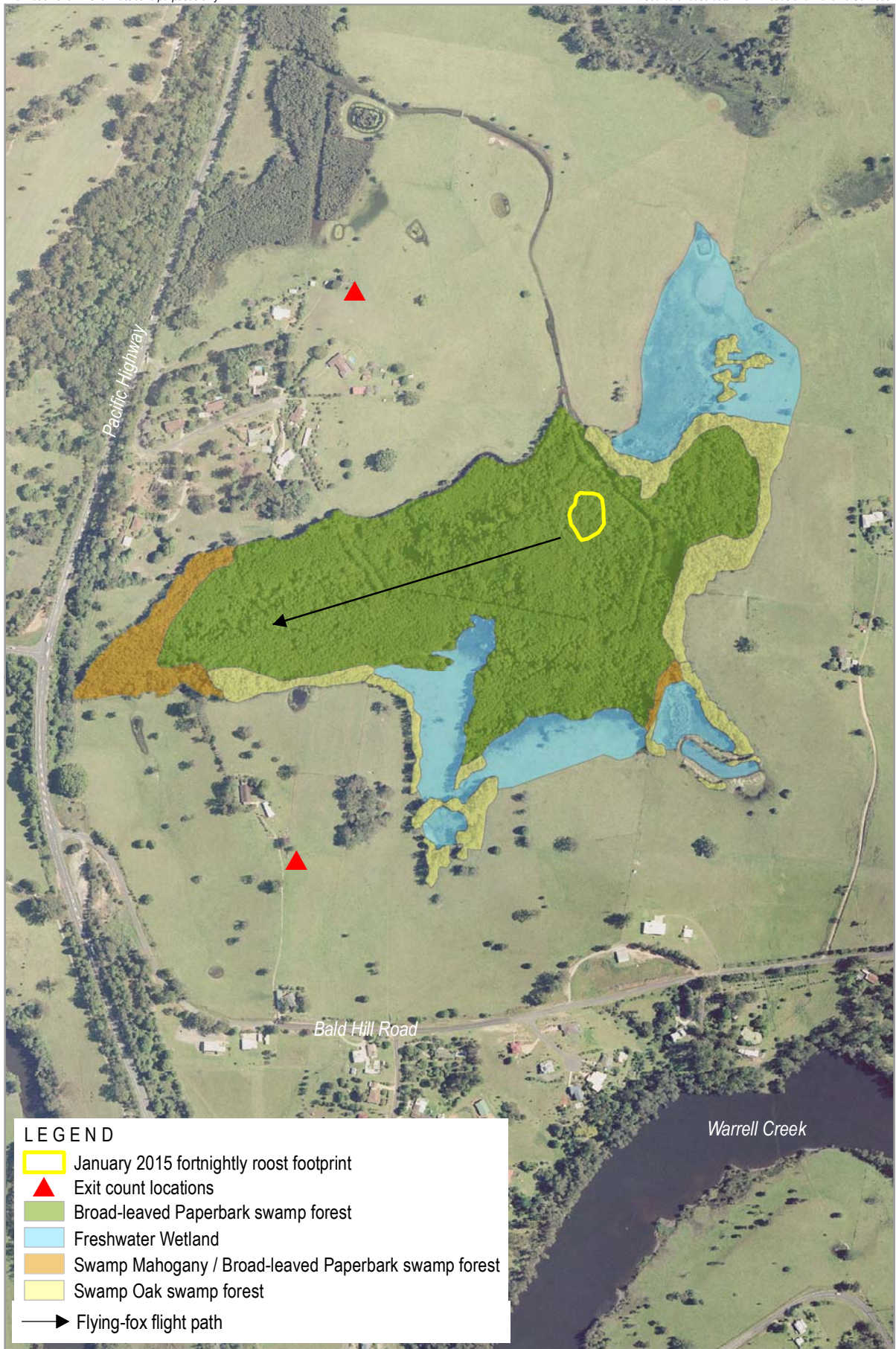
Yours sincerely

GeoLINK



Tom Pollard
Ecologist

Information shown is for illustrative purposes only

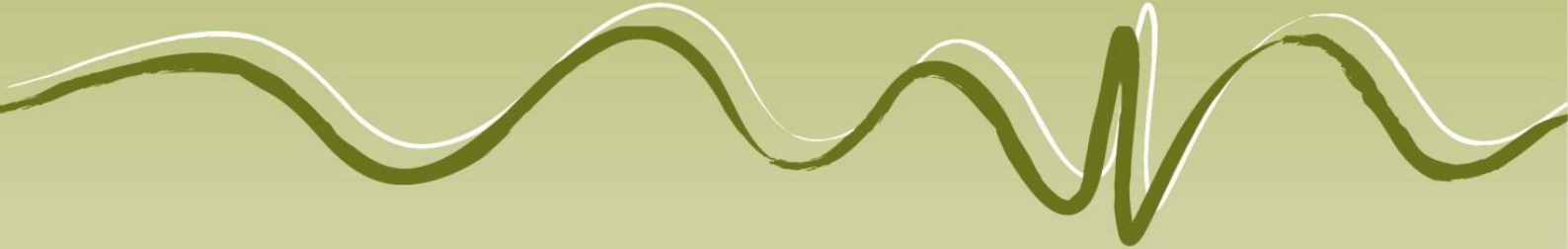


0 150



Flying-fox Monitoring January 2015

Warrell Creek to Nambucca Heads Pacific Highway Upgrade



PO Box 119
Lennox Head NSW 2478
T 02 6687 7666

PO Box 1446
Coffs Harbour NSW 2450
T 02 6651 7666

info@geolink.net.au

Prepared for: Jacobs
© GeoLINK, 2015

<i>UPR</i>	<i>Description</i>	<i>Date Issued</i>	<i>Issued By</i>
2182-1119	First issue	05/02/2015	Tom Pollard



Table of Contents

1.	Introduction	1
1.1	Introduction	1
2.	Flying-fox Survey	2
2.1	Methodology	2
2.2	Results	3
2.2.1	Roost Footprint	3
2.2.2	Population Estimate – Exit Count	4
2.2.3	Detailed Data	6
2.3	Discussion	8
2.3.1	Population Estimates	8
2.3.2	Species Composition and Demographic Data	8
2.3.3	Phenology of Trees Region	8
2.4	Conclusion	10

Illustrations

Illustration 2.1	Location of Regional Flying-fox Camps	5
------------------	---------------------------------------	---

Tables

Table 2.1	Demographic Data of GHFF at Bowraville	6
-----------	--	---

Plates

Plate 2.1	Floodwaters at Bellingen Island	3
-----------	---------------------------------	---

Figures

Figure 2.1	Water Level Measurements at The Site	7
Figure 2.2	Population trends at the site and regional camps January 2014 to January 2015	9



1. Introduction

1.1 Introduction

Jacobs and NSW Roads and Maritime Services (RMS) are working to resolve issues relating to the Grey-headed Flying-fox (*Pteropus poliocephalus*) (GHFF) camp within the approved alignment of the Warrell Creek to Nambucca Heads (WC2NH) Pacific Highway upgrade project.

GeoLINK has been engaged to undertake monthly flying-fox monitoring at a camp near Macksville, located in a patch of Swamp Sclerophyll Forest vegetation north of Bald Hill Road (henceforth referred to as 'the site'). To date, monthly monitoring at the site has been undertaken by GeoLINK since July 2013. However, a significant amount of data from previous monitoring has also been collected irregularly at the site since occupation commenced in December 2011 (Eby 2012).

This report details the January 2015 seasonal flying-fox monitoring results.



2. Flying-fox Survey

2.1 Methodology

Fieldwork for the January 2015 seasonal flying-fox monitoring was undertaken by GeoLINK ecologist Dr Tom Pollard and Environmental Scientist Grant McLean. The fieldwork followed the methodology developed by Dr Eby for this roost (Eby 2013). Refer to that document for full details of the methodology. A summary of the main procedures used for the monitoring is provided below.

On 28 January a survey of the site was undertaken on foot to locate and map any roosting flying-foxes. When flying-fox are present at the site, data on species composition, demographics, reproductive status and behaviour are also collected.

The water level at the site was measured at a previously established measurement point. The water level at this location is representative of the average level beneath the camp.

Comparative data on species composition, demographics, reproductive status and behaviour is also typically collected at a control site located at Bellinghen Island (when flying-foxes are present) (approximately 31 km north north-west of the Macksville camp). However, for the current monitoring event the Bellinghen Island camp was inaccessible due to flooding and therefore the comparative data was collected at Bowraville instead (approximately 11 km north-west of the Macksville camp). Observational comments from the regional flying-fox camps at Gordon Park camp, Nambucca Heads (approximately 12 km north-east of the Macksville camp) and Bellinghen Island were made (refer to **Illustration 2.1** for location of these regional camps).

Following the site traverse, a dusk exit count survey was undertaken at the site on the evening of 28 January to provide an estimate of the number of flying-foxes currently roosting at the camp. Two observers were strategically located for the count on a northern and southern ridge overlooking the camp. No additional observers were required, as in the site traverse it had been observed that flying-fox were not roosting at the site. Additional observers (up to five individuals during the seasonal peak in numbers during summer) have been used previously to effectively undertake the exit count. As flying-fox were not observed to be roosting at the site, an additional exit count on the second night of monitoring was not considered to be necessary.

Observers were located at the following vantage points:

- in a paddock to the north of the swamp sclerophyll forest (off Wedgewood Drive); and
- on a ridge south of the camp (41 Bald Hill Road).

The survey extended over approximately 30 minutes from sunset until dark (approximately 8:00 pm to 8:30 pm).

2.2 Results

2.2.1 Roost Footprint

No flying-foxes were observed to be roosting at the site in the camp traverse.

The flying-fox roost footprint at Gordon Park (Nambucca Heads) remains relatively extensive, and is generally consistent with that recorded in the last monthly monitoring event.

The extent of the roost at Bowraville is consistent with that observed in the last monthly monitoring event in December 2014 and occupies the weed-infested mid-storey vegetation (mainly Small-leaved Privet and Camphor Laurel) between the loop access road and the Nambucca River.

It was not possible to definitively assess the extent of the Bellingen Island roost footprint as access to the camp was blocked due to floodwater being present in the channel (refer to **Plate 2.1**). However, flying-fox were observed to be roosting in trees within the parkland area at the entrance to the island. This has not been observed since the population was relatively large in summer 2014 and may indicate that the roost has expanded somewhat recently (consequently the population estimate for Bellingen Islands for the current monitoring event was increased in line with this observation refer to **Section 2.2.2**).

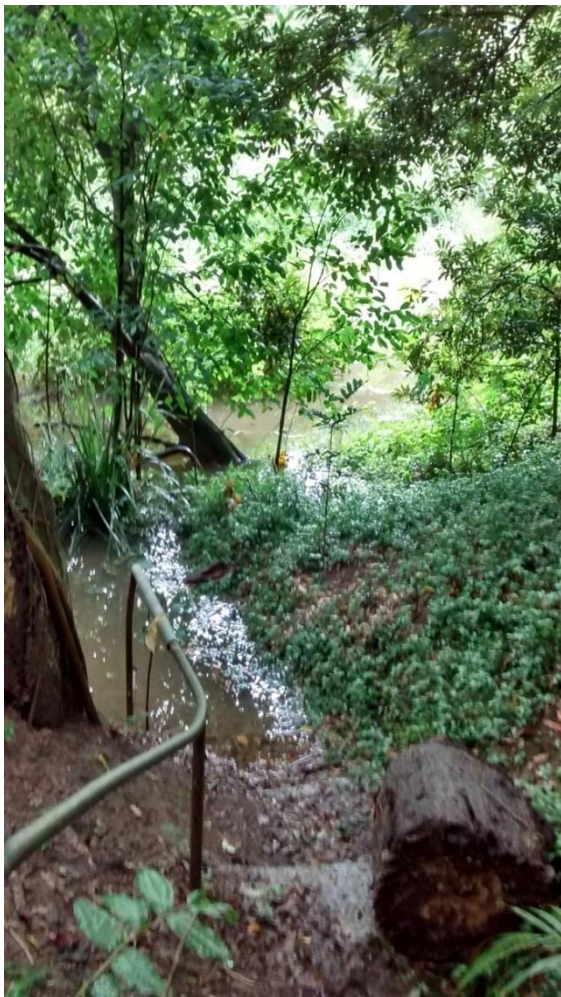


Plate 2.1 Floodwaters at Bellingen Island



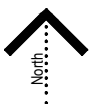
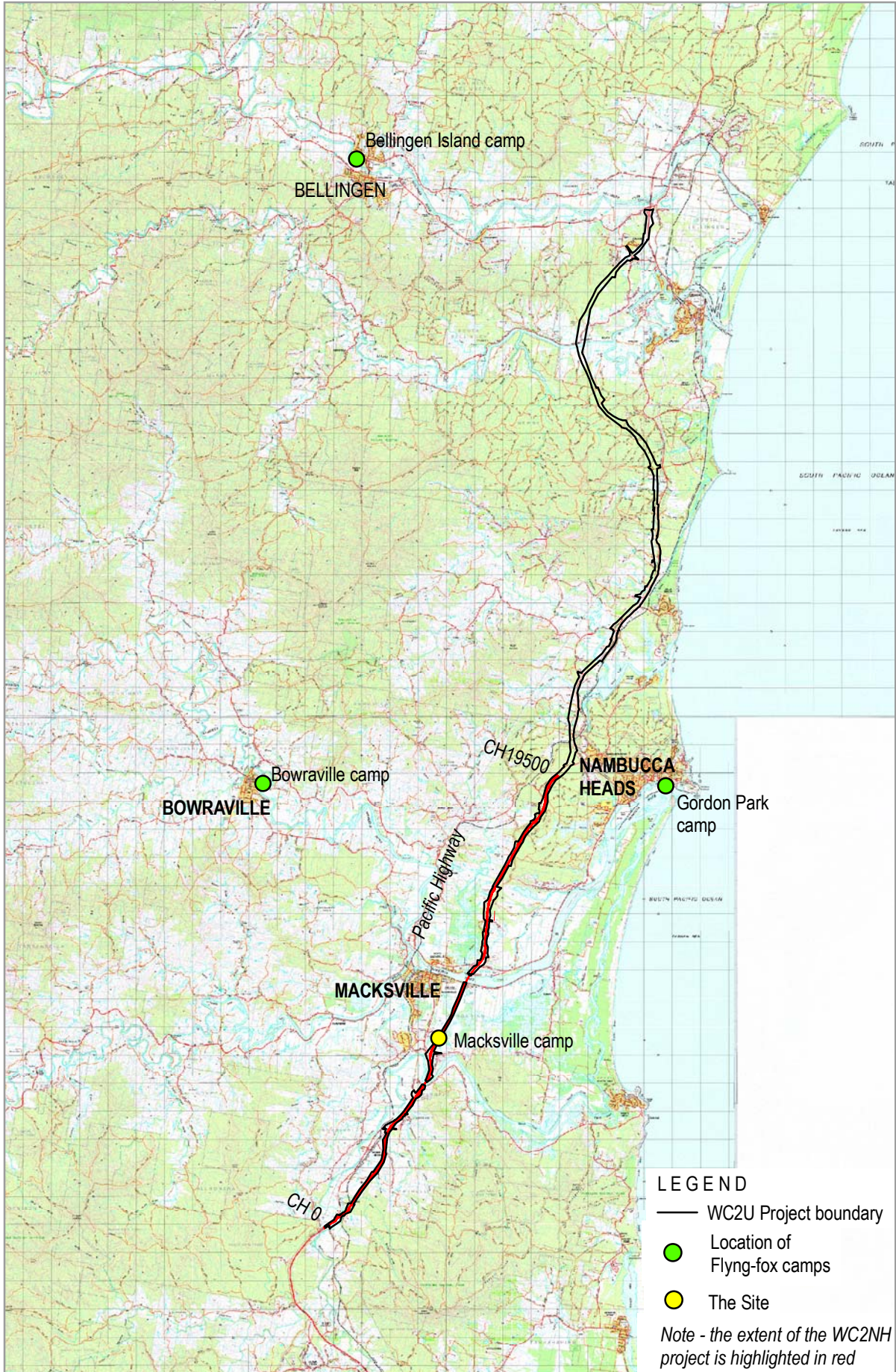
2.2.2 Population Estimate – Exit Count

No flying-foxes were observed flying from the site in the exit count. Approximately 3,000 flying-fox were observed to be flying across the site, predominantly coming from the north-west (possibly originating from Bowraville or Bellingen), with lesser numbers flying across the site from the north (possibly originating from the Gordon Park camp at Nambucca Heads).

The location of the regional flying-fox camps visited is shown in **Illustration 2.1**. No exit count was conducted at any of these regional camps. However, rough population estimates for these camps based on extrapolation of counts in individual trees and the roost footprint are as follows:

- Gordon Park: approximately 10,000 individuals (population size is broadly consistent with that recorded in the last monthly monitoring event);
- Bowraville: 3,000 to 5,000 individuals recorded (population size is broadly consistent with that recorded in the last monthly monitoring); and
- Bellingen Island: estimated to number approximately 10,000 (population size may have increased since the last monitoring event; however a traverse of the camp to establish this was not possible due to floodwaters being present).

Information shown is for illustrative purposes only



0 4 km



Location of Regional Flying-fox camps

2.2.3 Detailed Data

2.2.3.1 Species Composition

No flying-foxes were recorded at the site. Therefore, no detailed species composition data was collected at the site for the current monitoring event.

The species composition and proportions at the regional camps visited was as follows:

- Bellinghen Island – GHFF >95%, Black Flying-fox (however, this is based on observations on the accessible periphery of the camp and may not represent the proportions further in);
- Gordon Park – GHFF >90%, Black Flying-fox <10%;
- Bowraville – GHFF >95%, Black Flying-fox <5%.

2.2.3.2 Habitat Characteristics and Demographic Composition

No detailed demographic composition data at the site was collected for the current monitoring event.

As mentioned previously, comparison data had to be collected at Bowraville, as the Bellinghen Island camp was inaccessible due to floodwaters). The structure of the vegetation at the Bowraville camp consists of widely spaced emergent rainforest trees (e.g. Native Tamarind (*Diploglottis cunninghamii*) above a midstorey of weeds dominated by Narrow-leaved Privet (*Ligustrum sinense*) and Camphor Laurel (*Cinnamomum camphora*). All flying-fox present were observed to be roosting in this mid-storey vegetation.

Data of habitat characteristics and demographic composition at the Bowraville Camp is provided in **Table 2.1**. Data was only able to be collected from seven demographic count points. Females were more numerous than males in all of the demographic counts. Female GHFF with dependant young were present at all of the count points. The proportion of females with young was generally high, ranging between 60 and 90%, with four out of seven of the counts having 90%.

Table 2.1 Demographic Data of GHFF at Bowraville

Tree Code	Tree Species	Height (m); DBH (cm)	Approximate Location	Sex Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
Bo1	Small-leaved Privet	4; 20	North-western fringe of camp	10:4	yes	60%
Bo2	Small-leaved Privet	3; 20	North-western fringe of camp	10:1	yes	90%
Bo3	Small-leaved Privet	4; 20	Western fringe of camp	10:1	yes	90%
Bo4	Camphor Laurel	5; 30	Western fringe of camp	10:3	yes	70%
Bo5	Small-leaved Privet	3; 15	Western fringe of camp	10:0	yes	90%
Bo6	Camphor Laurel	5; 30	South-western fringe of camp	10:0	yes	90%

General observations of the flying-foxes present at Bellingen Island (eastern fringe only) and Gordon Park camp indicated that both female and male GHFF were present. Females with dependant young were also observed and similar to Bowraville were present in relatively high numbers.

2.2.3.3 Water level at the site

Water level at the representative measurement location at the site was approximately 73 cm in depth as is shown in **Figure 2.1**. This substantial increase in water depth at the site follows moderate to heavy rainfall on a number of occasions over the past month.

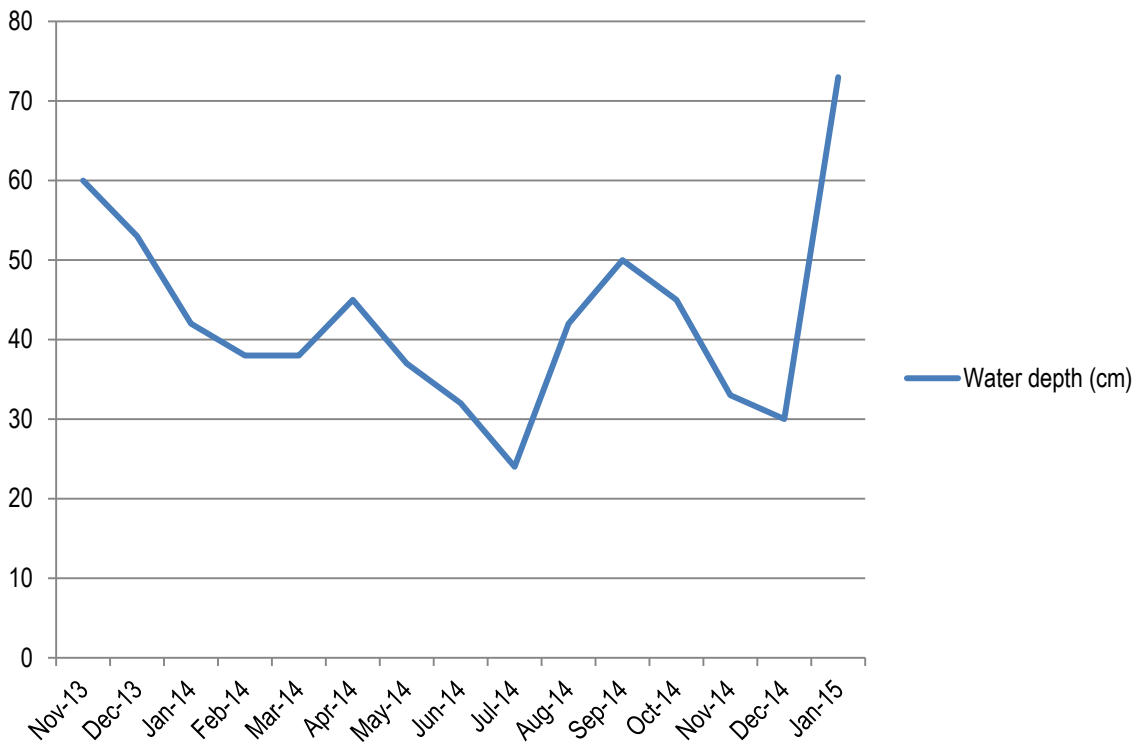


Figure 2.1 Water Level Measurements at The Site



2.3 Discussion

2.3.1 Population Estimates

No flying-foxes were observed to be roosting at the site during the roost traverse undertaken for the current monitoring event. Nor were any flying-foxes observed to be flying from the site in the exit count. The results of the exit count from the previous monitoring event in mid-January 2015 indicated that between 3,000 and 5,000 flying-foxes had been roosting at the site. This was the first time that flying-foxes had been recorded roosting at the site since early-mid April 2014.

Figure 2.2 shows the trend of flying-fox population at the site and other regional sites between January 2014 and January 2015. General comments on the population trends are that:

- the flying-fox populations at the site, Bellingen Island and Bowraville (excluding the outlier recorded in November at Bowraville) are considerably lower this summer compared with 2014;
- the flying-fox population at Gordon Park has remained relatively stable over the 12 month period; and
- flying-foxes had a period of absence at all sites during winter with the exception of Gordon Park.

The possibility that the camp formed as a replacement for the camp at Bowraville which has a long history of use, but was not occupied from autumn 2011 - winter 2012 has previously been identified (Eby 2012). More recently flying-foxes have been present at the Bowraville camp from October 2013 to March 2014 and again from from October 2014 until present (January 2015) (refer to GeoLINK monitoring reports). The absence of flying-fox over the last summer period at the site (excepting the brief occupation recorded in the previous monitoring event in mid-January 2015) may therefore be related this re-occupation of the nearby Bowraville camp by flying-foxes. Further monitoring over the next few months of 2015 should help to clarify whether this is the case.

2.3.2 Species Composition and Demographic Data

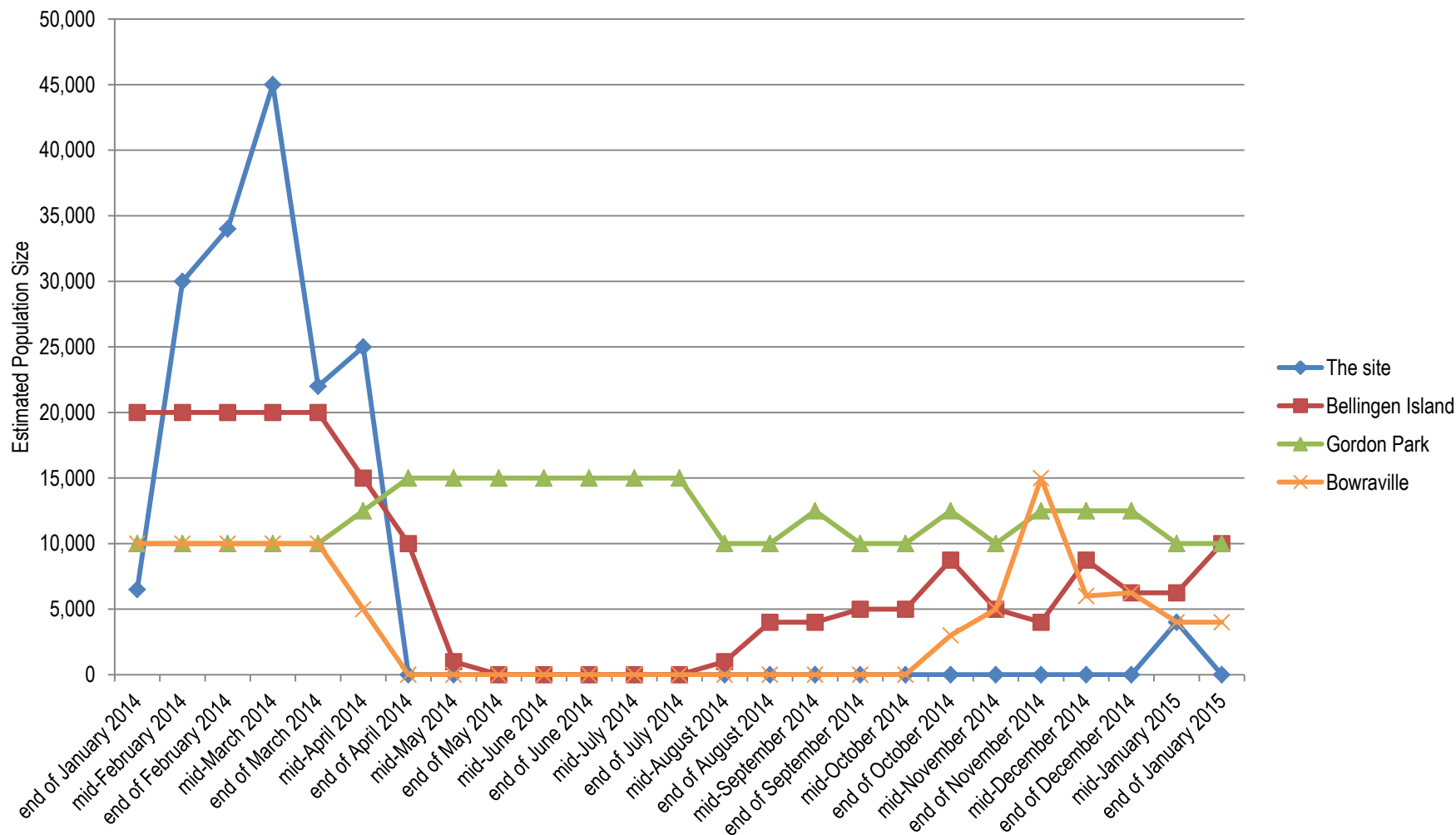
At occupied camps GHFF dominated the species composition and Black Flying-fox accounted for a small proportion of approximately 5-10% of all individuals present. This result was the same as was recorded in the January 2014 monthly monitoring (GeoLINK 2014).

The demographic data collected at the site, and at regional camps, indicates that the camp is currently supporting dependent young GHFF in relatively high numbers. These young will not be fully independent until approximately March. Flightless young are typically left at a camp while females forage in late November (Eby 2012).

2.3.3 Phenology of Trees Region

Flowering of a number of highly productive nectar source trees for GHFF in the upper North Coast region of NSW in January includes Forest Red Gum (*E. tereticornis*) (high altitude), Grey Ironbark (*E. siderophloia*) (foothills and ranges), Coastal Blackbutt (*E. pilularis*) (foothills and ranges), and a number of *Corymbia* species including Spotted Gum (*Corymbia maculata* and *C. variegata*), Red Bloodwood (*C. gummifera*) and Pink Bloodwood (*C. intermedia*). These highly productive nectar source trees can be considered key diet species for GHFF (Eby 2012; Eby and Law 2008). Observations when travelling between regional flying-fox camps indicated that light to moderate flowering of Pink Bloodwood (*C. intermedia*) is currently occurring in the region.

Figure 2.2 Population trends at the site and regional camps January 2014 to January 2015





2.4 Conclusion

The results of the January 2015 seasonal flying-fox monitoring indicate that after a brief stop-over at the site observed in the previous monitoring event in mid-January 2015, flying-foxes are once again absent from the site. The absence of flying-fox at the site since April 2014 (excepting the mid-January monitoring result) may be related to the re-occupation of the nearby Bowraville camp by flying-foxes. Numbers of flying-foxes at other regional camps are generally moderate in relation to the higher numbers recorded in the 2013-2014 summer-autumn season, with the exception of the Gordon Park camp which has retained a generally steady population of flying-foxes over the past 12 months.

The monitoring of GHFF demographics indicated that regional flying-fox camps are currently supporting a relatively high number of dependent GHFF young.



Tom Pollard

Ecologist



References

Eby, P. and Law, B. (2008). Ranking the feeding habitat of Grey-headed flying foxes for conservation management. Department of Environment, Heritage, Water and the Arts, Canberra.

Eby, P. (2012). An Assessment of the Flying-fox Camp at Macksville. Unpublished report to NSW Roads and Maritime Services.

Eby, P. (2013). A Field Monitoring Program Proposed for the Macksville Flying-fox Roost. Unpublished report to Sinclair Knight Merz.

GeoLINK (2014). Flying-fox Monitoring, Warrell Creek to Nambucca Heads Pacific Highway Upgrade, January 2014. Unpublished report to Jacobs and NSW Roads and Maritime Services. GeoLINK, Lennox Head.

27 February 2015
Ref No: 2182-1120

The Manager
Jacobs
PO Box 2147
DANGAR NSW 2309

Attention: Rachel Vazey

Dear Rachel,

February 2015 fortnightly Flying-fox monitoring report

This short report details the findings of the February 2015 fortnightly Grey-headed Flying-fox (GHFF) monitoring at the Macksville camp (the site) undertaken between standard monthly monitoring events. The purpose of collecting additional data more frequently is to form a clearer picture of short-term population fluctuations at the camp. For more detailed information on methodology used for this monitoring, refer to the monthly flying-fox monitoring reports.

Flying-foxes at the Site

A traverse of the site was undertaken on 19 February 2015. No flying-fox were roosting at the site. Flying-fox were also absent in the previous monitoring event at the end of January, after a brief temporary return of a small number of flying-foxes to the site in mid-January.

An exit count was conducted at two vantage points north and south of the site on the evening of 19 February. No flying-foxes were observed flying from the site in the exit count. Approximately 3,000 flying-fox were observed to be flying across the site, predominantly coming from the north-west (possibly originating from Bowraville or Bellingen), with lesser numbers flying across the site from the north (possibly originating from the Gordon Park camp at Nambucca Heads).

Other regional flying-fox camps were visited on 20 February. General observations made at these camps are as follows:

Bellingen Island:

GHFF (>90%) and Black Flying-fox (<10%) were present. The number of flying-foxes appears to have increased at Bellingen Island since the last monitoring event (at that time estimated to be approximately 10,000 individuals). The estimated number in the current monitoring event was approximately 15,000 individuals. The roost area has also expanded as would be expected with a greater number of flying-foxes roosting at the camp, with flying-foxes now roosting higher up in the rainforest canopy. Visual observations indicated that female GHFF were supporting dependent young. Flying-foxes continue to be absent from the Camphor Laurel vegetation behind Wheatley Street.

Gordon Park (Nambucca Heads):

GHFF (>90%) and Black Flying-fox (<10%) were present. The estimated number of flying foxes and the roost area is approximately the same as was recorded in the previous monitoring event (estimated to be approximately 10,000 individuals). As was the case at Bellingen Island, GHFF with dependent young were also observed.

ABN 79 896 839 729
ACN 101 084 557

Return address:
PO Box 119
LENNOX HEAD
NSW 2478

LENNOX HEAD
T 02 6687 7666
F 02 6687 7782

COFFS HARBOUR
T 02 6651 7666
F 02 6651 7733

www.geolink.net.au



Bowraville:

Both GHFF (>95%) and Black Flying-fox (<5%) were observed. It was estimated that approximately 3,000 to 5,000 flying-foxes were present at the Bowraville roost, which is consistent with numbers recorded in the previous monitoring event. Female GHFF with dependant young were also observed.

Flowering of Key Foraging Resources

Flowering of a number of highly productive nectar source trees for GHFF in the upper North Coast region of NSW in February includes Broad-leaved Paperbark (*Melaleuca quinquenervia*) Coastal Blackbutt (*E. pilularis*) (foothills and ranges), and a number of *Corymbia* species including Spotted Gum (*Corymbia maculata* and *C. variegata*), Red Bloodwood (*C. gummifera*) and Pink Bloodwood (*C. intermedia*). These highly productive nectar source trees can be considered key diet species for GHFF (Eby 2012; Eby and Law 2008). Observations when travelling between regional flying-fox camps indicated light flowering of Pink Bloodwood and Broad-leaved Paperbark is currently occurring.

If you have any queries regarding this report, please feel free to call on 02 6621 6677.

Yours sincerely

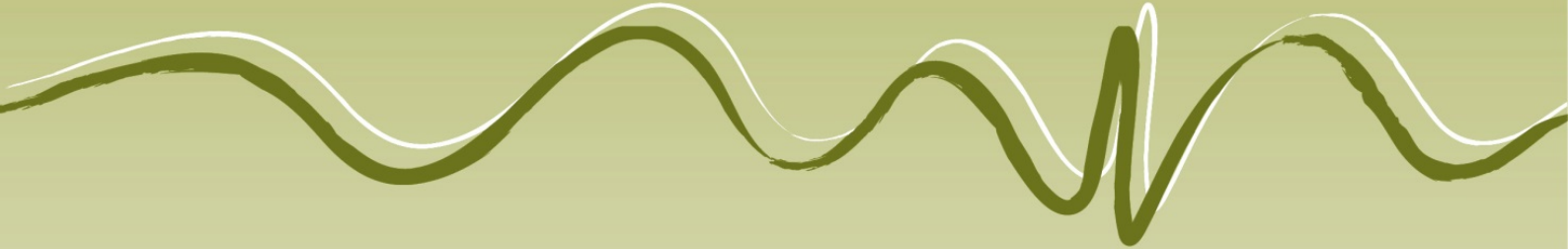
GeoLINK



Tom Pollard
Ecologist

Flying-fox Monitoring February 2015

Warrell Creek to Nambucca Heads Pacific Highway Upgrade



GeoLINK
environmental management and design

PO Box 119
Lennox Head NSW 2478
T 02 6687 7666

PO Box 1446
Coffs Harbour NSW 2450
T 02 6651 7666

info@geolink.net.au

Prepared for: Jacobs
© GeoLINK, 2015

<i>UPR</i>	<i>Description</i>	<i>Date Issued</i>	<i>Issued By</i>
2182-1122	First issue	05/03/2015	Tom Pollard



Table of Contents

1.	Introduction	2
1.1	Introduction	2
2.	Flying-fox Survey	3
2.1	Methodology	3
2.2	Results	4
2.2.1	Roost Footprint	4
2.2.2	Population Estimate – Exit Count	4
2.2.3	Detailed Data	7
2.3	Discussion	9
2.3.1	Population Estimates	9
2.3.2	Species Composition and Demographic Data	9
2.3.3	Phenology of Trees Region	9
2.4	Conclusion	9

Illustrations

Illustration 2.1	Location of Regional Flying-fox Camps	6
------------------	---------------------------------------	---

Tables

Table 2.1	Demographic Data of GHFF at Bellinghen Island	7
-----------	---	---

Plates

Plate 2.1	Roosting Grey-headed flying-foxes in mid-storey vegetation at Bowraville	4
Plate 2.2	A stream of Flying-fox flying over the site from the north-west	5

Figures

Figure 2.1	Water Level Measurements at The Site	8
------------	--------------------------------------	---



1. Introduction

1.1 Introduction

Jacobs and NSW Roads and Maritime Services (RMS) are working to resolve issues relating to the Grey-headed Flying-fox (*Pteropus poliocephalus*) (GHFF) camp within the approved alignment of the Warrell Creek to Nambucca Heads (WC2NH) Pacific Highway upgrade project.

GeoLINK has been engaged to undertake monthly flying-fox monitoring at a camp near Macksville, located in a patch of Swamp Sclerophyll Forest vegetation north of Bald Hill Road (henceforth referred to as 'the site'). To date, monthly monitoring at the site has been undertaken by GeoLINK since July 2013. However, a significant amount of data from previous monitoring has also been collected irregularly at the site since occupation commenced in December 2011 (Eby 2012).

This report details the February 2015 monthly flying-fox monitoring results.



2. Flying-fox Survey

2.1 Methodology

Fieldwork for the February 2015 monthly flying-fox monitoring was undertaken by GeoLINK ecologist Dr Tom Pollard and Environmental Scientist Kale Hardy-Porter. The fieldwork followed the methodology developed by Dr Eby for this roost (Eby 2013). Refer to that document for full details of the methodology. A summary of the main procedures used for the monitoring is provided below.

The fieldwork for this monthly monitoring event was conducted on 2-3 March rather than at the end of February as would typically occur to retain a reasonable gap between monitoring events. This was due to the previous monitoring event in mid-January 2015 needing to be conducted a little later than anticipated to coincide with the OEH national flying-fox census that was timed for the 19-22 January. GeoLINK collects data for the site to include in this national census on behalf of RMS.

On 2 March a survey of the site was undertaken on foot to locate and map any roosting flying-foxes. When flying-fox are present at the site, data on species composition, demographics, reproductive status and behaviour are collected. The water level at the site was also measured at a previously established measurement point. The water level at this location is representative of the average level beneath the camp.

Following the site traverse, a dusk exit count survey was undertaken at the site on the evening of 2 March to provide an estimate of the number of flying-foxes currently roosting at the camp. Two observers were strategically located for the count on a northern and southern ridge overlooking the camp. No additional observers were required, as in the site traverse it had been observed that flying-fox were not roosting at the site. Additional observers (up to five individuals during the seasonal peak in numbers during summer) have been used previously to effectively undertake the exit count.

Observers were located at the following vantage points:

- in a paddock to the north of the swamp sclerophyll forest (off Wedgewood Drive); and
- on a ridge south of the camp (41 Bald Hill Road).

The survey extended over approximately 45 minutes from sunset until dark (approximately 7:30 pm to 8:15 pm).

Comparative data on species composition, demographics, reproductive status and behaviour is also typically collected at a control site located at Bellingen Island (approximately 31 km north north-west of the Macksville camp). Observational comments from other regional flying-fox camps at Gordon Park camp, Nambucca Heads (approximately 12 km north-east of the Macksville camp) and Bowraville were also made (refer to **Illustration 2.1** for location of these regional camps).

2.2 Results

2.2.1 Roost Footprint

No flying-foxes were observed to be roosting at the site in the camp traverse.

The flying-fox roost footprints at both Bowraville and Gordon Park (Nambucca Heads) are generally consistent with that recorded in the last monthly monitoring event. At Bowraville flying-foxes were observed to only be roosting in the weedy midstorey vegetation 2-7 m above the ground (refer to **Plate 2.1**).

The Bellingen Island roost footprint has expanded over the last two months and now covers much of the island, with the highest numbers present in the southern and eastern sections. Roosting individuals are predominantly occupying the midstorey vegetation approximately 5-15 m above the ground and are not roosting in the canopy of the emergent rainforest trees as happens when the camp is particularly full.



Plate 2.1 Roosting Grey-headed flying-foxes in mid-storey vegetation at Bowraville

2.2.2 Population Estimate – Exit Count

No flying-foxes were observed flying from the site in the exit count. Approximately 3,000 flying-fox were observed to be flying across the site, predominantly coming from the north-west (possibly originating from Bowraville or Bellingen), with lesser numbers flying across the site from the north (possibly originating from the Gordon Park camp at Nambucca Heads) (refer to **Plate 2.2**). A similar scenario was also recorded in the previous two monitoring events.

The location of the regional flying-fox camps visited is shown in **Illustration 2.1**. No exit count was conducted at any of these regional camps. However, rough population estimates for these camps based on extrapolation of counts in individual trees and the roost footprint are as follows:

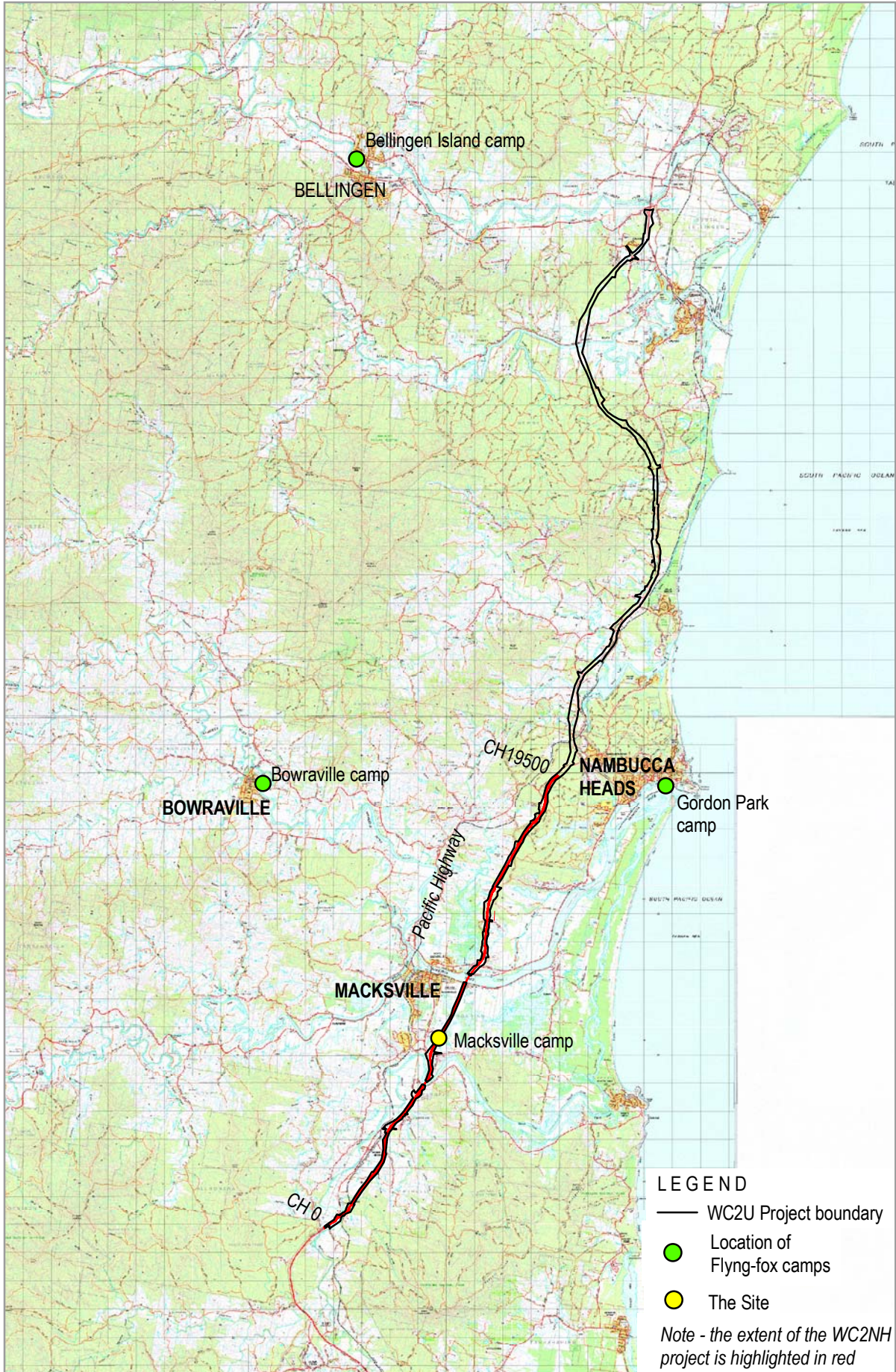
- Gordon Park: approximately 10,000-15,000 individuals (population size is broadly consistent with that recorded in the last monthly monitoring event);
- Bowraville: approximately 5,000 individuals recorded (population size is broadly consistent with that recorded in the last monthly monitoring); and

- Bellingham Island: estimated to number approximately 15,000-20,000 (population size has increased since the last monitoring event).



Plate 2.2 A stream of Flying-fox flying over the site from the north-west

Information shown is for illustrative purposes only



0 4 km

Location of Regional Flying-fox camps

2.2.3 Detailed Data

2.2.3.1 Species Composition

No flying-foxes were recorded at the site. Therefore, no detailed species composition data was collected at the site for the current monitoring event.

The species composition and proportions at the regional camps visited was as follows:

- Bellinghen Island – GHFF >95%, Black Flying-fox <5%;
- Gordon Park – GHFF >90%, Black Flying-fox <10%;
- Bowraville – GHFF >95%, Black Flying-fox <5%.

Similar proportions were recorded in the previous monthly monitoring event.

2.2.3.2 Habitat Characteristics and Demographic Composition

No detailed demographic composition data at the site was collected for the current monitoring event.

Comparison demographic data was collected from the Bellinghen Island camp. The structure of the vegetation at the Bellinghen Island camp consists of a canopy of emergent rainforest species (with some large native figs of substantial diameter and up to 40 m in height) over a relatively open understorey. Most of the flying-foxes were roosting in either Creek Sandpaper Fig (*Ficus coronata*) or Giant Stinging Tree (*Dendrocnide excelsa*). As mentioned previously, all flying-fox present were observed to be roosting in the mid-storey vegetation approximately 5-15 m above the ground and are not currently roosting in the canopy of the emergent rainforest trees as happens when the camp is particularly full.

Data of habitat characteristics and demographic composition at Bellinghen Island is provided in **Table 2.1**. Females were more numerous than males in all of the demographic counts. Female GHFF with dependant young were present at all of the count points. The proportion of females with young was generally high, ranging between 60 and 100%, with an average incidence of 78%.

Table 2.1 Demographic Data of GHFF at Bellinghen Island

Tree Code	Tree Species	Height (m); DBH (cm)	Approximate Location	Sex Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
BI1	Giant Stinging Tree	6; 40	Eastern channel section	10:2	yes	60%
BI2	Unknown sp.	5; 40	South-eastern section	10:3	yes	90%
BI3	Castor Oil Plant (exotic)	4; 10	Southern section	10:4	yes	80%
BI4	Creek Sandpaper Fig	7; 30	Southern section	10:3	yes	90%

Tree Code	Tree Species	Height (m); DBH (cm)	Approximate Location	Sex Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
BI5	Creek Sandpaper Fig	6; 20	Southern section	10:3	yes	80%
BI6	Creek Sandpaper Fig	8; 40	Southern section	10:2	yes	80%
BI7	Moreton Bay Fig	10; 50	Southern section	10:1	yes	100%
BI8	Moreton Bay Fig	20; 100	South-eastern section	10:3	yes	70%
BI9	Creek Sandpaper Fig	7; 20	Western section	10:4	yes	60%
BI10	Stag	6; 15	Western section	10:3	yes	70%

General observations of the flying-foxes present at the Gordon Park and Bowraville camps indicated that both female and male GHFF were present. Females with dependant young were also observed in relatively high numbers at these camps.

2.2.3.3 Water level at the site

Water level at the representative measurement location at the site was approximately 83 cm in depth as is shown in **Figure 2.1**. This substantial increase in water depth at the site follows moderate to heavy rainfall on a number of occasions over the past two months. This water level is the highest that has been recorded over the period since November 2013.

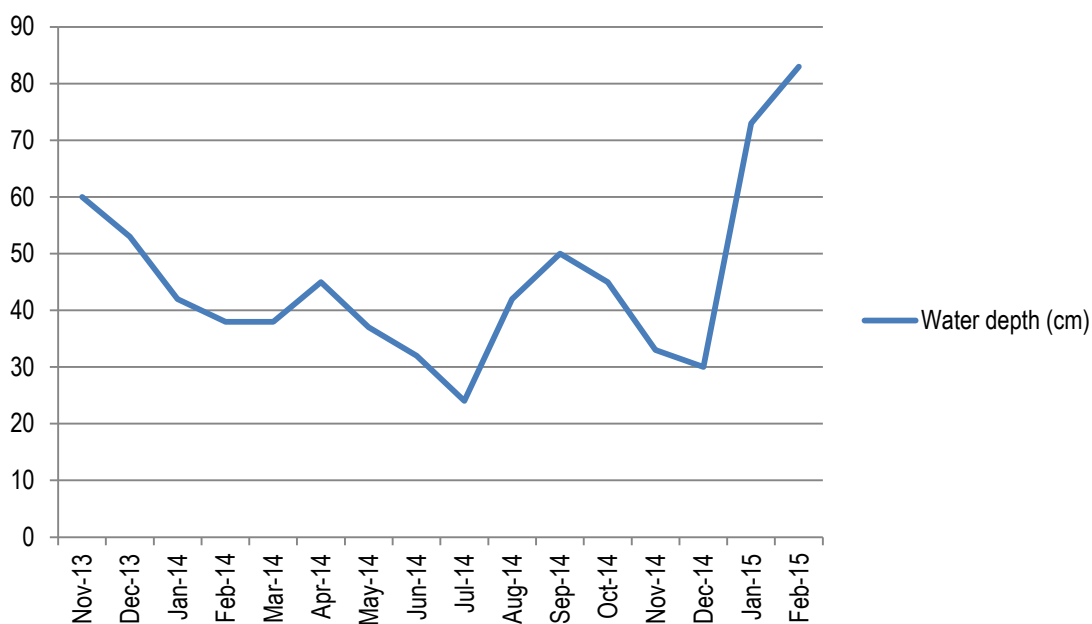


Figure 2.1 Water Level Measurements at The Site



2.3 Discussion

2.3.1 Population Estimates

No flying-foxes were observed to be roosting at the site during the roost traverse undertaken for the current monitoring event. Nor were any flying-foxes observed to be flying from the site in the exit count. The results of the exit count from recent monitoring at the site in mid-January 2015 indicated that between 3,000 and 5,000 flying-foxes had been roosting at the site at that time. However, since this time no flying-foxes have been observed to be roosting at the camp, indicating that the roosting was temporary. This was the first time that flying-foxes had been recorded roosting at the site since early-mid April 2014.

In February 2014, monitoring of flying-fox numbers at the site in an exit count indicated that approximately 34,000 flying-foxes were roosting at the site at that time (GeoLINK 2014). High numbers of flying-foxes at the site in February 2014 also corresponded with relatively high numbers at Bellingen Island and Gordon Park, and more moderate numbers at Bowraville.

2.3.2 Species Composition and Demographic Data

At occupied camps GHFF dominated the species composition and Black Flying-fox accounted for a small proportion of approximately 5-10% of all individuals present.

The demographic data collected at Bellingen, and at other regional camps, indicates that GHFF in the region are still currently supporting dependent young GHFF in relatively high numbers, as has been the case for several months. These young will not be fully independent until approximately March. Flightless young are typically left at a camp while females forage in late November (Eby 2012).

2.3.3 Phenology of Trees Region

Flowering of a number of highly productive nectar source trees for GHFF in the upper North Coast region of NSW in February includes Broad-leaved Paperbark (*Melaleuca quinquenervia*) Coastal Blackbutt (*E. pilularis*) (foothills and ranges), and a number of *Corymbia* species including Spotted Gum (*Corymbia maculata* and *C. variegata*), Red Bloodwood (*C. gummifera*) and Pink Bloodwood (*C. intermedia*). These highly productive nectar source trees can be considered key diet species for GHFF (Eby 2012; Eby and Law 2008). Observations when travelling between regional flying-fox camps indicated light flowering of Pink Bloodwood and light to moderate flowering of Broad-leaved Paperbark is currently occurring.

2.4 Conclusion

The results of the February 2015 monthly flying-fox monitoring indicate that after a brief stop-over at the site observed during mid-January 2015, flying-foxes continue to be absent from the site.

The monitoring of GHFF demographics indicated that regional flying-fox camps are currently supporting a relatively high number of dependent GHFF young that will typically reach independence shortly sometime in March.



Tom Pollard

Tom Pollard

Ecologist



References

Eby, P. and Law, B. (2008). Ranking the feeding habitat of Grey-headed flying foxes for conservation management. Department of Environment, Heritage, Water and the Arts, Canberra.

Eby, P. (2012). An Assessment of the Flying-fox Camp at Macksville. Unpublished report to NSW Roads and Maritime Services.

Eby, P. (2013). A Field Monitoring Program Proposed for the Macksville Flying-fox Roost. Unpublished report to Sinclair Knight Merz.

GeoLINK (2014). *Flying-fox Monitoring, Warrell Creek to Nambucca Heads Pacific Highway Upgrade*, February 2014. Unpublished report to Jacobs and NSW Roads and Maritime Services. GeoLINK, Lennox Head.

24 March 2015
Ref No: 2182-1123

The Manager
Jacobs
PO Box 2147
DANGAR NSW 2309

Attention: Rachel Vazey

Dear Rachel,

March 2015 fortnightly Flying-fox monitoring report

This short report details the findings of the March 2015 fortnightly Grey-headed Flying-fox (GHFF) monitoring at the Macksville camp (the site) undertaken between standard monthly monitoring events. The purpose of collecting additional data more frequently is to form a clearer picture of short-term population fluctuations at the camp. For more detailed information on methodology used for this monitoring, refer to the monthly flying-fox monitoring reports.

Flying-foxes at the Site

A traverse of the site was undertaken on 19 March 2015. No flying-fox were roosting at the site. This follows on from a brief temporary return of a small number of flying-foxes to the site in mid-January.

An exit count was conducted at two vantage points north and south of the site on the evening of 19 March. No flying-foxes were observed flying from the site in the exit count, and only a small number were observed to be flying over the site. However, numerous flying-foxes were observed flying over the Macksville golf course heading east. Subsequent observations by GeoLINK have indicated that approximately 10,000 flying-foxes are currently roosting in the Melaleuca swamp forest between the golf club and the cemetery on the urban fringe of Macksville. GHFF (95%) and Black Flying-foxes (5%) were present and dependent young were present. This camp is approximately 1.2 km to the northwest of the site and west of the current highway alignment. It is likely that the flying-foxes observed flying over the golf course originated from this camp. Future monitoring will include observations collected from this camp, with the aim of obtaining a clearer understanding of local usage of habitats around Macksville by flying-foxes.

Other regional flying-fox camps were visited on 18 March. General observations made at these camps are as follows:

Bellingen Island:

GHFF (>95%) and Black Flying-fox (<5%) were present. The number of flying-foxes appears to have decreased slightly at Bellingen Island since the last monitoring event (at that time estimated to be approximately 15,000 – 20,000 individuals). The estimated number in the current monitoring event was approximately 15,000 individuals. The flying-foxes were observed to be predominately occupying the mid-storey of the rainforest canopy. Observations also indicated that female GHFF were supporting dependent young.

Flying-foxes continue to be absent from the Camphor Laurel vegetation behind Wheatley Street.

ABN 79 896 839 729
ACN 101 084 557

Return address:
PO Box 119
LENNOX HEAD
NSW 2478

LENNOX HEAD
T 02 6687 7666
F 02 6687 7782

COFFS HARBOUR
T 02 6651 7666
F 02 6651 7733

www.geolink.net.au

Gordon Park (Nambucca Heads):

GHFF (>95%) and Black Flying-fox (<5%) were present. The estimated number of flying foxes and the roost area is approximately the same as was recorded in the previous monitoring event (estimated to be approximately 10,000 individuals). As was the case at Bellingen Island, GHFF with dependent young were also observed.

Bowraville:

Both GHFF (>95%) and Black Flying-fox (<5%) were observed. It was estimated that approximately 3,000 flying-foxes were present at the Bowraville roost, which is slightly less than the numbers recorded in the previous monitoring event (3,000 – 5,000). Female GHFF with dependant young were also observed.

Flowering of Key Foraging Resources

Flowering of a number of highly productive nectar source trees for GHFF in the upper North Coast region of NSW in March includes Broad-leaved Paperbark (*Melaleuca quinquenervia*), Coastal Blackbutt (*E. pilularis*) (foothills and ranges), and a number of *Corymbia* species including Spotted Gum (*Corymbia maculata* and *C. variegata*), Red Bloodwood (*C. gummifera*) and Pink Bloodwood (*C. intermedia*). These highly productive nectar source trees can be considered key diet species for GHFF (Eby 2012; Eby and Law 2008). Observations when travelling between regional flying-fox camps indicated moderate flowering of Broad-leaved Paperbark and light flowering of Pink Bloodwood is currently occurring.

If you have any queries regarding this report, please feel free to call on 02 6687 7666.

Yours sincerely

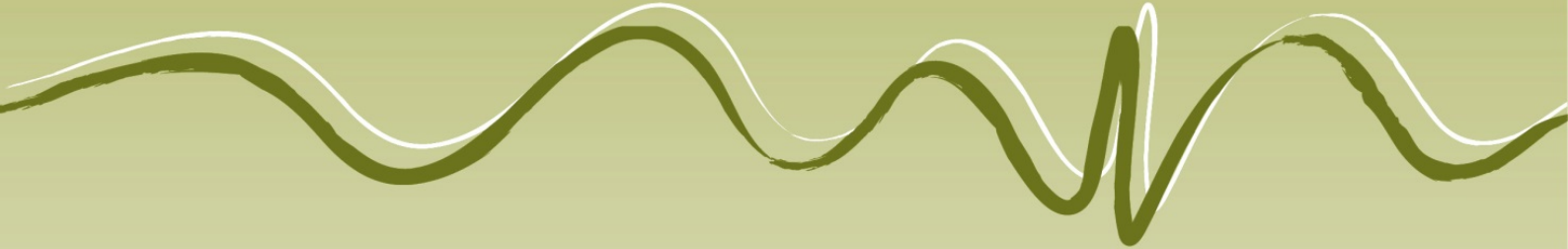
GeoLINK



Jessica O'Leary
Ecologist

Flying-fox Monitoring March 2015

Warrell Creek to Nambucca Heads Pacific Highway Upgrade



GeoLINK
environmental management and design

PO Box 119
Lennox Head NSW 2478
T 02 6687 7666

PO Box 1446
Coffs Harbour NSW 2450
T 02 6651 7666

info@geolink.net.au

Prepared for: Jacobs
© GeoLINK, 2015

<i>UPR</i>	<i>Description</i>	<i>Date Issued</i>	<i>Issued By</i>
2182-1124	First issue	07/04/2015	Tom Pollard



Table of Contents

1.	Introduction	2
1.1	Introduction	2
2.	Flying-fox Survey	3
2.1	Methodology	3
2.2	Results	4
2.2.1	Roost Footprint	4
2.2.2	Population Estimate – Exit Count	4
2.2.3	Detailed Data	8
2.3	Discussion	11
2.3.1	Population Estimates	11
2.3.2	Species Composition and Demographic Data	11
2.3.3	Phenology of Trees Region	11
2.4	Conclusion	12

Illustrations

Illustration 2.1	Macksville Cemetery Flying-fox roost footprint	6
Illustration 2.2	Location of Regional Flying-fox Camps	7

Tables

Table 2.1	Demographic Data of GHFF at Macksville Cemetery	8
Table 2.2	Demographic Data of GHFF at Bellingen Island	9

Plates

Plate 2.1	Broad-leaved Paperbark within Macksville cemetery flying-fox camp	4
-----------	---	---

Figures

Figure.1	Water Level Measurements at The Site	10
----------	--------------------------------------	----



1. Introduction

1.1 Introduction

Jacobs and NSW Roads and Maritime Services (RMS) are working to resolve issues relating to the Grey-headed Flying-fox (*Pteropus poliocephalus*) (GHFF) camp within the approved alignment of the Warrell Creek to Nambucca Heads (WC2NH) Pacific Highway upgrade project.

GeoLINK has been engaged to undertake monthly flying-fox monitoring at a camp near Macksville, located in a patch of Swamp Sclerophyll Forest vegetation north of Bald Hill Road (henceforth referred to as 'the site'). To date, monthly monitoring at the site has been undertaken by GeoLINK since July 2013. However, a significant amount of data from previous monitoring has also been collected irregularly at the site since occupation commenced in December 2011 (Eby 2012).

This report details the March 2015 monthly flying-fox monitoring results.



2. Flying-fox Survey

2.1 Methodology

Fieldwork for the March 2015 monthly flying-fox monitoring was undertaken by GeoLINK ecologists Dr Tom Pollard and David Havilah, GeoLINK Environmental Scientist Kale Hardy-Porter, and ecologist Frank Makin (GeoLINK subcontractor). The fieldwork followed the methodology developed by Dr Eby for this roost (Eby 2013). Refer to that document for full details of the methodology. A summary of the main procedures used for the monitoring is provided below.

The fieldwork for this monthly monitoring event was conducted on 1 and 2 April rather than at the end of March so that property access to the newly established Macksville cemetery flying-fox camp could be organised.

On 1 April a survey of the site was undertaken on foot to locate and map any roosting flying-foxes. When flying-fox are present at the site, data on species composition, demographics, reproductive status and behaviour are collected. In light of the continued absence of flying-foxes at the site and the recent establishment of a flying-fox camp within 2 km of the site adjacent to Macksville cemetery (refer to **Section 2.2**), to provide some information relating to flying-foxes currently camping in the local area this data was instead collected from the Macksville cemetery camp.

The water level at the site was measured at a previously established measurement point. The water level at this location is representative of the average level beneath the camp.

Following the site traverse, a dusk exit count survey was undertaken at the site on the evening of 2 March to provide an estimate of the number of flying-foxes currently roosting at the camp. Two observers were strategically located for the count on a northern and southern ridge overlooking the camp. In addition to this two observers were also located east and west of the Macksville cemetery camp to undertake an exit count of this camp.

Observers were located at the following vantage points for the site:

- in a paddock to the north of the swamp sclerophyll forest (off Wedgewood Drive); and
- on a ridge south of the camp (41 Bald Hill Road).

Observers were located at the following vantage points for the Macksville cemetery camp:

- adjacent to the Pacific Highway at the edge of the Macksville Golf Course; and
- near the entrance to Macksville cemetery on Wallace Street.

The survey extended over approximately 45 minutes from sunset until dark (approximately 6:45 pm to 7:30 pm).

Comparative data on species composition, demographics, reproductive status and behaviour is also typically collected at a control site located at Bellingen Island (approximately 31 km north north-west of the Macksville camp). Observational comments from other regional flying-fox camps at Gordon Park camp, Nambucca Heads (approximately 12 km north-east of the Macksville camp) and Bowraville were also made (refer to **Illustration 2.1** for location of these regional camps).

2.2 Results

2.2.1 Roost Footprint

No flying-foxes were observed to be roosting at the site in the camp traverse.

The flying-fox roost footprint at the Macksville Cemetery camp was mapped by GPS and found to be approximately 2.49 ha in size (refer to **Illustration 2.1**). The camp is located within an area of Swamp Sclerophyll Forest dominated by Broad-leaved Paperbark (*Melaleuca quinquenervia*) with a height of approximately 8-12 m (refer to **Plate 2.1**). The water depth beneath this camp was approximately 20-40 cm.



Plate 2.1 Broad-leaved Paperbark within Macksville cemetery flying-fox camp

The flying-fox roost footprints at Gordon Park (Nambucca Heads) was generally consistent with the recorded extends from the last monthly monitoring event, while the roost footprints at both Bowraville and Bellingen Island have decreased. It should be noted however that several thousand flying-foxes were observed to be roosting nearby in Bellingen at Wheatley Street in Camphor Laurel vegetation (as has been previously recorded).


2.2.2 Population Estimates

2.2.2.1 Exit Counts

No flying-foxes were observed flying from the site in the exit count. A stream of flying-foxes was observed to the north east of the site, presumably originating from the nearby Macksville cemetery camp.

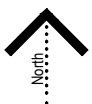
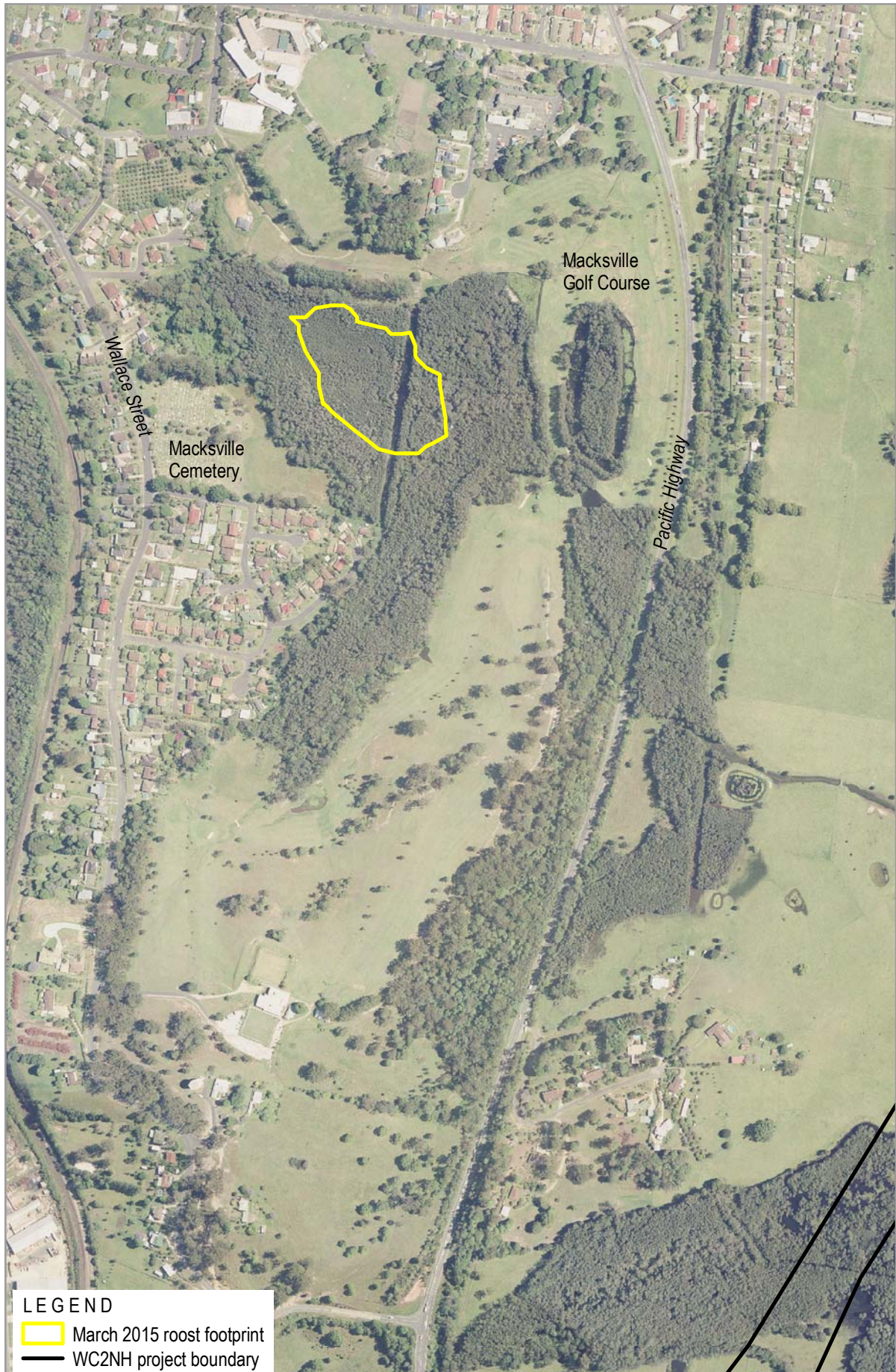
The exit count undertaken for the Macksville cemetery camp indicated that approximately 7,500 flying-foxes are currently roosting at this camp.

2.2.2.2 Direct Counts



The location of the regional flying-fox camps visited is shown in **Illustration 2.1**. No exit count was conducted at any of these regional camps. However, rough population estimates for these camps based on extrapolation of counts in individual trees and the roost footprint are as follows:

- Gordon Park: approximately 10,000-15,000 individuals (population size is broadly consistent with that recorded in the last monthly monitoring event);
- Bowraville: approximately 1,000-2,500 individuals recorded (population size has decreased since the last monthly monitoring event); and
- Bellingen Island: estimated to number approximately 10,000 (population size has decreased since the last monitoring event). However, as mentioned previously several thousand flying-foxes are currently roosting nearby at Wheatley Street.

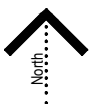
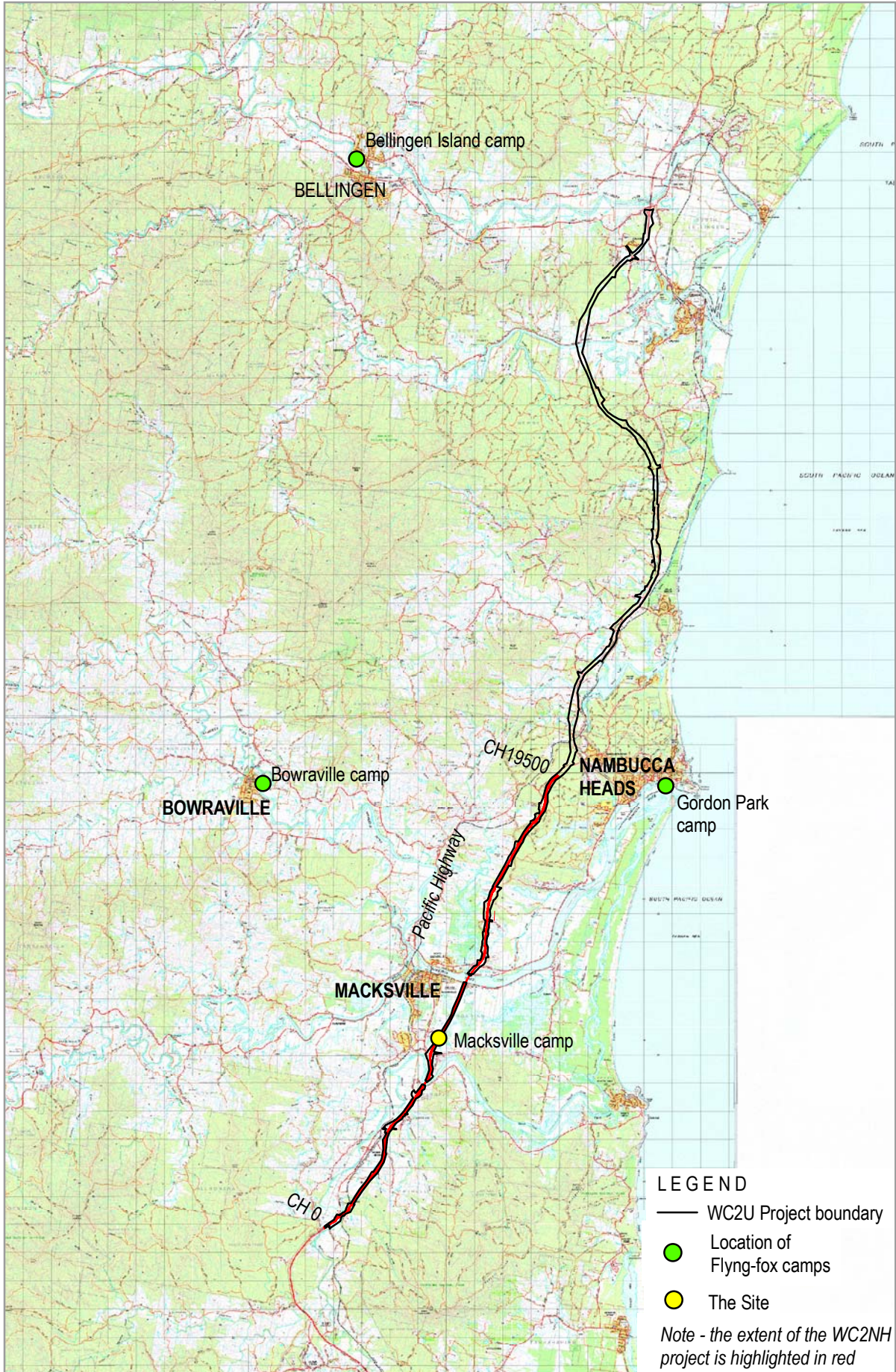


0 150



Macksville Cemetery Flying-fox Roost Footprint

Information shown is for illustrative purposes only



0 4 km



Location of Regional Flying-fox camps

2.2.3 Detailed Data

2.2.3.1 Species Composition

No flying-foxes were recorded at the site. Therefore, no detailed species composition data was collected at the site for the current monitoring event.

The species composition and proportions at the regional camps (including the Macksville cemetery camp) visited was as follows:

- Macksville Cemetery – GHFF >95%, Black Flying-fox <5%;
- Bellingen Island – GHFF >95%, Black Flying-fox <5%;
- Gordon Park – GHFF >90%, Black Flying-fox <10%;
- Bowraville – GHFF 100%.

A similar species composition of GHFF making up at least 90% of all flying-foxes present was also recorded in the previous monitoring event.


2.2.3.2 Habitat Characteristics and Demographic Composition

As mentioned previously, no detailed demographic composition data at the site was collected for the current monitoring event. Instead this data was collected at the Macksville cemetery camp (refer to **Table 2.1**). The vegetation at the Macksville cemetery flying-fox camp consists of a dense stand of Broad-leaved Paperbark forest approximately 8-12 m in height growing on swampy low-lying ground. Females were more numerous than males at the majority of the demographic counts. A relatively low proportion of female GHFF were recorded with young that showed some dependant behaviour (clinging to their mother). This proportion ranged between 0% and 30%, with an average incidence of 7%.

Comparison data of habitat characteristics and demographic composition at Bellingen Island is provided in **Table 2.2**. The structure of the vegetation at the Bellingen Island camp consists of a canopy of emergent rainforest species (with some large native figs of substantial diameter and up to 40 m in height) over a relatively open understorey. Most of the flying-foxes were roosting in either Creek Sandpaper Fig (*Ficus coronata*) or Giant Stinging Tree (*Dendrocnide excelsa*). Females were more numerous than males in all but one of the demographic counts. A relatively low proportion of female GHFF were recorded with young that showed some dependant behaviour (clinging to their mother). This proportion ranged between 0% and 50%, with an average incidence of 17%.

Table 2.1 Demographic Data of GHFF at Macksville Cemetery

Tree Code	Tree Species	Height (m); DBH (cm)	Approximate Location	Sex Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
MC1	Broad-leaved Paperbark	8; 30	Western section	10:4	yes	10%
MC2	Broad-leaved Paperbark	10; 40	Western section	10:3	no	n/a
MC3	Broad-	12; 50	South-western	10:6	yes	10%



Tree Code	Tree Species	Height (m); DBH (cm)	Approximate Location	Sex Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
	leaved Paperbark		section			
MC4	Broad-leaved Paperbark	10; 40	South-western section	10:4	no	n/a
MC5	Broad-leaved Paperbark	8; 40	Southern section	10:5	no	n/a
MC6	Broad-leaved Paperbark	12; 40	Southern section	10:3	yes	20%
MC7	Broad-leaved Paperbark	8; 25	Southern section	10:5	yes	10%
MC8	Swamp Mahogany	8; 30	Eastern section	10:7	no	n/a
MC9	Broad-leaved Paperbark	10; 50	Eastern section	10:3	yes	10%
MC10	Broad-leaved Paperbark	10; 40	Eastern section	10:4	yes	10%

Table 2.2 Demographic Data of GHFF at Bellingham Island

Tree Code	Tree Species	Height (m); DBH (cm)	Approximate Location	Sex Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
BI1	Giant Stinging Tree	7; 30	Eastern channel section	10:13	yes	10%
BI2	Unknown sp.	5; 40	Eastern channel section	10:4	yes	10%
BI3	Giant Stinging Tree	8; 50	Eastern channel section	10:3	yes	30%
BI4	Unknown sp.	8; 35	South-eastern section	10:4	no	n/a
BI5	Creek Sandpaper Fig	6; 20	Southern section	10:3	yes	40%
BI6	Creek Sandpaper Fig	8; 40	Southern section	10:2	yes	10%
BI7	Giant Stinging Tree	10; 50	Southern section	10:4	no	n/a

Tree Code	Tree Species	Height (m); DBH (cm)	Approximate Location	Sex Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
BI8	Moreton Bay Fig	20; 90	South-eastern section	10:5	yes	30%
BI9	Creek Sandpaper Fig	5; 20	Western section	10:3	yes	40%
BI10	Giant Stinging Tree	7; 30	Western section	10:2	no	n/a

General observations of the flying-foxes present at the Gordon Park and Bowraville camps indicated that both female and male GHFF were present. Similar to the Macksville cemetery and Bellingen Island flying-fox camps only a relatively small proportion of female GHFF were supporting young that were showing some dependent behaviour.

2.2.3.3 Water level at the site

Water level at the representative measurement location at the site was approximately 68 cm in depth as is shown in **Figure 2.1**. Water levels have now decreased slightly from a peak in February 2015.

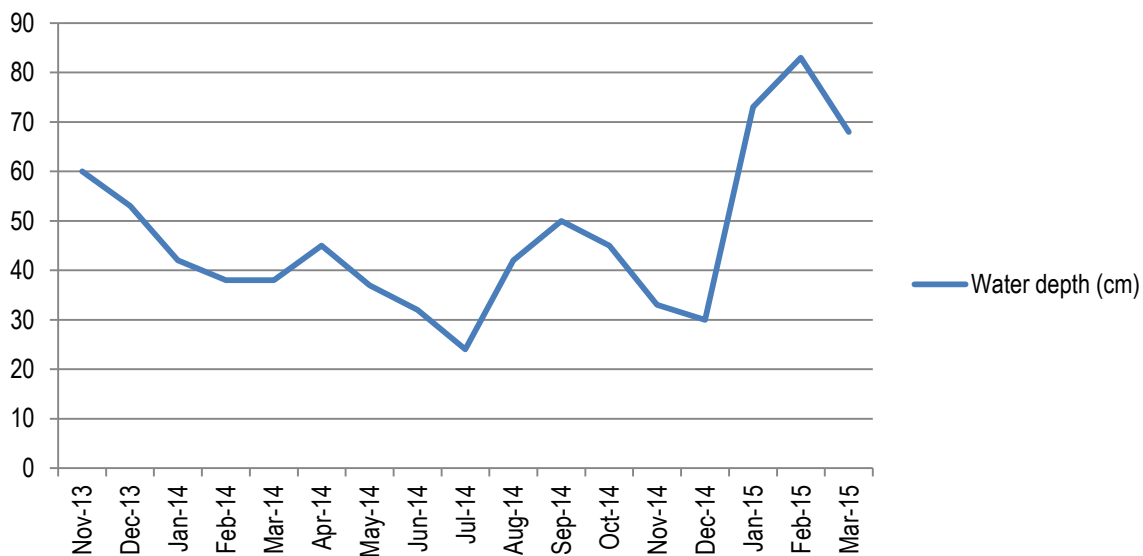


Figure.1 Water Level Measurements at The Site



2.3 Discussion

2.3.1 Population Estimates

No flying-foxes were observed to be roosting at the site during the roost traverse undertaken for the current monitoring event. Nor were any flying-foxes observed to be flying from the site in the exit count. The absence of flying-foxes at the site now extends from mid-April 2014 until present (excluding the temporary return of a relatively small number of flying-foxes in mid-January 2015). For comparison, in March 2014 the exit count at the site indicated that approximately 22,000 flying-foxes were roosting at the site at that time (GeoLINK 2014).

The exit count conducted at the nearby Macksville cemetery camp indicated that a moderate number (approximately 7,500) of flying-foxes (predominantly GHFF) are currently roosting at an alternative location within approximately 1-2 km of the site. Based on observations and timing of flying-fox streams across the site in previous monitoring events, along with reports of odour on the Pacific Highway near the Macksville cemetery camp it is surmised that this camp may have been occupied for at least six weeks (i.e. at least since mid-February 2015).

Flying-fox numbers appear to have recently decreased at the Bowraville camp. This decrease in numbers locally is most likely related to foraging resource availability, in particular extensive flowering of Broad-leaved Paperbark in the coastal lowlands. A similar decrease was also noted at Bellingen Island. However, several thousand flying-foxes were observed to be roosting nearby at Wheatley Street in Bellingen. Taking this into consideration, the overall Bellingen sub-population may have remained relatively constant since the last monitoring event.

For comparison, in March 2014 flying-fox numbers at all of the visited regional camps were at relatively high levels of above 10,000 individuals (GeoLINK 2014).

2.3.2 Species Composition and Demographic Data

At occupied camps GHFF dominated the species composition and Black Flying-fox accounted for a small proportion of approximately 0-10% of all individuals present.

The demographic data collected at Macksville cemetery and Bellingen Island in the current monitoring event indicates that only a small proportion of female GHFF in the region were supporting young that display some dependent behaviour (i.e. clinging to their mothers) at the time of monitoring. The remainder of the young flying-foxes in these camps are now fully independent. Full independence is typically reached around March (Eby 2012).

2.3.3 Phenology of Trees Region

Flowering of a number of highly productive nectar source trees for GHFF in the upper North Coast region of NSW in March includes Broad-leaved Paperbark (*Melaleuca quinquenervia*) Coastal Blackbutt (*E. pilularis*) (foothills and ranges), and a number of *Corymbia* species including Spotted Gum (*Corymbia maculata* and *C. variegata*), Red Bloodwood (*C. gummifera*) and Pink Bloodwood (*C. intermedia*). These highly productive nectar source trees can be considered key diet species for GHFF (Eby 2012; Eby and Law 2008). Observations when travelling between regional flying-fox camps indicated moderate flowering of Broad-leaved Paperbark is currently occurring.



2.4 Conclusion

The results of the March 2015 monthly flying-fox monitoring indicate that after a brief stop-over at the site observed during mid-January 2015, flying-foxes continue to be absent from the site. Within the last few months a moderate number of flying-foxes have established a camp nearby to the site, adjacent to Macksville cemetery. Up until the end of February 2015 no WC2NH Pacific Highway upgrade construction activities have occurred in proximity to the site. Considering this, the reason for flying-foxes being absent from the site and establishing nearby in vegetation adjacent to Macksville cemetery (less than 2 km away from the site) remains unclear.



Tom Pollard

Ecologist



References

Eby, P. and Law, B. (2008). Ranking the feeding habitat of Grey-headed flying foxes for conservation management. Department of Environment, Heritage, Water and the Arts, Canberra.

Eby, P. (2012). An Assessment of the Flying-fox Camp at Macksville. Unpublished report to NSW Roads and Maritime Services.

Eby, P. (2013). A Field Monitoring Program Proposed for the Macksville Flying-fox Roost. Unpublished report to Sinclair Knight Merz.

GeoLINK (2014). *Flying-fox Monitoring, Warrell Creek to Nambucca Heads Pacific Highway Upgrade*, March 2014. Unpublished report to Jacobs and NSW Roads and Maritime Services. GeoLINK, Lennox Head.

20 April 2015
Ref No: 2182-1126

The Manager
Jacobs
PO Box 2147
DANGAR NSW 2309

Attention: Rachel Vazey

Dear Rachel,

April 2015 fortnightly Flying-fox monitoring report

This short report details the findings of the April 2015 fortnightly Grey-headed Flying-fox (GHFF) monitoring at the Macksville camp (the site) undertaken between standard monthly monitoring events. The purpose of collecting additional data more frequently is to form a clearer picture of short-term population fluctuations at the camp. For more detailed information on methodology used for this monitoring, refer to the monthly flying-fox monitoring reports.

Observations The Site

A traverse of the site was undertaken on 15 April 2015. No flying-fox were roosting at the site. This absence of flying-foxes at the site has now extended from mid-April 2014 until present, with the exception of a temporary occupation by a small number of flying-foxes in mid-January 2015

An exit count was conducted at two vantage points north and south of the site on the evening of 16 April. No flying-foxes were observed flying from the site in the exit count. Several thousand flying-foxes were observed to be flying over the site in a southerly direction, most likely originating from the nearby Macksville Cemetery flying-fox camp that has recently established in the Melaleuca swamp forest between the golf club and the cemetery on the urban fringe of Macksville.

Other regional flying-fox camps were visited on 16 April. General observations made at these camps are as follows:

Macksville Cemetery

Observations indicated that the roost extent is similar to that recorded in the March monthly monitoring event. This would suggest that a similar number of flying-foxes (approximately 7,500 counted by exit counted in the March monitoring event) are currently roosting at this camp.

The vast majority of flying-foxes observed were GHFF, with only 0-5% of the overall population being Black Flying-foxes. No dependent young flying-foxes were observed and mating behaviours were evident.

Bellingen Island:

No flying-foxes were observed to be camped at Bellingen Island. However, GHFF numbering between 2,500 and 5,000 were observed to be roosting nearby in the exotic Camphor Laurel and Slash Pine vegetation behind Wheatley Street, as has occasionally

ABN 79 896 839 729
ACN 101 084 557

Return address:
PO Box 119
LENNOX HEAD
NSW 2478

LENNOX HEAD
T 02 6687 7666
F 02 6687 7782

COFFS HARBOUR
T 02 6651 7666
F 02 6651 7733

www.geolink.net.au

been the case over the past 18 months. Flying-foxes were also absent from Bellingen Island in late autumn and winter of 2014.

Bowraville:

No flying-foxes were observed to be camped at Bowraville. Flying-foxes were also absent from Bowraville in late autumn, winter and early Spring of 2014.

Gordon Park (Nambucca Heads):

GHFF (>95%) and Black Flying-fox (<5%) were present. The estimated number of flying foxes and the roost area is approximately the same as was recorded in the previous monitoring event (estimated to be approximately 10,000 individuals). As was observed at the Macksville cemetery camp, no dependent young were flying-foxes were present and mating behaviours were evident.

Flowering of Key Foraging Resources

Flowering of a number of highly productive nectar source trees for GHFF in the upper North Coast region of NSW in April includes Broad-leaved Paperbark (*Melaleuca quinquenervia*), Coastal Blackbutt (*E. pilularis*) (lowlands) and Swamp Mahogany (*E. robusta*). These highly productive nectar source trees can be considered key diet species for GHFF (Eby 2012; Eby and Law 2008). Observations when travelling between regional flying-fox camps indicated moderate flowering of Broad-leaved Paperbark is continuing at present.

If you have any queries regarding this report, please feel free to call on 02 6687 7666.

Yours sincerely

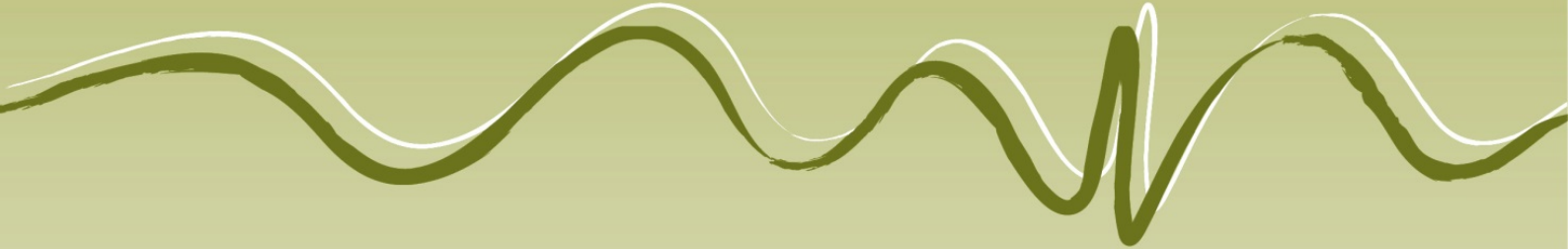
GeoLINK



Tom Pollard
Ecologist

Flying-fox Monitoring April 2015

Warrell Creek to Nambucca Heads Pacific Highway Upgrade



GeoLINK
environmental management and design

PO Box 119
Lennox Head NSW 2478
T 02 6687 7666

PO Box 1446
Coffs Harbour NSW 2450
T 02 6651 7666

info@geolink.net.au

Prepared for: Jacobs
© GeoLINK, 2015

<i>UPR</i>	<i>Description</i>	<i>Date Issued</i>	<i>Issued By</i>
2182-1127	First issue	12/05/2015	Tom Pollard



Table of Contents

1.	Introduction	1
1.1	Introduction	1
2.	Flying-fox Survey	2
2.1	Methodology	2
2.2	Results	3
2.2.1	Roost Footprint	3
2.2.2	Population Estimates	4
2.2.3	Detailed Data	7
2.3	Discussion	10
2.3.1	Population Estimates	10
2.3.2	Species Composition and Demographic Data	10
2.3.3	Phenology of Trees Region	10
2.4	Conclusion	12

Illustrations

Illustration 2.1	Location of Regional Flying-fox Camps	5
------------------	---------------------------------------	---

Tables

Table 2.1	Demographic Data of GHFF at Macksville Cemetery Camp	8
Table 2.2	Demographic Data of GHFF at Wheatley Street Camp	8

Plates

Plate 2.1	GHFF in rainforest canopy at Gordon Park	3
Plate 2.2	GHFF in Camphor Laurels at Wheatley Street, Bellingen	4

Figures

Figure 2.1	Water Level Measurements at The Site	9
Figure 2.2	Population trends at the site and regional camps April 2014 to April 2015	11



1. Introduction

1.1 Introduction

Jacobs and NSW Roads and Maritime Services (RMS) are working to resolve issues relating to the Grey-headed Flying-fox (*Pteropus poliocephalus*) (GHFF) camp within the approved alignment of the Warrell Creek to Nambucca Heads (WC2NH) Pacific Highway upgrade project.

GeoLINK has been engaged to undertake monthly flying-fox monitoring at a camp near Macksville, located in a patch of Swamp Sclerophyll Forest vegetation north of Bald Hill Road (henceforth referred to as 'the site'). To date, monthly monitoring at the site has been undertaken by GeoLINK since July 2013. However, a significant amount of data from previous monitoring has also been collected irregularly at the site since occupation commenced in December 2011 (Eby 2012).

This report details the April 2015 seasonal flying-fox monitoring results.



2. Flying-fox Survey

2.1 Methodology

Fieldwork for the April 2015 seasonal flying-fox monitoring was undertaken by GeoLINK ecologists Dr Tom Pollard and Jessica O'Leary and GeoLINK environmental scientists Kale Hardy-Porter and Grant McLean. The fieldwork followed the methodology developed by Dr Eby for this roost (Eby 2013). Refer to that document for full details of the methodology. A summary of the main procedures used for the monitoring is provided below.

On 28 April a survey of the site was undertaken on foot to locate and map any roosting flying-foxes. When flying-fox are present at the site, data on species composition, demographics, reproductive status and behaviour are also collected.

The water level at the site was measured at a previously established measurement point. The water level at this location is representative of the average level beneath the camp.

In light of the continued absence of flying-foxes at the site and the recent establishment of a flying-fox camp within 2 km of the site adjacent to Macksville cemetery to provide some information relating to flying-foxes currently camping in the local area this data was instead collected from the Macksville cemetery camp.

Following the site traverse, a dusk exit count survey was undertaken at the site on the evening of 28 April to provide an estimate of the number of flying-foxes currently roosting at the camp. Two observers were strategically located for the count on a northern and southern ridge overlooking the camp. In addition to this two observers were also located east and west of the Macksville cemetery camp to undertake an exit count of this camp.

Observers were located at the following vantage points for the site:

- in a paddock to the north of the swamp sclerophyll forest (off Wedgewood Drive); and
- on a ridge south of the camp (41 Bald Hill Road).

Observers were located at the following vantage points for the Macksville cemetery camp:

- adjacent to the Pacific Highway at the edge of the Macksville Golf Course; and
- near the entrance to Macksville cemetery on Wallace Street.

The survey extended over approximately 1 hour from sunset until dark (approximately 5:30 pm to 6:30 pm).

Other regional flying-fox camps at Gordon Park, Nambucca Heads (approximately 12 km north-east of the Macksville camp), Bowraville and Bellingen Island were visited on 29 April and observational comments made (refer to **Illustration 2.1** for location of these regional camps).

2.2 Results

2.2.1 Roost Footprint

No flying-foxes were observed to be roosting at the site in the camp traverse.

The flying-fox roost footprint at the Macksville Cemetery camp was mapped by GPS and found to be approximately 1.39 ha in size, a substantial reduction on the area of 2.49 ha recorded in the March 2015 monthly monitoring event (refer to **Illustration 2.1**). The camp is located within an area of Swamp Sclerophyll Forest dominated by Broad-leaved Paperbark (*Melaleuca quinquenervia*) with a height of approximately 8-12 m. The water depth beneath this camp was approximately 20-40 cm.

The flying-fox roost footprint at Gordon Park (Nambucca Heads) remains relatively extensive, and is generally consistent with that recorded in the last monthly monitoring event (refer to **Plate 2.1**).

Flying-foxes were absent at both the Bowraville and Bellingen Island camp. This was also observed in the fortnightly monitoring in mid-April. However, several thousand individuals were observed to be roosting at Bellingen in the Camphor Laurel and Slash Pine vegetation adjacent to Wheatley Street, as has been recorded since the March 2015 monthly monitoring event (refer to **Plate 2.2**).



Plate 2.1 GHFF in rainforest canopy at Gordon Park



Plate 2.2 GHFF in Camphor Laurels at Wheatley Street, Bellinghen

2.2.2 Population Estimates

2.2.2.1 Exit Count

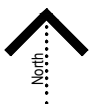
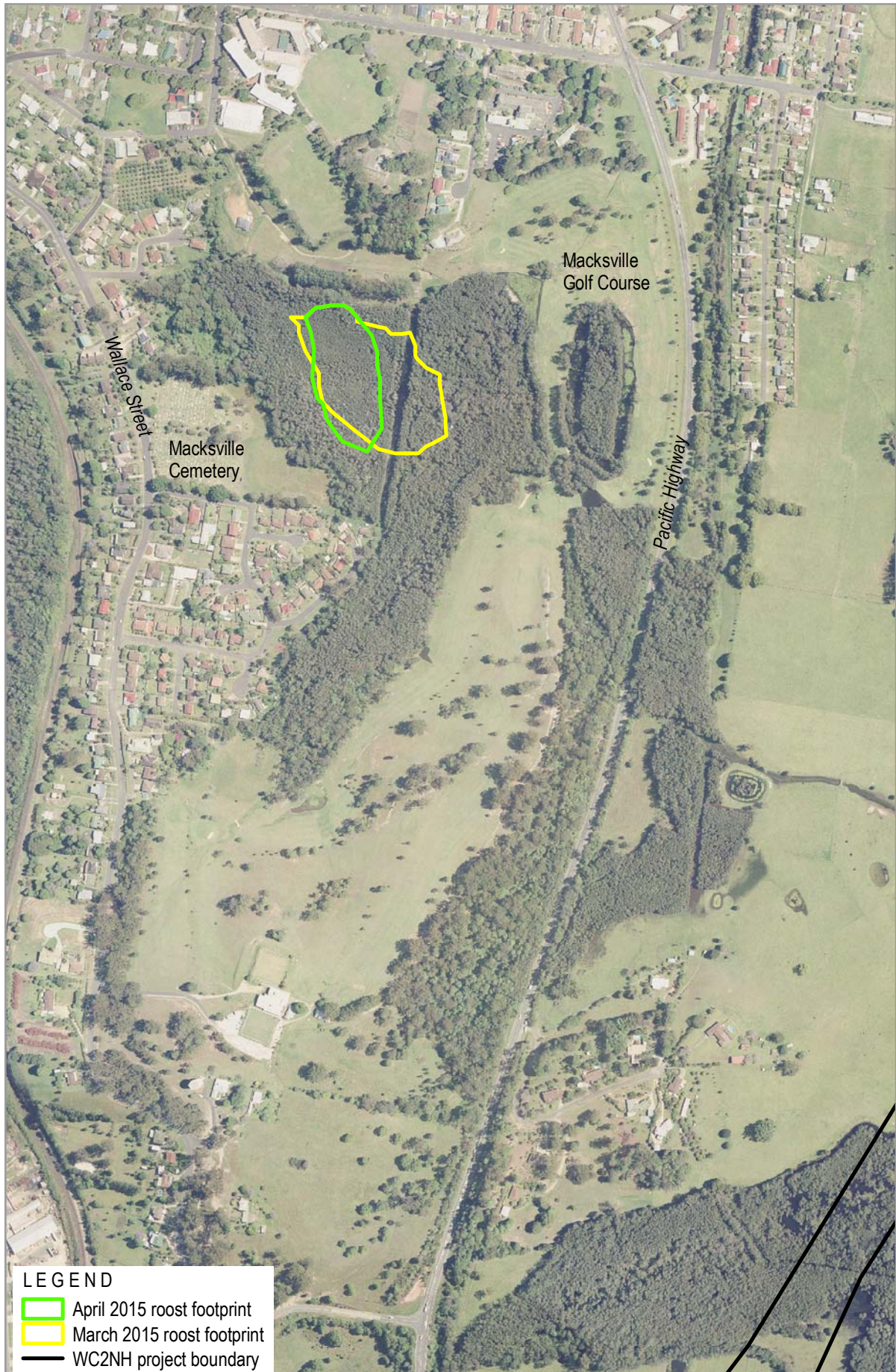
No flying-foxes were observed flying from the site in the exit count. Approximately 1,500 flying-fox were observed to be flying across the site, predominantly coming from the north-west (most likely originating at the nearby Macksville cemetery camp).

The exit count undertaken for the Macksville cemetery camp indicated that approximately 6,000 flying-foxes were roosting at this camp.

2.2.2.2 Direct Counts

No exit count was conducted at any of the regional camps (refer to **Illustration 2.2**). However, rough population estimates for these camps based on extrapolation of counts in individual trees and the roost footprint are as follows:

- Gordon Park: approximately 10,000 to 15,000 individuals (population size is broadly consistent with that recorded in the last monthly monitoring event);
- Bowraville: no individuals recorded (flying-foxes have now been absent since mid-April); and
- Bellinghen Island: no individuals recorded (flying-foxes have now been absent since mid-April); however, as mentioned previously several thousand flying-foxes are currently roosting nearby at Wheatley Street).

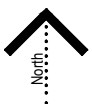
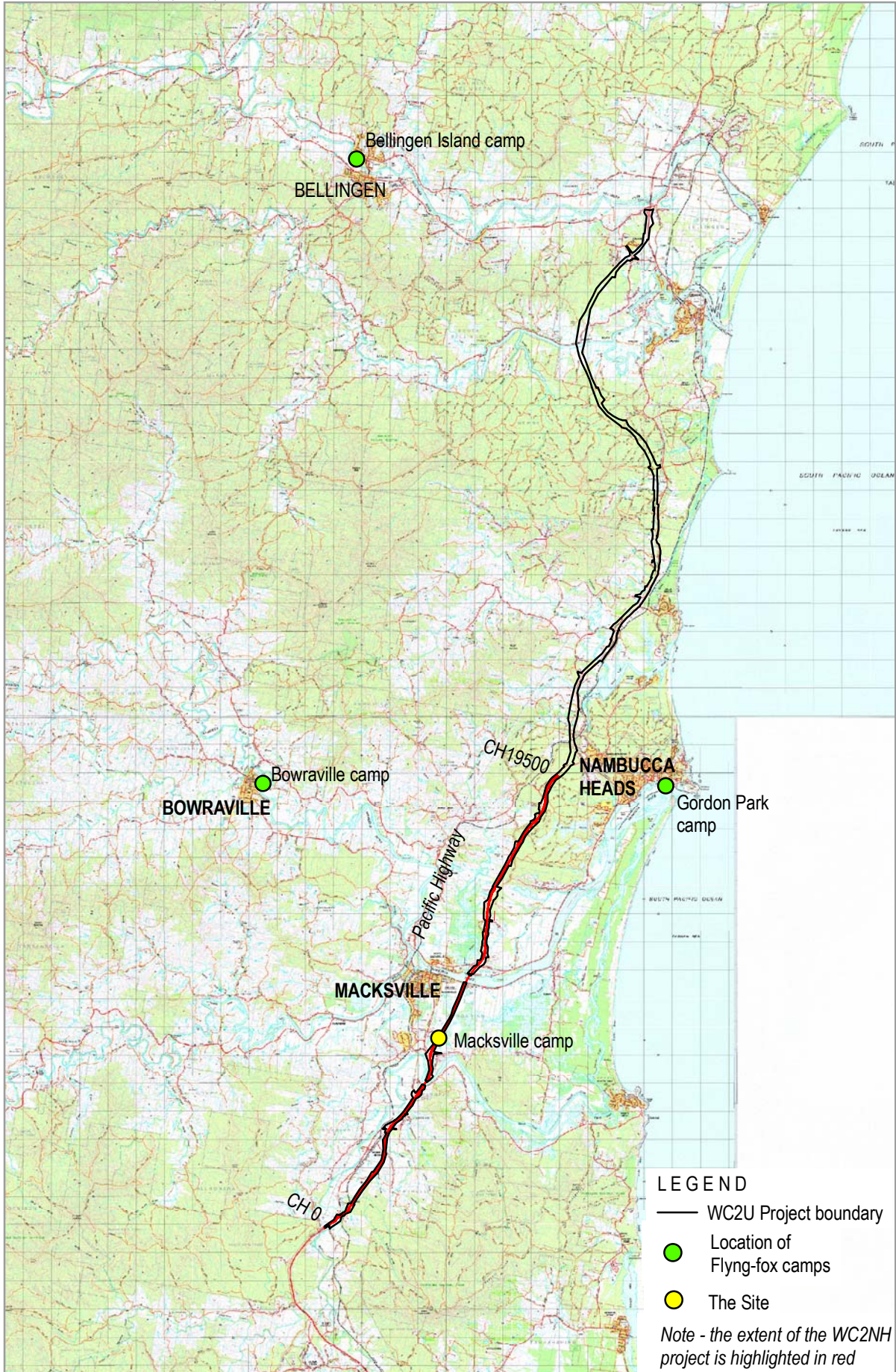


0 150



Macksville Cemetery Flying-fox Roost Footprint

Information shown is for illustrative purposes only



0 4 km





2.2.3 Detailed Data

2.2.3.1 Species Composition

No flying-foxes were recorded at the site. Therefore, no detailed species composition data was collected at the site for the current monitoring event.

The species composition and proportions at the regional camps (including the Macksville cemetery camp) visited was as follows:

- Macksville Cemetery – GHFF >95%, Black Flying-fox <5%.
- Gordon Park – GHFF >90%, Black Flying-fox <10%.
- Wheatley Street, Bellingen – GHFF 100%, Black Flying-fox 0%.

A similar species composition of GHFF making up at least 90% of all flying-foxes present was also recorded in the previous monitoring event.

2.2.3.2 Habitat Characteristics and Demographic Composition

No detailed demographic composition data at the site was collected for the current monitoring event.

As mentioned previously, no detailed demographic composition data at the site was collected for the current monitoring event. Instead this data was collected at the Macksville cemetery camp (refer to **Table 2.1**). The vegetation at the Macksville cemetery flying-fox camp consists of a dense stand of Broad-leaved Paperbark forest approximately 8-12 m in height growing on swampy low-lying ground.

Results of the demographic counts at the Macksville cemetery camp indicated that females were more numerous than males, making up between 59% and 83% of all individuals present. No dependent young were observed with the female GHFF (refer to **Table 2.1**).

As no flying-foxes were present in the current monitoring event at Bellingen Island, comparison data of habitat characteristics and demographic composition was collected nearby at Wheatley Street, and is provided in **Table 2.2**. The flying-foxes at this location are spread out in a linear camp, roughly parallel with Wheatley Street (in **Table 2.2**, locations east, middle and west refer to the general location along the approximately east-west orientated camp). The vegetation in which flying-foxes are roosting consists of a dense overstorey of introduced Camphor Laurel (*Cinnamomum camphora*) and Slash Pine (*Pinus elliotii*) between 8 and 15 m tall over a very open understorey (except for edges in which some weeds are present).

Results of the demographic counts at the Wheatley Street camp indicated that females were more numerous than males in all but one of the demographic counts, occurring in similar proportions to those recorded in the Macksville cemetery camp. No dependent young were observed with the female GHFF (refer to **Table 2.2**).

Table 2.1 Demographic Data of GHFF at Macksville Cemetery Camp

Tree Code	Tree Species	Height (m); DBH (cm)	Approximate Location	Sex Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
MC1	Broad-leaved Paperbark	12; 40	Eastern section	10:7	no	n/a
MC2	Broad-leaved Paperbark	10; 50	Eastern section	10:5	no	n/a
MC3	Broad-leaved Paperbark	10; 40	South-eastern section	10:4	no	n/a
MC4	Broad-leaved Paperbark	10; 40	South-eastern section	10:4	no	n/a
MC5	Broad-leaved Paperbark	8; 25	Southern section	10:3	no	n/a
MC6	Broad-leaved Paperbark	11; 40	South-western section	10:6	no	n/a
MC7	Broad-leaved Paperbark	8; 25	South-western section	10:4	no	n/a
MC8	Swamp Mahogany	8; 25	Western section	10:2	no	n/a
MC9	Broad-leaved Paperbark	6; 20	Western section	10:4	no	n/a
MC10	Broad-leaved Paperbark	10; 40	Western section	10:3	no	n/a

Table 2.2 Demographic Data of GHFF at Wheatley Street Camp

Tree Code	Tree Species	Height (m); DBH (cm)	Approximate Location	Sex Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
BI1	Camphor Laurel	8; 40	East	10:4	no	n/a
BI2	Camphor Laurel	10; 40	East	10:2	no	n/a
BI3	Camphor Laurel	12; 50	East	10:5	no	n/a
BI4	Camphor Laurel	7; 30	East	10:5	no	n/a
BI5	Camphor Laurel	8; 40	Middle	10:7	no	n/a
BI6	Slash Pine	10; 40	Middle	10:3	no	n/a

Tree Code	Tree Species	Height (m); DBH (cm)	Approximate Location	Sex Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
BI7	Camphor Laurel	10; 40	West	10:5	no	n/a
BI8	Camphor Laurel	9; 30	West	4:10	no	n/a
BI9	Camphor Laurel	10; 30	West	10:5	no	n/a
BI10	Camphor Laurel	12; 40	West	10:4	no	n/a

General observations of the flying-foxes present at Bellingin Island (eastern fringe only) and Gordon Park camp indicated that both female and male GHFF were present. Females with dependant young were also observed and similar to Bowraville were present in relatively high numbers.

2.2.3.3 Water level at the site

Water level at the representative measurement location at the site was approximately 55 cm in depth as is shown in **Figure 2.1**. The water level has declined over the last two months, following a peak in levels in January 2015 following heavy rainfall.

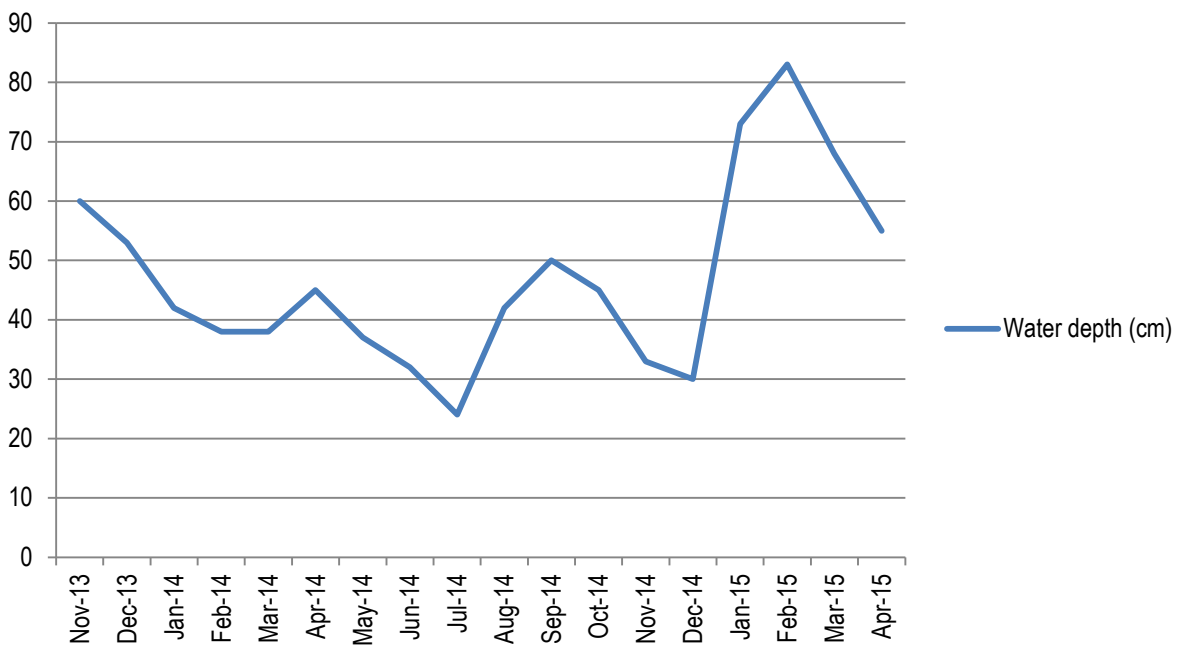


Figure 2.1 Water Level Measurements at The Site



2.3 Discussion

2.3.1 Population Estimates

No flying-foxes were observed to be roosting at the site during the roost traverse undertaken for the current monitoring event. Nor were any flying-foxes observed to be flying from the site in the exit count. Flying-foxes have not been camped at the site (excluding a brief return in January 2015) since mid-April 2014 over a year ago.

Figure 2.2 shows the trend of flying-fox population at the site and other regional sites between April 2014 and April 2015. General comments on the population trends are that:

- At the Site flying-foxes have been absent for the entire period (except for a small number present in mid-January 2015).
- Flying-foxes have established a new camp over the past 3 months at Macksville cemetery, which is relatively close to the site.
- The flying-fox population at Gordon Park has remained relatively stable over the 12 month period.
- The flying-fox population at most Bellingen Island and Bowraville has departed over the past month, as was also observed during the same period in 2014 (it should be noted however, that flying-foxes are still camped in Bellingen at the Wheatley Street camp).

The possibility that the camp formed as a replacement for the camp at Bowraville which has a long history of use, but more recent periods of non-occupation, has previously been identified (Eby 2012). More recently flying-foxes have been present at the Bowraville camp from October 2013 to March 2014 and again from October 2014 until March 2015 (refer to GeoLINK monitoring reports). The absence of flying-fox over the last summer period at the site (excepting the brief occupation recorded in the previous monitoring event in mid-January 2015) may therefore be related this re-occupation of the nearby Bowraville camp by flying-foxes. It is interesting to note that the new occupation of the Macksville cemetery camp coincides with the decline in flying-fox numbers at Bowraville moving into the winter period. Although it cannot be said with any certainty whether the flying-foxes now present at Macksville cemetery originated from the Bowraville camp.

2.3.2 Species Composition and Demographic Data

At occupied camps GHFF dominated the species composition and Black Flying-fox accounted for a small proportion of approximately 5-10% of all individuals present. The proportion of Black Flying-fox at occupied camps in April 2014 was higher at 15-30% (GeoLINK 2014).

As is expected, dependent young GHFF are no longer present at occupied camps as they typically reach full independence around March (Eby 2012).

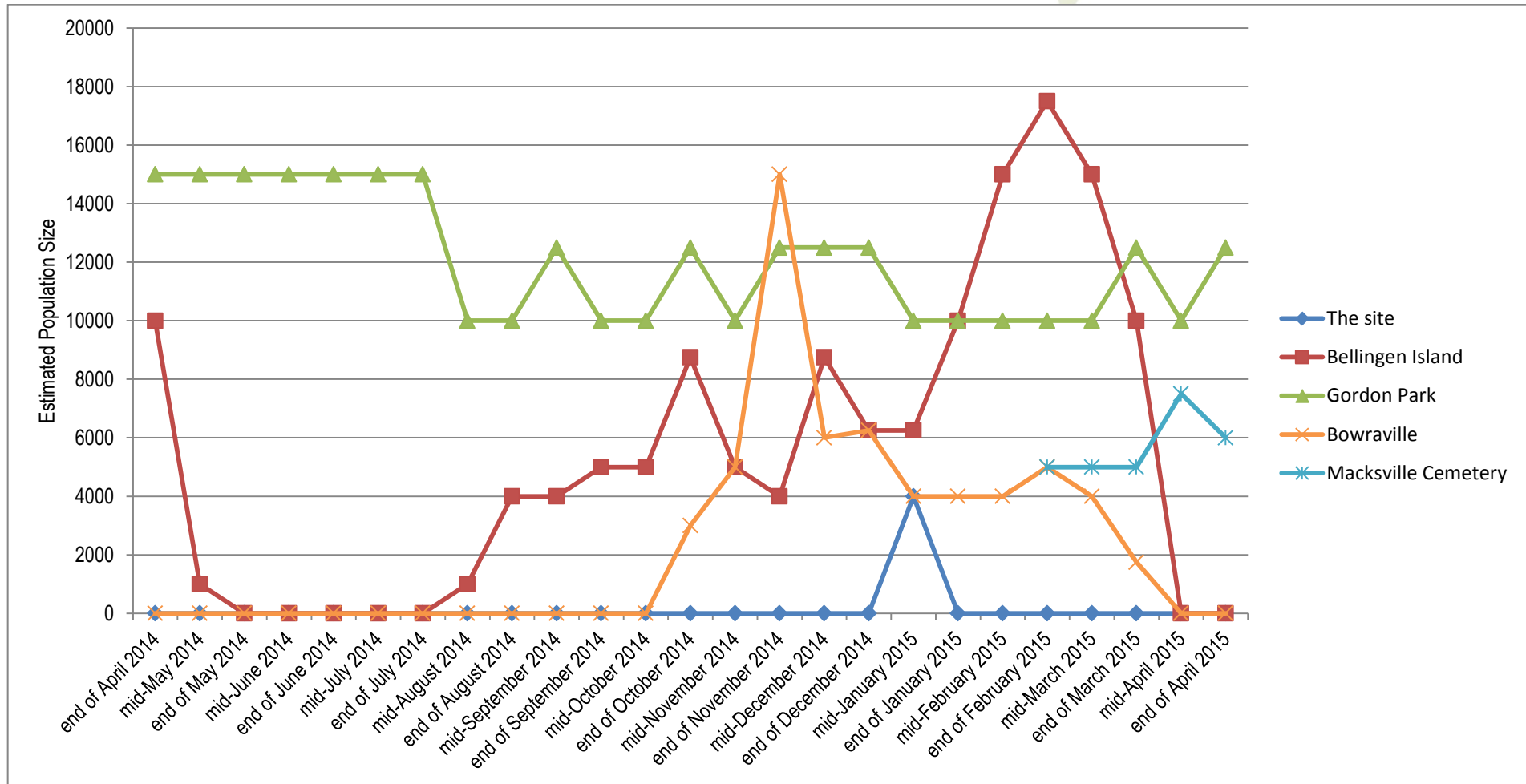
2.3.3 Phenology of Trees Region

Flowering of a number of highly productive nectar source trees for GHFF in the upper North Coast region of NSW in April includes Coastal Blackbutt (*E. pilularis*) (coastal lowlands), Swamp Mahogany (*E. robusta*), and Broad-leaved Paperbark (*Melaleuca quinquenervia*). These highly productive nectar source trees can be considered key diet species for GHFF (Eby 2012; Eby and Law 2008).

Observations when travelling between regional flying-fox camps indicated that moderate flowering of Broad-leaved Paperbark continues in the region.



Figure 2.2 Population trends at the site and regional camps April 2014 to April 2015



Note: population at Macksville cemetery from end of February 2015 until end of March 2015 is estimated based on likely date of first arrival and suggested population level (no exit count/ direct count from observations was made)



2.4 Conclusion

The results of the April 2015 seasonal flying-fox monitoring indicate that excluding a brief stop-over at the site observed in mid-January 2015, flying-foxes have been absent from the site now for the entire 12 month period. The absence of flying-fox at the site may be related to the re-occupation of the nearby Bowraville camp by flying-foxes, and this theory may be supported by a newly established camp at Macksville cemetery near the site. All other regional camps have displayed seasonal absences in the winter period except for the Gordon Park camp which has retained a generally steady population of flying-foxes over the past 12 months.



Tom Pollard

Ecologist



References

Eby, P. and Law, B. (2008). Ranking the feeding habitat of Grey-headed flying foxes for conservation management. Department of Environment, Heritage, Water and the Arts, Canberra.

Eby, P. (2012). An Assessment of the Flying-fox Camp at Macksville. Unpublished report to NSW Roads and Maritime Services.

Eby, P. (2013). A Field Monitoring Program Proposed for the Macksville Flying-fox Roost. Unpublished report to Sinclair Knight Merz.

GeoLINK (2014). Flying-fox Monitoring, Warrell Creek to Nambucca Heads Pacific Highway Upgrade, April 2014. Unpublished report to Jacobs and NSW Roads and Maritime Services. GeoLINK, Lennox Head.

26 May 2015
Ref No: 2182-1129

The Manager
Jacobs
PO Box 2147
DANGAR NSW 2309

Attention: Rachel Vazey

Dear Rachel,

May 2015 fortnightly Flying-fox monitoring report

This short report details the findings of the May 2015 fortnightly Grey-headed Flying-fox (GHFF) monitoring at the Macksville camp (the site) undertaken between standard monthly monitoring events. The purpose of collecting additional data more frequently is to form a clearer picture of short-term population fluctuations at the camp. For more detailed information on methodology used for this monitoring, refer to the monthly flying-fox monitoring reports.

Observations *The Site*

A traverse of the site was undertaken on 15 May 2015. No flying-fox were found to be roosting at the site. This absence of flying-foxes at the site has now extended from mid-April 2014 until present, with the exception of a temporary occupation by a small number of flying-foxes in mid-January 2015.

An exit count was conducted at two vantage points north and south of the site on the evening of 15 May. No flying-foxes were observed flying from the site in the exit count, nor were any flying-foxes observed to be flying over the site as had been recorded in recent monitoring events (likely originating from the nearby Macksville Cemetery flying-fox camp).

Other regional flying-fox camps were visited on 15 May. General observations made at these camps are as follows:

Macksville Cemetery

Observations indicated a reduced roost extent compared with that recorded in the April monthly monitoring event. It is estimated that the camp currently supports approximately 5,000 flying-foxes.

The vast majority of flying-foxes observed were GHFF, with only 0-5% of the overall population being Black Flying-foxes. No dependent young were observed.

Bellingen Island:

No flying-foxes were observed to be camped at Bellingen Island.

Approximately 2,500-5,000 flying-foxes were observed to be roosting nearby to Bellingen Island in the exotic Camphor Laurel and Slash Pine vegetation behind Wheatley Street. The species composition of this camp consisted of approximately 95% GHFF and 5% Black Flying-foxes. No dependent young were observed.

ABN 79 896 839 729
ACN 101 084 557

Return address:
PO Box 119
LENNOX HEAD
NSW 2478

LENNOX HEAD
T 02 6687 7666
F 02 6687 7782

COFFS HARBOUR
T 02 6651 7666
F 02 6651 7733

www.geolink.net.au



Bowraville:

No flying-foxes were observed at the Bowraville camp at the time of the monitoring event.

Gordon Park (Nambucca Heads):

It is estimated that approximately 10,000 flying-foxes were camped at Gordon Park at the time of the monitoring, which is consistent with the population level recorded for some time now. GHFF (>95%) and Black Flying-fox (<5%) were present. No dependent young were observed.

Flowering of Key Foraging Resources

Flowering of a number of highly productive nectar source trees for GHFF in the upper North Coast region of NSW in May includes Broad-leaved Paperbark (*Melaleuca quinquenervia*), Coastal Blackbutt (*E. pilularis*) (lowlands) and Swamp Mahogany (*E. robusta*). These highly productive nectar source trees can be considered key diet species for GHFF (Eby 2012; Eby and Law 2008). Observations when travelling between regional flying-fox camps indicated moderate flowering of Broad-leaved Paperbark is continuing at present along with light flowering of Swamp Mahogany.

If you have any queries regarding this report, please feel free to call on 02 6621 6677.

Yours sincerely

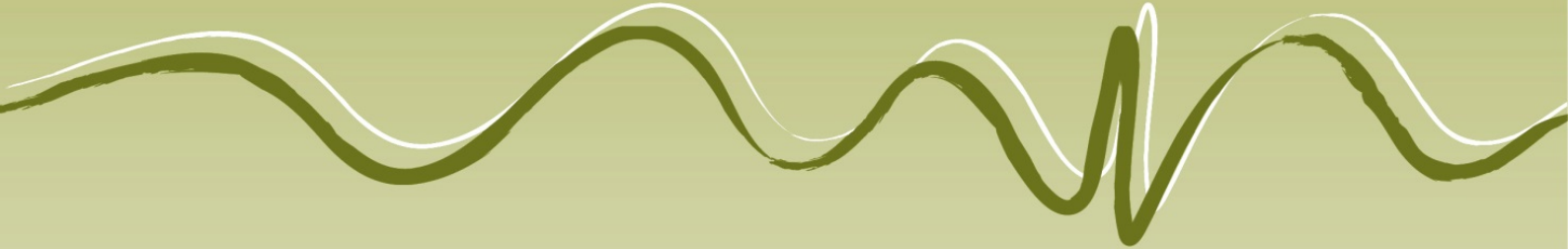
GeoLINK



Tom Pollard
Ecologist

Flying-fox Monitoring May 2015

Warrell Creek to Nambucca Heads Pacific Highway Upgrade



GeoLINK
environmental management and design

PO Box 119
Lennox Head NSW 2478
T 02 6687 7666

PO Box 1446
Coffs Harbour NSW 2450
T 02 6651 7666

info@geolink.net.au

Prepared for: Jacobs
© GeoLINK, 2015

<i>UPR</i>	<i>Description</i>	<i>Date Issued</i>	<i>Issued By</i>
2182-1131	First issue	03/06/2015	Tom Pollard



Table of Contents

1.	Introduction	2
1.1	Introduction	2
2.	Flying-fox Survey	3
2.1	Methodology	3
2.2	Results	4
2.2.1	Roost Footprint	4
2.2.2	Population Estimates	4
2.2.3	Detailed Data	7
2.3	Discussion	10
2.3.1	Population Estimates	10
2.3.2	Species Composition and Demographic Data	10
2.3.3	Phenology of Trees Region	10
2.4	Conclusion	10

Illustrations

Illustration 2.1	Macksville Cemetery Flying-fox roost footprint	5
Illustration 2.2	Location of Regional Flying-fox Camps	6

Tables

Table 2.1	Demographic Data of GHFF at Macksville Cemetery	7
Table 2.2	Demographic Data of GHFF at Wheatley Street	8

Figures

Figure.1	Water Level Measurements at The Site	9
----------	--------------------------------------	---



1. Introduction

1.1 Introduction

Jacobs and NSW Roads and Maritime Services (RMS) are working to resolve issues relating to the Grey-headed Flying-fox (*Pteropus poliocephalus*) (GHFF) camp within the approved alignment of the Warrell Creek to Nambucca Heads (WC2NH) Pacific Highway upgrade project.

GeoLINK has been engaged to undertake monthly flying-fox monitoring at a camp near Macksville, located in a patch of Swamp Sclerophyll Forest vegetation north of Bald Hill Road (henceforth referred to as 'the site'). To date, monthly monitoring at the site has been undertaken by GeoLINK since July 2013. However, a significant amount of data from previous monitoring has also been collected irregularly at the site since occupation commenced in December 2011 (Eby 2012).

This report details the May 2015 monthly flying-fox monitoring results.



2. Flying-fox Survey

2.1 Methodology

Fieldwork for the May 2015 monthly flying-fox monitoring was undertaken by GeoLINK ecologists Dr Tom Pollard and Jessica O'Leary, GeoLINK Environmental Scientist Kale Hardy-Porter, and ecologist Frank Makin (GeoLINK subcontractor). The fieldwork followed the methodology developed by Dr Eby for this roost (Eby 2013). Refer to that document for full details of the methodology. A summary of the main procedures used for the monitoring is provided below.

The fieldwork for this monthly monitoring event was conducted on 28-29 May.

On 28 May a survey of the site was undertaken on foot to locate and map any roosting flying-foxes. When flying-fox are present at the site, data on species composition, demographics, reproductive status and behaviour are collected. In light of the continued absence of flying-foxes at the site and the recent establishment of a flying-fox camp within 2 km of the site adjacent to Macksville cemetery (refer to **Section 2.2**), to provide some information relating to flying-foxes currently camping in the local area this data was instead collected from the Macksville cemetery camp.

The water level at the site was measured at a previously established measurement point. The water level at this location is representative of the average level beneath the camp.

A dusk exit count survey was undertaken at the site on the evening of 28 May to provide an estimate of the number of flying-foxes currently roosting at the camp. Two observers were strategically located for the count on a northern and southern ridge overlooking the camp. In addition to this two observers were also located east and west of the Macksville cemetery camp to undertake an exit count of this camp.

Observers were located at the following vantage points for the site:

- in a paddock to the north of the swamp sclerophyll forest (off Wedgewood Drive); and
- on a ridge south of the camp (41 Bald Hill Road).

Observers were located at the following vantage points for the Macksville cemetery camp:

- adjacent to the Pacific Highway at the edge of the Macksville Golf Course; and
- near the entrance to Macksville cemetery on Wallace Street.

The survey extended over approximately 45 minutes from sunset until dark (approximately 5:00 pm to 5:45 pm).

Other regional flying-fox camps at Gordon Park, Nambucca Heads (approximately 12 km north-east of the Macksville camp), Bowraville and Bellingen Island were visited on 29 May and observational comments made (refer to **Illustration 2.1** for location of these regional camps). As no flying-foxes were present in the current monitoring event at Bellingen Island, comparison data of habitat characteristics and demographic composition was collected nearby at Wheatley Street.



2.2 Results

2.2.1 Roost Footprint

No flying-foxes were observed to be roosting at the site in the camp traverse.

The flying-fox roost footprint at the Macksville Cemetery camp was mapped by GPS and found to be approximately 2.72 ha in size (refer to **Illustration 2.1**), a slight increase in size compared with 1.39 ha measured in the March monitoring event. The camp is located within an area of Swamp Sclerophyll Forest dominated by Broad-leaved Paperbark (*Melaleuca quinquenervia*) with a height of approximately 8-12 m. The water depth beneath this camp was approximately 10-30 cm at the time of the survey.

The flying-fox roost footprint at Gordon Park (Nambucca Heads) remains relatively extensive, and is generally consistent with that recorded in the last monthly monitoring event. Flying-foxes were absent at both the Bowraville and Bellingen Island camp. However, several thousand individuals were observed to be roosting at Bellingen in the Camphor Laurel and Slash Pine vegetation adjacent to Wheatley Street.

2.2.2 Population Estimates

2.2.2.1 Exit Counts

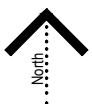
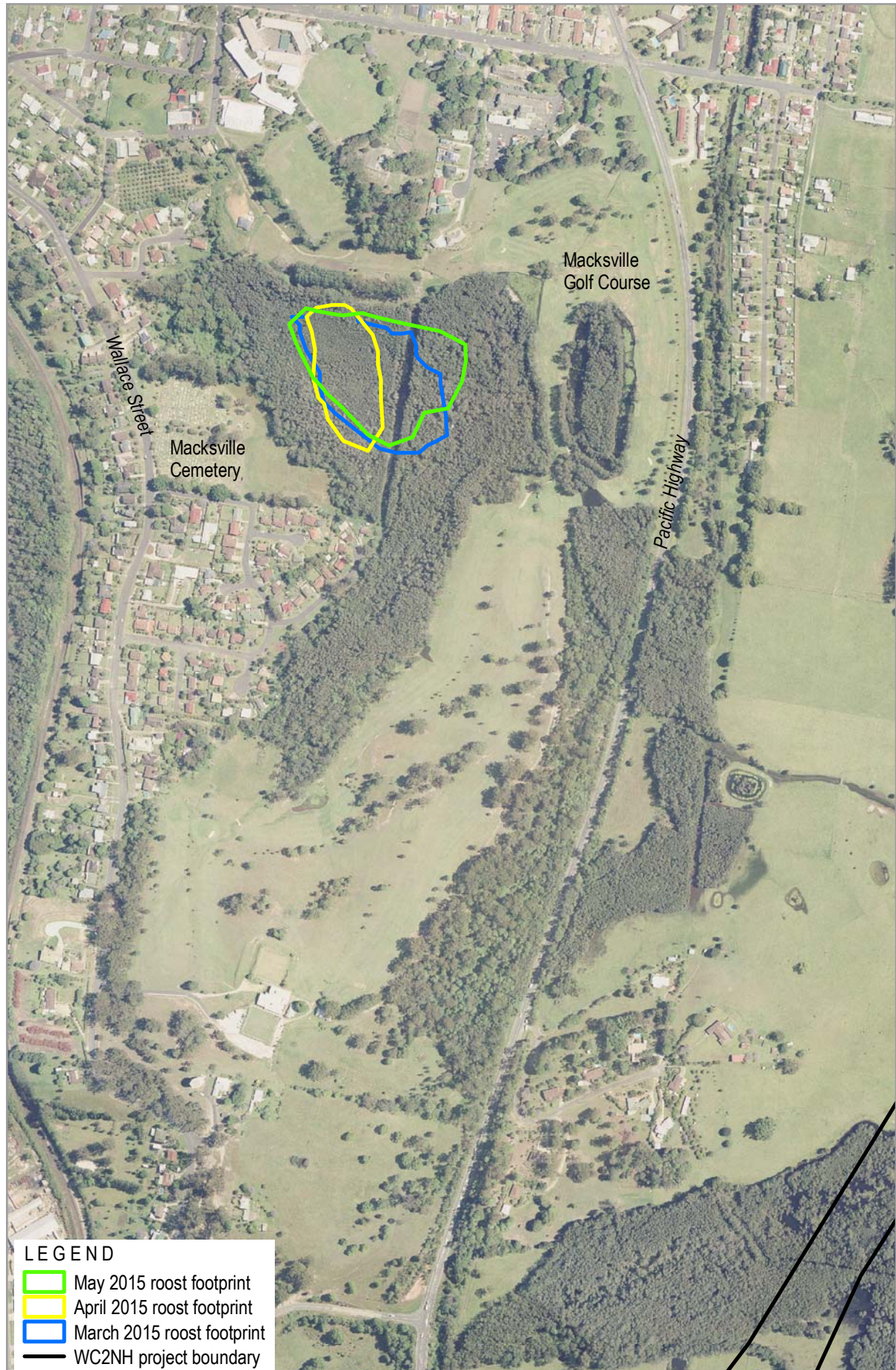
No flying-foxes were observed flying from the site in the exit count. Nor were any flying-foxes observed to be flying across the site.

The exit count undertaken for the Macksville cemetery camp indicated that approximately 15,000 flying-foxes were roosting at this camp at the time of the monitoring event.

2.2.2.2 Direct Counts

The location of the regional flying-fox camps visited is shown in **Illustration 2.1**. No exit count was conducted at any of these regional camps. However, rough population estimates for these camps based on extrapolation of counts in individual trees and the roost footprint are as follows:

- Gordon Park: approximately 10,000 to 15,000 individuals (population size is broadly consistent with that recorded in the last monthly monitoring event);
- Bowraville: no individuals recorded (flying-foxes have now been absent since mid-April); and
- Bellingen Island: no individuals recorded (flying-foxes have now been absent since mid-April); however, as mentioned previously several thousand flying-foxes are currently roosting nearby at Wheatley Street).

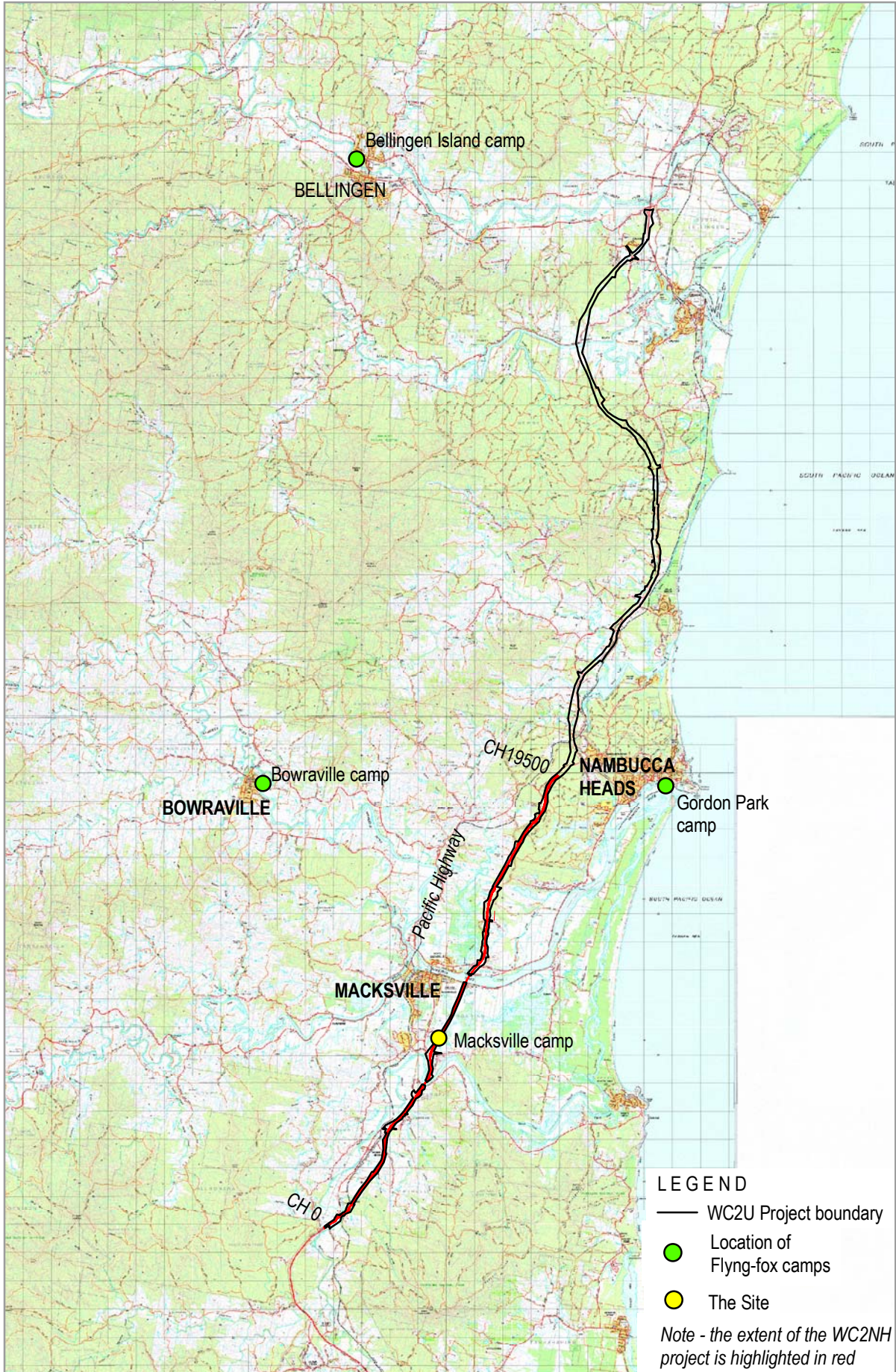


0 150



Macksville Cemetery Flying-fox Roost Footprint

Information shown is for illustrative purposes only



0 4 km



Location of Regional Flying-fox camps

2.2.3 Detailed Data

2.2.3.1 Species Composition

No flying-foxes were recorded at the site. Therefore, no detailed species composition data was collected at the site for the current monitoring event.

The species composition and proportions at the regional camps (including the Macksville cemetery camp) visited was as follows:

- Macksville Cemetery – GHFF >95%, Black Flying-fox <5%.
- Gordon Park – GHFF >90%, Black Flying-fox <10%.
- Wheatley Street, Bellingen – GHFF 95%, Black Flying-fox 5%.

A similar species composition of GHFF making up at least 90% of all flying-foxes present was also recorded in the previous monitoring event.

2.2.3.2 Habitat Characteristics and Demographic Composition

As mentioned previously, no detailed demographic composition data at the site was collected for the current monitoring event. Instead this data was collected at the Macksville cemetery camp (refer to **Table 2.1**). The vegetation at the Macksville cemetery flying-fox camp consists of a dense stand of Broad-leaved Paperbark forest approximately 8-12 m in height growing on swampy low-lying ground.


Results of the demographic counts at the Macksville cemetery camp indicated that females were more numerous than males, making up between 57% and 83% of all individuals present. No dependent young were observed with the female GHFF (refer to **Table 2.1**).

As no flying-foxes were present in the current monitoring event at Bellingen Island, comparison data of habitat characteristics and demographic composition was collected nearby at Wheatley Street, and is provided in **Table 2.2**. The flying-foxes at this location are spread out in a linear camp, roughly parallel with Wheatley Street (in **Table 2.2**, locations east, middle and west refer to the general location along the approximately east-west orientated camp). The vegetation in which flying-foxes are roosting consists of a dense overstorey of introduced Camphor Laurel (*Cinnamomum camphora*) and Slash Pine (*Pinus elliotii*) between 8 and 15 m tall over a very open understorey (except for edges in which some weeds are present).

Results of the demographic counts at the Wheatley Street camp indicated that females were more numerous than males in all of the demographic counts, and occurring in similar proportions to those recorded in the Macksville cemetery camp making up between 62% and 83% of all individuals present. No dependent young were observed with the female GHFF (refer to **Table 2.2**).

Table 2.1 Demographic Data of GHFF at Macksville Cemetery

Tree Code	Tree Species	Height (m); DBH (cm)	Approximate Location	Sex Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
MC1	Broad-leaved Paperbark	10; 50	Western section	10:4	no	n/a



Tree Code	Tree Species	Height (m); DBH (cm)	Approximate Location	Sex Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
MC2	Broad-leaved Paperbark	10; 40	Western section	10:5	no	n/a
MC3	Broad-leaved Paperbark	10; 50	Western section	10:4	no	n/a
MC4	Broad-leaved Paperbark	8; 30	South-western section	10:8	no	n/a
MC5	Broad-leaved Paperbark	10; 30	South-western section	10:3	no	n/a
MC6	Broad-leaved Paperbark	10; 40	Southern section	10:3	no	n/a
MC7	Broad-leaved Paperbark	8; 25	Eastern section	10:4	no	n/a
MC8	Broad-leaved Paperbark	8; 30	Eastern section	10:2	no	n/a
MC9	Broad-leaved Paperbark	10; 60	Northern section	10:4	no	n/a
MC10	Broad-leaved Paperbark	8; 30	Northern section	10:5	no	n/a

Table 2.2 Demographic Data of GHFF at Wheatley Street

Tree Code	Tree Species	Height (m); DBH (cm)	Approximate Location	Sex Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
WS1	Giant Stinging Tree	9; 50	South-eastern section	10:3	no	n/a
WS2	Creek Sandpaper Fig	7; 30	South-eastern section	10:5	no	n/a
WS3	Giant Stinging Tree	8; 35	South-eastern section	10:3	no	n/a
WS4	Creek Sandpaper Fig	8; 30	South-eastern section	10:2	no	n/a

Tree Code	Tree Species	Height (m); DBH (cm)	Approximate Location	Sex Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
WS5	Creek Sandpaper Fig	6; 20	Southern section	10:6	no	n/a
WS6	Creek Sandpaper Fig	7; 20	Southern section	10:3	no	n/a
WS7	Giant Stinging Tree	10; 40	Southern section	10:4	no	n/a
WS8	Unknown sp.	8; 50	Eastern channel section	10:4	no	n/a
WS9	Giant Stinging Tree	5; 20	Eastern channel section	10:5	no	n/a
WS10	Giant Stinging Tree	9; 60	Eastern channel section	10:2	no	n/a

General observations of the flying-foxes present at Gordon Park camp indicated that both female and male GHFF were present. Females with dependant young were not observed at Gordon Park.

2.2.3.3 Water level at the site

Water level at the representative measurement location at the site was approximately 50 cm in depth as is shown in **Figure 2.1**. Water levels are now showing a decreasing trend after a peak in February.

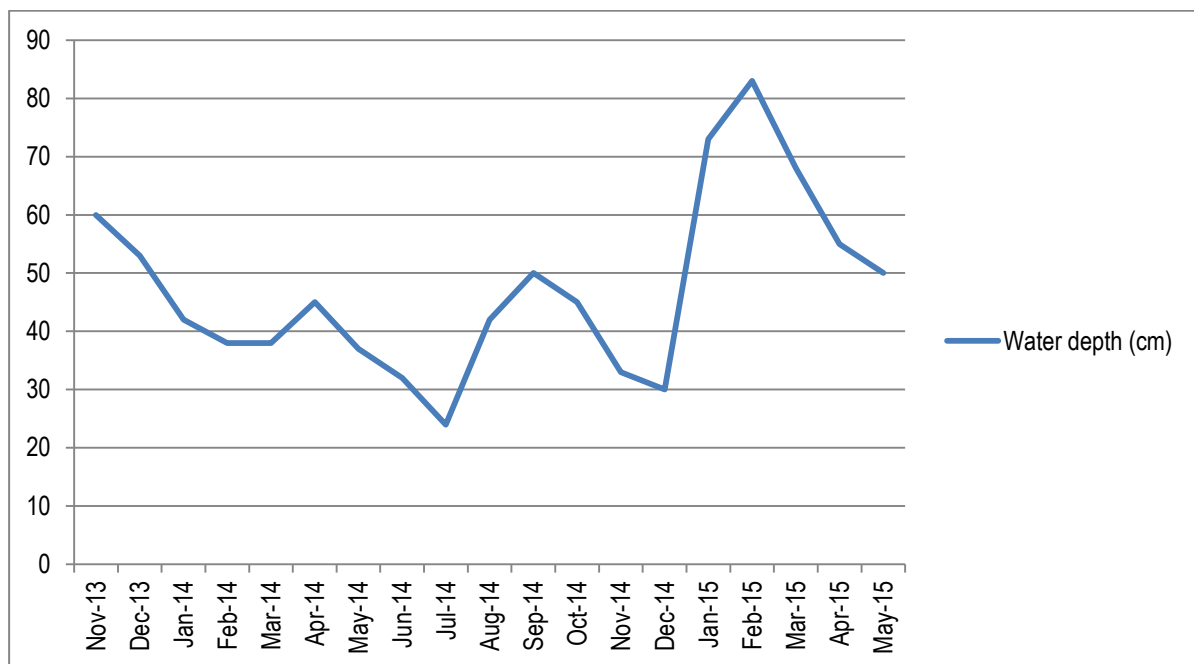


Figure.1 Water Level Measurements at The Site



2.3 Discussion

2.3.1 Population Estimates

No flying-foxes were observed to be roosting at the site during the roost traverse undertaken for the current monitoring event. Nor were any flying-foxes observed to be flying from the site in the exit count. The absence of flying-foxes at the site now extends from mid-April 2014 until present (excluding the temporary return of a relatively small number of flying-foxes in mid-January 2015).

The exit count conducted at the nearby Macksville cemetery camp indicated that a relatively large number (approximately 15,000) of flying-foxes (predominantly GHFF) are currently roosting at this alternative location within approximately 1-2 km of the site. This represents a substantial increase in numbers from the 5,000 to 7,500 flying-foxes counted at this camp in recent previous monitoring events. These elevated numbers of flying-foxes are likely related to the current widespread availability of Broad-leaved Paperbark nectar on the coastal lowlands.

The absence of flying-foxes at both the Bowraville and Bellingen Island camp, recorded in mid-April 2015 continues. However, several thousand individuals were recorded roosting at Bellingen in the Camphor Laurel and Slash Pine vegetation adjacent to Wheatley Street, as has been recorded since March 2015.

2.3.2 Species Composition and Demographic Data

At occupied camps GHFF dominated the species composition and Black Flying-fox accounted for a small proportion of approximately 5-10% of all individuals present. A similar result was also noted in the monitoring undertaken in May 2014 (GeoLINK 2014).

As is expected, dependent young GHFF are no longer present at occupied camps as they typically reach full independence around March (Eby 2012).

2.3.3 Phenology of Trees Region

Flowering of a number of highly productive nectar source trees for GHFF in the upper North Coast region of NSW in May includes Broad-leaved Paperbark (*Melaleuca quinquenervia*), Coastal Blackbutt (*E. pilularis*) (lowlands) and Swamp Mahogany (*E. robusta*). These highly productive nectar source trees can be considered key diet species for GHFF (Eby 2012; Eby and Law 2008). Observations when travelling between regional flying-fox camps indicated moderate flowering of Broad-leaved Paperbark is continuing at present along with light flowering of Swamp Mahogany.

2.4 Conclusion

The results of the May 2015 flying-fox monitoring indicate that excluding a brief stop-over at the site observed in mid-January 2015, flying-foxes have been absent from the site now for over 12 months.

Flying-foxes remain absent from both the Bowraville camp and the Bellingen Island camp. However, GHFF are still camped in a separate nearby camp in Bellingen. In contrast to these population declines, the numbers of flying-foxes at Gordon Park remain relatively high.



Tom Pollard

Tom Pollard

Ecologist



References

Eby, P. and Law, B. (2008). Ranking the feeding habitat of Grey-headed flying foxes for conservation management. Department of Environment, Heritage, Water and the Arts, Canberra.

Eby, P. (2012). An Assessment of the Flying-fox Camp at Macksville. Unpublished report to NSW Roads and Maritime Services.

Eby, P. (2013). A Field Monitoring Program Proposed for the Macksville Flying-fox Roost. Unpublished report to Sinclair Knight Merz.

GeoLINK (2014). *Flying-fox Monitoring, Warrell Creek to Nambucca Heads Pacific Highway Upgrade*, May 2014. Unpublished report to Jacobs and NSW Roads and Maritime Services. GeoLINK, Lennox Head.

16 June 2015
Ref No: 2182-1135

The Manager
Jacobs
PO Box 2147
DANGAR NSW 2309

Attention: Rachel Vazey

Dear Rachel,

June 2015 fortnightly Flying-fox monitoring report

This short report details the findings of the June 2015 fortnightly Grey-headed Flying-fox (GHFF) monitoring at the Macksville camp (the site) undertaken between standard monthly monitoring events. The purpose of collecting additional data more frequently is to form a clearer picture of short-term population fluctuations at the camp. For more detailed information on methodology used for this monitoring, refer to the monthly flying-fox monitoring reports.

Observations

The Site

The site was visually inspected for flying-foxes on 10 June. No flying-foxes were found to be roosting at the site at this time. This absence of flying-foxes at the site has now extended from mid-April 2014 until present, with the exception of a temporary occupation by a small number of flying-foxes in mid-January 2015.

An exit count was conducted at two vantage points north and south of the site on the evening of 10 June. No flying-foxes were observed to be flying from the site in the exit count however, several thousand flying-foxes were observed to be flying over the site from the north-west (likely originating from the nearby Macksville Cemetery flying-fox camp).

Other regional flying-fox camps were visited on 11 June. General observations made at these camps are as follows:

Macksville Cemetery

Observations indicated a similar roost extent to that recorded in the May monthly monitoring event. It is estimated that the camp currently supports approximately 15,000 flying-foxes.

The monitoring indicated the presence of a substantial population of Black Flying-foxes currently roosting at this camp, particularly around the fringes, estimated to account for approximately 20-30% of the total flying-fox population. No dependent young were observed.

Bellingen Island:

No flying-foxes were observed to be camped at Bellingen Island.

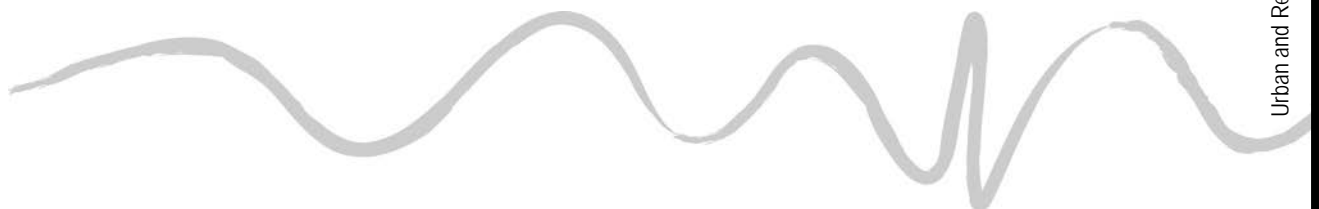
ABN 79 896 839 729
ACN 101 084 557

Return address:
PO Box 119
LENNOX HEAD
NSW 2478

LENNOX HEAD
T 02 6687 7666
F 02 6687 7782

COFFS HARBOUR
T 02 6651 7666
F 02 6651 7733

www.geolink.net.au



Approximately 2,500 flying-foxes were observed to be roosting nearby to Bellingen Island in the exotic Camphor Laurel and Slash Pine vegetation behind Wheatley Street. There has been a decrease in flying-fox numbers at this camp since the previous monitoring event. Observations indicated that the species composition of this camp consisted entirely of GHFF. No dependent young were observed.

Bowraville:

No flying-foxes were observed at the Bowraville camp at the time of the monitoring event.

Gordon Park (Nambucca Heads):

It is estimated that approximately 10,000-15,000 flying-foxes were camped at Gordon Park at the time of the monitoring, which is consistent with the population level recorded for some time now. GHFF (>95%) and Black Flying-fox (<5%) were present. No dependent young were observed.

Flowering of Key Foraging Resources

Flowering of a number of highly productive nectar source trees for GHFF in the upper North Coast region of NSW in June includes Broad-leaved Paperbark (*Melaleuca quinquenervia*), Swamp Mahogany (*E. robusta*), and Coastal Blackbutt (*E. pilularis*) and Forest Red Gum (*E. tereticornis*) (both on the coastal lowlands). These highly productive nectar source trees can be considered key diet species for GHFF (Eby 2012; Eby and Law 2008).

Observations when travelling between regional flying-fox camps indicated that Broad-leaved Paperbark flowering has now essentially finished. None of the other key diet species listed above were observed to be flowering in the region, however flowering of other (non-key) species that are nectar sources was observed; particularly heavy flowering of Coast Banksia (*Banksia integrifolia*).

If you have any queries regarding this report, please feel free to call on 02 6621 6677.

Yours sincerely

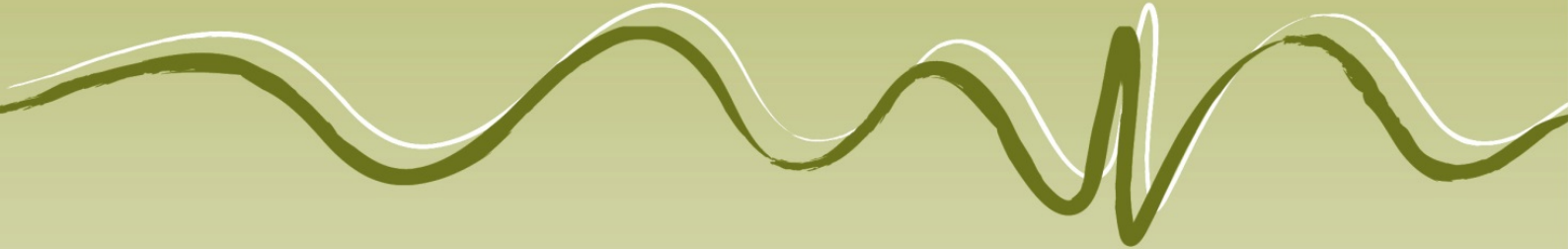
GeoLINK



Tom Pollard
Ecologist

Flying-fox Monitoring June 2015

Warrell Creek to Nambucca Heads Pacific Highway Upgrade



GeoLINK
environmental management and design

PO Box 119
Lennox Head NSW 2478
T 02 6687 7666

PO Box 1446
Coffs Harbour NSW 2450
T 02 6651 7666

info@geolink.net.au

Prepared for: Jacobs
© GeoLINK, 2015

<i>UPR</i>	<i>Description</i>	<i>Date Issued</i>	<i>Issued By</i>
2182-1136	First issue	25/06/2015	Tom Pollard



Table of Contents

1.	Introduction	2
1.1	Introduction	2
2.	Flying-fox Survey	3
2.1	Methodology	3
2.2	Results	5
2.2.1	Roost Footprint	5
2.2.2	Population Estimates	5
2.2.3	Detailed Data	8
2.3	Discussion	11
2.3.1	Population Estimates	11
2.3.2	Species Composition and Demographic Data	11
2.3.3	Phenology of Trees Region	11
2.4	Conclusion	11

Illustrations

Illustration 2.1	Macksville Cemetery Flying-fox roost footprint	6
Illustration 2.2	Location of Regional Flying-fox Camps	7

Tables

Table 2.1	Demographic Data of GHFF at Macksville Cemetery	8
Table 2.2	Demographic Data of GHFF at Wheatley Street	9

Figures

Figure.1	Water Level Measurements at The Site	10
----------	--------------------------------------	----



1. Introduction

1.1 Introduction

Jacobs and NSW Roads and Maritime Services (RMS) are working to resolve issues relating to the Grey-headed Flying-fox (*Pteropus poliocephalus*) (GHFF) camp within the approved alignment of the Warrell Creek to Nambucca Heads (WC2NH) Pacific Highway upgrade project.

GeoLINK has been engaged to undertake monthly flying-fox monitoring at a camp near Macksville, located in a patch of Swamp Sclerophyll Forest vegetation north of Bald Hill Road (henceforth referred to as 'the site'). To date, monthly monitoring at the site has been undertaken by GeoLINK since July 2013. However, a significant amount of data from previous monitoring has also been collected irregularly at the site since occupation commenced in December 2011 (Eby 2012).

This report details the June 2015 monthly flying-fox monitoring results.



2. Flying-fox Survey

2.1 Methodology

Fieldwork for the June 2015 monthly flying-fox monitoring was undertaken by GeoLINK ecologists Dr Tom Pollard, David Havilah and Jessica O’Leary, and GeoLINK Environmental Scientist Kale Hardy-Porter. The fieldwork followed the methodology developed by Dr Eby for this roost (Eby 2013). Refer to that document for full details of the methodology. A summary of the main procedures used for the monitoring is provided below.

The fieldwork for this monthly monitoring event was conducted on 23-24 June.

On 23 June an assessment of the site was undertaken on foot to locate and map any roosting flying-foxes. Vegetation clearing within the Swamp Sclerophyll Forest that has previously supported the flying-fox camp at the site has now been completed (refer to **Plate 2.1**). Due to presence of windrowed trees throughout the site it was not considered safe to traverse the area. Consequently, the assessment of whether flying-fox were roosting at the site was limited to sharp clapping of the hands and listening for a vocal response from any roosting flying-foxes. It is also worth noting that at the time of the monitoring loud noise from rock fill being placed in the swamp along the alignment was occurring (this would likely be acting as a deterrent to any flying-foxes choosing to roost at the site at present).

When flying-fox are present at the site, data on species composition, demographics, reproductive status and behaviour are collected. In light of the continued absence of flying-foxes at the site and recent establishment of the flying-fox camp at Macksville cemetery (2 km away) (refer to **Section 2.2**), data was instead collected there to provide some information relating to flying-foxes currently camping in the local area.

The water level measuring point within the swamp was also inaccessible due to the clearing operations, and the water depth was therefore estimated based on visual observations and comparison with levels seen in the previous fortnightly monitoring event two weeks previous.

A dusk exit count survey was undertaken at the site on the evening of 23 June to provide an estimate of the number of flying-foxes currently roosting at the camp. Two observers were strategically located for the count on a northern and southern ridge overlooking the camp. In addition to this, two observers were also located east and west of the Macksville cemetery camp to undertake an exit count of this camp.

Observers were located at the following vantage points for the site:

- in a paddock to the north of the swamp sclerophyll forest (off Wedgewood Drive); and
- on a ridge south of the camp (41 Bald Hill Road).

Observers were located at the following vantage points for the Macksville cemetery camp:

- adjacent to the Pacific Highway at the edge of the Macksville Golf Course; and
- near the entrance to Macksville cemetery on Wallace Street.

The survey extended over approximately 45 minutes from sunset until dark (approximately 5:15 pm to 6:00 pm).

Other regional flying-fox camps at Gordon Park, Nambucca Heads (approximately 12 km north-east of the Macksville camp), Bowraville and Bellingen Island were visited on 24 June and observational comments made (refer to **Illustration 2.1** for location of these regional camps). As no flying-foxes were present in the current monitoring event at Bellingen Island, comparison data of habitat characteristics and demographic composition was collected nearby at Wheatley Street.



Plate 2.1 Vegetation clearing for the WC2NH project at the site (June 23 2015)



2.2 Results

2.2.1 Roost Footprint

No flying-foxes were observed to be roosting at the site.

The flying-fox roost footprint at the Macksville Cemetery camp was mapped by GPS and found to be approximately 1.65 ha in size (refer to **Illustration 2.1**), which is a substantial decrease in size compared with the May monthly monitoring. The camp is located within an area of Swamp Sclerophyll Forest dominated by Broad-leaved Paperbark (*Melaleuca quinquenervia*) with a height of approximately 8-12 m. The water depth beneath this camp was approximately 10-30 cm at the time of the survey.

The flying-fox roost footprint at Gordon Park (Nambucca Heads) remains relatively extensive, but appears to have decreased slightly in extent since the previous monitoring event. Flying-foxes were absent at both the Bowraville and Bellingen Island camp. However, a relatively small area of Camphor Laurel and Slash Pine vegetation adjacent to Wheatley Street nearby to Bellingen Island is still be utilised by flying-foxes, as has been recorded sporadically previously. The roost area of the Wheatley Street camp was considerably smaller than that recorded in the previous monitoring event and is now focused on the north-east corner of the vegetation near the Rural Fire Service shed. The vegetation in which flying-foxes are roosting consists of a dense overstorey of introduced Camphor Laurel (*Cinnamomum camphora*) and Slash Pine (*Pinus elliotii*) between 8 and 15 m tall over a very open understorey (except for edges in which some weeds are present).

2.2.2 Population Estimates

2.2.2.1 Exit Counts

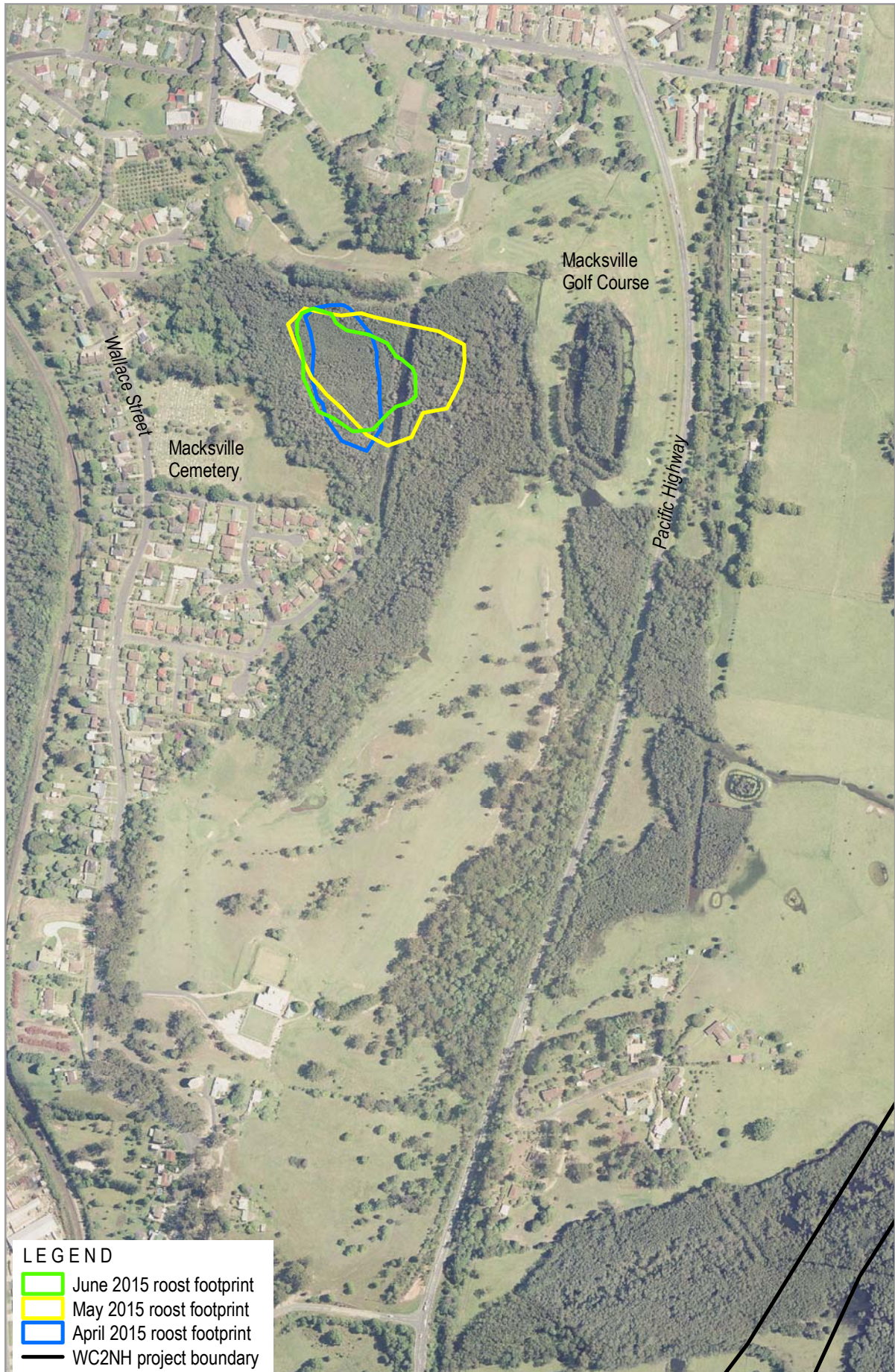
No flying-foxes were observed flying from the site in the exit count. Nor were any flying-foxes observed to be flying across the site.

The exit count undertaken for the Macksville cemetery camp indicated that approximately 7,750 flying-foxes were roosting at this camp at the time of the monitoring event.

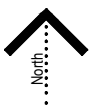
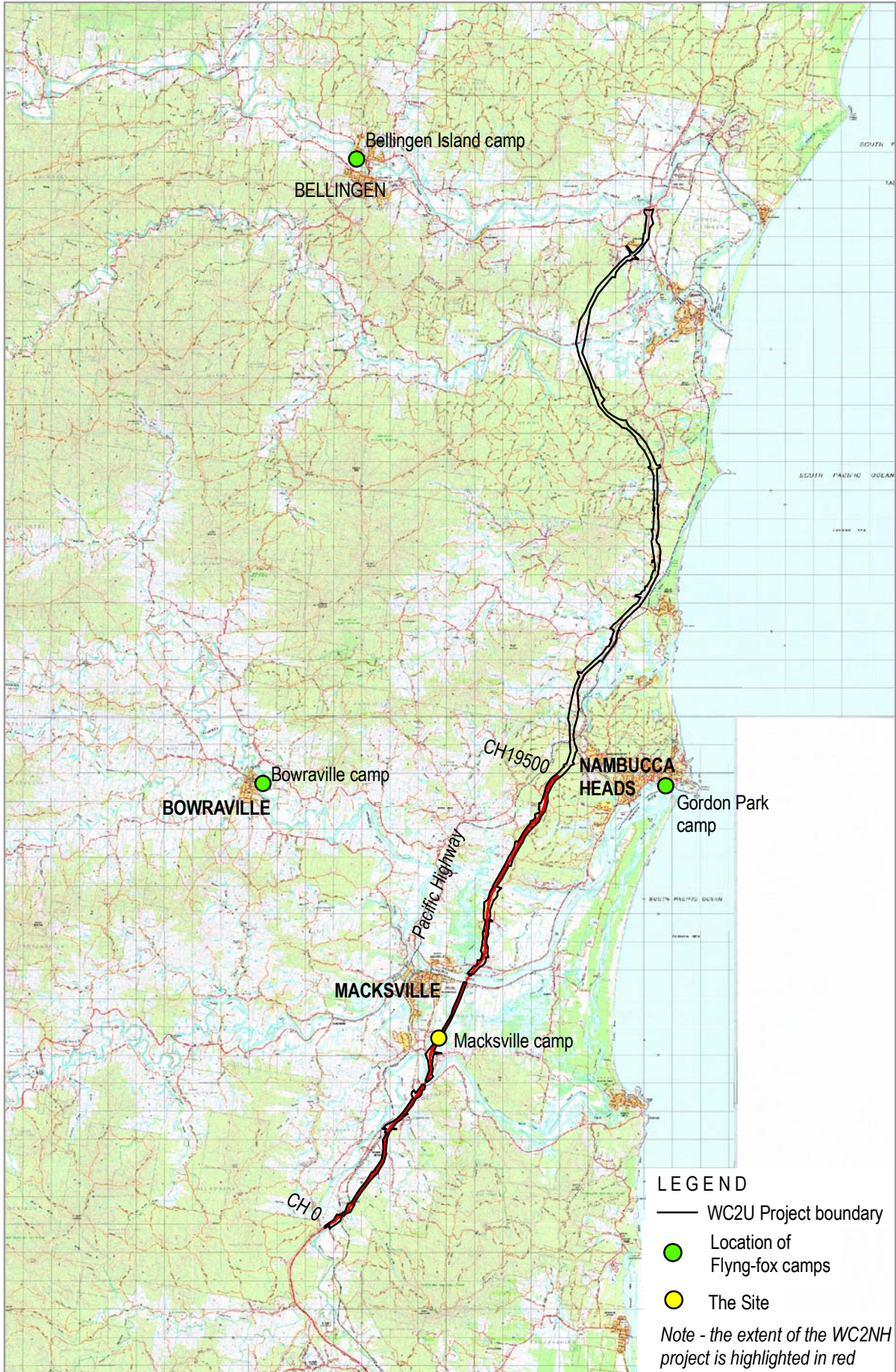
2.2.2.2 Direct Counts

The location of the regional flying-fox camps visited is shown in **Illustration 2.1**. No exit count was conducted at any of these regional camps. However, rough population estimates for these camps based on extrapolation of counts in individual trees and the roost footprint are as follows:

- Gordon Park: approximately 10,000 individuals (population size similar to that recorded in the last monthly monitoring event);
- Bowraville: no individuals recorded (flying-foxes have now been absent since mid-April); and
- Bellingen Island: no individuals recorded (flying-foxes have now been absent since mid-April); however, approximately 1,000 flying-foxes are currently roosting nearby at Wheatley Street; a substantial decrease since the previous monitoring event.



Information shown is for illustrative purposes only



0 4 km



Location of Regional Flying-fox camps

2.2.3 Detailed Data

2.2.3.1 Species Composition

No flying-foxes were recorded at the site. Therefore, no detailed species composition data was collected at the site for the current monitoring event.

The species composition and proportions at the regional camps (including the Macksville cemetery camp) visited was as follows:

- Macksville Cemetery – GHFF 80%, Black Flying-fox 20%.
- Gordon Park – GHFF >90%, Black Flying-fox <10%.
- Wheatley Street, Bellingen – GHFF 100%, Black Flying-fox 0%.

2.2.3.2 Habitat Characteristics and Demographic Composition

As mentioned previously, no detailed demographic composition data at the site was collected for the current monitoring event. Instead this data was collected at the Macksville cemetery camp (refer to **Table 2.1**). The vegetation at the Macksville cemetery flying-fox camp consists of a dense stand of Broad-leaved Paperbark forest approximately 8-12 m in height growing on swampy low-lying ground.

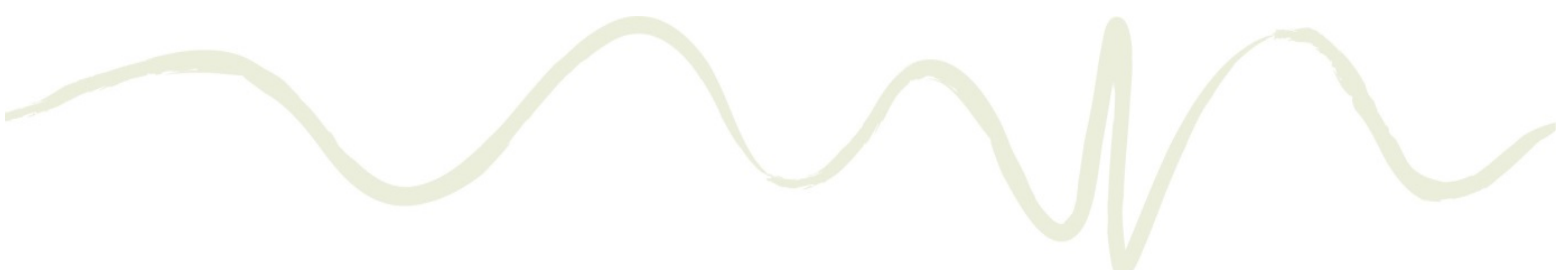
Results of the demographic counts at the Macksville cemetery camp indicated that females were more numerous than males, making up between 56% and 71% of all individuals present. No dependent young are present at this time of year (refer to **Table 2.1**).

As no flying-foxes were present in the current monitoring event at Bellingen Island, comparison data of habitat characteristics and demographic composition was collected nearby at Wheatley Street, and is provided in **Table 2.2**. Due to the small numbers of flying-foxes roosting at Wheatley Street at present (approximately 1,000) it was only possible to collect data for five demographic data points.

Results of the demographic counts at the Wheatley Street camp indicated that females were more numerous than males in the majority of the demographic counts, and occurring in similar proportions to those recorded in the Macksville cemetery camp making up between 59% and 67% of all individuals present (refer to **Table 2.2**).

Table 2.1 Demographic Data of GHFF at Macksville Cemetery

Tree Code	Tree Species	Height (m); DBH (cm)	Approximate Location	Sex Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
MC1	Broad-leaved Paperbark	8; 40	Eastern section	10:6	no	n/a
MC2	Broad-leaved Paperbark	11; 50	Eastern section	10:4	no	n/a
MC3	Broad-leaved Paperbark	9; 45	Eastern section	10:5	no	n/a
MC4	Broad-leaved	8; 25	South-eastern section	10:8	no	n/a



Tree Code	Tree Species	Height (m); DBH (cm)	Approximate Location	Sex Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
	Paperbark					
MC5	Broad-leaved Paperbark	9; 30	South-eastern section	10:5	no	n/a
MC6	Broad-leaved Paperbark	10; 50	Southern section	10:5	no	n/a
MC7	Broad-leaved Paperbark	8; 25	Southern section	10:6	no	n/a
MC8	Broad-leaved Paperbark	9; 30	Western section	10:4	no	n/a
MC9	Broad-leaved Paperbark	7; 20	Western section	10:5	no	n/a
MC10	Broad-leaved Paperbark	10; 40	Western section	10:8	no	n/a

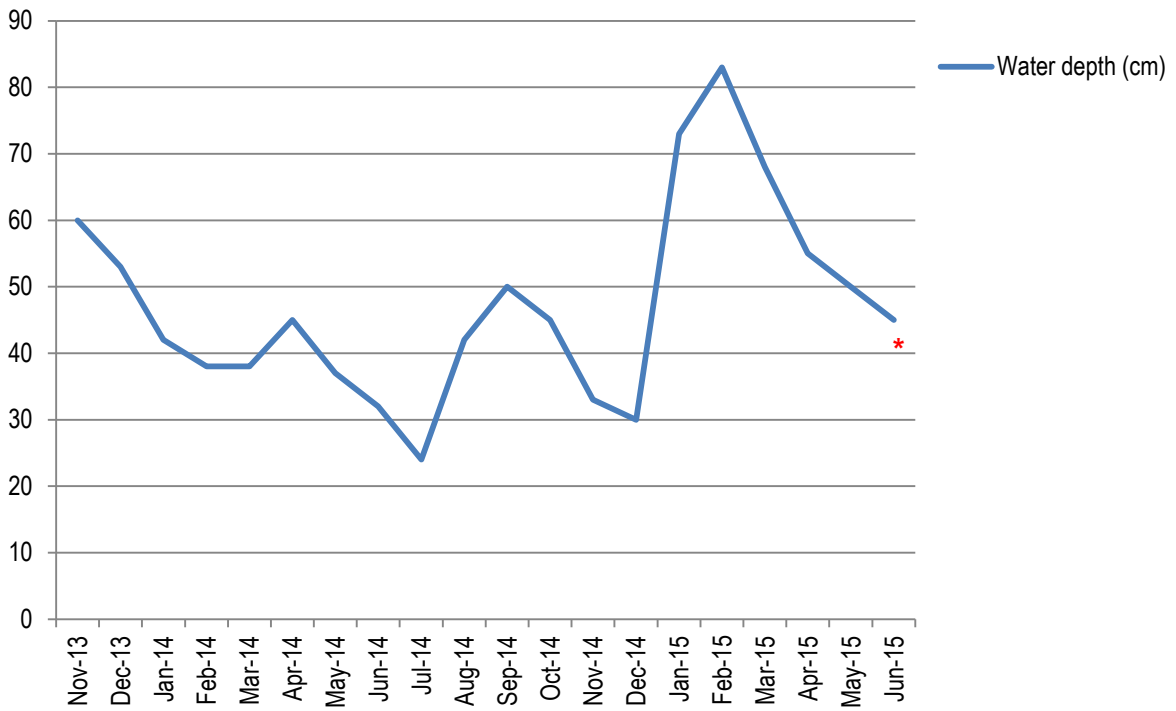
Table 2.2 Demographic Data of GHFF at Wheatley Street

Tree Code	Tree Species	Height (m); DBH (cm)	Approximate Location	Sex Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
WS1	Camphor Laurel	9; 40	South-eastern section	10:5	no	n/a
WS2	Camphor Laurel	7; 20	South-eastern section	10:7	no	n/a
WS3	Camphor Laurel	8; 30	South-eastern section	10:7	no	n/a
WS4	Camphor Laurel	7; 30	South-eastern section	10:5	no	n/a
WS5	Camphor Laurel	8; 50	Southern section	10:5	no	n/a

* Note: due to small population present only 5 demographic count points could be completed

2.2.3.3 Water level at the site

General observation of the water level at the site indicated that the water level has continued to decrease since a peak in February (however, no direct measurement was made – refer to **Section 2.1**). The water level at the site was estimated to be approximately 45 cm in depth as is shown in **Figure 2.1**.



* Water level estimated

Figure.1 Water Level Measurements at The Site



2.3 Discussion

2.3.1 Population Estimates

The absence of flying-foxes at the site now extends from mid-April 2014 until present (excluding the temporary return of a relatively small number of flying-foxes in mid-January 2015).

The exit count conducted at the nearby Macksville cemetery camp indicated that the number of flying-foxes has reduced substantially from around 15,000 individuals recorded in the previous monitoring event in May to 7,750 individuals recorded in the current monitoring event. During the peak in flying-fox numbers species such as Broad-leaved Paperbark and Coast Banksia were prominently flowering. The availability of these foraging resources may have been supporting elevated flying-fox numbers in the coastal lowlands at this time.

The absence of flying-foxes at both the Bowraville and Bellingen Island camp, recorded in mid-April 2015 continues. However, flying-foxes are still roosting nearby in Bellingen in the Camphor Laurel and Slash Pine vegetation adjacent to Wheatley Street, as has been recorded since March 2015. Numbers at the Wheatley Street camp were substantially lower in this monitoring event which may be a reflection of local resource availability. A lack of strong flowering of any of the key flying-fox foraging resources in the region at the time of the current monitoring event is likely to be an influencing factor in lower flying-fox numbers in Bellingen.

2.3.2 Species Composition and Demographic Data

At occupied camps GHFF dominated the species composition and Black Flying-fox accounted for a small proportion of approximately 5-20% of all individuals present. A similar result was also noted in the monitoring undertaken in June 2014 (GeoLINK 2014). As was noted in the last fortnightly monitoring event, a substantial increase in the proportion of Black Flying-fox roosting at the Macksville cemetery camp has recently occurred (making up $\geq 20\%$ of all individuals present). A similar species composition was also recorded in the previous monitoring event.


As expected, dependent young GHFF were not recorded in occupied camps as they typically reach full independence around March (Eby 2012).

2.3.3 Phenology of Trees Region

Flowering of a number of highly productive nectar source trees for GHFF in the upper North Coast region of NSW in June includes Broad-leaved Paperbark (*Melaleuca quinquenervia*) Forest Red Gum (*Eucalyptus tereticornis*) (coastal lowlands), Coastal Blackbutt (*E. pilularis*) (coastal lowlands) and Swamp Mahogany (*E. robusta*). These highly productive nectar source trees can be considered key diet species for GHFF (Eby 2012; Eby and Law 2008). Of these key diet species, observations when travelling between regional flying-fox camps indicated only very light flowering of Coastal Blackbutt is occurring. Strong flowering of the non-key diet species Coast Banksia also continues.

2.4 Conclusion

The results of the June 2015 flying-fox monitoring indicate that excluding a brief stop-over at the site observed in mid-January 2015, flying-foxes have been absent from the site now for over 12 months.



Flying-foxes remain absent from both the Bowraville camp and the Bellingen Island camp. However, a small number of GHFF are still camped in a separate nearby camp in Bellingen. In general flying-fox numbers are lower at all occupied camps this monitoring event when compared with results from the previous monthly monitoring event. This may indicate that the recent availability of foraging resources (e.g. Broad-leaved Paperbark and Coast Banksia) has peaked.



Tom Pollard

Ecologist



References

Eby, P. and Law, B. (2008). Ranking the feeding habitat of Grey-headed flying foxes for conservation management. Department of Environment, Heritage, Water and the Arts, Canberra.

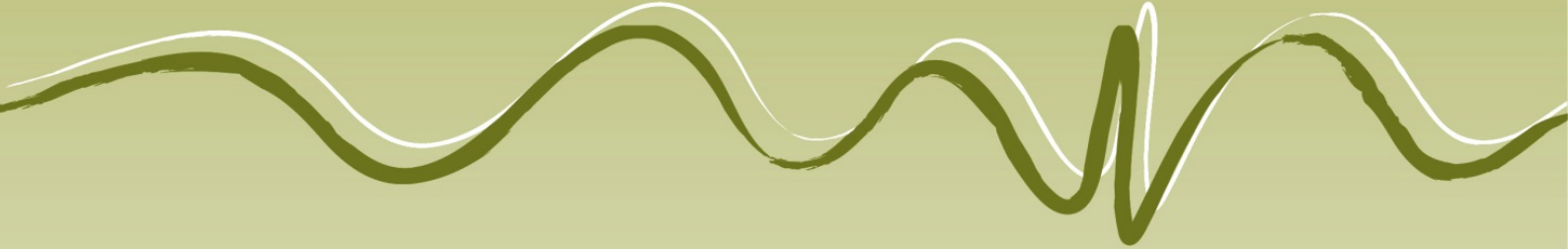
Eby, P. (2012). An Assessment of the Flying-fox Camp at Macksville. Unpublished report to NSW Roads and Maritime Services.

Eby, P. (2013). A Field Monitoring Program Proposed for the Macksville Flying-fox Roost. Unpublished report to Sinclair Knight Merz.

GeoLINK (2014). *Flying-fox Monitoring, Warrell Creek to Nambucca Heads Pacific Highway Upgrade*, June 2014. Unpublished report to Jacobs and NSW Roads and Maritime Services. GeoLINK, Lennox Head.

Flying-fox Monitoring July 2015

Warrell Creek to Nambucca Heads Pacific Highway Upgrade



PO Box 119
Lennox Head NSW 2478
T 02 6687 7666

PO Box 1446
Coffs Harbour NSW 2450
T 02 6651 7666

PO Box 1267
Armidale NSW 2350

Unit 10 Warina Walk Arcade
156 Molesworth St
Lismore NSW 2480

info@geolink.net.au

Prepared for: Roads and Maritime Services
© GeoLINK, 2015

<i>UPR</i>	<i>Description</i>	<i>Date Issued</i>	<i>Issued By</i>
2182-1138	First issue	06/08/2015	David Andrighetto



Table of Contents

1.	Introduction	1
1.1	Introduction	1
2.	Flying-fox Survey	2
2.1	Methodology	2
2.2	Results	4
2.2.1	Roost Footprint	4
2.2.2	Population Estimates	4
2.2.3	Detailed Data	6
2.3	Discussion	9
2.3.1	Population Estimates	9
2.3.2	Species Composition and Demographic Data	9
2.3.3	Phenology of Trees in Region	9
2.4	Conclusion	11

Illustration

Illustration 2.1	Location of Regional Flying-fox Camps	5
------------------	---------------------------------------	---

Table

Table 2.1	Demographic Data of GHFF at the Bellinghen Island Camp	7
-----------	--	---

Plate

Plate 2.1	Vegetation clearing in June 2015 at the site	3
-----------	--	---

Figures

Figure 2.1	Water Level Measurements at The Site	8
Figure 2.2	Population trends at the site and regional camps April 2014 to April 2015	10



1. Introduction

1.1 Introduction

NSW Roads and Maritime Services (RMS) is working to resolve issues relating to a Grey-headed Flying-fox (*Pteropus poliocephalus*) (GHFF) camp that has intermittently been present within the approved alignment of the Warrell Creek to Nambucca Heads (WC2NH) Pacific Highway upgrade project near Macksville. The camp is located in a patch of Swamp Sclerophyll Forest vegetation north of Bald Hill Road (henceforth referred to as 'the site').

GeoLINK has undertaken monitoring at the site on at least a monthly basis since July 2013. Prior to this, irregular monitoring of flying-foxes at the site has been undertaken since the initial establishment of the camp in December 2011 (Eby 2012).

This report details the July 2015 seasonal flying-fox monitoring results.



2. Flying-fox Survey

2.1 Methodology

The following personnel undertook fieldwork for the July 2015 seasonal flying-fox monitoring:

- Tom Pollard (GeoLINK sub-consultant ecologist);
- Jessica O’Leary (GeoLINK ecologist);
- Kale Hardy-Porter (GeoLINK environmental scientist); and
- Terry Tweedie (GeoLINK sub-consultant ecologist).

The fieldwork followed the methodology developed by Dr Eby for this roost (Eby 2013). Refer to that document for full details of the methodology. A summary of the main procedures used for the monitoring is provided below.

On 29 July the presence of flying-foxes at the site was assessed by undertaking a traverse of the area previously known to support flying-foxes in conjunction with a few sharp handclaps aimed at eliciting a vocal response from any flying-foxes roosting at the site.

When flying-fox are present at the site, the following data is collected:

- the area of the roost footprint (mapped by GPS);
- species composition;
- demographics;
- reproductive status; and
- behaviour.

However, as the initial traverse indicated that no flying-foxes were present at the site, it was not possible to collect this data.

In light of the continued absence of flying-foxes at the site (since early April 2014) and the establishment of a flying-fox camp within 2 km of the site adjacent to Macksville cemetery sometime early in 2015, this data has recently been collected from the Macksville cemetery camp instead of at the site to provide some information relating to flying-foxes currently camping in the local area. However, at the time of the current monitoring event no flying foxes were present at the Macksville cemetery camp, and therefore no data was able to be collected.

The water level at the site was also measured. Clearing of vegetation within the alignment at the site has now been completed (refer to **Plate 2.1**) and placement of rock fill over the swamp in well progressed. The previous water measurement point is no longer present, and the previously established water measurement point has been relocated to the western side of the alignment (approximate GPS location 492866, 6600756 [GDA 94, Zone 56]). The water level at this location is representative of the average level at the site.

Following the site traverse, a dusk exit count survey was undertaken at the site on the evening of 29 July to provide an estimate of the number of flying-foxes currently roosting at the camp. Two observers were strategically located for the count on a northern and southern ridge overlooking the camp. In addition to this two observers were also located east and west of the Macksville cemetery camp to undertake an exit count of this camp.

Observers were located at the following vantage points for the site:

- in a paddock to the north of the swamp sclerophyll forest (off Wedgewood Drive); and
- on a ridge south of the camp (41 Bald Hill Road).

Observers were located at the following vantage points for the Macksville cemetery camp:

- adjacent to the Pacific Highway at the edge of the Macksville Golf Course; and
- near the entrance to Macksville cemetery on Wallace Street.

The survey extended over approximately 45 minutes from sunset until dark (approximately 5:15 pm to 6:00 pm).

Other regional flying-fox camps at Gordon Park, Nambucca Heads (approximately 12 km north-east of the Macksville camp), Bowraville and Bellingen Island were visited on 30 July and observational comments made (refer to **Illustration 2.1** for location of these regional camps).



Plate 2.1 Vegetation clearing in June 2015 at the site



2.2 Results

2.2.1 Roost Footprint

No flying-foxes were observed to be roosting at the site in the camp traverse.

The flying-fox roost footprint at Gordon Park (Nambucca Heads) remains relatively extensive, and is consistent with that recorded in the last monthly monitoring event. It should be noted that, although the roost extent remains approximately the same as that recorded in the previous monitoring event, the density of flying foxes within this roost appears to have increased, with roosting flying-foxes currently extended into the canopy of eucalypt trees along the upper section of Wellington Drive on the western edge of the roost.

Flying-foxes were absent at both Macksville Cemetery and Bowraville. Flying foxes were observed to be roosting at Bellingen Island. This is the first occurrence of flying foxes roosting at Bellingen Island since mid-April 2015. The roost occupied a relatively small part of the central and eastern section of the rainforest vegetation. No flying-foxes were observed to be present at the nearby Wheatley Street camp in Bellingen.

2.2.2 Population Estimates

2.2.2.1 Exit Count

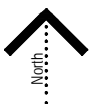
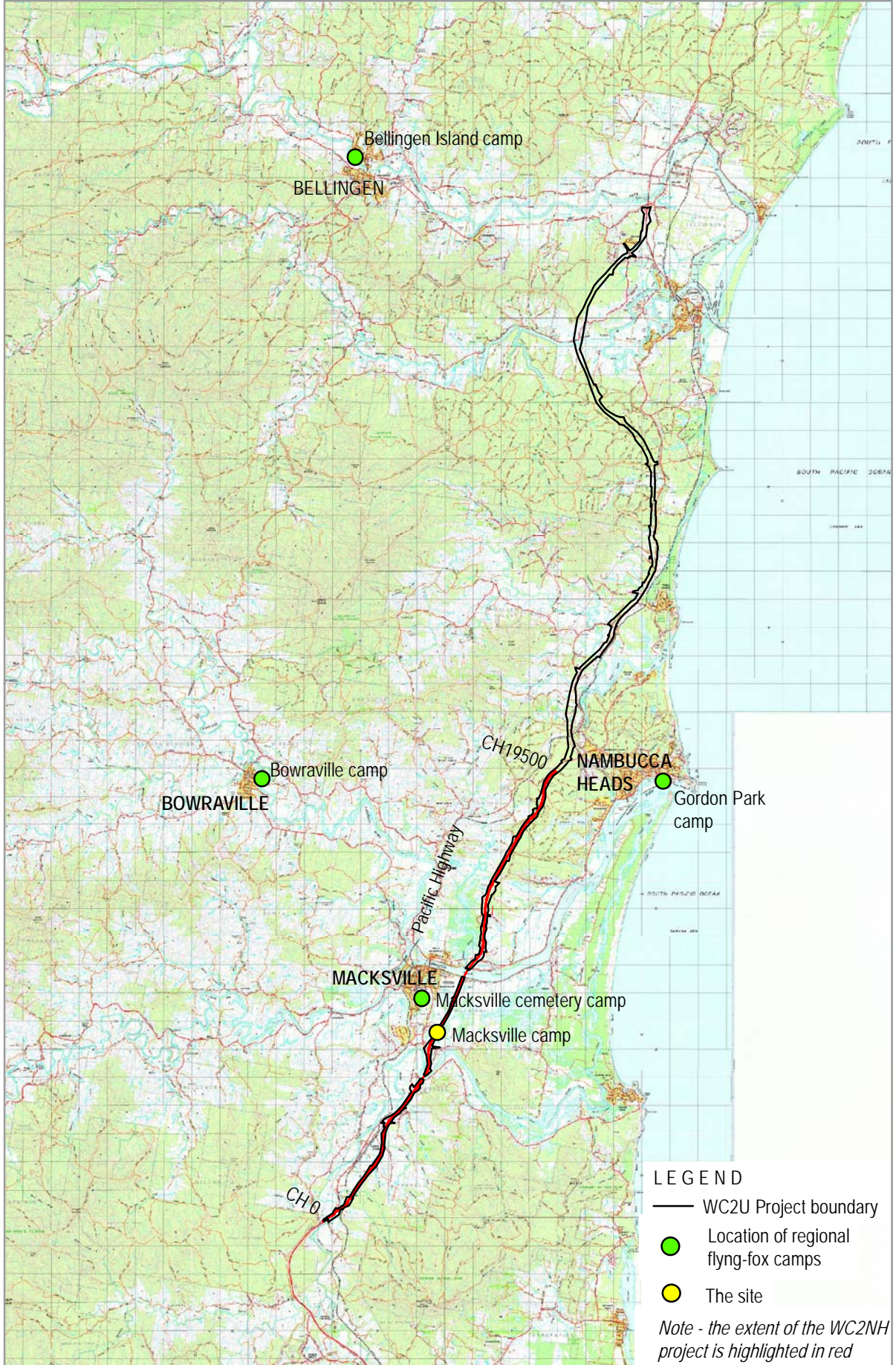
No flying-foxes were observed flying from the site in the exit count. Nor were any flying-foxes recorded exiting the Macksville Cemetery camp.

2.2.2.2 Direct Counts

No exit count was conducted at any of the regional camps (refer to **Illustration 2.1**). However, rough population estimates for these camps based on extrapolation of counts in individual trees and the roost footprint are as follows:

- Macksville Cemetery: no individuals recorded;
- Gordon Park: approximately 15,000 individuals (roosting in eucalypt canopies may indicate that the population size has increased since the last monthly monitoring event);
- Bowraville: no individuals recorded;
- Bellingen Island: approximately 5000 individuals recorded; and
- Wheatley Street, Bellingen: no individuals recorded.

Information shown is for illustrative purposes only



0 4 km





2.2.3 Detailed Data

2.2.3.1 Species Composition

No flying-foxes were recorded at the site or at the nearby Macksville cemetery camp. Therefore, no detailed species composition data was collected at the locality for the current monitoring event.

The species composition and proportions at occupied regional camps were as follows:

- Gordon Park – GHFF >90%, Black Flying-fox <10%.
- Bellingen Island – GHFF 95%, Black Flying-fox <5%.

A similar species composition of GHFF making up at least 80% of all flying-foxes present was also recorded in the previous monthly monitoring event in June 2015 (the lowest proportion was recorded at the Macksville Cemetery camp).

2.2.3.2 Habitat Characteristics and Demographic Composition

As mentioned previously, due to an absence of flying-foxes no detailed demographic composition data was collected at either the site or the nearby Macksville Cemetery camp for the current monitoring event.

To provide comparative information relating to flying-foxes occupying the broader region surrounding the site, data of habitat characteristics and demographic composition was collected at Bellingen Island camp. This data is shown in **Table 2.1**.

Results of the demographic counts at the Bellingen Island camp indicated that females dominated the counts, making up between 77% and 100% of all individuals present. No dependent young were observed with the female GHFF (refer to **Table 2.1**).

Table 2.1 Demographic Data of GHFF at the Bellinghen Island Camp

Tree Code	Tree Species	GPS (easting, northing; GDA 94, Zone 56)	Height (m); DBH (cm)	Demographic Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
BI1	Creek Sandpaper Fig	490054, 6631611	7; 30	10:1	no	n/a
BI2	Creek Sandpaper Fig	490056, 6631613	9; 30	10:0	no	n/a
BI3	Moreton Bay Fig	490042, 6631630	8; 50	10:3	no	n/a
BI4	Creek Sandpaper Fig	490038, 6631632	5; 20	10:1	no	n/a
BI5	Creek Sandpaper Fig	490026, 6631642	6; 30	10:0	no	n/a
BI6	Moreton Bay Fig	490007, 6631652	7; 40	10:2	no	n/a
BI7	Unknown sp.	490001, 6031634	9; 20	10:3	no	n/a
BI8	Creek Sandpaper Fig	489997, 6631630	8; 20	10:0	no	n/a
BI9	Giant Stinging Tree	490028, 6631597	30; 120	10:2	no	n/a
BI10	Creek Sandpaper Fig	490028, 6631603	10; 20	10:1	no	n/a

General observations of the flying-foxes present at Gordon Park camp indicated that both female and male GHFF were present. As for the Bellinghen Island camp, no female flying-foxes with dependant young were observed.

2.2.3.3 Water level at the site

Water level at the site measured at the representative measurement location was approximately 40 cm in depth as is shown in **Figure 2.1**. The water level has continued to decrease since a peak in February.

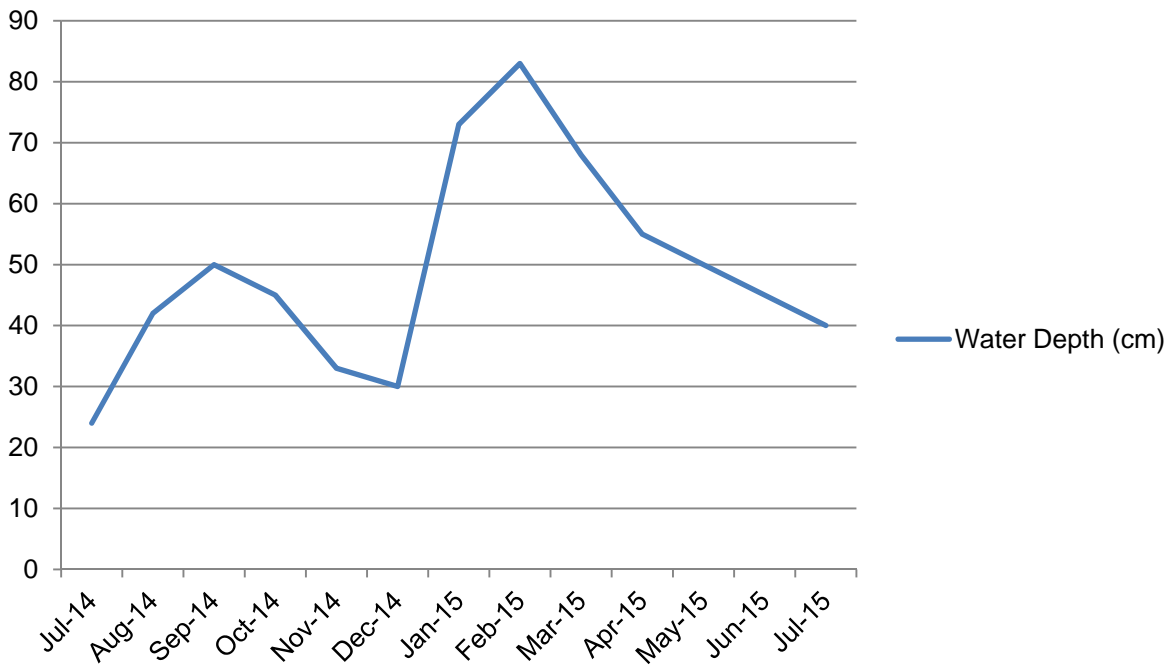


Figure 2.1 Water Level Measurements at The Site



2.3 Discussion

2.3.1 Population Estimates

No flying-foxes were observed to be roosting at the site during the roost traverse undertaken for the current monitoring event. Nor were any flying-foxes observed to be flying from the site in the exit count. Flying-foxes have not been camped at the site (excluding a brief return in January 2015) since mid-April 2014 over a year ago.

Figure 2.2 shows the trend of flying-fox population at the site and other regional sites between July 2014 and July 2015. General comments on the population trends are that:

- At the site flying-foxes have been absent for the entire period (except for a small number present in mid-January 2015).
- Flying-foxes established at the Macksville Cemetery camp sometime early in 2015 (suggested to be late February), but had departed by July.
- The flying-fox population at Gordon Park has remained relatively stable over the 12-month period.
- Flying-foxes have been absent from Bowraville since mid-April 2015, as was also observed during the same period in 2014.
- Flying-foxes have been absent from Bellingen Island since mid-April 2015, but have now returned in low numbers during July (the flying-foxes were present at Wheatley Street while Bellingen Island was unoccupied, but had departed by July).

2.3.2 Species Composition and Demographic Data

At occupied camps GHFF dominated the species composition and Black Flying-fox accounted for a small proportion of approximately 5-10% of all individuals present. The proportion of Black Flying-fox at occupied camps in July 2014 was similar (GeoLINK 2014).

As is expected, dependent young GHFF are not currently present at occupied camps as they typically reach full independence around March (Eby 2012).

2.3.3 Phenology of Trees in Region

July flowering of a number of highly productive nectar source trees in the upper North Coast region of NSW includes Swamp Mahogany (*Eucalyptus robusta*), Coastal Blackbutt (*Eucalyptus pilularis*) (coastal lowlands), Forest Red Gum (*Eucalyptus tereticornis*) (coastal lowlands) and Broad-leaved Paperbark (*Melaleuca quinquenervia*). These highly productive nectar source trees can be considered key diet species for GHFF (Eby 2012; Eby and Law 2008).

Observations when travelling between regional flying-fox camps did not record strong flowering in any of these key diet species. However, moderate flowering of Coast Banksia (*Banksia integrifolia*), a non-key diet species for GHFF, continues in the region.

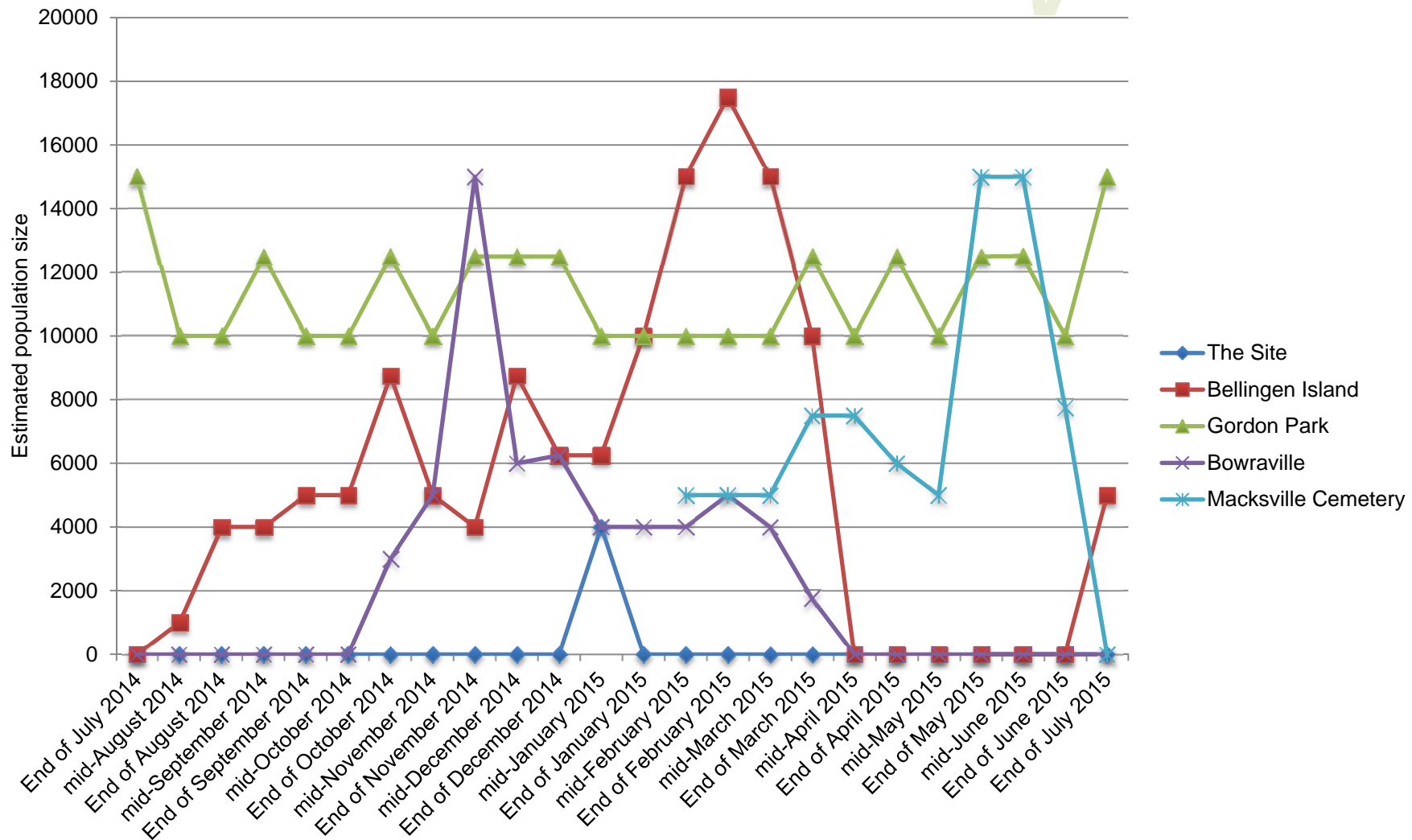


Figure 2.2 Population trends at the site and regional camps July 2014 to July 2015

Note: population at Macksville cemetery from end of February 2015 until end of March 2015 is estimated based on likely date of first arrival and suggested population level (no exit count/ direct count from observations was made)



2.4 Conclusion

The results of the July 2015 seasonal flying-fox monitoring indicate that, excluding a brief stopover at the site observed in mid-January 2015, flying-foxes have been absent from the site now for 14 months. After establishing a camp near the Macksville Cemetery over the period of February 2015 to June 2015, flying-foxes have recently departed. All other regional camps have displayed seasonal absences in the winter period except for the Gordon Park camp, which has retained a generally steady population of flying-foxes over the past 12 months.

David Andrighetto

Ecologist



References

Eby, P. and Law, B. (2008). Ranking the feeding habitat of Grey-headed flying foxes for conservation management. Department of Environment, Heritage, Water and the Arts, Canberra.

Eby, P. (2012). An Assessment of the Flying-fox Camp at Macksville. Unpublished report to NSW Roads and Maritime Services.

Eby, P. (2013). A Field Monitoring Program Proposed for the Macksville Flying-fox Roost. Unpublished report to Sinclair Knight Merz.

GeoLINK (2014). Flying-fox Monitoring, Warrell Creek to Nambucca Heads Pacific Highway Upgrade, July 2014. Unpublished report to Jacobs and NSW Roads and Maritime Services. GeoLINK, Lennox Head.

Flying-fox Monitoring August 2015

Warrell Creek to Nambucca Heads Pacific Highway Upgrade



PO Box 119
Lennox Head NSW 2478
T 02 6687 7666

PO Box 1446
Coffs Harbour NSW 2450
T 02 6651 7666

PO Box 1267
Armidale NSW 2350
T 0488 677 666

Unit 10 Warina Walk Arcade
156 Molesworth St
Lismore NSW 2480
T 02 6621 6677

info@geolink.net.au

<i>UPR</i>	<i>Description</i>	<i>Date Issued</i>	<i>Issued By</i>
2182-1139	First issue	08/09/2015	David Andrighetto



Table of Contents

1.	Introduction	1
1.1	Introduction	1
2.	Flying-fox Survey	2
2.1	Methodology	2
2.2	Results	4
2.2.1	Roost Footprint	4
2.2.2	Population Estimates	4
2.2.3	Detailed Data	7
2.3	Discussion	9
2.3.1	Population Estimates	9
2.3.2	Species Composition and Demographic Data	9
2.3.3	Phenology of Trees in Region	10
2.4	Conclusion	10

Illustrations

Illustration 2.1	Location of Regional Flying-fox Camps.....	6
------------------	--	---

Tables

Table 2.1	Demographic Data of GHFF at the Bellinghen Island Camp.....	8
-----------	---	---

Plates

Plate 2.1	Construction at the Site in August 2015	3
Plate 2.2	Roosting Grey-headed Flying-foxes at Bellinghen Island in August 2015	4

Figures

Figure 2.1	Water Level Measurements at The Site.....	9
------------	---	---



1. Introduction

1.1 Introduction

NSW Roads and Maritime Services (RMS) are working to resolve issues relating to a Grey-headed Flying-fox (*Pteropus poliocephalus*) (GHFF) camp that has intermittently been present within the approved alignment of the Warrell Creek to Nambucca Heads (WC2NH) Pacific Highway upgrade project near Macksville. The camp is located in a patch of Swamp Sclerophyll Forest vegetation north of Bald Hill Road (henceforth referred to as 'the site').

GeoLINK has undertaken monitoring at the site on at least a monthly basis since July 2013. Prior to this, irregular monitoring of flying-foxes at the site has been undertaken since the initial establishment of the camp in December 2011 (Eby 2012).

This report details the August 2015 monthly flying-fox monitoring results.



2. Flying-fox Survey

2.1 Methodology

The following personnel undertook fieldwork for the August 2015 seasonal flying-fox monitoring:

- Tom Pollard (GeoLINK sub-consultant ecologist)
- Jessica O’Leary (GeoLINK ecologist)
- Frank Makin (GeoLINK ecologist)
- Terry Tweedie (GeoLINK sub-consultant ecologist).

The fieldwork followed the methodology developed by Dr Eby for this roost (Eby 2013). Refer to that document for full details of the methodology. A summary of the main procedures used for the monitoring is provided below.

On 26 August the presence of flying-foxes at the site was assessed by undertaking a traverse of the area previously known to support flying-foxes in conjunction with a few sharp handclaps aimed at eliciting a vocal response from any flying-foxes roosting at the site.

When flying-fox are present at the site, the following data is collected:

- The area of the roost footprint (mapped by GPS)
- Species composition
- Demographics
- Reproductive status
- Behaviour.

However, as the initial traverse indicated that no flying-foxes were present at the site, no further data collection was required.

In light of the continued absence of flying-foxes at the site (since early April 2014) and the establishment of a flying-fox camp within two kilometres of the site adjacent to Macksville cemetery sometime early in 2015, this data has recently been collected from the Macksville cemetery camp instead of at the site to provide some information relating to flying-foxes currently camping in the local area. However, at the time of the current monitoring event no flying foxes were present at the Macksville cemetery camp, and therefore no data was able to be collected.

The water level at the site was also measured. Clearing of vegetation within the alignment at the site has now been completed and placement of rock fill over the swamp is well progressed (refer to **Plate 2.1**). The water level at this location is representative of the average level at the site.

Following the site traverse, a dusk exit count survey was undertaken at the site on the evening of 26 August to provide an estimate of the number of flying-foxes currently roosting at the camp. Two observers were strategically located for the count on a northern and southern ridge overlooking the camp. In addition to this two observers were also located east and west of the Macksville cemetery camp to undertake an exit count of this camp.

Observers were located at the following vantage points for the site:

- In a paddock to the north of the swamp sclerophyll forest (off Wedgewood Drive)
- On a ridge south of the camp (41 Bald Hill Road).

Observers were located at the following vantage points for the Macksville cemetery camp:

- Adjacent to the Pacific Highway at the edge of the Macksville Golf Course
- Near the entrance to Macksville cemetery on Wallace Street.

The survey extended over approximately 45 minutes from sunset until dark (approximately 5:30 pm to 6:15 pm).

Other regional flying-fox camps at Gordon Park, Nambucca Heads (approximately 12 kilometres north-east of the Macksville camp), Bowraville and Bellingen Island were visited on 26 August and observational comments made (refer to **Illustration 2.1** for location of these regional camps).



Plate 2.1 Construction at the Site in August 2015

2.2 Results

2.2.1 Roost Footprint

No flying-foxes were observed to be roosting at the site in the camp traverse.

The flying-fox roost footprint at Gordon Park (Nambucca Heads) remains relatively extensive, and is consistent with that recorded in the last monthly monitoring event. The roost includes the core rainforest canopy and also extends into the canopy of eucalypt trees along the upper section of Wellington Drive on the western edge of the roost.

Flying-foxes were absent at both Macksville Cemetery and Bowraville.

Flying foxes were observed to be roosting at Bellingen Island (refer to **Plate 2.2**). The roost occupied most of the central and eastern section of the rainforest vegetation. No flying-foxes were observed to be present at the nearby Wheatley Street camp in Bellingen.



Plate 2.2 Roosting Grey-headed Flying-foxes at Bellingen Island in August 2015

2.2.2 Population Estimates

2.2.2.1 Exit Count

No flying-foxes were observed flying from the site in the exit count. Nor were any flying-foxes recorded exiting the Macksville Cemetery camp.

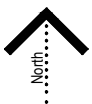


2.2.2.2 Direct Counts

No exit count was conducted at any of the regional camps (refer to **Illustration 2.1**). However, rough population estimates for these camps based on extrapolation of counts in individual trees and the roost footprint are as follows:

- Macksville Cemetery: no individuals recorded.
- Gordon Park: approximately 15,000 individuals.
- Bowraville: no individuals recorded.
- Bellingen Island: approximately 10,000 individuals recorded.
- Wheatley Street, Bellingen: no individuals recorded.

Information shown is for illustrative purposes only



0 4 km





2.2.3 Detailed Data

2.2.3.1 Species Composition

No flying-foxes were recorded at the site or at the nearby Macksville cemetery camp. Therefore, no detailed species composition data was collected at the locality for the current monitoring event.

The species composition and proportions at occupied regional camps were as follows:

- Gordon Park – GHFF >90%, Black Flying-fox <10%.
- Bellingen Island – GHFF 95%, Black Flying-fox <5%.

2.2.3.2 Habitat Characteristics and Demographic Composition

As mentioned previously, due to an absence of flying-foxes no detailed demographic composition data was collected at either the site or the nearby Macksville Cemetery camp for the current monitoring event.

To provide comparative information relating to flying-foxes occupying the broader region surrounding the site, data of habitat characteristics and demographic composition was collected at Bellingen Island camp. This data is shown in **Table 2.1**.

Results of the demographic counts at the Bellingen Island camp indicated that females dominated the counts, making up between 71% and 100% of all individuals present. No dependent young were observed with the female GHFF (refer to **Table 2.1**).

Table 2.1 Demographic Data of GHFF at the Bellinghen Island Camp

Tree Code	Tree Species	GPS (easting, northing; GDA 94, Zone 56)	Height (m); DBH (cm)	Demographic Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
BI1	Red Cedar	490057, 6631630	8; 30	10:1	no	n/a
BI2	White Beech	490050, 6631633	8; 30	10:1	no	n/a
BI3	Giant Stinging Tree	490044, 6631636	9; 30	10:3	no	n/a
BI4	Creek Sandpaper Fig	490041, 6631630	7; 15	10:1	no	n/a
BI5	Creek Sandpaper Fig	490036, 6631627	9; 30	10:2	no	n/a
BI6	Creek Sandpaper Fig	490028, 6631617	8; 15	10:4	no	n/a
BI7	Creek Sandpaper Fig	490018, 6631609	12; 30	10:3	no	n/a
BI8	Unknown sp.	490000, 6631620	10; 30	10:0	no	n/a
BI9	Small-leaved Fig	490017, 6631631	12; 80	10:1	no	n/a
BI10	Giant Stinging Tree	490024, 6631641	8; 40	10:0	no	n/a

General observations of the flying-foxes present at Gordon Park camp indicated that both female and male GHFF were present. As for the Bellinghen Island camp, no female flying-foxes with dependant young were observed.

2.2.3.3 Water level at the site

Water level at the site measured at the representative measurement location was approximately 30 cm in depth as is shown in **Figure 2.1**. The water level has continued to decrease since a peak in February 2015.

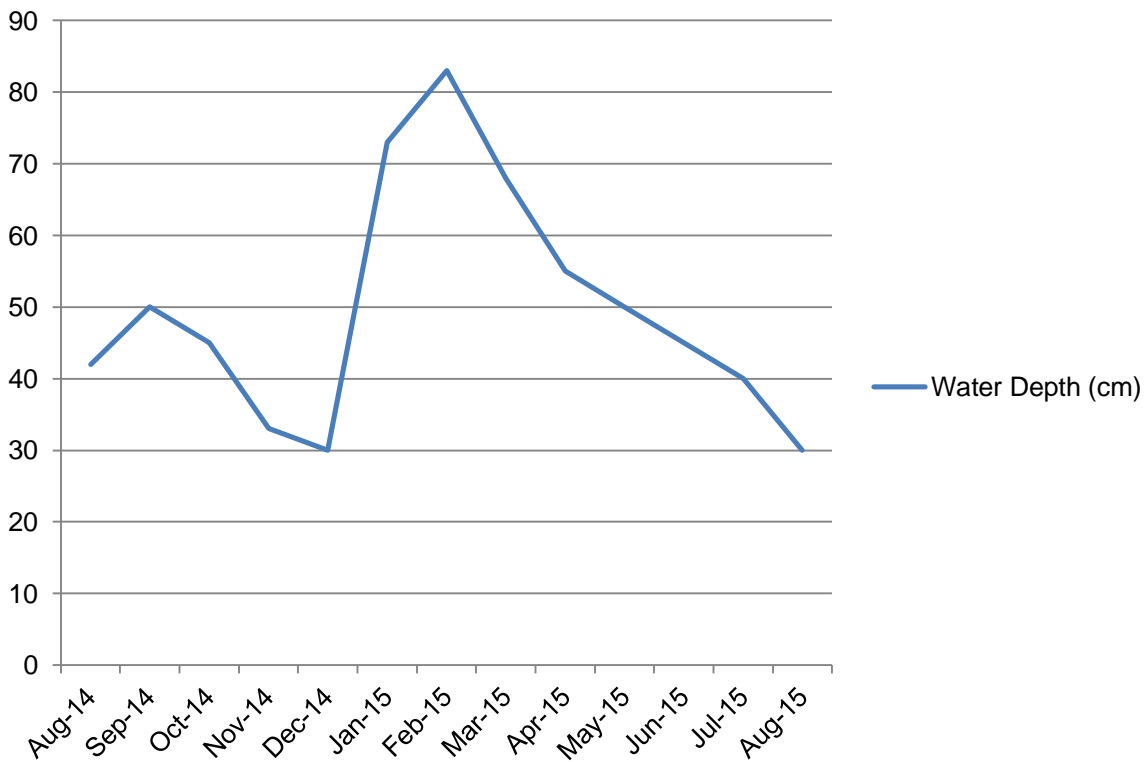


Figure 2.1 Water Level Measurements at The Site

2.3 Discussion

2.3.1 Population Estimates

No flying-foxes were observed to be roosting at the site during the roost traverse undertaken for the current monitoring event. Nor were any flying-foxes observed to be flying from the site in the exit count. Flying-foxes have not been camped at the site (excluding a brief return in January 2015) since mid-April 2014 over a year ago.

Flying-foxes have now been absent at Bowraville since mid-April 2015. This had also been the case at Bellingen Island until last month when a modest number, estimated to be around 5,000 individuals, returned to this camp. In the current monitoring event the estimated population size at Bellingen Island was double this at 10,000 individuals. The Macksville Cemetery camp has remained unoccupied for approximately two months now following a temporary occupation over the summer-autumn period of 2015.

2.3.2 Species Composition and Demographic Data

At occupied camps GHFF dominated the species composition and Black Flying-fox accounted for a small proportion of approximately 5-10% of all individuals present. The same proportions were also recorded in the previous monthly monitoring event. The proportion of Black Flying-fox at occupied camps was also similar at the same time of year in 2014 (GeoLINK 2014).

As is expected, dependent young GHFF are not currently present at occupied camps as they typically are born later in spring (Eby 2012).



2.3.3 Phenology of Trees in Region

August flowering of a number of highly productive nectar source trees in the upper North Coast region of NSW includes Coastal Blackbutt (*Eucalyptus pilularis*) (coastal lowlands), Forest Red Gum (*Eucalyptus tereticornis*) (coastal lowlands and inland low altitude) and Grey Ironbark (*Eucalyptus siderophloia*) (coastal lowlands). These highly productive nectar source trees can be considered key diet species for GHFF (Eby 2012; Eby and Law 2008). Other non-key diet species for GHFF observed to be flowering in the region and supplying a nectar resource for GHFF include Coast Banksia (*Banksia integrifolia*).

Observations when travelling between regional flying-fox camps indicated moderate flowering of Forest Red Gum and Grey Ironbark is now occurring. Flowering was observed on Forest Red Gum trees around the periphery of the rainforest vegetation at Gordon Park.

2.4 Conclusion

The results of the August 2015 monthly flying-fox monitoring indicate that excluding a brief stopover at the site observed in mid-January 2015, flying-foxes have been absent from the site now for 15 months. After temporarily establishing a camp near the Macksville Cemetery over the period of February 2015 to June 2015, flying-foxes have now departed. Flying-foxes have now returned to the Bellingen Island camp following a late autumn-winter absence. All other regional camps have displayed seasonal absences in the winter period except for the Gordon Park camp, which has retained a generally steady population of flying-foxes over the past 12 months



David Andrighetto

Ecologist



References

Eby, P. and Law, B. (2008). Ranking the feeding habitat of Grey-headed flying foxes for conservation management. Department of Environment, Heritage, Water and the Arts, Canberra.

Eby, P. (2012). An Assessment of the Flying-fox Camp at Macksville. Unpublished report to NSW Roads and Maritime Services.

Eby, P. (2013). A Field Monitoring Program Proposed for the Macksville Flying-fox Roost. Unpublished report to Sinclair Knight Merz.

GeoLINK (2014). Flying-fox Monitoring, Warrell Creek to Nambucca Heads Pacific Highway Upgrade, August 2014. Unpublished report to Jacobs and NSW Roads and Maritime Services. GeoLINK, Lennox Head.

Flying-fox Monitoring September 2015

Warrell Creek to Nambucca Heads Pacific Highway Upgrade



PO Box 119
Lennox Head NSW 2478
T 02 6687 7666

PO Box 1446
Coffs Harbour NSW 2450
T 02 6651 7666

PO Box 1267
Armidale NSW 2350
T 0488 677 666

Unit 10 Warina Walk Arcade
156 Molesworth St
Lismore NSW 2480
T 02 6621 6677

info@geolink.net.au

<i>UPR</i>	<i>Description</i>	<i>Date Issued</i>	<i>Issued By</i>
2182-1140	First issue	09/10/2015	David Andrighetto



Table of Contents

1.	Introduction	1
1.1	Introduction	1
2.	Flying-fox Survey	2
2.1	Methodology	2
2.2	Results	4
2.2.1	Roost Footprint	4
2.2.2	Population Estimates	4
2.2.3	Detailed Data	6
2.3	Discussion	9
2.3.1	Population Estimates	9
2.3.2	Species Composition and Demographic Data	9
2.3.3	Phenology of Trees in Region	9
2.4	Conclusion	10

Illustrations

Illustration 2.1	Location of Regional Flying-fox Camps.....	5
------------------	--	---

Tables

Table 2.1	Demographic Data of GHFF at the Bellingham Island Camp.....	7
-----------	---	---

Plates

Plate 2.1	Roosting Grey-headed Flying-foxes at Bellingham Island in September 2015	6
-----------	--	---

Figures

Figure 2.1	Water Level Measurements at The Site.....	8
------------	---	---



1. Introduction

1.1 Introduction

NSW Roads and Maritime Services (RMS) are working to resolve issues relating to a Grey-headed Flying-fox (*Pteropus poliocephalus*) (GHFF) camp that has intermittently been present within the approved alignment of the Warrell Creek to Nambucca Heads (WC2NH) Pacific Highway upgrade project near Macksville. The camp is located in a patch of Swamp Sclerophyll Forest vegetation north of Bald Hill Road (henceforth referred to as 'the site').

GeoLINK has undertaken monitoring at the site on at least a monthly basis since July 2013. Prior to this, irregular monitoring of flying-foxes at the site has been undertaken since the initial establishment of the camp in December 2011 (Eby 2012).

This report details the September 2015 monthly flying-fox monitoring results.



2. Flying-fox Survey

2.1 Methodology

The following personnel undertook fieldwork for the September 2015 seasonal flying-fox monitoring:

- Tom Pollard (GeoLINK sub-consultant ecologist);
- Jessica O’Leary (GeoLINK ecologist);
- Frank Makin (GeoLINK ecologist); and
- Kale Hardy-Porter (GeoLINK environmental scientist).

The fieldwork followed the methodology developed by Dr Eby for this roost (Eby 2013). Refer to that document for full details of the methodology. A summary of the main procedures used for the monitoring is provided below.

On 29 September the presence of flying-foxes at the site was assessed by undertaking a traverse of the area previously known to support flying-foxes in conjunction with a few sharp handclaps aimed at eliciting a vocal response from any flying-foxes roosting at the site.

When flying-fox are present at the site, the following data is collected:

- the area of the roost footprint (mapped by GPS);
- species composition;
- demographics;
- reproductive status; and
- behaviour.

However, as the initial traverse indicated that no flying-foxes were present at the site this data was not collected.

In light of the continued absence of flying-foxes at the site (since early April 2014) and the establishment of a flying-fox camp within two kilometres of the site adjacent to Macksville cemetery sometime early in 2015, this data has recently been collected from the Macksville cemetery camp instead of at the site to provide some information relating to flying-foxes currently camping in the local area. However, at the time of the current monitoring event no flying foxes were present at the Macksville cemetery camp, and therefore no data was collected at the Macksville cemetery camp either.

The water level at the site was also measured at a previously established water measurement point. The water level at this location is representative of the average level at the site.

Following the site traverse, a dusk exit count survey was undertaken at the site on the evening of 29 September to provide an estimate of the number of flying-foxes currently roosting at the camp. Two observers were strategically located for the count on a northern and southern ridge overlooking the camp. In addition to this two observers were also located east and west of the Macksville cemetery camp to undertake an exit count of this camp.



Observers were located at the following vantage points for the site:

- in a paddock to the north of the swamp sclerophyll forest (off Wedgewood Drive); and
- on a ridge south of the camp (41 Bald Hill Road).

Observers were located at the following vantage points for the Macksville cemetery camp:

- adjacent to the Pacific Highway at the edge of the Macksville Golf Course; and
- near the entrance to Macksville cemetery on Wallace Street.

The survey extended over approximately 45 minutes from sunset until dark (approximately 5:45 pm to 6:30 pm).

Other regional flying-fox camps at Gordon Park, Nambucca Heads (approximately 12 kilometres north-east of the Macksville camp), Bowraville and Bellingen Island were visited on 30 September and observational comments made (refer to **Illustration 2.1** for location of these regional camps).



2.2 Results

2.2.1 Roost Footprint

No flying-foxes were observed to be roosting at the site in the camp traverse.

Flying-foxes were also absent at both Macksville Cemetery and Bowraville.

The flying-fox roost footprint at Gordon Park (Nambucca Heads) was observed to remain relatively extensive, but may have contracted somewhat from that recorded in the last monthly monitoring event.

The flying-fox roost footprint at Bellingen Island occupied most of the central and eastern section of the rainforest vegetation. This is consistent with the area that was occupied in the last monthly monitoring event. No flying-foxes were observed to be present at the nearby Wheatley Street camp in Bellingen.

2.2.2 Population Estimates

2.2.2.1 Exit Count

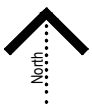
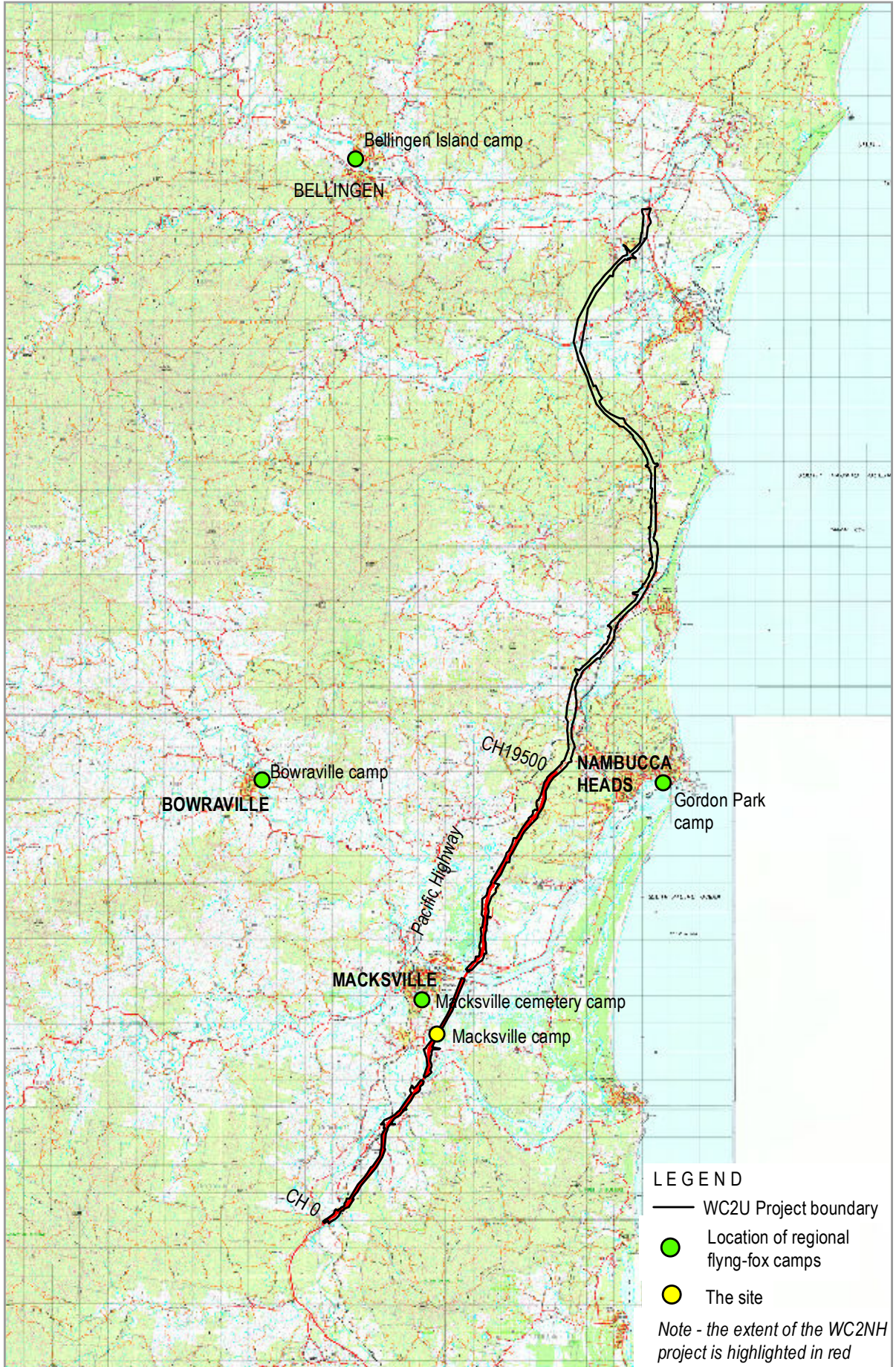
No flying-foxes were observed flying from the site in the exit count. Nor were any flying-foxes recorded exiting the Macksville Cemetery camp. A small number of flying-foxes (<50 individuals) originating from other camps were randomly observed flying over observers to forage on flowering trees nearby.

2.2.2.2 Direct Counts

No exit count was conducted at any of the regional camps (refer to **Illustration 2.1**). However, rough population estimates for these camps based on extrapolation of counts in individual trees and the roost footprint are as follows:

- Macksville Cemetery: no individuals recorded
- Gordon Park: approximately 10,000-15,000 individuals
- Bowraville: no individuals recorded
- Bellingen Island: approximately 7,500-10,000 individuals recorded
- Wheatley Street, Bellingen: no individuals recorded

Information shown is for illustrative purposes only



0 4 km

2.2.3 Detailed Data

2.2.3.1 Species Composition

No flying-foxes were recorded at the site or at the nearby Macksville cemetery camp. Therefore, no detailed species composition data was collected at the locality for the current monitoring event.

The species composition and proportions at occupied regional camps were as follows:

- Gordon Park – GHFF >90%, Black Flying-fox <10%.
- Bellingen Island – GHFF 95%, Black Flying-fox <5%.

2.2.3.2 Habitat Characteristics and Demographic Composition

As mentioned previously, due to an absence of flying-foxes no detailed demographic composition data was collected at either the site or the nearby Macksville Cemetery camp for the current monitoring event.

To provide comparative information relating to flying-foxes occupying the broader region surrounding the site, data of habitat characteristics and demographic composition was collected at Bellingen Island camp. This data is shown in **Table 2.1**.

Results of the demographic counts at the Bellingen Island camp indicated that females dominated the counts, making up between 63% and 91% of all individuals present (excluding the 'bachelor' tree at BI8, in which only males were roosting). A small proportion of GHFF females with dependent young were also observed at point counts, ranging between 10 and 20% of the females counted (refer to **Table 2.1** and **Plate 2.1**).



Plate 2.1 Roosting Grey-headed Flying-foxes at Bellingen Island in September 2015

Table 2.1 Demographic Data of GHFF at the Bellinghen Island Camp

Tree Code	Tree Species	GPS (easting, northing; GDA 94, Zone 56)	Height (m); DBH (cm)	Demographic Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
BI1	Creek Sandpaper Fig	489950, 6631618	7; 30	10:1	no	n/a
BI2	White Cedar	489970, 6631613	10; 30/30 (multiple trunks)	10:2	no	n/a
BI3	Small-leaved Fig	489983, 6631635	12; 100	10:4	yes	10
BI4	Giant Stinging Tree	489979, 6631609	8; 25	10:6	no	n/a
BI5	Creek Sandpaper Fig	489999, 6631609	8; 20	10:6	no	n/a
BI6	Creek Sandpaper Fig	490050, 6631596	6; 15	10:2	yes	20
BI7	Creek Sandpaper Fig	490027, 6631613	10; 20	10:2	yes	10
BI8	Giant Stinging Tree	490032, 6631613	20; 70	0:10 (no females present – 'bachelor' tree)	no	n/a
BI9	Red Cedar	490073, 6631616	8; 20	10:2	yes	10
BI10	Moreton Bay Fig	490039, 6631620	10; 40	10:2	no	n/a

General observations of the flying-foxes present at Gordon Park camp indicated that both female and male GHFF were present and a small number of female flying-foxes with dependant young were observed.

2.2.3.3 Water level at the site

Water level at the site measured at the representative measurement location was approximately 30 cm in depth as is shown in **Figure 2.1**. The water level has remained steady since the last monitoring event.

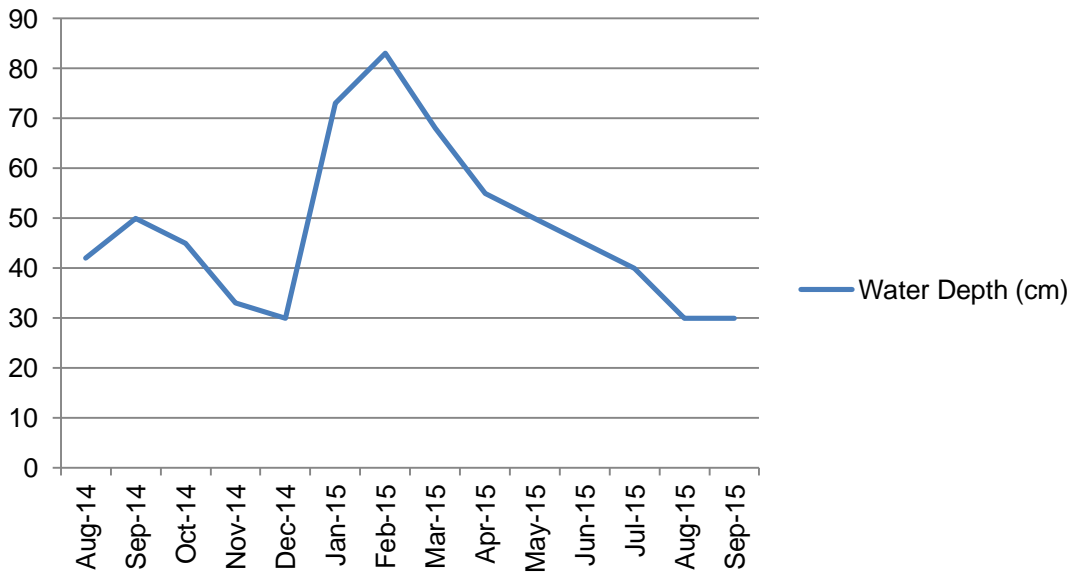


Figure 2.1 Water Level Measurements at The Site



2.3 Discussion

2.3.1 Population Estimates

No flying-foxes were observed to be roosting at the site during the roost traverse undertaken for the current monitoring event. Nor were any flying-foxes observed to be flying from the site in the exit count. Flying-foxes have not been camped at the site (excluding a brief return in January 2015) since mid-April 2014.

The Macksville Cemetery camp has remained unoccupied for approximately three months now following a temporary occupation over the summer-autumn period of 2015.

Flying-foxes have now been absent at Bowraville since mid-April 2015. Bellingen Island had also been unoccupied between mid-April 2015 and July 2015, when a modest number, estimated to be around 5,000 individuals, returned to this camp. Since then, flying-fox numbers at Bellingen Island have been estimated at around 7,500-10,000 individuals.

2.3.2 Species Composition and Demographic Data

At occupied camps GHFF dominated the species composition and Black Flying-fox accounted for a small proportion of approximately 5-10% of all individuals present. The same proportions were also recorded in the previous monthly monitoring event.

Most GHFF births typically occur in October (Department of Environment 2015). The relatively low proportion of dependent young (between 10-20% of females with dependent young) recorded at the Bellingen Island camp in the current monitoring event fits with this pattern, as the monitoring occurred before the main birthing period in October. The proportion of female GHFF with dependent young is expected to be substantially higher in the next monitoring event in October when the bulk of births have occurred.

2.3.3 Phenology of Trees in Region

September flowering of a number of highly productive nectar source trees in the upper North Coast region of NSW includes Coastal Blackbutt (*Eucalyptus pilularis*) (coastal lowlands), Forest Red Gum (*Eucalyptus tereticornis*) (coastal lowlands and inland low altitude) and Grey Ironbark (*Eucalyptus siderophloia*) (coastal lowlands). These highly productive nectar source trees can be considered key diet species for GHFF (Eby 2012; Eby and Law 2008).

Observations when travelling between regional flying-fox camps indicated light flowering of Forest Red Gum and Grey Ironbark is now occurring.



2.4 Conclusion

The results of the September 2015 monthly flying-fox monitoring indicate that excluding a brief stopover at the site observed in mid-January 2015, flying-foxes have been absent from the site now since mid-April 2014. After temporarily establishing a camp near the Macksville Cemetery over the period of February 2015 to June 2015, flying-foxes are no longer present. Flying-foxes have now returned to the Bellingen Island camp following a late autumn-winter absence. All regional camps have displayed seasonal absences in the winter period except for the Gordon Park camp, which has retained a generally steady population of flying-foxes over the past 12 months.

Low numbers of dependent GHFF young were observed at the Bellingen Island and Gordon Park camps in the current monitoring event. Given that October is typically the period when most young GHFF are born, the proportion of females with dependent young is expected to be substantially higher in the next monitoring event in October.

David Andrighetto

Ecologist



References

Department of the Environment (2015). *Pteropus poliocephalus* in Species Profile and Threats Database, Department of the Environment, Canberra. Available from: <http://www.environment.gov.au/sprat>. Accessed Thu, 8 Oct 2015.

Eby, P. and Law, B. (2008). Ranking the feeding habitat of Grey-headed flying foxes for conservation management. Department of Environment, Heritage, Water and the Arts, Canberra.

Eby, P. (2012). An Assessment of the Flying-fox Camp at Macksville. Unpublished report to NSW Roads and Maritime Services.

Eby, P. (2013). A Field Monitoring Program Proposed for the Macksville Flying-fox Roost. Unpublished report to Sinclair Knight Merz.

Flying-fox Monitoring October 2015

Warrell Creek to Nambucca Heads Pacific Highway Upgrade



PO Box 119
Lennox Head NSW 2478
T 02 6687 7666

PO Box 1446
Coffs Harbour NSW 2450
T 02 6651 7666

PO Box 1267
Armidale NSW 2350
T 0488 677 666

Unit 10 Warina Walk Arcade
156 Molesworth St
Lismore NSW 2480
T 02 6621 6677

info@geolink.net.au

Prepared for: Roads and Maritime Services
© GeoLINK, 2015

<i>UPR</i>	<i>Description</i>	<i>Date Issued</i>	<i>Issued By</i>
2182-1141	First issue	09/11/2015	David Andrighetto



Table of Contents

1.	Introduction	1
1.1	Introduction	1
2.	Flying-fox Survey	2
2.1	Methodology	2
2.2	Results	4
2.2.1	Roost Footprint	4
2.2.2	Population Estimates	4
2.2.3	Detailed Data	7
2.3	Discussion	12
2.3.1	Population Estimates	12
2.3.2	Species Composition and Demographic Data	12
2.3.3	Phenology of Trees in Region	13
2.4	Conclusion	15

Illustrations

Illustration 2.1	Location of Regional Flying-fox Camps	5
Illustration 2.2	Macksville Cemetery Roost Footprint	6

Tables

Table 2.1	Demographic Data of GHFF at the Macksville Cemetery Camp	9
Table 2.2	Demographic Data of GHFF at the Bellingin Island Camp	9

Plates

Plate 2.1	Dense Broad-leaved Paperbark Forest at Macksville Cemetery Camp	8
-----------	---	---

Figures

Figure 2.1	Water Level Measurements at The Site	11
Figure 2.2	Population trends at the site and regional camps October 2014 to October 2015	14



1. Introduction

1.1 Introduction

NSW Roads and Maritime Services (RMS) are working to resolve issues relating to a Grey-headed Flying-fox (*Pteropus poliocephalus*) (GHFF) camp that has intermittently been present within the approved alignment of the Warrell Creek to Nambucca Heads (WC2NH) Pacific Highway upgrade project near Macksville. The camp is located in a patch of Swamp Sclerophyll Forest vegetation north of Bald Hill Road (henceforth referred to as 'the site').

GeoLINK has undertaken monitoring at the site on at least a monthly basis since July 2013. Prior to this, irregular monitoring of flying-foxes at the site has been undertaken since the initial establishment of the camp in December 2011 (Eby 2012).

This report details the October 2015 seasonal flying-fox monitoring results.



2. Flying-fox Survey

2.1 Methodology

The following personnel undertook fieldwork for the October 2015 seasonal flying-fox monitoring:

- Tom Pollard (GeoLINK sub-consultant ecologist);
- Jessica O’Leary (GeoLINK ecologist);
- Frank Makin (GeoLINK ecologist); and
- Terry Tweedie (GeoLINK sub-consultant ecologist).

The fieldwork followed the methodology developed by Dr Eby for this roost (Eby 2013). Refer to that document for full details of the methodology. A summary of the main procedures used for the monitoring is provided below.

On 22 October the presence of flying-foxes at the site was assessed by undertaking a traverse of the area previously known to support flying-foxes in conjunction with a few sharp handclaps aimed at eliciting a vocal response from any flying-foxes roosting at the site.

When flying-fox are present at the site, the following data is collected:

- the area of the roost footprint (mapped by GPS);
- species composition;
- demographics;
- reproductive status; and
- behaviour.

However, as the initial traverse indicated that no flying-foxes were present at the site, it was not possible to collect this data.

In light of the continued absence of flying-foxes at the site (since early April 2014) and the seasonal occupation of a flying-fox camp within two kilometres of the site adjacent to Macksville cemetery (first observed early in the summer of 2015), this data has recently been collected from the Macksville cemetery camp instead of at the site to provide some information relating to flying-foxes currently camping in the local area.

The water level at the site was also measured (approximate GPS location 492866, 6600756 [GDA 94, Zone 56]). The water level at this location is representative of the average level at the site.

Following the site traverse, a dusk exit count survey was undertaken at the site on the evening of 22 October to provide an estimate of the number of flying-foxes currently roosting at the camp (as no flying-foxes were recorded exiting the site, a second exit-count on the following night to confirm approximate numbers roosting at the site was not considered necessary). Two observers were strategically located for the count on a northern and southern ridge overlooking the camp. In addition to this two observers were also located east and west of the Macksville cemetery camp to undertake an exit count of this camp.



Observers were located at the following vantage points for the site:

- in a paddock to the north of the swamp sclerophyll forest (off Wedgewood Drive); and
- on a ridge south of the camp (41 Bald Hill Road).

Observers were located at the following vantage points for the Macksville cemetery camp:

- adjacent to the Pacific Highway at the edge of the Macksville Golf Course; and
- near the entrance to Macksville cemetery on Wallace Street.

The survey extended over approximately 45 minutes from sunset until dark (approximately 7:00 pm to 7:45 pm).

Other regional flying-fox camps at Gordon Park, Nambucca Heads (approximately 12 kilometres north-east of the Macksville camp), Bowraville and Bellingen Island were visited on 23 October and observational comments made (refer to **Illustration 2.1** for location of these regional camps).



2.2 Results

2.2.1 Roost Footprint

No flying-foxes were observed to be roosting at the site in the camp traverse. Flying-foxes were also absent from Bowraville and Wheatley Street in Bellingen.

Regionally, flying-foxes were observed to be roosting at Macksville Cemetery, Bellingen Island, and Gordon Park (Nambucca Heads). The roost footprint recorded at Macksville Cemetery was approximately 1.99 ha and is shown in **Illustration 2.2**.

2.2.2 Population Estimates

2.2.2.1 Exit Count

No flying-foxes were observed flying from the site in the exit count. Nearby, approximately 4,500 flying-foxes were recorded exiting the Macksville Cemetery camp, most of which were flying from the camp in a westerly direction.

2.2.2.2 Direct Counts

No exit count was conducted at any of the regional camps (excluding the Macksville Cemetery camp) (refer to **Illustration 2.2**). However, rough population estimates for these camps based on extrapolation of counts in individual trees and the roost footprint are as follows:

- Gordon Park: approximately 10,000 individuals
- Bowraville: no individuals recorded
- Bellingen Island: approximately 5000 individuals recorded
- Wheatley Street, Bellingen: no individuals recorded

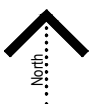
Information shown is for illustrative purposes only



LEGEND

- WC2U Project boundary
- Location of regional flying-fox camps
- The site

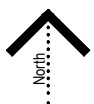
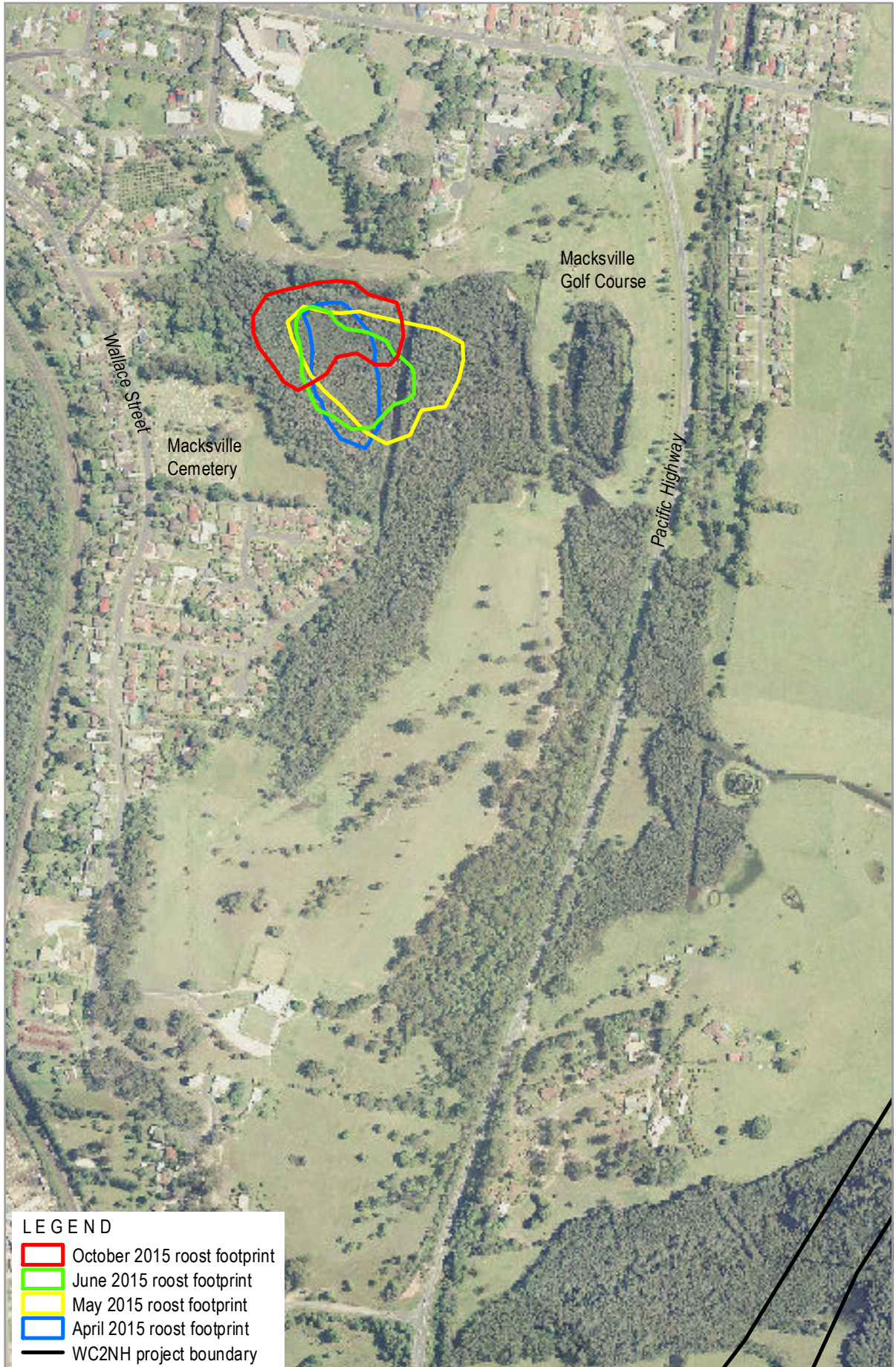
Note - the extent of the WC2NH project is highlighted in red



0 4 km

Location of Regional Flying-fox Camps

Information shown is for illustrative purposes only



0 140

GeoLINK
environmental management and design

Macksville Cemetery Flying-fox Roost Footprint

WC2NH Flying-fox Monitoring Report – October 2015
2182-1142

Illustration 2.2



2.2.3 Detailed Data

2.2.3.1 Species Composition

The species composition and proportions at occupied camps were as follows:

- Macksville Cemetery – GHFF 70%, Black Flying-fox 30%
- Gordon Park – GHFF 80%, Black Flying-fox 20%.
- Bellingen Island – GHFF 95%, Black Flying-fox 5%.

2.2.3.2 Habitat Characteristics and Demographic Composition

As mentioned previously, no flying-foxes were recorded at the site and therefore, no detailed species composition data was collected. Instead, this data was collected at the nearby Macksville Cemetery camp for the current monitoring period (refer to **Plate 2.1**).

Results of the demographic counts at the Macksville Cemetery camp indicated that females dominated the counts (excluding one demographic point count which was a 'bachelor' tree exclusively supporting male GHFF), making up between 59% and 83% of all individuals present. Dependent young were observed with the female GHFF at a relatively low to moderate level, with the proportion of females with young ranging between 0% and 50% (refer to **Table 2.1**).

To provide comparative information relating to flying-foxes occupying the broader region surrounding the site, data of habitat characteristics and demographic composition was collected at Bellingen Island camp.

Results of the demographic counts at the Bellingen Island camp indicated that females dominated the counts, making up between 67% and 91% of all individuals present. Dependent young were observed with the female GHFF at moderate levels (although variable), with the proportion of females with young ranging between 30% and 70% (refer to **Table 2.2**).



Plate 2.1 Dense Broad-leaved Paperbark Forest at Macksville Cemetery Camp

Table 2.1 Demographic Data of GHFF at the Macksville Cemetery Camp

Tree Code	Tree Species	GPS (easting, northing; GDA 94, Zone 56)	Height (m); DBH (cm)	Demographic Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
MC1	Broad-leaved Paperbark	492104, 6601866	12; 40	10:4	yes	20
MC2	Broad-leaved Paperbark	492086, 6601866	10; 30	10:7	no	0
MC3	Broad-leaved Paperbark	492036, 6601860	15; 50	10:2	yes	40
MC4	Swamp Oak	492014, 6601853	18; 40	10:4	yes	50
MC5	Broad-leaved Paperbark	492025, 6601784	15; 30	10:2	yes	40
MC6	Broad-leaved Paperbark	492049, 6601746	15; 40	10:5	no	n/a
MC7	Broad-leaved Paperbark	492068, 6601751	12; 30	10:3	yes	50
MC8	Broad-leaved Paperbark	492147, 6601782	12; 30	10:3	yes	30
MC9	Broad-leaved Paperbark	492171, 6601807	15; 40	0:10	no	n/a (a bachelor male tree)
MC10	Broad-leaved Paperbark	492174, 6601826	15; 50	10:2	yes	30

Table 2.2 Demographic Data of GHFF at the Bellingen Island Camp

Tree Code	Tree Species	GPS (easting, northing; GDA 94, Zone 56)	Height (m); DBH (cm)	Demographic Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
BI1	Creek Sandpaper Fig	490065, 6631623	8; 30	10:2	yes	40
BI2	Creek Sandpaper Fig	490044, 6631624	7; 20	10:3	yes	50
BI3	Giant Stinging Tree	490066, 6631596	12; 50	10:3	yes	30

Tree Code	Tree Species	GPS (easting, northing; GDA 94, Zone 56)	Height (m); DBH (cm)	Demographic Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
BI4	Creek Sandpaper Fig	490050, 6631603	8; 30	10:1	yes	50
BI5	Unknown sp.	490029, 6631605	15; 60	10:4	yes	40
BI6	Giant Stinging Tree	490003, 6631585	15; 70	10:2	yes	70
BI7	Giant Stinging Tree	489978, 6631577	9; 30	10:5	yes	40
BI8	Creek Sandpaper Fig	489968, 6631592	7; 30	10:2	yes	60
BI9	Creek Sandpaper Fig	489995, 6631598	8; 40	10:2	yes	40
BI10	Creek Sandpaper Fig	489991, 6631624	8; 30	10:3	yes	30

General observations of the flying-foxes present at Gordon Park camp indicated that both female and male GHFF were present and that female flying-foxes were carrying dependant young.

2.2.3.3 Water level at the site

Water level at the site measured at the representative measurement location was approximately 20 cm in depth as is shown in **Figure 2.1**. The water level has continued to decrease throughout 2015 since a peak in February.

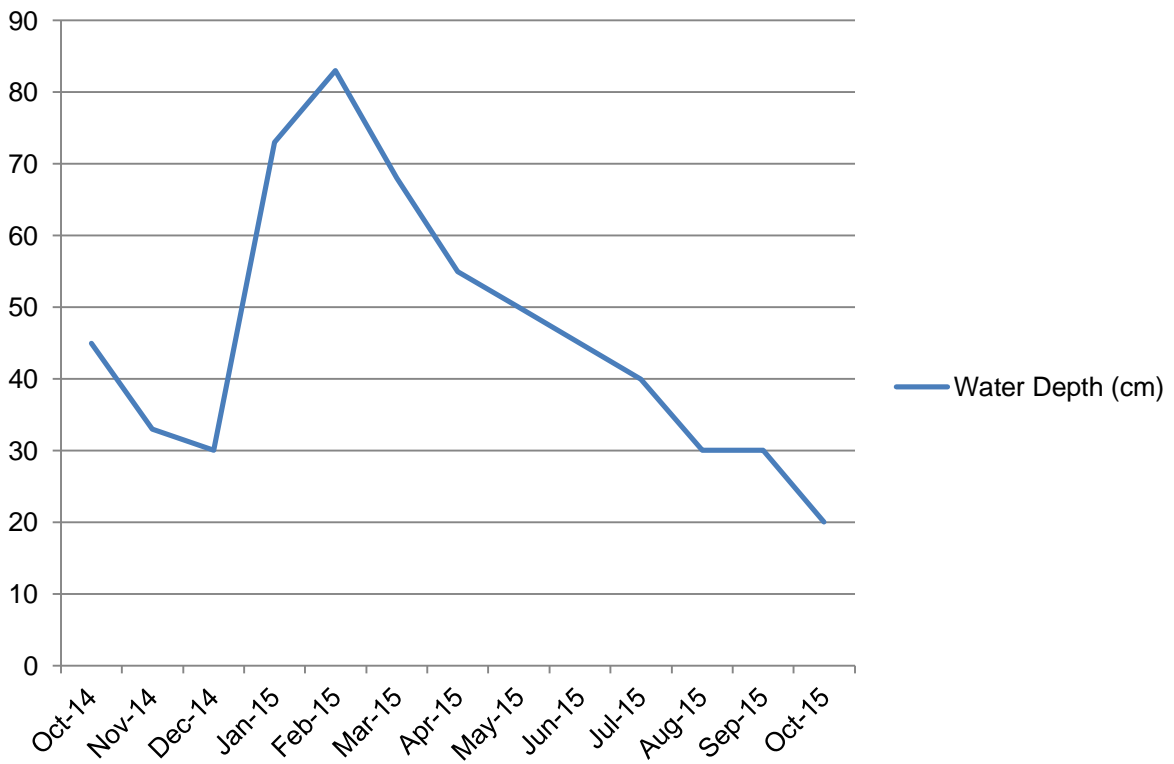


Figure 2.1 Water Level Measurements at The Site



2.3 Discussion

2.3.1 Population Estimates

No flying-foxes were observed to be roosting at the site during the roost traverse undertaken for the current monitoring event. Nor were any flying-foxes observed to be flying from the site in the exit count. Flying-foxes have not been camped at the site (excluding a brief return in January 2015) since mid-April 2014.

Figure 2.2 shows the trend of flying-fox population at the site and other regional sites between October 2014 and October 2015. General comments on the population trends are that:


- At the site flying-foxes have been absent for the entire period (except for a small number present in mid-January 2015).
- Flying-foxes established at the Macksville Cemetery camp sometime early in 2015 (suggested to be late February), temporarily departed over the winter-early spring period (July-September) and were present again later in spring in October 2015.
- The flying-fox population at Gordon Park has remained relatively stable over the 12-month period, consistently containing a moderate number of flying-foxes, estimated at over 10,000 individuals.
- Flying-foxes have been absent from Bowraville since mid-April 2015, as was also observed during the same period in 2014 and are yet to re-roost at this camp in 2015.
- Flying-foxes were absent from Bellingen Island from mid-April 2015 until July 2015, but have now returned to this camp in relatively low numbers (estimated to be less than 10,000 individuals).

2.3.2 Species Composition and Demographic Data

In the previous monthly flying-fox monitoring undertaken in September (GeoLINK 2015), the proportion of dependent female GHFF with dependent young at Bellingen Island was relatively low at between 10-20%. As expected, with further births occurring in October, the proportion of female GHFF with dependent young recorded at Bellingen Island in the current monitoring event was higher, averaging 45% (range 30-70%). This proportion was even lower at the Macksville Cemetery camp, where the proportion of female GHFF with dependent young recorded averaged 33% (range 0-50%).

The proportion of female GHFF with dependent young recorded at Bellingen Island in the current monitoring event is substantially lower than the average proportion of 62% (range 40-90%) recorded at the same time of year in 2014 (GeoLINK 2014). This may relate to unfavourable observing conditions as weather conditions consisted of heavy cloud and showers leading to flying-foxes being generally inactive. Consequently, the accuracy of the demographic counts may not be as high as previous monitoring events, particularly with respect to the proportion of female GHFF supporting dependent young, which may have been undetected wrapped beneath their mother's wing.

At occupied camps GHFF dominated the species composition with Black Flying-fox accounting for between 5% and 30% of all individuals present. The proportion of Black Flying-fox was highest at the Macksville Cemetery camp, but it appears that Black Flying-foxes have also recently increased at the Gordon Park camp; with previous monthly monitoring indicating only approximately 10% of all individuals present were Black Flying-fox. The proportion of Black Flying-fox at occupied camps in October 2014 was also substantially lower than that recorded in the current monitoring event, ranging between 5-10% (GeoLINK 2014).



As is expected, dependent young GHFF are currently present at occupied camps and are currently being carried to feeding sites by their mothers (Department of Environment 2015).

2.3.3 Phenology of Trees in Region

October flowering of a number of highly productive nectar source trees for GHFF in the upper North Coast region of NSW in October includes Large-leaved Spotted Gum (*Corymbia henryi*), Narrow-leaved Red Gum (*Eucalyptus seeana*), Grey Ironbark (*E. siderophloia*) (coastal lowlands and foothills and ranges), Forest Red Gum (*E. tereticornis*) (inland low altitude and high altitude) and Silky Oak (*Grevillea robusta*). These nectar source trees can be considered key diet species for GHFF (Eby 2012; Eby and Law 2008). Observations when travelling between regional flying-fox camps indicated that light flowering of Grey Ironbark is continuing. Further afield in the Clarence valley light flowering of Forest Red Gum was also observed. Heavy flowering of Silky Oak was also observed around Bellingen and Bowraville.

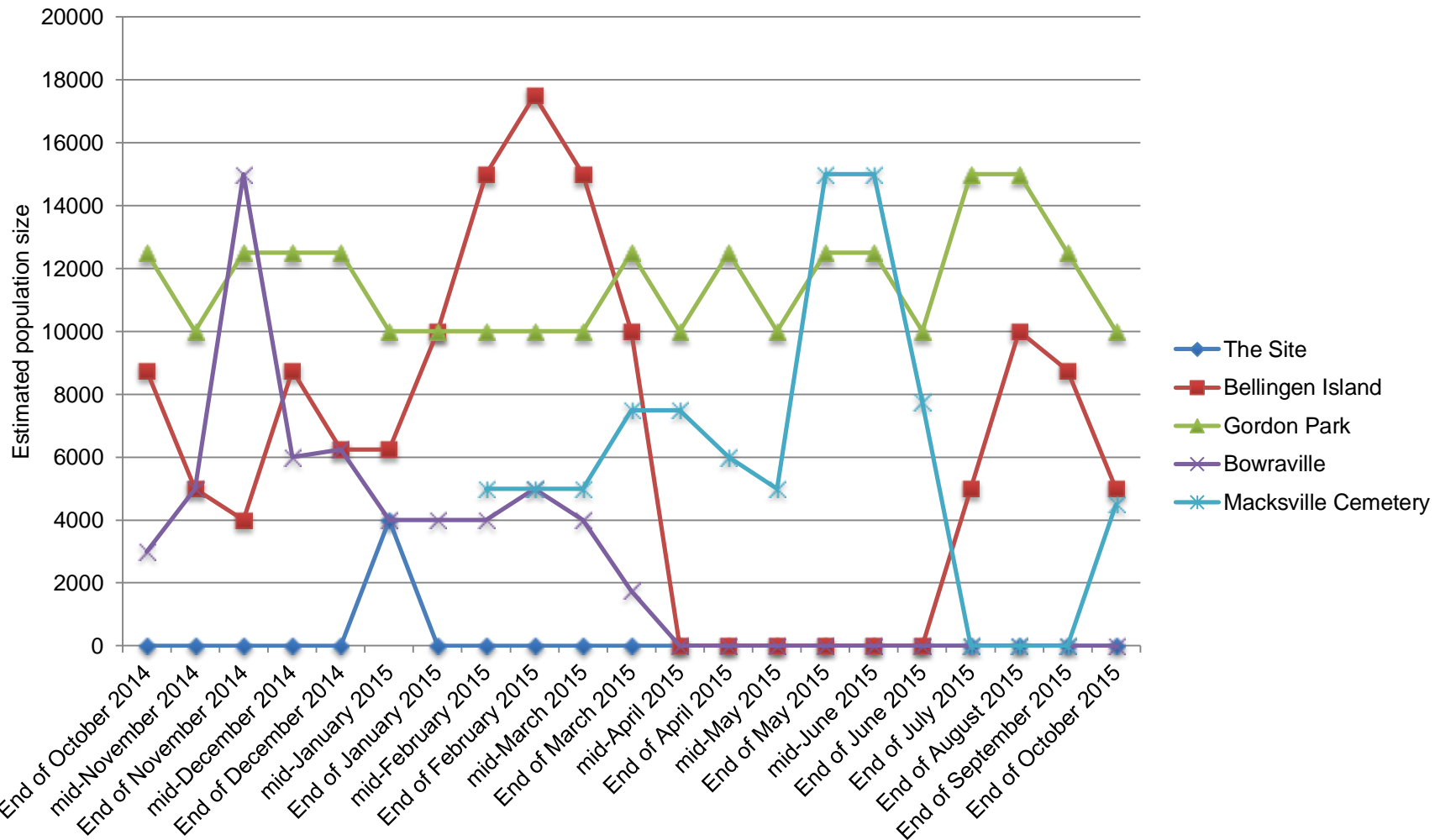


Figure 2.2 Population trends at the site and regional camps October 2014 to October 2015

Note: population at Macksville cemetery from end of February 2015 until end of March 2015 is estimated based on likely date of first arrival and suggested population level (no exit count/ direct count from observations was made)



2.4 Conclusion

The results of the October 2015 seasonal flying-fox monitoring indicate that excluding a brief stopover at the site observed in mid-January 2015, flying-foxes have been absent from the site now for 17 months. After establishing a camp near the Macksville Cemetery over the period of February 2015 to June 2015, flying-foxes departed for the winter months but have recently returned in low numbers. All other regional camps have displayed seasonal absences in the winter period except for the Gordon Park camp, which has retained a generally steady population of flying-foxes over the past 12 months. Dependent young GHFF are currently present at occupied camps, but potentially in lower numbers than those recorded at the same time in 2014.

David Andrighetto

Ecologist



References

Department of the Environment (2015). *Pteropus poliocephalus* in Species Profile and Threats Database, Department of the Environment, Canberra. Available from: <http://www.environment.gov.au/sprat>. Accessed Wed, 4 Nov 2015.

Eby, P. and Law, B. (2008). Ranking the feeding habitat of Grey-headed flying foxes for conservation management. Department of Environment, Heritage, Water and the Arts, Canberra.

Eby, P. (2012). An Assessment of the Flying-fox Camp at Macksville. Unpublished report to NSW Roads and Maritime Services.

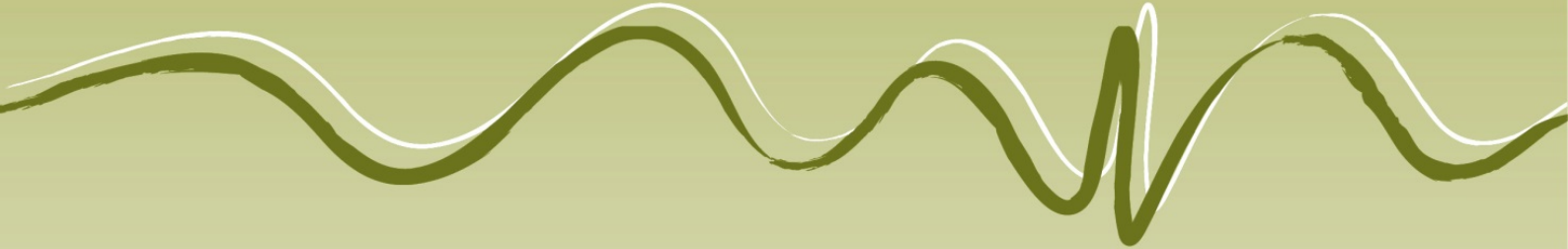
Eby, P. (2013). A Field Monitoring Program Proposed for the Macksville Flying-fox Roost. Unpublished report to Sinclair Knight Merz.

GeoLINK (2014). Flying-fox Monitoring, Warrell Creek to Nambucca Heads Pacific Highway Upgrade, October 2014. Unpublished report to Jacobs and NSW Roads and Maritime Services. GeoLINK, Lennox Head.

GeoLINK (2015). Flying-fox Monitoring, Warrell Creek to Nambucca Heads Pacific Highway Upgrade, September 2015. Unpublished report to NSW Roads and Maritime Services. GeoLINK, Lennox Head.

Flying-fox Monitoring November 2015

Warrell Creek to Nambucca Heads Pacific Highway Upgrade



GeoLINK
environmental management and design

PO Box 119
Lennox Head NSW 2478
T 02 6687 7666

PO Box 1446
Coffs Harbour NSW 2450
T 02 6651 7666

info@geolink.net.au

Prepared for: Roads and Maritime Services
© GeoLINK, 2015

<i>UPR</i>	<i>Description</i>	<i>Date Issued</i>	<i>Issued By</i>
2182-1143	First issue	08/12/2015	David Andrighetto



Table of Contents

1.	Introduction	1
1.1	Introduction	1
2.	Flying-fox Survey	2
2.1	Methodology	2
2.2	Results	3
2.2.1	Roost Footprint	3
2.2.2	Population Estimates	3
2.2.3	Detailed Data	6
2.3	Discussion	8
2.3.1	Population Estimates	8
2.3.2	Species Composition and Demographic Data	9
2.3.3	Phenology of Trees in Region	9
2.4	Conclusion	9

Illustrations

Illustration 2.1	Location of Regional Flying-fox Camps	4
Illustration 2.2	Macksville Cemetery Roost Footprint	5

Tables

Table 2.1	Demographic Data of GHFF at the Macksville Cemetery Camp	6
Table 2.2	Demographic Data of GHFF at the Bellingen Island Camp	7

Figures

Figure 2.1	Water Level Measurements at the Site	8
------------	--------------------------------------	---



1. Introduction

1.1 Introduction

NSW Roads and Maritime Services (RMS) are working to resolve issues relating to a Grey-headed Flying-fox (*Pteropus poliocephalus*) (GHFF) camp that has intermittently been present within the approved alignment of the Warrell Creek to Nambucca Heads (WC2NH) Pacific Highway upgrade project near Macksville. The camp is located in a patch of Swamp Sclerophyll Forest vegetation north of Bald Hill Road (henceforth referred to as 'the site').

GeoLINK has undertaken monitoring at the site on at least a monthly basis since July 2013. Prior to this, irregular monitoring of flying-foxes at the site has been undertaken since the initial establishment of the camp in December 2011 (Eby 2012).

This report details the November 2015 monthly flying-fox monitoring results.



2. Flying-fox Survey

2.1 Methodology

The following personnel undertook fieldwork for the November 2015 seasonal flying-fox monitoring:

- Tom Pollard (GeoLINK sub-consultant ecologist);
- Jessica O’Leary (GeoLINK ecologist);
- Frank Makin (GeoLINK ecologist); and
- Grant McLean (GeoLINK environmental scientist).

The fieldwork followed the methodology developed by Dr Eby for this roost (Eby 2013). Refer to that document for full details of the methodology. A summary of the main procedures used for the monitoring is provided below.

On 25 November 2015 the presence of flying-foxes at the site was assessed by undertaking a traverse of the area previously known to support flying-foxes in conjunction with a few sharp handclaps aimed at eliciting a vocal response from any flying-foxes roosting at the site.

When flying-fox are present at the site, the following data is collected:

- the area of the roost footprint (mapped by GPS);
- species composition;
- demographics;
- reproductive status; and
- behaviour.

However, as the initial traverse indicated that no flying-foxes were present at the site this data was not collected.

In light of the continued absence of flying-foxes at the site (since early April 2014) and the seasonal occupation of a flying-fox camp within 2 km of the site adjacent to Macksville cemetery (first observed early in the summer of 2015), this data has recently been collected from the Macksville cemetery camp instead of at the site to provide some information relating to flying-foxes currently camping in the local area.

The water level at the site was also measured (approximate GPS location 492866, 6600756 [GDA 94, Zone 56]). The water level at this location is representative of the average level at the site.

Following the site traverse, a dusk exit count survey was undertaken at the site on the evening of 25 November 2015 to provide an estimate of the number of flying-foxes currently roosting at the camp. Two observers were strategically located for the count on a northern and southern ridge overlooking the camp. In addition to this two observers were also located in proximity to the Macksville cemetery camp to undertake an exit count of this camp.

Observers were located at the following vantage points for the site:

- in a paddock to the north of the swamp sclerophyll forest (off Wedgewood Drive); and
- on a ridge south of the camp (41 Bald Hill Road).



Observers were located at the following vantage points for the Macksville cemetery camp:

- near the corner of Boundary Street and Boulton Street; and
- at the entrance to Macksville cemetery on Wallace Street.

Recent observations had shown that the vast majority of flying-foxes are currently exiting the Macksville cemetery camp in a westerly and north-westerly direction and therefore the usual vantage point to the east of the camp adjacent to the Pacific Highway at the edge of the Macksville Golf Course was not used in this exit count.

The exit count extended over approximately 45 minutes from sunset until dark (approximately 7:45 pm to 8:30 pm).

Other regional flying-fox camps at Gordon Park, Nambucca Heads (approximately 12 km north-east of the Macksville camp), Bowraville and Bellingen Island were visited on 26 November 2015 and observational comments made. Refer to **Illustration 2.1** for the location of the subject regional camps.

2.2 Results

2.2.1 Roost Footprint

No flying-foxes were observed to be roosting at the site in the camp traverse. Flying-foxes were also absent from Bowraville and Wheatley Street in Bellingen.

Regionally, flying-foxes were observed to be roosting at Macksville Cemetery, Bellingen Island, and Gordon Park (Nambucca Heads). The roost footprint recorded at Macksville Cemetery was approximately 4.1 ha and is shown in **Illustration 2.2**.

2.2.2 Population Estimates

2.2.2.1 Exit Count

No flying-foxes were observed flying from the site in the exit count. Nearby, approximately 19,000 flying-foxes were recorded exiting the Macksville Cemetery camp. Nearly all of these individuals were observed to be flying from the camp in a westerly and north-westerly direction.

2.2.2.2 Direct Counts

No exit count was conducted at any of the regional camps (excluding the Macksville Cemetery camp). However, rough population estimates for these camps based on extrapolation of counts in individual trees and the roost footprint are as follows:

- Gordon Park: approximately 10,000 individuals.
- Bowraville: no individuals recorded.
- Bellingen Island: approximately 5,000 individuals.
- Wheatley Street, Bellingen: no individuals recorded.

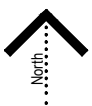
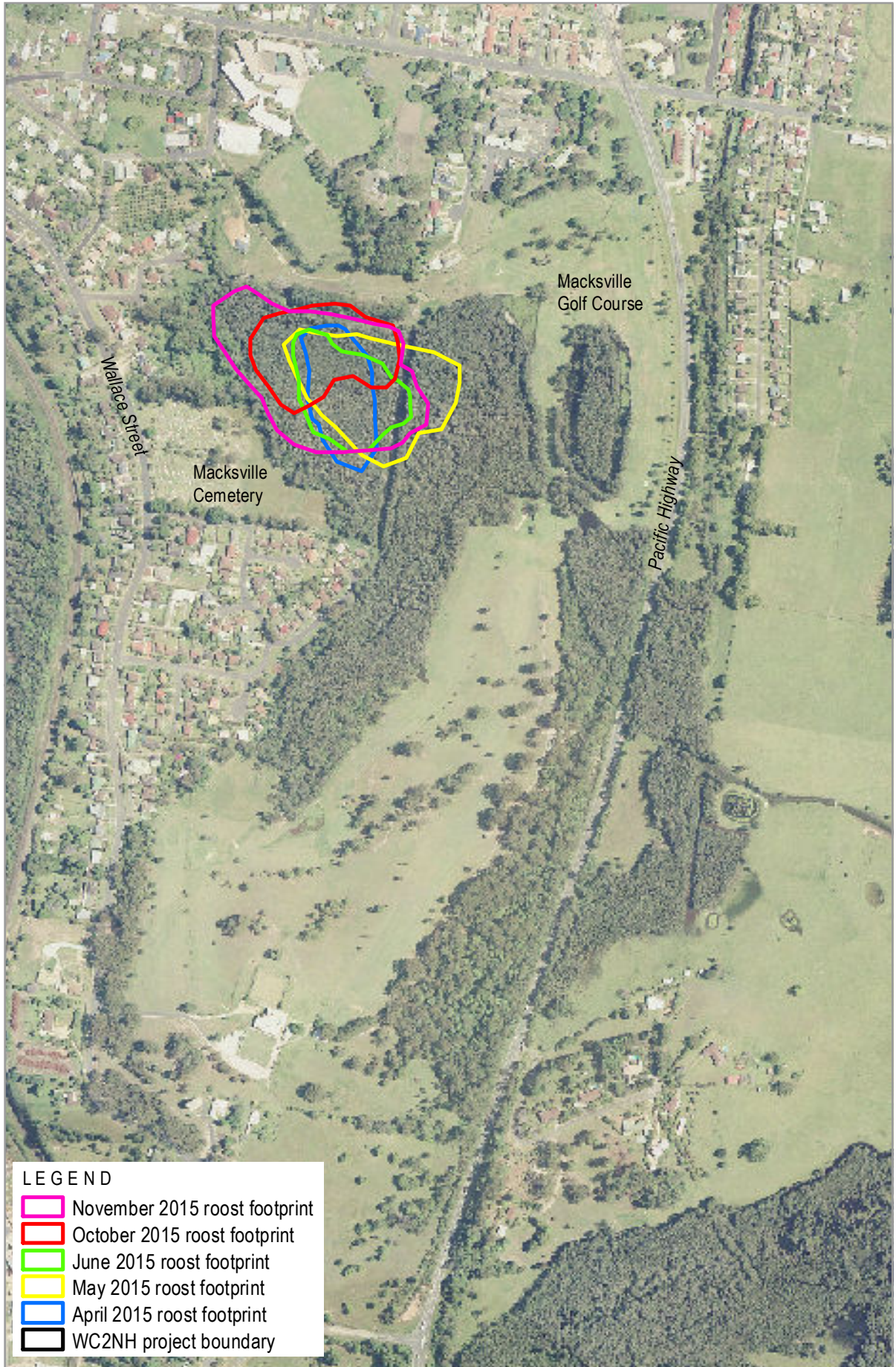
Information shown is for illustrative purposes only



0 4 km

Location of Regional Flying-fox Camps

Information shown is for illustrative purposes only



0 150



Macksville Cemetery Flying-fox Roost Footprint

2.2.3 Detailed Data

2.2.3.1 Species Composition

The species composition and proportions at occupied camps were as follows:

- Macksville Cemetery – GHFF 95%, Black Flying-fox 5%.
- Gordon Park – GHFF 80%, Black Flying-fox 20%.
- Bellingen Island – GHFF 95%, Black Flying-fox 5%.

2.2.3.2 Habitat Characteristics and Demographic Composition

As mentioned previously, no flying-foxes were recorded at the site and therefore, no detailed species composition data was collected. Instead, this data was collected at the nearby Macksville Cemetery camp for the current monitoring event.

Results of the demographic counts at the Macksville Cemetery camp indicated that females dominated the counts, making up between 59% and 83% of all individuals present. Dependent young were observed with the female GHFF at a moderate level, with the proportion of females with young ranging between 30% and 60% (refer to **Table 2.1**).

Table 2.1 Demographic Data of GHFF at the Macksville Cemetery Camp

Tree Code	Tree Species	GPS (easting, northing; GDA 94, Zone 56)	Height (m); DBH (cm)	Demographic Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
MC1	Broad-leaved Paperbark	491995, 6601794	12; 40	10:3	yes	60
MC2	Broad-leaved Paperbark	492018, 6601761	12; 30	10:5	yes	50
MC3	Broad-leaved Paperbark	492019, 6601742	14; 30	10:2	yes	60
MC4	Broad-leaved Paperbark	492036, 6601729	12; 40	10:3	yes	30
MC5	Broad-leaved Paperbark	492050, 6601710	15; 40	10:8	yes	40
MC6	Broad-leaved Paperbark	492081, 6601693	15; 60	10:3	yes	50
MC7	Broad-leaved Paperbark	492130, 6601700	12; 30	10:2	yes	60
MC8	Broad-leaved Paperbark	492172, 6601750	15; 40	10:4	yes	40

Tree Code	Tree Species	GPS (easting, northing; GDA 94, Zone 56)	Height (m); DBH (cm)	Demographic Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
MC9	Broad-leaved Paperbark	492172, 6601784	12; 50	10:3	yes	60
MC10	Broad-leaved Paperbark	492170, 6601816	15; 50	10:4	yes	50

To provide comparative information relating to flying-foxes occupying the broader region surrounding the site, data of habitat characteristics and demographic composition was collected at Bellingen Island camp (refer to **Table 2.2**).

Table 2.2 Demographic Data of GHFF at the Bellingen Island Camp

Tree Code	Tree Species	GPS (easting, northing; GDA 94, Zone 56)	Height (m); DBH (cm)	Demographic Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
BI1	Creek Sandpaper Fig	490028, 6631635	7; 20	10:4	yes	30
BI2	White Cedar	490039, 6631616	9; 40	10:5	yes	30
BI3	Giant Stinging Tree	490053, 6631617	8; 30	10:3	yes	60
BI4	Giant Stinging Tree	490048, 6631602	12; 50	10:3	yes	50
BI5	Creek Sandpaper Fig	490029, 6631605	8; 30	10:5	yes	50
BI6	Unknown sp.	490030, 6631584	15; 70	10:2	yes	50
BI7	Creek Sandpaper Fig	490020, 6631595	9; 40	10:4	yes	40
BI8	Creek Sandpaper Fig	490007, 6631596	7; 30	10:8	yes	20
BI9	Small-leaved Fig	490016, 6631609	15; 80	10:3	yes	40
BI10	Creek Sandpaper Fig	489992, 6631598	8; 30	10:3	yes	40

Results of the demographic counts at the Bellinghen Island camp indicated that females dominated the counts, making up between 56% and 83% of all individuals present. Dependent young were observed with the female GHFF at a moderate level, with the proportion of females with young ranging between 20% and 60% (refer to **Table 2.2**).

General observations of the flying-foxes present at Gordon Park camp indicated that both female and male GHFF were present and a moderate to high number of female flying-foxes with dependant young were observed.

2.2.3.3 Water Level at the Site

Water level at the site measured at the representative measurement location was approximately 20 cm in depth as is shown in **Figure 2.1**. The water level has remained at a relatively low level since August.

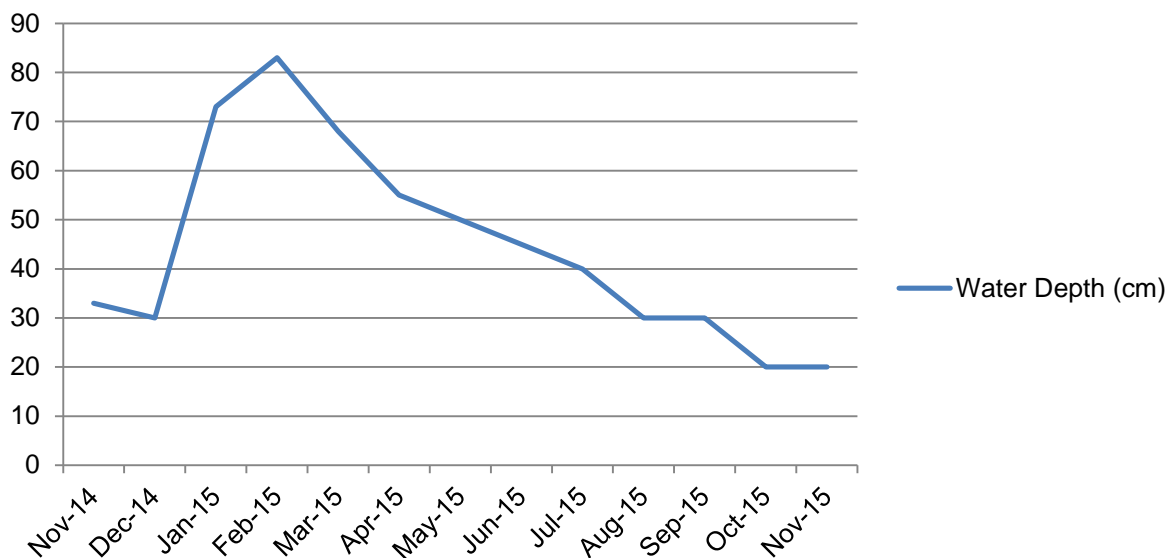



Figure 2.1 Water Level Measurements at the Site

2.3 Discussion

2.3.1 Population Estimates

No flying-foxes were observed to be roosting at the site during the roost traverse undertaken for the current monitoring event. Nor were any flying-foxes observed to be flying from the site in the exit count. Flying-foxes have not been camped at the site (excluding a brief return in January 2015) since mid-April 2014.

The number of Flying-foxes roosting at the Macksville Cemetery camp has increased substantially over the last month, from around 4,500 in October to an estimated 19,000 in the current monitoring event. Flying-foxes were temporarily absent from this camp over the winter-early spring period (July-September) of 2015.



Flying-foxes continue to be absent from the Bowraville camp. No flying-foxes have been recorded roosting at Bowraville since mid-April 2015. For comparison, in November 2014 approximately 15,000 flying-foxes were roosting at the Bowraville camp (GeoLINK 2014).

The number of flying-foxes roosting at Bellingen Island remains relatively low at an estimated 5,000 individuals. In November 2014, similar low numbers of flying-foxes were recorded (GeoLINK 2014). Numbers have not exceeded 10,000 individuals at Bellingen Island since returning after a winter absence.

2.3.2 Species Composition and Demographic Data

At occupied camps GHFF dominated the species composition and Black Flying-fox accounted for a relatively small proportion of approximately 5-20% of all individuals present. Some variability in the proportion of flying-fox species has been noted in recent monitoring events, with the most obvious change being a reduction in the proportion of Black Flying-fox being recorded at the Macksville Cemetery camp in the current monitoring event (from an estimated 30% last month to only 5% in the current monitoring event).

As was expected the proportion of female GHFF with dependent young recorded in demographic counts in the current monitoring event was higher than was recorded in the previous month. This is likely the result of young being larger and consequently more easy to observe. In addition, weather conditions this month were more favourable and daytime flying-fox activity was enhanced which aided in detection of young on their mothers. However, the proportion of GHFF females with dependent young at Bellingen appears to be slightly lower than at the same time of year in 2014, with 40-80% of females supporting young in November 2014 (GeoLINK 2014) compared with 20-60% in the current monitoring event.


2.3.3 Phenology of Trees in Region

Key GHFF nectar diet tree species in the upper North Coast region of NSW that flower in October/November include Narrow-leaved Red Gum (*Eucalyptus seeana*), Grey Ironbark (*E. siderophloia*) (coastal lowlands and foothills and ranges), Forest Red Gum (*E. tereticornis*) (inland low altitude and high altitude), Black Bean (*Castanospermum australe*) and Silky Oak (*Grevillea robusta*) (Eby and Law 2008). Blackbutt (*Eucalyptus pilularis*) may also flower during this period and comprises a key nectar diet species (Eby 2012).

Observations when travelling between regional flying-fox camps found light flowering of Grey Ironbark and light to moderate flowering of Coastal Blackbutt. Further north around Grafton, Large-leaved Spotted Gum (*Corymbia henryi*) was also in flower (with low number of trees in heavy flower), however these trees are located outside the nightly foraging range of the flying-foxes roosting at the surveyed camps.

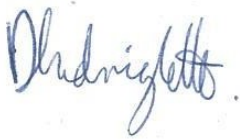
2.4 Conclusion

The results of the November 2015 monthly flying-fox monitoring indicate that excluding a brief stopover at the site observed in mid-January 2015, flying-foxes have been absent from the site now since mid-April 2014. After establishing a camp nearby to the site at the Macksville Cemetery over the period of February 2015 to June 2015, flying-foxes departed for the winter months. They have recently returned and were in relatively high numbers at the time of the current monitoring event.



Flying-foxes have now also returned to the Bellingen Island camp following a late autumn-winter absence, but numbers have consistently been relatively low not exceeding 10,000 individuals. Since departing Borwaville in late autumn flying-foxes have not returned yet for the usual occupation of this camp over the warmer period of the year. All regional camps have displayed seasonal absences in the winter period except for the Gordon Park camp, which has retained a generally steady population of flying-foxes over the past 12 months.

Dependent young GHFF are currently present at occupied camps, but at a somewhat lower level than was recorded at the same time in 2014.



David Andrighetto

Ecologist



References

Eby, P. and Law, B. (2008). *Ranking the feeding habitat of Grey-headed flying foxes for conservation management*. Department of Environment, Heritage, Water and the Arts, Canberra.

Eby, P. (2012). *An Assessment of the Flying-fox Camp at Macksville*. Unpublished report to NSW Roads and Maritime Services.

Eby, P. (2013). *A Field Monitoring Program Proposed for the Macksville Flying-fox Roost*. Unpublished report to Sinclair Knight Merz.

GeoLINK (2014). *Flying-fox Monitoring, Warrell Creek to Nambucca Heads Pacific Highway Upgrade, November 2014*. Unpublished report to Jacobs and NSW Roads and Maritime Services. GeoLINK, Lennox Head.

Flying-fox Monitoring December 2015

Warrell Creek to Nambucca Heads Pacific Highway Upgrade



PO Box 119
Lennox Head NSW 2478
T 02 6687 7666

PO Box 1446
Coffs Harbour NSW 2450
T 02 6651 7666

PO Box 1267
Armidale NSW 2350
T 0488 677 666

Unit 10 Warina Walk Arcade
156 Molesworth St
Lismore NSW 2480
T 02 6621 6677

info@geolink.net.au

Prepared for: Roads and Maritime Services
© GeoLINK, 2015

<i>UPR</i>	<i>Description</i>	<i>Date Issued</i>	<i>Issued By</i>
2182-1146	First issue	06/01/2015	David Andrighetto



Table of Contents

1.	Introduction	1
1.1	Introduction	1
2.	Flying-fox Survey	2
2.1	Methodology	2
2.2	Results	3
2.2.1	Roost Footprint	3
2.2.2	Population Estimates	3
2.2.3	Detailed Data	6
2.3	Discussion	9
2.3.1	Population Estimates	9
2.3.2	Species Composition and Demographic Data	10
2.3.3	Phenology of Trees in Region	10
2.4	Conclusion	10

Illustrations

Illustration 2.1	Location of Regional Flying-fox Camps	4
Illustration 2.2	Macksville Cemetery Roost Footprint	5

Tables

Table 2.1	Demographic Data of GHFF at the Macksville Cemetery Camp	6
Table 2.2	Demographic Data of GHFF at the Bellingen Island Camp	7

Figures

Figure 2.1	Water Level Measurements at the Site	9
------------	--------------------------------------	---



1. Introduction

1.1 Introduction

NSW Roads and Maritime Services (RMS) are working to resolve issues relating to a Grey-headed Flying-fox (*Pteropus poliocephalus*) (GHFF) camp that has intermittently been present within the approved alignment of the Warrell Creek to Nambucca Heads (WC2NH) Pacific Highway upgrade project near Macksville. The camp is located in a patch of Swamp Sclerophyll Forest vegetation north of Bald Hill Road (henceforth referred to as 'the site').

GeoLINK has undertaken monitoring at the site on at least a monthly basis since July 2013. Prior to this, irregular monitoring of flying-foxes at the site has been undertaken since the initial establishment of the camp in December 2011 (Eby 2012).

This report details the December 2015 monthly flying-fox monitoring results.



2. Flying-fox Survey

2.1 Methodology

The following personnel undertook fieldwork for the December 2015 seasonal flying-fox monitoring:

- David Andrighetto (GeoLINK ecologist);
- Grant McLean (GeoLINK ecologist);
- Frank Makin (GeoLINK ecologist); and
- Kale Hardie-Porter (GeoLINK environmental scientist).

The fieldwork followed the methodology developed by Dr Eby for this roost (Eby 2013). Refer to that document for full details of the methodology. A summary of the main procedures used for the monitoring is provided below.

On 21 December 2015 the presence of flying-foxes at the site was assessed by undertaking a traverse of the area previously known to support flying-foxes in conjunction with a few sharp handclaps aimed at eliciting a vocal response from any flying-foxes roosting at the site.

When flying-fox are present at the site, the following data is collected:

- the area of the roost footprint (mapped by GPS);
- species composition;
- demographics;
- reproductive status; and
- behaviour.

However, as the initial traverse indicated that no flying-foxes were present at the site this data was not collected.

In light of the continued absence of flying-foxes at the site (since early April 2014) and the seasonal occupation of a flying-fox camp within two kilometres of the site adjacent to Macksville cemetery (first observed early in the summer of 2015), this data has recently been collected from the Macksville cemetery camp instead of at the site to provide some information relating to flying-foxes currently camping in the local area.

The water level at the site was also measured (approximate GPS location 492866, 6600756 [GDA 94, Zone 56]). The water level at this location is representative of the average level at the site.

Following the site traverse, a dusk exit count survey was undertaken at the site on the evening of 21 December 2015 to provide an estimate of the number of flying-foxes currently roosting at the camp. Two observers were strategically located for the count on a northern and southern ridge overlooking the camp. In addition to this two observers were also located in proximity to the Macksville cemetery camp to undertake an exit count of this camp.

Observers were located at the following vantage points for the site:

- in a paddock to the north of the swamp sclerophyll forest (off Wedgewood Drive); and
- on a ridge south of the camp (41 Bald Hill Road).



Observers were located at the following vantage points for the Macksville cemetery camp:

- near the corner of Boundary Street and Boulton Street; and
- at the entrance to Macksville cemetery on Wallace Street.

Recent observations had shown that the vast majority of flying-foxes are currently exiting the Macksville cemetery camp in a westerly and north-westerly direction and therefore the usual vantage point to the east of the camp adjacent to the Pacific Highway at the edge of the Macksville Golf Course was not used in this exit count.

The exit count extended over approximately 45 minutes from sunset until dark (approximately 7:55 pm to 8:40 pm).

Other regional flying-fox camps at Gordon Park, Nambucca Heads (approximately 12 kilometres north-east of the Macksville camp), Bowraville and Bellingen Island were visited on 21 December 2015 and observational comments made. Refer to **Illustration 2.1** for the location of the subject regional camps.

2.2 Results

2.2.1 Roost Footprint

No flying-foxes were observed to be roosting at the site in the camp traverse. Flying-foxes were also absent from Bowraville and Wheatley Street in Bellingen.

Regionally, flying-foxes were observed to be roosting at Macksville Cemetery, Bellingen Island, and Gordon Park (Nambucca Heads). The roost footprint recorded at Macksville Cemetery was approximately four hectares (similar to the November 2015 monitoring) and is shown in **Illustration 2.2**.

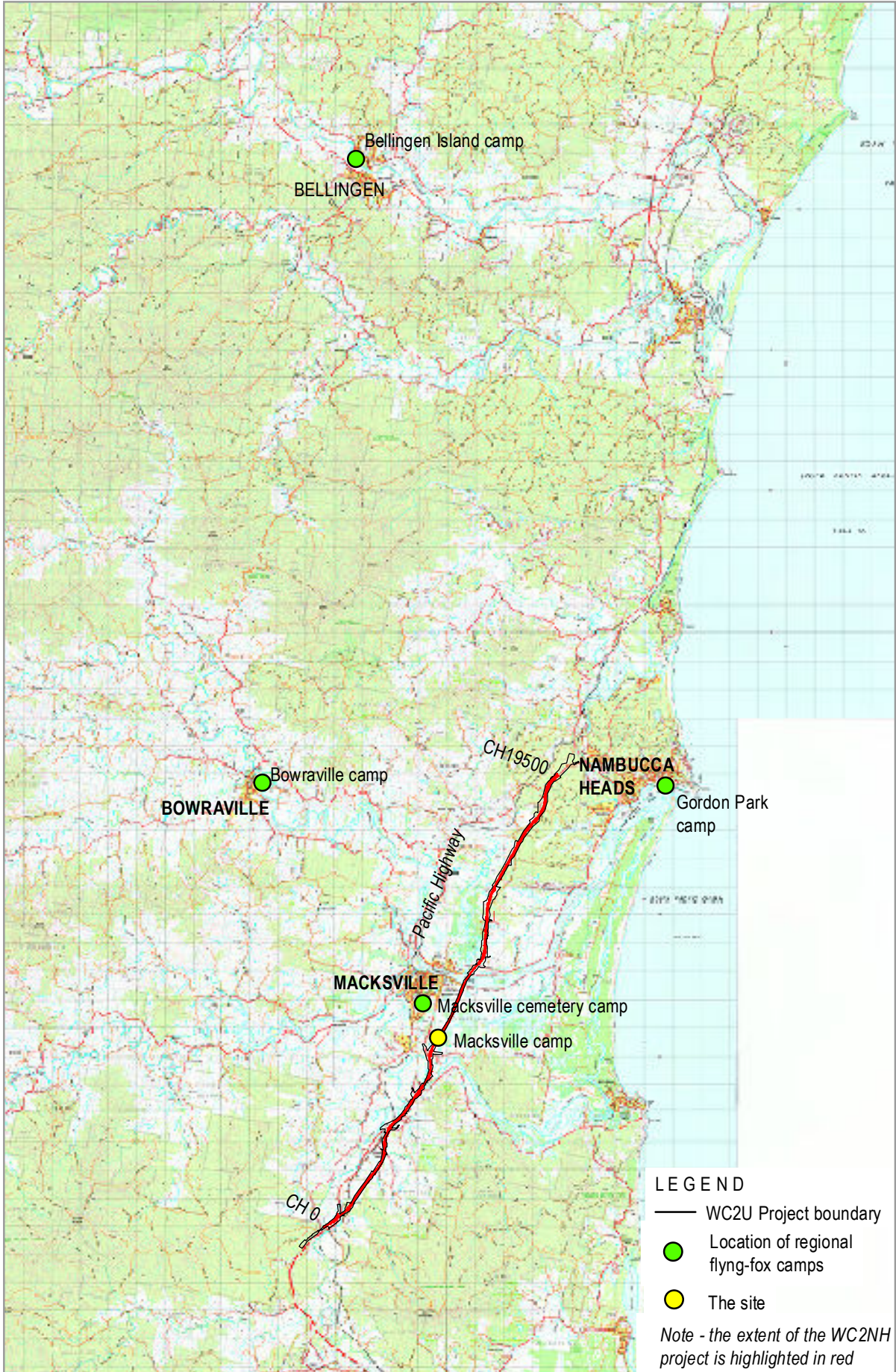
2.2.2 Population Estimates

2.2.2.1 Exit Count

No flying-foxes were observed flying from the site in the exit count. The exit count at the Macksville Cemetery camp recorded over 30,000 flying-foxes. It was not possible to accurately estimate the number of animals as:

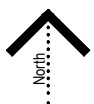
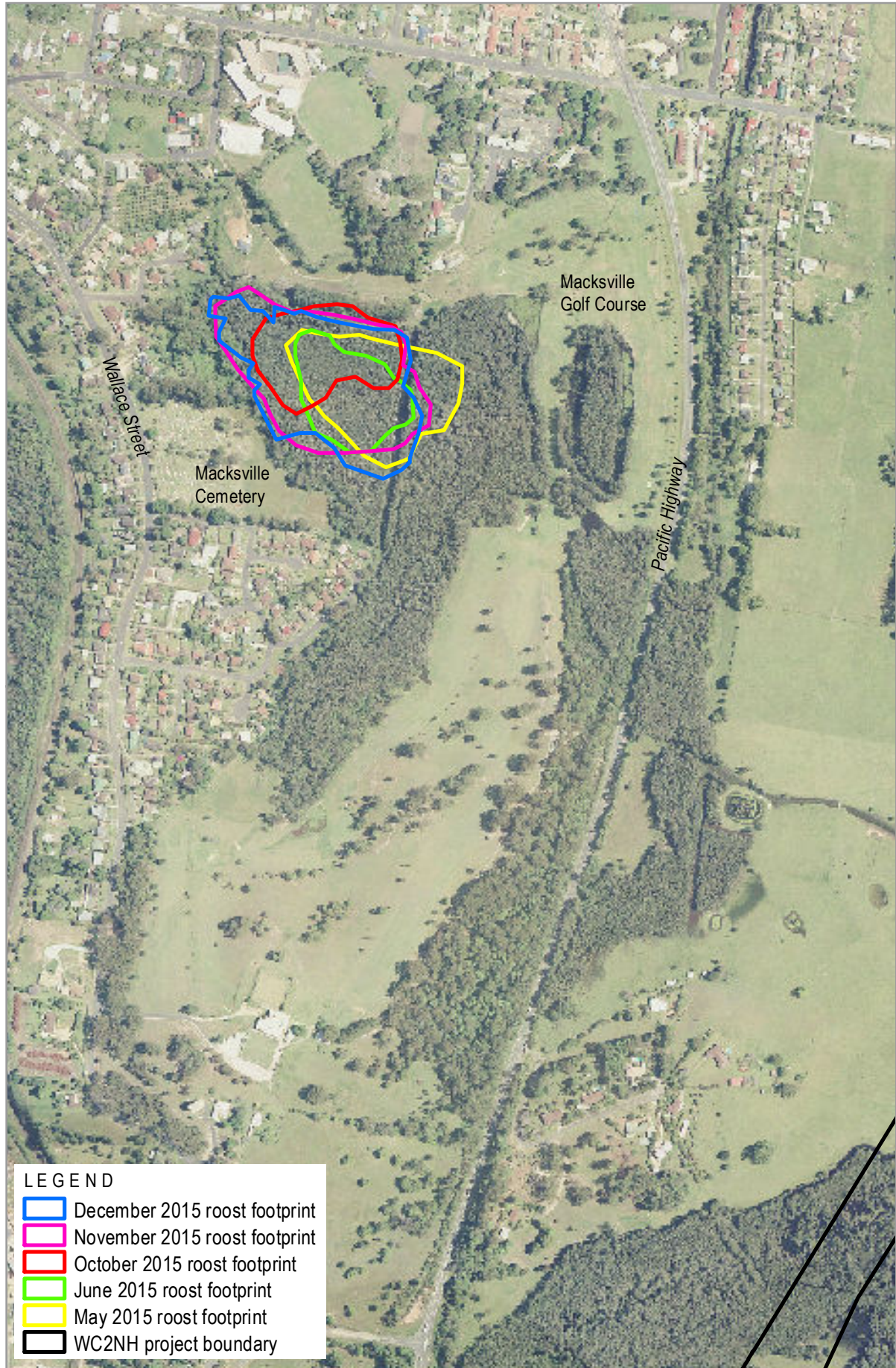
- The flying-foxes were utilising three broad fly-out 'streams' to the west, north-west and south. The southern stream was not present during the previous (November 2015) flying-fox monitoring event.
- Approximately 10-20 % of animals changed direction during the fly-out.

Information shown is for illustrative purposes only



0 4 km

Location of Regional Flying-fox Camps



0 150

2.2.2.2 Direct Counts

No exit counts were conducted at any of the regional camps (excluding the Macksville Cemetery camp). However, rough population estimates for these camps based on extrapolation of counts in individual trees and the roost footprint are as follows:

- Gordon Park: approximately 10,000 individuals (similar to the previous monitoring event).
- Bowraville: no individuals recorded (same as the previous monitoring event).
- Bellingen Island: >20,000 individuals (significantly larger than the previous monitoring event with approximately ¾ of Bellingen Island occupied by the camp, including the lower portion of emergent figs).
- Wheatley Street, Bellingen: no individuals recorded (same as the previous monitoring event).

2.2.3 Detailed Data

2.2.3.1 Species Composition

The species composition and proportions at occupied camps were as follows:

- Macksville Cemetery – GHFF >95%, Black Flying-fox <5%.
- Gordon Park – GHFF 80%, Black Flying-fox 20%.
- Bellingen Island – GHFF >95%, Black Flying-fox <5%.

2.2.3.2 Habitat Characteristics and Demographic Composition

As mentioned previously, no flying-foxes were recorded at the site and therefore, no detailed species composition data was collected. Instead, this data was collected at the nearby Macksville Cemetery camp for the current monitoring event.

Results of the demographic counts at the Macksville Cemetery camp indicated that females dominated the counts, making up between 37% and 83% (average 61%) of all individuals present at count locations (which excluded male 'bachelor' trees). Dependent young were observed with the female GHFF at a moderate to high level, with the proportion of females with young ranging between 30% and 100% (average 65%) (refer to **Table 2.1**).

Table 2.1 Demographic Data of GHFF at the Macksville Cemetery Camp

Tree Code	Tree Species	GPS (easting, northing; GDA 94, Zone 56)	Height (m); DBH (cm)	Demographic Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
MC1	Broad-leaved Paperbark	491985, 6601770	15; 30	10:4	yes	80
MC2	Broad-leaved Paperbark	491990, 6601775	15; 40	10:3	yes	40
MC3	Broad-leaved	491988, 6601813	18; 30&40	10:3	yes	50

Tree Code	Tree Species	GPS (easting, northing; GDA 94, Zone 56)	Height (m); DBH (cm)	Demographic Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
	Paperbark					
MC4	Broad-leaved Paperbark	491958, 6601867	18; 40	10:7	yes	30
MC5	Broad-leaved Paperbark	491963, 6601902	16; 35	10:9	yes	40
MC6	Broad-leaved Paperbark	491986, 6601883	16; 35	10:8	yes	40
MC7	Broad-leaved Paperbark	492014, 6601864	12; 30	10:2	yes	100
MC8	Broad-leaved Paperbark	492042, 6601873	15; 30	10:3	yes	90
MC9	Broad-leaved Paperbark	492084, 6601866	13; 30	10:7	yes	90
MC10	Broad-leaved Paperbark	492169, 6601857	15; 50	10:17	yes	90

To provide comparative information relating to flying-foxes occupying the broader region surrounding the site, data of habitat characteristics and demographic composition was collected at Bellingen Island camp (refer to **Table 2.2**).

Table 2.2 Demographic Data of GHFF at the Bellingen Island Camp

Tree Code	Tree Species	GPS (easting, northing; GDA 94, Zone 56)	Height (m); DBH (cm)	Demographic Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
BI1	Creek Sandpaper Fig	490043, 6631625	8; 20	10:5	yes	100
BI2	Creek Sandpaper Fig	490049, 6631616	9; 20	10:6	yes	70
BI3	Rainforest sp.	490042, 6631621	9; 20	10:6	yes	90
BI4	Creek Sandpaper Fig	490034, 6631620	8; 20	10:3	yes	90

Tree Code	Tree Species	GPS (easting, northing; GDA 94, Zone 56)	Height (m); DBH (cm)	Demographic Ratio (female:male)	Presence of Dependant Young (yes/no)	%females with Dependant Young
BI5	Giant Stinging Tree	490020, 6631605	12; 50	10:5	yes	70
BI6	Giant Stinging Tree	490057, 6631511	12; 50	10:5	yes	70
BI7	Creek Sandpaper Fig	489995, 6631608	12; 25	10:6	yes	90
BI8	Giant Stinging Tree	489988, 6631614	25; 60	10:14	yes	90
BI9	Creek Sandpaper Fig	489995, 6631615	15; 60	10:3	yes	100
BI10	Giant Stinging Tree	489991, 6631616	10; 40	10:3	yes	90

Results of the demographic counts at the Bellingen Island camp indicated that females dominated the counts, making up between 42% and 77% (average 64%) of all individuals present at count locations (which excluded male 'bachelor' trees). Dependent young were observed with the female GHFF at a high level, with the proportion of females with young ranging between 70% and 100% (average 86%) (refer to **Table 2.2**).

General observations of the flying-foxes present at Gordon Park camp indicated that both female and male GHFF were present and a moderate to high number of female flying-foxes with dependant young were observed.

2.2.3.3 Water level at the site

Water level at the site measured at the representative measurement location was approximately 10 cm in depth as is shown in **Figure 2.1**. The water level has been steadily decreasing since a peak in February 2015.

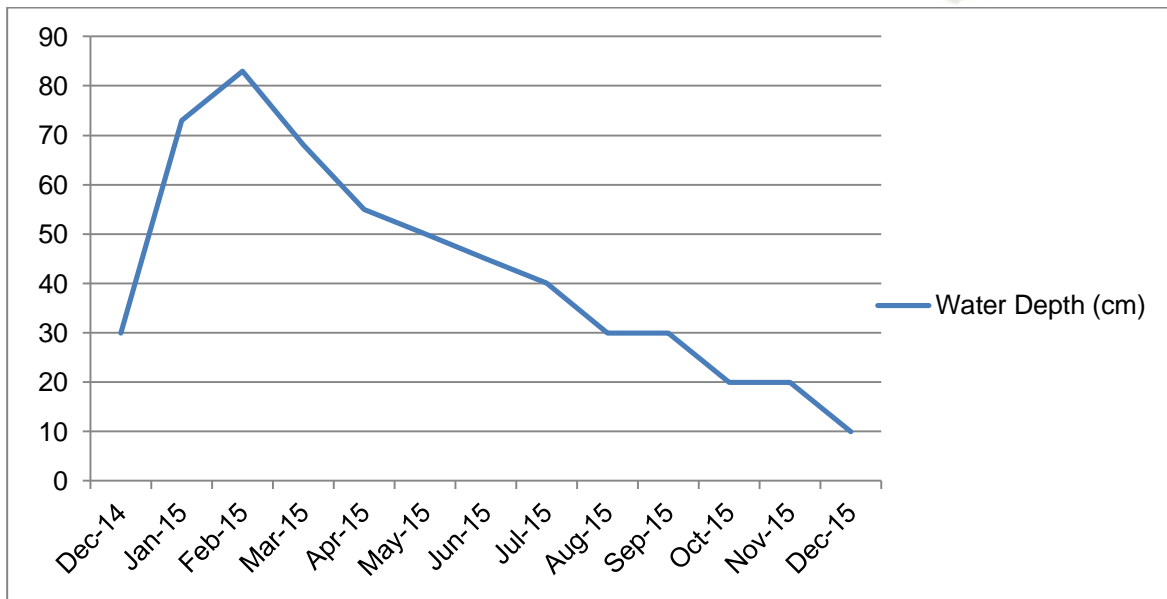


Figure 2.1 Water Level Measurements at the Site

2.3 Discussion

2.3.1 Population Estimates

No flying-foxes were observed to be roosting at the site during the roost traverse undertaken for the current monitoring event. Nor were any flying-foxes observed to be flying from the site in the exit count. Flying-foxes have not been camped at the site (excluding a brief return in January 2015) since mid-April 2014.

The number of flying-foxes roosting at the Macksville Cemetery camp has increased substantially over the last two months, from around 4,500 in October to an estimated >30,000 during the current monitoring event. This is the largest number of individuals recorded at the camp since the camp was detected in February 2015. This camp has been occupied for seven of the 10 months since detected. Flying-foxes were absent from the camp over the winter-early spring period (July-September) of 2015. The Macksville Cemetery camp appears to be used as a replacement camp to the site.

Flying-foxes continue to be absent from the Bowraville camp. No flying-foxes have been recorded roosting at Bowraville since mid-April 2015. For comparison, in December 2014 approximately 5,000-7,500 flying-foxes were roosting at the Bowraville camp (GeoLINK 2014).

The number of flying-foxes roosting at Bellingen Island has increased substantially from an estimated 5,000 individuals in November 2015, to >20,000 individuals during the current monitoring event. In December 2014, approximately 5,000-7,500 flying-foxes were recorded (GeoLINK 2014). Numbers have not exceeded 10,000 individuals at Bellingen Island since March 2015.

An estimated 10,000 flying-foxes were recorded at the Gordon Park camp (similar to last month). Of the camps monitored as part of this project, the Gordon Park camp has been the only continuously occupied flying-fox camp (July 2013 to December 2015). Flying-fox numbers are also generally stable and range between 10,000 and 20,000 individuals.

2.3.2 Species Composition and Demographic Data

Both GHFF and Black Flying-foxes were present at all occupied camps. GHFF dominated the species composition comprising between 80 - >95% of all individuals present. Black Flying-fox accounted for a relatively small proportion (<5-20%) of all individuals present.

The proportion of female GHFF with dependent young recorded in demographic counts in the current monitoring event was higher than was recorded in the previous month for the second month in a row. This is likely to be from:

- The birthing period now being finished (i.e. all of this year's young are now born).
- The young being larger and consequently easier to observe.
- The weather conditions being warm, causing enhanced daytime flying-fox activity.

The proportion of GHFF females with dependent young at Bellingen was particularly high (average 86%) and greater than December in November 2014 (70%, GeoLINK 2014).

2.3.3 Phenology of Trees in Region


Nectar comprises a key foraging resource for flying-foxes in the region. During the December/ January period, a number of key diet nectar source trees in the upper North Coast region of NSW typically flower, including Black Bean (*Castanospermum australe*), **Red Bloodwood (*Corymbia gummifera*)**, **Pink Bloodwood (*Corymbia intermedia*)**, **Spotted Gum (*Corymbia maculata*)**, **Northern Spotted Gum (*Corymbia variegata*)**, New England Blackbutt (*Eucalyptus andrewsii*), River Red Gum (*Eucalyptus camaldulensis*), **Blackbutt (*Eucalyptus pilularis* – foothills and ranges)**, **Grey Ironbark (*Eucalyptus siderophloia* – foothills and ranges)** and **Forest Red Gum (*Eucalyptus tereticornis* – high altitude)** (Eby and Law 2008) (*Note: those in bold occur within a 50km radius of the site – Eby 2012*). Other flying-fox nectar and pollen diet tree species that occur within a 50km radius of the site and flower during the December/ January period include Smooth-barked Apple (*Angophora costata*), Rough-barked Apple (*Angophora floribunda*), Small-fruited Grey Gum (*Eucalyptus propinqua*) and Red Mahogany (*Eucalyptus resinifera*) (Eby 2012).

No flying-fox food trees were observed in the area when driving between the regional camps. Further north around Grafton, Large-leaved Spotted Gum (*Corymbia henryi*) and Rough-barked Apple Smudgee (*Angophora woodsiana*) were in flower, however these trees are located outside the nightly foraging range of the flying-foxes roosting at the surveyed camps.

2.4 Conclusion

The results of the December 2015 monthly flying-fox monitoring indicate that excluding a brief stopover at the site observed in mid-January 2015, flying-foxes have been absent from the site now since mid-April 2014. The nearby Macksville Cemetery camp which was detected in February 2015 and has supported flying-foxes for most months since (excluding three months from July to September 2015), supported large numbers of flying-foxes during the December monitoring event (estimated >30,000). The Macksville Cemetery camp appears to be used as a replacement camp to the site.

Flying-foxes have remained at the Bellingen Island camp following a brief late autumn-winter absence, with substantial number of animals present (>20,000) during the current monitoring event (the largest numbers since the camp returned). Since departing Borwaville in late autumn flying-foxes have not



returned yet for the usual occupation of this camp over the warmer period of the year. All regional camps have displayed seasonal absences in the 2015 winter period except for the Gordon Park camp, which has retained a generally steady population of flying-foxes over the past 12 months.

Dependent young GHFF are currently present at all occupied camps. A greater proportion of adult females supported dependant young at the Bellingin Island camp during the current monitoring event compared to the December 2014 monitoring event.



David Andrighetto

Ecologist



References

Eby, P. and Law, B. (2008). *Ranking the feeding habitat of Grey-headed flying foxes for conservation management*. Department of Environment, Heritage, Water and the Arts, Canberra.

Eby, P. (2012). *An Assessment of the Flying-fox Camp at Macksville*. Unpublished report to NSW Roads and Maritime Services.

Eby, P. (2013). *A Field Monitoring Program Proposed for the Macksville Flying-fox Roost*. Unpublished report to Sinclair Knight Merz.

GeoLINK (2014). *Flying-fox Monitoring, Warrell Creek to Nambucca Heads Pacific Highway Upgrade, December 2014*. Unpublished report to Jacobs and NSW Roads and Maritime Services. GeoLINK, Lennox Head.