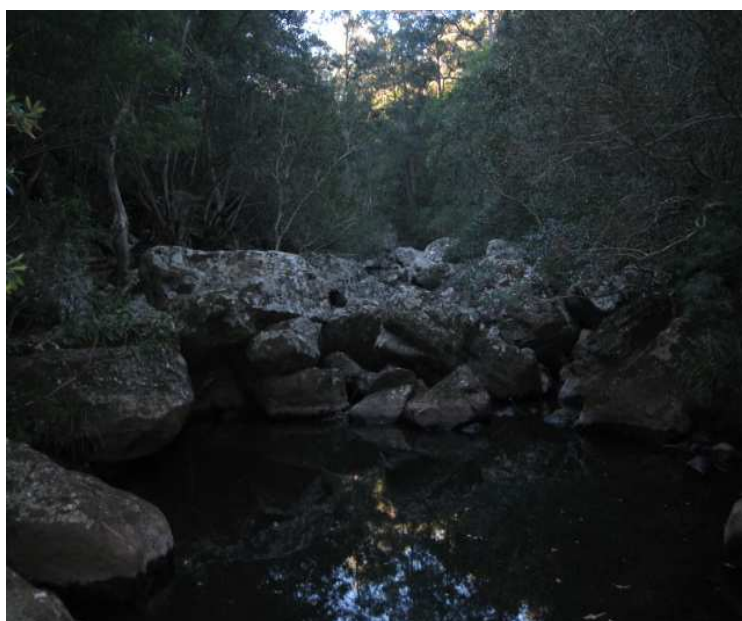




Additional Surveys for the Giant Burrowing Frog *Heleioporus australiacus*, North Nowra Link Road

Prepared for
Shoalhaven City Council

May 2011



DOCUMENT TRACKING

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Appendix A: January and March Weather Observations, Nowra

1 Introduction

1.1 BACKGROUND

This report details the results of targeted surveys for the Giant Burrowing Frog (*Heleioporus australiacus*) (GBF) undertaken during January and March 2011 in Bomaderry Creek Regional Park and adjoining lands. The additional frog surveys were commissioned by Shoalhaven City Council as part of the North Nowra Link Road environmental assessment process. The aim of the work was to provide additional information on the presence and status of the GBF in the area to clarify potential impacts to the species. The GBF is known from the Bomaderry Creek area from a single possible record of a call heard in 1992. Despite numerous searches since then, the species has not been recorded in the area.

The GBF is listed as a Vulnerable Species under Schedule 2 of the NSW *Threatened Species Conservation Act 1995* (TSC Act). At the national level, the species is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

2 Methods

2.1 STUDY AREA

The study focused on the primary areas of potential habitat for the GBF to the north and south of the central route option for the North Nowra Link Road. The survey area included habitat associated with the previous GBF record and other sites within the regional park and adjoining areas (Figure 1).

2.2 SURVEY TECHNIQUES

A combination of techniques was used in the survey, including call playback, spotlighting, tadpole searches and night driving surveys. Methods used were consistent with State and National amphibian survey guidelines (DECC 2009 and DEWHA 2010). Nocturnal surveys for the GBF were undertaken on 12 January, 21 and 22 March 2011, as these times coincided with optimum weather conditions as per the relevant survey guidelines.

Spotlighting and Call Playback

Spotlight searches were undertaken on each survey night and concentrated on accessible areas and potential breeding sites within and adjacent to primary GBF habitat (Figure 1). Spotlighting surveys were interspersed with periods of listening for calls without torchlight. Call playback and listening surveys were also used at selected sites (Figure 1) between spotlighting searches. At each call playback site, pre-recorded digital calls of the GBF were broadcast in multiple directions via a 15W megaphone for up to five minutes, followed by 10-15 minutes of listening for responses. Listening for calls was undertaken throughout the survey period. Spotlighting and call playback surveys were undertaken for three hours during each survey night, between approximately 0900 and 0000 hours (Eastern Standard Time). All frog species heard or observed during the survey were recorded, as well as any other fauna species of conservation significance.

Tadpole Searches

Searches for GBF tadpoles were undertaken during spotlighting surveys and targeted all areas of pooled water encountered within the study area. All tadpoles observed were identified and recorded.

Night Driving Surveys

Nocturnal searches for the GBF along vehicle tracks within the study area were undertaken via a slow moving vehicle. Driving surveys were undertaken on each survey night upon entering and exiting the study area, for approximately 50 minutes on each survey night.

2.3 SURVEY EFFORT

Survey effort involved a total of six hours spotlighting, three hours of call playback and two and a half hours of night driving surveys (Table 1).

Table 1: GBF survey effort employed over the study area

| DATE | METHOD | EFFORT |
|-----------------|---------------|------------|
| 12 January 2011 | Spotlighting | 2 hours |
| | Call playback | 1 hour |
| | Night driving | 0.75 hours |
| 21 March 2011 | Spotlighting | 2 hours |
| | Call playback | 1 hour |
| | Night driving | 0.92 hours |
| 22 March 2011 | Spotlighting | 2 hours |
| | Call playback | 1 hour |
| | Night driving | 0.83 hours |

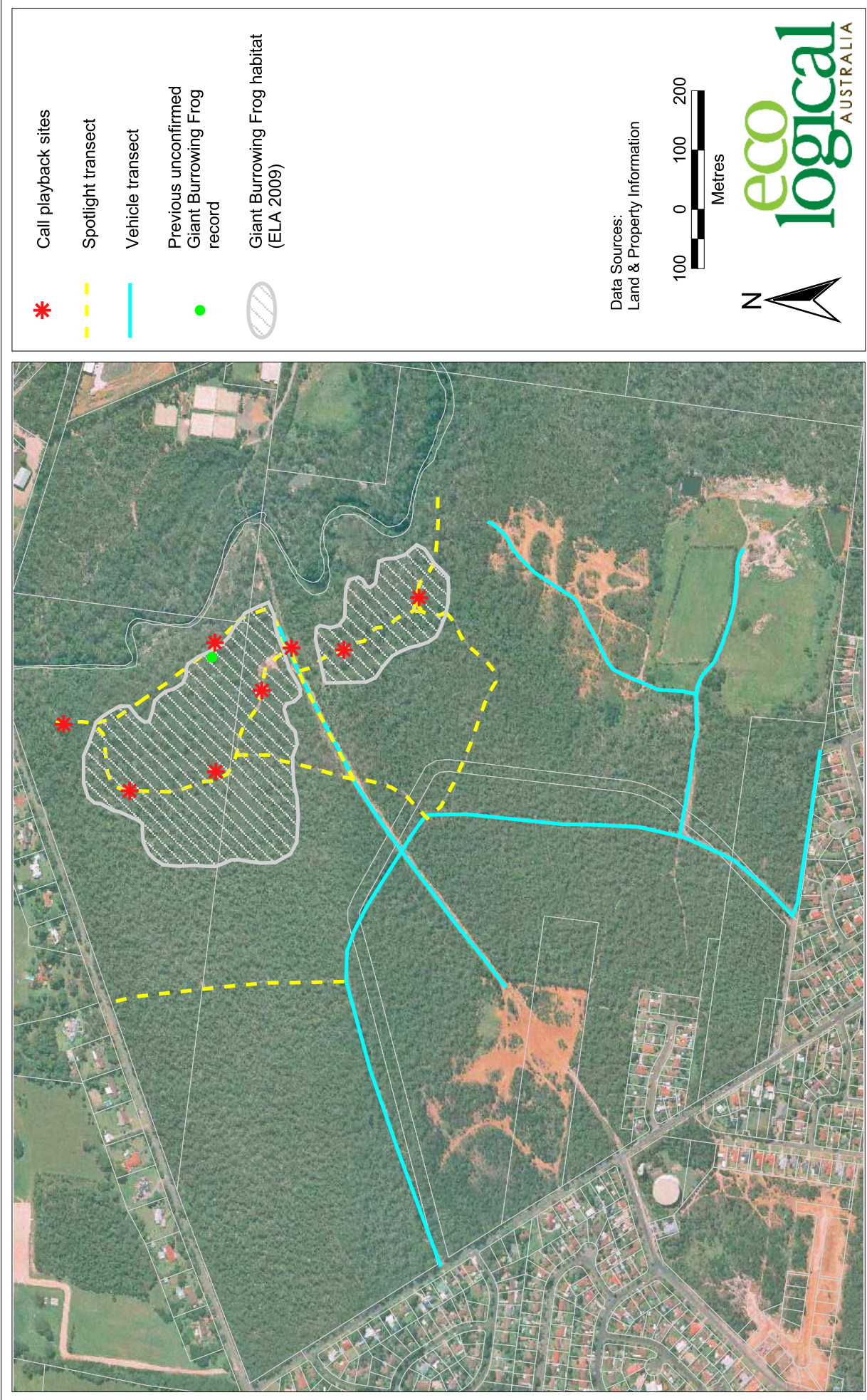
2.4 SURVEY CONDITIONS

Surveys were only undertaken when weather conditions were considered optimal according to DEWHA (2010) guidelines. Surveys were undertaken during warm, humid conditions following substantial rainfall. As an indication of rainfall, Nowra airport recorded 71mm of rain over four days preceding surveys on 12 January 2011, 118mm of rain during three days preceding surveys on 21 March 2011 which increased to 156mm within four days of surveys on the 22 March 2011 (Appendix A). Temperatures were warm during the survey period and humidity was generally high. Cloud cover was complete during each survey and light rain fell during parts of the surveys in March. Wind was absent during most of the survey period, although occasional mild gusts occurred during January surveys (Table 2).

Table 2: Survey conditions

| DATE | SURVEY TYPE | TEMP | WIND | CLOUD | MOON | RAIN |
|-----------------|-------------|---------|------|-------|------|------|
| 12 January 2011 | Nocturnal | 25-26°C | 0-2 | 8/8 | 0/4 | 0 |
| 21 March 2011 | Nocturnal | 20-21°C | 0 | 8/8 | 4/4 | 0-1 |
| 22 March 2011 | Nocturnal | 20-23°C | 0 | 7/8 | 4/4 | 0-2 |

Figure 1: Giant Burrowing Frog surveys - January and March 2011



3 Results

No GBF or other threatened frog species were recorded during the survey period. A total of nine frog species were recorded (Table 3). Few tadpoles were seen, all of which were of the Common Eastern Froglet *Crinia signifera*.

The threatened Grey-headed Flying-fox *Pteropus poliocephalus*, and Yellow-bellied Glider *Petaurus australis* were both heard near the western edge of Bomaderry Creek during the survey period.

Table 3: Survey results (frog species recorded)

| SCIENTIFIC NAME | COMMON NAME | DETECTION METHOD |
|------------------------------|-------------------------|------------------|
| <i>Crinia signifera</i> | Common Eastern Froglet | O |
| <i>Limnodynastes peronii</i> | Striped Marsh Frog | O |
| <i>Litoria dentata</i> | Bleating Tree Frog | O |
| <i>Litoria fallax</i> | Eastern Dwarf Tree Frog | C |
| <i>Litoria nudidigitus</i> | Leaf Green Tree Frog | C |
| <i>Litoria peronii</i> | Peron's Tree Frog | O |
| <i>Litoria verreauxii</i> | Whistling Tree Frog | C |
| <i>Pseudophryne bibronii</i> | Bibron's Toadlet | C |
| <i>Uperoleia sp.</i> | Toadlet | C |

O = Observed; C = Calls heard

4 Conclusions

Despite substantial survey effort during optimal conditions in January and March 2011, no evidence of the GBF was found in the study area. While the results of these surveys cannot conclusively discount the species from occurring in the area, they do support the concept that the GBF is not present within the Bomaderry Creek Regional Park.

5 References

DECC 2009. *Threatened species survey and assessment guidelines: Field survey methods for fauna – Amphibians*. NSW Department of Environment and Climate Change.

DEWHA 2010. *Survey guidelines for Australia's threatened frogs: Guidelines for detecting frogs listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999*. Department of the Environment, Water, Heritage and the Arts.

APPENDIX A:
WEATHER OBSERVATIONS, NOWRA

Nowra, New South Wales
January 2011 Daily Weather Observations



Additional Surveys for the Giant Burrowing Frog, North Nowra Link Road

| Date | Day | Temps | | Rain | Evap | Sun | Max wind gust | | | 9am | | | | | | 3pm | | | | | |
|------|-----|-----------|-----------|------|------|-----|---------------|-------------|---------------|------------|---------|----------------|------|-------------|-------------|------------|---------|----------------|------|-------------|-------------|
| | | Min °C | Max °C | | | | Dirn | Spd km/h | Time local | Temp °C | RH % | Cld eighths | Dirn | Spd km/h | MSLP hPa | Temp °C | RH % | Cld eighths | Dirn | Spd km/h | MSLP hPa |
| | | | | | | | | | | | | | | | | | | | | | |
| 1 | Sa | 18.9 | 36.5 | 0 | | | SSE | 41 | 19:21 | 29.9 | 52 | NNW | 19 | 1011.5 | 34.3 | 39 | | E | 20 | 1008.4 | |
| 2 | Su | 17.6 | 24.1 | 0 | | | S | 33 | 18:56 | 22.3 | 72 | S | 13 | 1013.0 | 20.3 | 79 | | S | 20 | 1012.8 | |
| 3 | Mo | 15.5 | 19.2 | 1.6 | | | SSE | 30 | 15:21 | 16.1 | 99 | SSE | 11 | 1015.4 | 17.9 | 83 | | S | 15 | 1014.6 | |
| 4 | Tu | 14.6 | 20.2 | 1.6 | | | SSE | 31 | 08:05 | 18.8 | 74 | S | 19 | 1014.9 | 19.3 | 71 | | SE | 19 | 1012.2 | |
| 5 | We | 12.0 | 23.9 | 0 | | | NE | 30 | 14:26 | 19.1 | 74 | NNW | 6 | 1007.5 | 23.5 | 58 | | NE | 19 | 1005.2 | |
| 6 | Th | 16.1 | 23.6 | 1.8 | | | ESE | 30 | 11:54 | 19.3 | 83 | SSW | 13 | 1012.3 | 21.1 | 74 | | E | 9 | 1011.6 | |
| 7 | Fr | 15.1 | 26.1 | 0 | | | ENE | 31 | 11:45 | 21.7 | 71 | NE | 4 | 1014.3 | 24.5 | 65 | | ENE | 17 | 1013.6 | |
| 8 | Sa | 19.1 | 27.4 | 0 | | | NE | 39 | 16:35 | 23.8 | 74 | NNE | 11 | 1013.9 | 26.9 | 56 | | NE | 24 | 1012.0 | |
| 9 | Su | 19.7 | 24.8 | 27.2 | | | E | 33 | 11:26 | 20.6 | 100 | SSE | 20 | 1015.1 | 21.8 | 100 | | ESE | 13 | 1015.7 | |
| 10 | Mo | 20.4 | 25.3 | 31.0 | | | ENE | 41 | 12:09 | 21.0 | 96 | ENE | 26 | 1017.1 | 24.3 | 66 | | ENE | 24 | 1015.6 | |
| 11 | Tu | 19.8 | 25.3 | 11.4 | | | NNE | 46 | 19:36 | 24.0 | 83 | ENE | 17 | 1015.0 | 21.9 | 88 | | ESE | 9 | 1012.9 | |
| 12 | We | 20.9 | 28.5 | 1.6 | | | NE | 48 | 16:28 | 23.1 | 88 | ENE | 9 | 1012.8 | 27.7 | 65 | | NE | 30 | 1011.0 | |
| 13 | Th | 21.8 | 25.1 | 0 | | | NE | 46 | 13:37 | 22.8 | 85 | ENE | 13 | 1014.9 | 22.8 | 82 | | NE | 20 | 1014.1 | |
| 14 | Fr | 19.9 | 29.2 | 0 | | | NNE | 37 | 11:47 | 24.2 | 70 | NE | 17 | 1011.9 | 26.9 | 60 | | NE | 26 | 1007.7 | |
| 15 | Sa | 21.3 | 29.1 | 0 | | | SE | 31 | 13:51 | 24.6 | 76 | | Calm | 1008.4 | 26.7 | 64 | | SSE | 20 | 1007.6 | |
| 16 | Su | 20.2 | 30.1 | 0 | | | NE | 39 | 12:56 | 23.8 | 75 | NE | 7 | 1010.6 | 27.3 | 61 | | NE | 22 | 1006.9 | |
| 17 | Mo | 19.6 | 23.1 | 0 | | | SSE | 39 | 12:37 | 21.6 | 95 | SSE | 11 | 1003.3 | 20.5 | 79 | | SSE | 26 | 1003.2 | |
| 18 | Tu | 16.1 | 22.8 | 0 | | | SE | 31 | 09:37 | 20.3 | 74 | | Calm | 1008.2 | 20.6 | 62 | | SE | 17 | 1008.2 | |
| 19 | We | 16.9 | 22.1 | 0 | | | SSE | 28 | 15:58 | 18.2 | 83 | SSW | 6 | 1010.9 | 21.5 | 75 | | SSE | 13 | 1010.1 | |
| 20 | Th | 17.9 | 26.2 | 0.4 | | | ENE | 35 | 17:16 | 19.7 | 87 | SSE | 2 | 1014.4 | 25.5 | 64 | | NE | 24 | 1013.3 | |
| 21 | Fr | 16.3 | 28.3 | 0 | | | E | 33 | 13:15 | 23.5 | 67 | NNE | 9 | 1014.6 | 27.5 | 60 | | ENE | 24 | 1011.8 | |
| 22 | Sa | 17.8 | 28.7 | 5.6 | | | E | 35 | 12:53 | 23.3 | 69 | N | 6 | 1015.7 | 28.1 | 50 | | ENE | 22 | 1014.1 | |
| 23 | Su | 18.3 | 29.8 | 0 | | | ENE | 41 | 14:14 | 23.7 | 60 | NNW | 11 | 1011.3 | 27.9 | 48 | | NE | 30 | 1007.0 | |
| 24 | Mo | 17.4 | 28.5 | 0 | | | SSE | 48 | 16:38 | 27.1 | 53 | NW | 11 | 1002.5 | 26.5 | 68 | | SE | 7 | 1000.1 | |
| 25 | Tu | 19.3 | 29.4 | 0 | | | ENE | 28 | 13:01 | 21.3 | 71 | NW | 2 | 1008.8 | 26.9 | 60 | | E | 15 | 1006.3 | |
| 26 | We | 18.7 | 30.2 | 0 | | | SSE | 44 | 16:06 | 22.0 | 89 | S | 15 | 1013.3 | 29.6 | 68 | | E | 15 | 1008.8 | |
| 27 | Th | 21.4 | 29.2 | 0 | | | S | 30 | 13:36 | 23.6 | 76 | ESE | 7 | 1013.5 | 27.2 | 66 | | SSE | 20 | 1011.5 | |
| 28 | Fr | 19.0 | 23.8 | 0 | | | SE | 33 | 13:59 | 19.9 | 77 | SSE | 17 | 1020.0 | 22.6 | 54 | | SE | 22 | 1019.9 | |
| 29 | Sa | 14.7 | 25.3 | 0 | | | NE | 35 | 14:20 | 20.6 | 66 | SSW | 6 | 1021.6 | 24.0 | 61 | | NE | 20 | 1020.1 | |
| 30 | Su | 13.9 | 32.9 | 0 | | | ENE | 31 | 11:58 | 23.1 | 59 | NW | 19 | 1018.2 | 32.0 | 46 | | E | 22 | 1013.9 | |
| 31 | Mo | 19.4 | 37.2 | 0 | | | E | 31 | 13:40 | 28.1 | 44 | NNW | 13 | 1014.4 | 34.7 | 34 | | E | 24 | 1010.9 | |

Statistics for January 2011

| | | | | | | | | | | | | | | | | | | | | | |
|---------|------|------|------|--|--|--|---|----|--|------|-----|--|-----|------|--------|------|-----|--|----|----|--------|
| Mean | 18.1 | 27.0 | | | | | | | | 22.3 | 75 | | | 10 | 1012.9 | 25.2 | 64 | | | 19 | 1011.0 |
| Lowest | 12.0 | 19.2 | | | | | | | | 16.1 | 44 | | | Calm | 1002.5 | 17.9 | 34 | | SE | 7 | 1000.1 |
| Highest | 21.8 | 37.2 | 31.0 | | | | # | 48 | | 29.9 | 100 | | ENE | 26 | 1021.6 | 34.7 | 100 | | NE | 30 | 1020.1 |
| Total | | | 82.2 | | | | | | | | | | | | | | | | | | |

Observations were drawn from Nowra RAN Air Station AWS (station 068072)

The closest station with cloud observations is at Wollongong, about 58 km to the north.

Nowra, New South Wales
March 2011 Daily Weather Observations



| Date | Day | Temps | | Rain | Evap | Sun | Max wind gust | | | 9am | | | | 3pm | | | | | | | |
|---------------------------|-----|-----------|-----------|-------|------|-----|---------------|-------------|---------------|------------|---------|----------------|------|-------------|-------------|------------|---------|----------------|------|-------------|-------------|
| | | Min °C | Max °C | | | | Dirn | Spd km/h | Time local | Temp °C | RH % | Cld eighths | Dirn | Spd km/h | MSLP hPa | Temp °C | RH % | Cld eighths | Dirn | Spd km/h | MSLP hPa |
| | | | | | | | | | | | | | | | | | | | | | |
| 1 | Tu | 18.8 | 30.2 | 1.4 | | | W | 57 | 11:20 | 24.7 | 64 | | WNW | 13 | 1001.6 | 22.2 | 76 | | SSE | 28 | 1005.1 |
| 2 | We | 15.8 | 20.2 | 0 | | | E | 24 | 11:19 | 17.0 | 65 | | SE | 11 | 1017.7 | 19.2 | 63 | | NE | 13 | 1014.8 |
| 3 | Th | 13.3 | 30.0 | 0 | | | W | 41 | 12:15 | 20.2 | 59 | | WNW | 22 | 1008.8 | 28.9 | 17 | | WSW | 26 | 1006.9 |
| 4 | Fr | 13.8 | 26.1 | 0 | | | SSE | 37 | 14:12 | 19.0 | 55 | | NNW | 13 | 1011.2 | 24.1 | 55 | | SSE | 22 | 1010.7 |
| 5 | Sa | 14.1 | 21.5 | 0.2 | | | SE | 39 | 14:14 | 15.9 | 61 | | S | 19 | 1023.8 | 20.4 | 54 | | SSE | 19 | 1024.1 |
| 6 | Su | 14.2 | 22.5 | 0.8 | | | ENE | 28 | 12:34 | 16.3 | 78 | | WSW | 6 | 1027.8 | 20.0 | 48 | | ENE | 17 | 1026.8 |
| 7 | Mo | 11.4 | 24.4 | 0 | | | NE | 39 | 16:49 | 18.4 | 66 | | W | 13 | 1025.5 | 24.0 | 54 | | ENE | 22 | 1021.2 |
| 8 | Tu | 10.7 | 28.6 | 0 | | | ENE | 37 | 12:34 | 20.0 | 66 | | NW | 11 | 1018.8 | 27.7 | 48 | | NE | 26 | 1014.1 |
| 9 | We | 16.5 | 31.6 | 0 | | | WSW | 35 | 11:36 | 21.6 | 65 | | NW | 17 | 1014.2 | 30.4 | 30 | | NNW | 20 | 1011.9 |
| 10 | Th | 19.6 | 26.5 | 0 | | | W | 28 | 09:58 | 24.3 | 57 | | WNW | 11 | 1013.0 | 22.8 | 67 | | W | 11 | 1013.1 |
| 11 | Fr | 18.9 | 25.0 | 0.6 | | | ESE | 24 | 11:33 | 21.6 | 83 | | S | 11 | 1016.5 | 23.6 | 73 | | SE | 17 | 1015.9 |
| 12 | Sa | 19.8 | 29.6 | 0 | | | NE | 30 | 13:48 | 22.5 | 77 | | NNW | 6 | 1020.4 | 27.9 | 58 | | NE | 20 | 1018.2 |
| 13 | Su | 17.1 | 31.2 | 0 | | | ENE | 31 | 13:13 | 22.5 | 81 | | NNW | 9 | 1020.6 | 29.0 | 58 | | E | 20 | 1017.1 |
| 14 | Mo | 20.8 | 21.7 | 0 | | | SSE | 48 | 13:28 | 21.7 | 85 | | S | 22 | 1021.0 | 20.2 | 66 | | SSE | 24 | 1022.4 |
| 15 | Tu | 16.7 | 23.3 | 2.8 | | | SSW | 24 | 02:40 | 18.2 | 91 | | SW | 13 | 1022.0 | 21.9 | 70 | | ESE | 7 | 1018.6 |
| 16 | We | 13.9 | 22.7 | 0 | | | SSE | 30 | 14:26 | 20.9 | 84 | | S | 13 | 1017.5 | 20.0 | 91 | | SE | 17 | 1017.8 |
| 17 | Th | 16.7 | 20.7 | 2.6 | | | S | 30 | 22:20 | 17.8 | 88 | | S | 6 | 1020.2 | 19.3 | 80 | | SSE | 15 | 1018.5 |
| 18 | Fr | 16.8 | 19.7 | 0 | | | S | 35 | 03:26 | 17.2 | 85 | | S | 22 | 1016.9 | 18.7 | 79 | | S | 20 | 1015.6 |
| 19 | Sa | 16.6 | 20.3 | 15.6 | | | SSW | 37 | 21:25 | 18.1 | 98 | | SSE | 11 | 1016.2 | 18.7 | 97 | | SSE | 15 | 1014.7 |
| 20 | Su | 16.2 | 22.4 | 57.4 | | | NE | 39 | 13:40 | 18.9 | 100 | | SW | 11 | 1013.9 | 18.3 | 95 | | E | 11 | 1012.5 |
| 21 | Mo | 18.1 | 21.0 | 45.6 | | | ENE | 50 | 23:14 | 19.5 | 100 | | ESE | 9 | 1008.2 | 20.9 | 100 | | E | 22 | 1004.7 |
| 22 | Tu | 16.7 | 28.1 | 37.2 | | | E | 26 | 12:03 | 20.1 | 99 | | NW | 15 | 1000.1 | 26.6 | 67 | | E | 13 | 999.1 |
| 23 | We | 17.4 | 26.8 | 0 | | | W | 54 | 13:53 | 22.7 | 71 | | NW | 19 | 1001.9 | 25.6 | 44 | | WNW | 28 | 1001.2 |
| 24 | Th | 14.8 | 24.9 | 0 | | | NW | 61 | 11:11 | 19.4 | 55 | | N | 13 | 1003.7 | 24.0 | 40 | | NW | 28 | 1001.8 |
| 25 | Fr | 16.5 | 23.9 | 0 | | | WNW | 46 | 03:22 | 17.9 | 60 | | WNW | 26 | 1006.9 | 22.4 | 54 | | NNW | 13 | 1008.5 |
| 26 | Sa | 14.2 | 21.3 | 0 | | | S | 43 | 10:34 | 17.2 | 66 | | SSW | 17 | 1020.4 | 19.8 | 53 | | S | 24 | 1020.8 |
| 27 | Su | 14.8 | 20.2 | 0 | | | S | 33 | 09:53 | 16.5 | 70 | | WNW | 7 | 1025.4 | 16.0 | 93 | | ESE | 20 | 1025.5 |
| 28 | Mo | 14.7 | 23.7 | 2.2 | | | ENE | 24 | 14:27 | 16.3 | 93 | | NW | 7 | 1027.3 | 22.2 | 52 | | ENE | 13 | 1025.9 |
| 29 | Tu | 12.8 | 25.5 | 0 | | | ENE | 35 | 15:19 | 15.9 | 96 | | NW | 7 | 1025.6 | 23.9 | 67 | | E | 19 | 1021.3 |
| 30 | We | 14.5 | 30.0 | 0 | | | S | 43 | 22:58 | 18.4 | 82 | | WNW | 13 | 1018.8 | 29.1 | 35 | | W | 22 | 1014.6 |
| 31 | Th | 16.1 | 17.9 | 0 | | | SSE | 44 | 23:14 | 17.0 | 72 | | S | 11 | 1024.2 | 17.1 | 62 | | S | 22 | 1024.2 |
| Statistics for March 2011 | | | | | | | | | | | | | | | | | | | | | |
| Mean | | 15.9 | 24.6 | | | | | | | 19.3 | 76 | | | 13 | 1016.5 | 22.7 | 62 | | | 19 | 1015.1 |
| Lowest | | 10.7 | 17.9 | | | | | | | 15.9 | 55 | | # | 6 | 1000.1 | 16.0 | 17 | | ESE | 7 | 999.1 |
| Highest | | 20.8 | 31.6 | 57.4 | | | NW | 61 | | 24.7 | 100 | | WNW | 26 | 1027.8 | 30.4 | 100 | | # | 28 | 1026.8 |
| Total | | | | 166.4 | | | | | | | | | | | | | | | | | |

Observations were drawn from Nowra RAN Air Station AWS (station 068072)

The closest station with cloud observations is at Wollongong, about 58 km to the north.

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FAUNA SURVEYS - NORTH NOWRA LINK ROAD

Prepared for
Shoalhaven City Council

May 2011



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| Prepared by | David Coombes |
| Approved by | Rohan Watson |
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Appendix A: Weather Observations, Nowra

1 Introduction

1.1 BACKGROUND

This report details the results of targeted surveys for the Eastern Pygmy-possum *Cercartetus nanus* and Spotted-tailed Quoll *Dasyurus maculatus*, undertaken during March 2011 within Bomaderry Creek Regional Park and adjoining lands. The surveys were commissioned by Shoalhaven City Council as part of additional information requested for the North Nowra Link Road environmental assessment process. Further information on the attributes of the Grey-headed Flying-fox *Pteropus poliocephalus* colony in Bomaderry Creek was also requested by consent authorities and is presented in this report.

The aim of the survey work was to provide additional information on the presence and status of the Eastern Pygmy-possum and Spotted-tailed Quoll to assist with assessing potential impacts to these species from the proposed link road. A single record of the Eastern Pygmy-possum exists within the study area to the north of the Regional Park. The Spotted-tailed Quoll has not been recorded within the study area, but has been recorded within the locality.

The Eastern Pygmy-possum, Spotted-tailed Quoll and Grey-headed Flying-fox are listed as Vulnerable under Schedule 2 of the NSW *Threatened Species Conservation Act 1995* (TSC Act). At the national level, the Spotted-tailed Quoll is listed as Endangered and the Grey-headed Flying-fox is listed as Vulnerable under the schedules of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

2 Survey Methods

2.1 EASTERN PYGMY-POSSUM

The Eastern Pygmy-possum was targeted by a combination of Elliott trapping and pitfall trapping in areas of suitable habitat close to each of the three link road route options. Survey areas were initially selected to sample likely habitat (Scribbly Gum – Bloodwood Woodland) mapped as occurring along each of the route options. Refinement of survey sites involved selecting areas of good quality habitat (primarily tree hollows and high densities of foraging resources such as *Lambertia formosa* and *Banksia spinulosa*), that were close to each proposed route option, but also concealed from public view. At the request of the National Parks and Wildlife Service (NPWS), construction of pitfall traps (which involves some vegetation clearing and soil disturbance) was not undertaken within NPWS lands.

Elliott trapping

Elliott trapping surveys targeting the Eastern Pygmy-possum were conducted over four consecutive nights during between 7 and 10 March 2011. Overall 75 A-type Elliott traps were used to gain a total trapping effort of 300 trap-nights. At each of the three trapping sites, 25 Elliott traps were placed on the ground at approximately 10m intervals, generally within a grid pattern along three transects (Figure 1). Where possible, traps were placed close to foraging resources, particularly flowering Banksias. All traps were baited with a mixture of peanut butter, honey and rolled oats and were checked each morning soon after sunrise. Captured animals were identified and then released at the trap site.

Pitfall trapping

In each of the three trapping sites associated with the link road route options, one pitfall trap was installed, comprising two pits approximately 15m apart, connected by drift fencing (Figure 1). Pitfall trapping was conducted in conjunction with Elliott trapping over four consecutive nights between 7 and 10 March 2011, giving a total pitfall trapping effort of 24 trap-nights.

Pitfall buckets were approximately 300mm wide and 450mm deep. Builder's dampcourse approximately 400mm high was used for drift fencing between the two pits. The bottom section of fencing was covered by soil and vegetation close to the fencing was removed, to form a barrier to small mammals. Traps were checked each morning shortly after sunrise and any animals captured were identified and released at the trap site.

2.2 SPOTTED-TAILED QUOLL

The Spotted-tailed Quoll was targeted by remote cameras stations due to the species large home range and the need to survey over a longer period. Areas associated with Bomaderry Creek gorge were considered the most likely habitat for the species. Four Reconyx Hyperfire infra-red motion-activated cameras and bait stations were placed approximately 500m apart on the western edge of the Bomaderry Creek gorge in association with gully slopes or cliffs (Figure 1). The cameras were attached to tree trunks about 1m from the ground, and provided night and day surveillance of fauna investigating the bait stations. Bait stations were fixed to the ground and contained tinned cat food (fish) and raw chicken wings. The four cameras were in use from 7 March to 28 March 2011, giving a survey effort of 80 camera days/nights. Baits were replaced mid way through the survey period.

2.3 SURVEY EFFORT

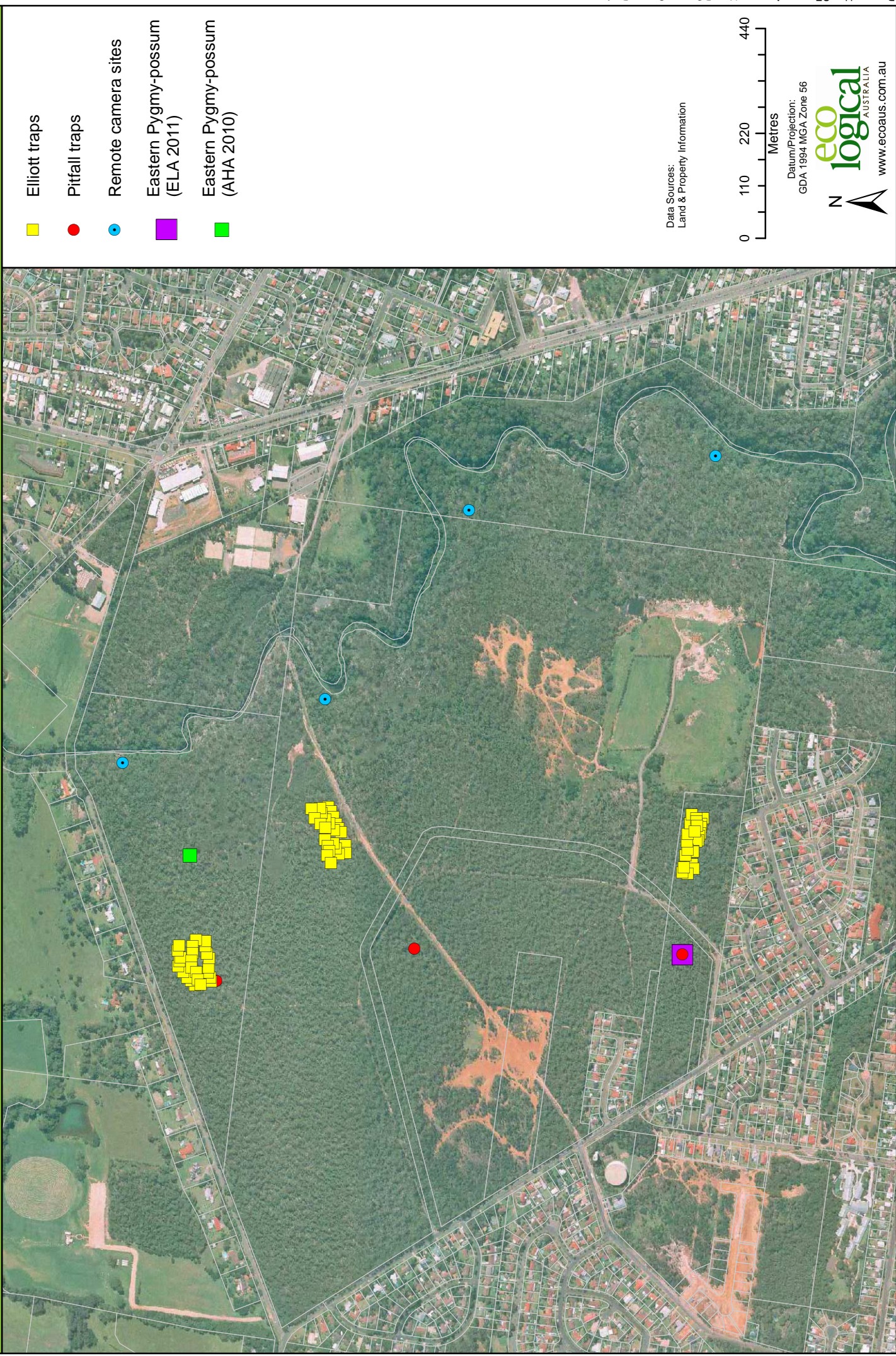
A total of 300 Elliott trap nights, 24 pitfall trap nights and 80 remote camera days/nights were employed during the survey period, as summarised in Table 1 below.

The surveys undertaken for the Eastern Pygmy-possum and Spotted-tailed Quoll are consistent with the relevant regulatory guidelines.

Table 1: Fauna survey effort employed over the study area

| DATE | METHOD | EFFORT | TARGET SPECIES |
|-----------------|-------------------------------|-----------------------|----------------------|
| 7-10 March 2011 | Elliott Trapping (type A x75) | 300 trap-nights | Eastern Pygmy-possum |
| 7-10 March 2011 | Pitfall Trapping (x6) | 24 trap-nights | Eastern Pygmy-possum |
| 7-28 March 2011 | Remote camera station (x4) | 80 camera days/nights | Spotted Tailed Quoll |

Figure 1: Survey sites and Eastern Pygmy-possum records



2.4 SURVEY CONDITIONS

Elliott trapping and Pitfall trapping conditions between 7 and 10 May 2011 were dry, with no rain and temperatures ranging from approximately 11 to 32°C, based on Bureau of Meteorology weather observations from Nowra Airport. Remote camera surveys between 7 and 28 March 2011 encountered the same temperature range as above, with occasional light rain and one period of heavy rainfall between 19 and 22 March (Appendix A).

3 Results

3.1 EASTERN PYGMY-POSSUM

One Eastern Pygmy-possum was recorded in the pitfall trap located in the south west of the study area (Figure 1), close to the Falcon Crescent gate. The same individual was captured on two of the four surveys nights. No other Eastern Pygmy-possums were recorded during the survey and no other vertebrate species were captured by pitfall traps. Numerous Brown Antechinus *Antechinus stuartii* were captured at all Elliott trap sites and a single Bush Rat *Rattus fuscipes* was captured in the northern Elliott trap site.

3.2 SPOTTED-TAILED QUOLL

The Spotted-tailed Quoll was not recorded during the survey period. Six common mammals and one bird were recorded by remote camera surveys (Table 2).

Table 2: Survey results

| CATEGORY | COMMON NAME | SCIENTIFIC NAME | DETECTION METHOD |
|----------|-----------------------------|---------------------------------|----------------------------------|
| Mammals | Brown Antechinus | <i>Antechinus stuartii</i> | Elliott Trapping / Remote Camera |
| | Bush Rat | <i>Rattus fuscipes</i> | Elliott Trapping / Remote Camera |
| | Common Brushtail Possum | <i>Trichosurus vulpecula</i> | Remote Camera |
| | Eastern Grey Kangaroo | <i>Macropus giganteus</i> | Remote Camera |
| | Eastern Pygmy-possum | <i>Cercartetus nanus</i> | Pitfall Trapping |
| | Red Fox * | <i>Vulpes vulpes</i> * | Remote Camera |
| | Swamp Wallaby | <i>Wallabia bicolor</i> | Remote Camera |
| Reptiles | Lace Monitor | <i>Varanus varius</i> | Opportunistic observation |
| Birds | Laughing Kookaburra | <i>Dacelo novaeguineae</i> | Remote Camera |

Bold = threatened species (TSC Act), * = introduced species.

3.3 GREY-HEADED FLYING-FOX

No field surveys were undertaken for the Grey-headed Flying-fox. The following information on the species and the roosting area is provided via correspondence or discussions with Geraldine Hawkins (NANA wildlife carer), Phil Craven (National Parks and Wildlife Service), and Mike Smith (Shoalhaven City Council) (personal communications February, April and May 2011).

The Grey-headed Flying-fox is known to regularly roost in the southern parts of the study area near Bomaderry Creek on a seasonal basis, generally between September and May. The camp has been occupied on five of the past eight years since monitoring of the camp has been undertaken, and has probably been used over a much longer period. Estimates of the camp size over the last three years are between 5,000 and 15,000 individuals, utilising an area of up to 4.7 ha. The camp has been confirmed as a maternity roost, with adult males, females, and dependent young observed. Foetuses have also been found on the ground beneath the roosting area, suggesting that females give birth within the camp.

4 Conclusions

The Eastern Pygmy-possum is known to occur in the north and south of the study area (Figure 1), but is expected to occur more widely given the presence of suitable habitat over most of the Regional Park and adjoining vegetated areas. The species is known to inhabit a range of vegetation types from heath to rainforest, although in the study area, Scribbly Gum – Bloodwood woodland containing tree hollows and a heathy understorey of myrtaceous shrubs are likely to be preferred habitat. Extensive surveys would be required to establish the species population size and distribution within the area.

Although the study area contains suitable habitat for the Spotted-tailed Quoll, the species remains unrecorded from the Bomaderry Creek Regional Park. These survey results, together with a lack of previous records, suggest that the species may not be present or may not be a permanent resident of the Park and adjoining areas.

Up to 15,000 Grey-headed Flying-foxes roost along Bomaderry Creek on a generally regular and seasonal basis. The camp is significant because of its size, relatively protected location, strategic position in relation to broader foraging resources, and use as a maternity roost.

5 References

Allison Hunt and Associates. 2010. *Nowra Bomaderry Urban Release Areas Infrastructure Ecology*. Report prepared for Shoalhaven City Council.

APPENDIX A:
WEATHER OBSERVATIONS, NOWRA

Nowra, New South Wales
March 2011 Daily Weather Observations

| Date | Day | Temps | | Rain | Evap | Sun | Max wind gust | | | 9am | | | | | 3pm | | | | | | |
|---------------------------|-----|-----------|-----------|-------|------|-----|---------------|-------------|---------------|------------|---------|----------------|------|-------------|-------------|------------|---------|----------------|------|-------------|-------------|
| | | Min °C | Max °C | | | | Dirn | Spd km/h | Time local | Temp °C | RH % | Cld eighths | Dirn | Spd km/h | MSLP hPa | Temp °C | RH % | Cld eighths | Dirn | Spd km/h | MSLP hPa |
| | | | | | | | | | | | | | | | | | | | | | |
| 1 | Tu | 18.8 | 30.2 | 1.4 | | | W | 57 | 11:20 | 24.7 | 64 | | WNW | 13 | 1001.6 | 22.2 | 76 | | SSE | 28 | 1005.1 |
| 2 | We | 15.8 | 20.2 | 0 | | | E | 24 | 11:19 | 17.0 | 65 | | SE | 11 | 1017.7 | 19.2 | 63 | | NE | 13 | 1014.8 |
| 3 | Th | 13.3 | 30.0 | 0 | | | W | 41 | 12:15 | 20.2 | 59 | | WNW | 22 | 1008.8 | 28.9 | 17 | | WSW | 26 | 1006.9 |
| 4 | Fr | 13.8 | 26.1 | 0 | | | SSE | 37 | 14:12 | 19.0 | 55 | | NNW | 13 | 1011.2 | 24.1 | 55 | | SSE | 22 | 1010.7 |
| 5 | Sa | 14.1 | 21.5 | 0.2 | | | SE | 39 | 14:14 | 15.9 | 61 | | S | 19 | 1023.8 | 20.4 | 54 | | SSE | 19 | 1024.1 |
| 6 | Su | 14.2 | 22.5 | 0.8 | | | ENE | 28 | 12:34 | 16.3 | 78 | | WSW | 6 | 1027.8 | 20.0 | 48 | | ENE | 17 | 1026.8 |
| 7 | Mo | 11.4 | 24.4 | 0 | | | NE | 39 | 16:49 | 18.4 | 66 | | W | 13 | 1025.5 | 24.0 | 54 | | ENE | 22 | 1021.2 |
| 8 | Tu | 10.7 | 28.6 | 0 | | | ENE | 37 | 12:34 | 20.0 | 66 | | NW | 11 | 1018.8 | 27.7 | 48 | | NE | 26 | 1014.1 |
| 9 | We | 16.5 | 31.6 | 0 | | | WSW | 35 | 11:36 | 21.6 | 65 | | NW | 17 | 1014.2 | 30.4 | 30 | | NNW | 20 | 1011.9 |
| 10 | Th | 19.6 | 26.5 | 0 | | | W | 28 | 09:58 | 24.3 | 57 | | WNW | 11 | 1013.0 | 22.8 | 67 | | W | 11 | 1013.1 |
| 11 | Fr | 18.9 | 25.0 | 0.6 | | | ESE | 24 | 11:33 | 21.6 | 83 | | S | 11 | 1016.5 | 23.6 | 73 | | SE | 17 | 1015.9 |
| 12 | Sa | 19.8 | 29.6 | 0 | | | NE | 30 | 13:48 | 22.5 | 77 | | NNW | 6 | 1020.4 | 27.9 | 58 | | NE | 20 | 1018.2 |
| 13 | Su | 17.1 | 31.2 | 0 | | | ENE | 31 | 13:13 | 22.5 | 81 | | NNW | 9 | 1020.6 | 29.0 | 58 | | E | 20 | 1017.1 |
| 14 | Mo | 20.8 | 21.7 | 0 | | | SSE | 48 | 13:28 | 21.7 | 85 | | S | 22 | 1021.0 | 20.2 | 66 | | SSE | 24 | 1022.4 |
| 15 | Tu | 16.7 | 23.3 | 2.8 | | | SSW | 24 | 02:40 | 18.2 | 91 | | SW | 13 | 1022.0 | 21.9 | 70 | | ESE | 7 | 1018.6 |
| 16 | We | 13.9 | 22.7 | 0 | | | SSE | 30 | 14:26 | 20.9 | 84 | | S | 13 | 1017.5 | 20.0 | 91 | | SE | 17 | 1017.8 |
| 17 | Th | 16.7 | 20.7 | 2.6 | | | S | 30 | 22:20 | 17.8 | 88 | | S | 6 | 1020.2 | 19.3 | 80 | | SSE | 15 | 1018.5 |
| 18 | Fr | 16.8 | 19.7 | 0 | | | S | 35 | 03:26 | 17.2 | 85 | | S | 22 | 1016.9 | 18.7 | 79 | | S | 20 | 1015.6 |
| 19 | Sa | 16.6 | 20.3 | 15.6 | | | SSW | 37 | 21:25 | 18.1 | 98 | | SSE | 11 | 1016.2 | 18.7 | 97 | | SSE | 15 | 1014.7 |
| 20 | Su | 16.2 | 22.4 | 57.4 | | | NE | 39 | 13:40 | 18.9 | 100 | | SW | 11 | 1013.9 | 18.3 | 95 | | E | 11 | 1012.5 |
| 21 | Mo | 18.1 | 21.0 | 45.6 | | | ENE | 50 | 23:14 | 19.5 | 100 | | ESE | 9 | 1008.2 | 20.9 | 100 | | E | 22 | 1004.7 |
| 22 | Tu | 16.7 | 28.1 | 37.2 | | | E | 26 | 12:03 | 20.1 | 99 | | NW | 15 | 1000.1 | 26.6 | 67 | | E | 13 | 999.1 |
| 23 | We | 17.4 | 26.8 | 0 | | | W | 54 | 13:53 | 22.7 | 71 | | NW | 19 | 1001.9 | 25.6 | 44 | | WNW | 28 | 1001.2 |
| 24 | Th | 14.8 | 24.9 | 0 | | | NW | 61 | 11:11 | 19.4 | 55 | | N | 13 | 1003.7 | 24.0 | 40 | | NW | 28 | 1001.8 |
| 25 | Fr | 16.5 | 23.9 | 0 | | | WNW | 46 | 03:22 | 17.9 | 60 | | WNW | 26 | 1006.9 | 22.4 | 54 | | NNW | 13 | 1008.5 |
| 26 | Sa | 14.2 | 21.3 | 0 | | | S | 43 | 10:34 | 17.2 | 66 | | SSW | 17 | 1020.4 | 19.8 | 53 | | S | 24 | 1020.8 |
| 27 | Su | 14.8 | 20.2 | 0 | | | S | 33 | 09:53 | 16.5 | 70 | | WNW | 7 | 1025.4 | 16.0 | 93 | | ESE | 20 | 1025.5 |
| 28 | Mo | 14.7 | 23.7 | 2.2 | | | ENE | 24 | 14:27 | 16.3 | 93 | | NW | 7 | 1027.3 | 22.2 | 52 | | ENE | 13 | 1025.9 |
| 29 | Tu | 12.8 | 25.5 | 0 | | | ENE | 35 | 15:19 | 15.9 | 96 | | NW | 7 | 1025.6 | 23.9 | 67 | | E | 19 | 1021.3 |
| 30 | We | 14.5 | 30.0 | 0 | | | S | 43 | 22:58 | 18.4 | 82 | | WNW | 13 | 1018.8 | 29.1 | 35 | | W | 22 | 1014.6 |
| 31 | Th | 16.1 | 17.9 | 0 | | | SSE | 44 | 23:14 | 17.0 | 72 | | S | 11 | 1024.2 | 17.1 | 62 | | S | 22 | 1024.2 |
| Statistics for March 2011 | | | | | | | | | | | | | | | | | | | | | |
| Mean | | 15.9 | 24.6 | | | | | | | 19.3 | 76 | | | 13 | 1016.5 | 22.7 | 62 | | | 19 | 1015.1 |
| Lowest | | 10.7 | 17.9 | | | | | | | 15.9 | 55 | | # | 6 | 1000.1 | 16.0 | 17 | | ESE | 7 | 999.1 |
| Highest | | 20.8 | 31.6 | 57.4 | | | NW | 61 | | 24.7 | 100 | | WNW | 26 | 1027.8 | 30.4 | 100 | | # | 28 | 1026.8 |
| Total | | | | 166.4 | | | | | | | | | | | | | | | | | |

Observations were drawn from Nowra RAN Air Station AWS (station 068072)

The closest station with cloud observations is at Wollongong, about 58 km to the north.

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