The Gang-gang Cockatoo Citizen Science Survey

March 2014 - February 2015

Chris Davey and Kathy Eyles

Chris Davey

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This report was prepared by Chris Davey and Kathy Eyles for the Canberra Ornithologists Group (COG) Canberra, January 2016.

Contact address:
Gang-gang Survey Project
PO Box 301
Civic Square ACT 2601

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SUMMARY

The Gang-gang Cockatoo survey was a new venture for the Canberra Ornithologists Group (COG) where observations from the general public were encouraged, the survey went over a specific period, there were two different surveys imbedded in the one project and where observations could be recorded on paper forms or on-line.

The aims of the project were to expand our knowledge of the Gang-gangs within the COG area of interest, involve the membership and general public in a project on birds and promote the activities of COG. The public were asked to submit Gang-gang observations from the ACT and local region. There were 7189 records submitted. In addition to these primary observations, there were 6160 secondary observations giving a total of 13,329 Gang-gang records for analysis.

The observations indicate that the Gang-gang has an interesting and non-random distribution within the local area and certainly within the urban area of Canberra the Gang-gang is much more likely to be reported in some areas than others. There was a very good coverage of urban ACT, reasonable coverage within rural ACT and urban NSW but a poor coverage of rural NSW. The data were collected using a range of survey methodologies and exhibit a high level of spatial and temporal variation in observer effort.

Within urban Canberra those suburbs that are most likely to report Gang-gangs are those bordering the Canberra Nature Reserves of Mt Majura and Mt Ainslie Forest/Woodland Reserve, Gossan Hill Forest Reserve, Bruce and O'Connor Ridges Forest Reserve, Black Mountain Forest Reserve, Aranda Bushland Forest Reserve to the north of Lake Burley Griffin and Red Hill Woodland Reserve and Mt Taylor Woodland Reserve to the south.

This survey does not provide any information on movement patterns. Without this information it is not possible to determine the number of Gang-gangs within the local region. The survey has provided much back-ground information on the distribution and behaviour of Gang-gangs but a more detailed study, possibly with marked birds, is now needed to determine movement patterns within the suburbia and between urban and rural areas.

A lack of confirmed breeding is a disappointment but not surprising. Although there were many observations of birds inspecting prospective nest hollows, and in some cases showing some faithfulness to a particular site, as with movement patterns, a more detailed study is required to determine breeding success.

The survey did not intend to obtain information on hand feeding but many observers mentioned birds coming to feeders. It is suggested for the health of the bird that feed be limited and put out in the afternoon only and removed at night. This will ensure that birds seek naturally available food at first light when they are most hungry.

What factors determine why Gang-gangs are reported from different areas is unknown but factors such as habitat type, tree hollows, suburb plantings and hand feeding may all play a part. A study on the movement patterns is required for it is possible that the birds are very localised with little movement between areas. If so, their numbers could be most susceptible to changes in nature reserve management or habitat loss from urban development.

1. BACKGROUND

1.1 About the Gang-gang

Canberra, the Cockatoo capital of Australia, is fortunate to host 7 of the 14 species of Australian Cockatoos. Included amongst them is the Gang-gang Cockatoo *Callocephalon fimbriatum.* The Gang-gang Cockatoo holds a special place in Canberra as it is not only the faunal emblem of the ACT but it is also the logo for the ACT Parks and Conservation Service. The logo for the Canberra Ornithologists Group (COG) is the Gang-gang, the name for the COG newsletter is the Gang-gang and there is a regular well-known column in the Canberra Times that takes its name from this bird. In addition, and from the response to our survey, it is well loved in the hearts of many Canberrans.

The breeding distribution of the Gang-gang is confined to the south-eastern parts of Australia restricted to the forests and woodlands of the Great Divide between the Hunter region in the north to Melbourne in the south with a disjunct population in the western half of Victoria (Higgins, 1999) and most commonly reported in and to the north of the Gippsland area in Victoria (Barrett *et al.* 2003)

The Gang-gang shows altitudinal movement, generally resident in the forested high country to breed moving down to lower altitudes with more open wooded habitat during the winter months (Higgins, 1999). This movement does not appear to be consistent throughout the range and although casual observations suggests this occurs in the Canberra region there has been no systematic observations to confirm this movement pattern although a general increase in numbers in the Brindabella ranges during the summer months has been noted (Wilson, 1999). Whether this apparent movement locally has always occurred is unknown.

The first recorded observation of Gang-gangs in the literature in what is now urban Canberra was in 1929 at Yarralumla. It should be noted that there are very few recorded bird observations in the local district before that time and it was not until the 1940s that more detailed records became available. The bird was obviously known by the local Ngunnawal people who knew the Gang-gang as the *Wamburang*. Fraser and Gray (2013) note that the word Gang-gang is of aboriginal origin and suggests an onomatopoeic name.

1.2 About Citizen Science

COG has been involved in Citizen Science projects for many years. The Garden Bird Survey (a record of garden birds compiled by COG members) in now in its 35th year whilst general bird observations have been compiled into the COG database on a routine basis since at least the early 1980s. The Gang-gang survey was different and a new venture for the Group in that observations from the general public, rather than just COG members, were encouraged, the survey went over a specific period, there were two different surveys imbedded in the one project and observations could be recorded on paper forms or on-line.

There was a precursor to the project with COG member John Leonard organising four Gang-gang surveys. The first two were for one hour starting 11:00 am and held on 1 August 2010 and again 5 June 2011. The surveys were designed to obtain a snapshot of winter numbers in central Canberra (Leonard 2010, 2011). The second two surveys were conducted over the month of June 2012 with a repeat the following year and designed to cover urban Canberra and native reserves close to the urban areas (Leonard 2012, 2013).

1.3 About the project

During 2014 the Canberra Ornithologists Group celebrated 50 years of birding within the ACT and surrounding region and because of the Group's association with the bird, a 'Bird of the Year' project was launched in March 2014. The aims of the project were to:

- Expand on our knowledge of the Gang-gangs within the COG area of interest
- Involve the membership and general public in a project on birds
- Promote the activities of COG
- To identity key data and knowledge gaps to inform future research about the bird
- To provide data about population size and range to allow for monitoring of the species over time
- To inform the design and implementation of future citizen science surveys in the ACT.

In particular we wished to find out more about:

- Where the bird occurs in Canberra and the local region
- How does the Gang-gang use the landscape
- Group size and sex ratio
- What vegetation the birds are feeding on
- Whether the Gang-gang breeds in urban ACT or in the local nature reserves

2. METHODS

Throughout the survey period members of the public were asked to submit Gang-gang observations throughout an area covered by the Canberra Ornithologists Group's area of interest, that is a rectangle area from Goulburn to the north (Lat: 34^{o} 45' 00"), Bredbo in the south (Lat: 36^{o} 00' 00") to the Brindabella Ranges to the west (Long: 148^{o} 00' 00") and Lake Bathurst to the east (Long: 149^{o} 45' 00"), see Figure 1.

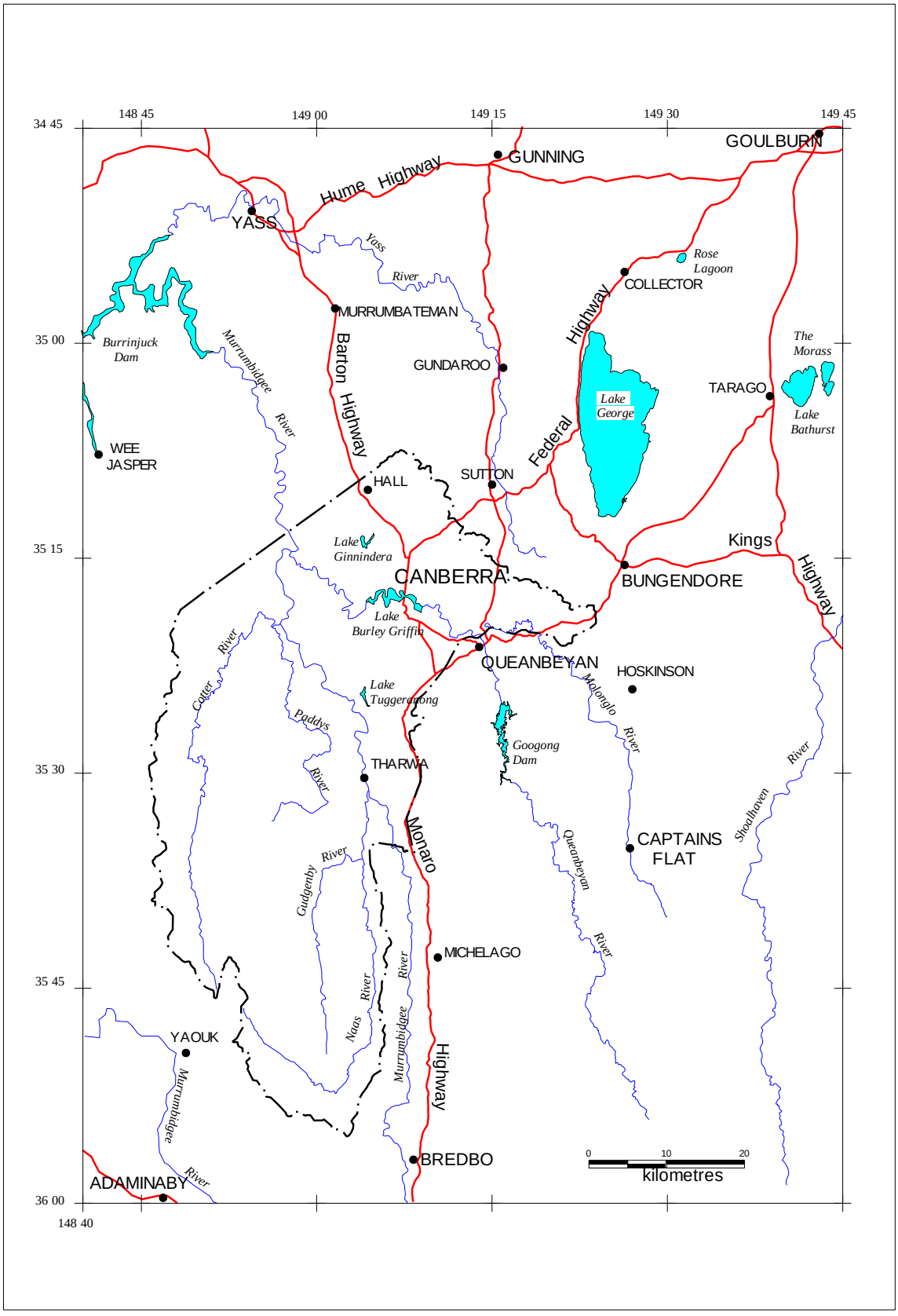


Figure 1. Canberra Ornithologists Group area of interest

Over a 12 month period starting March 2014 information on the Gang-gang was collected from three sources.

2.1 Primary Gang-gang observations

Primary observations were those collected specifically to record observations on the Gang-gang. There were two types of survey, Casual and Muster, each designed to collect different information.

2.1.1 Casual observations

The aim of this survey was to gather information on the location of birds, group size and sex ratios, behaviour and interaction with other species and food preferences.

Observations could either be provided on-line through a portal on the COG website or through paper forms which were made available on the website, in the monthly newsletter, or at the COG monthly meetings. For a copy of the paper form see Appendix I.

The on-line data entry system for the casual observations was developed for COG by the Atlas of Living Australia (ALA). Observations were entered via a portal, the entry page resembling the COG website with records passed to a temporary storage on the ALA host and with the on-line form the same format as the paper form. Registration and entry to the portal was possible through a user defined username and password. On initial registration the user was required to provide confirmation by acknowledging an email sent automatically by ALA. The site provided a map that could be resolved to different scales and an observation form to be filled in. By placing a dot on the map over a location and double clicking on the cursor the location in decimal degrees was allocated to the record. The location could also be entered manually. A written description of the location was also required. After completing the observation record the information was saved to the ALA host. Observers were able to view all their entered records which could then be viewed on the map. Editing of records at any time by the observer was possible. In addition, the COG administrator could view all records.

Records could be displayed by the administrator on the map and so check for any apparent incorrect locations. Where this occurred, records were amended after the observer had been contacted by the administrator. For ease of sorting and data correction, data were downloaded to a Gang-gang Microsoft EXCEL database maintained by the COG administrator on a regular basis. All records provided on paper forms were entered to the Gang-gang EXCEL database, the columns were formatted and alignment in the same way as that required by the on-line system. Any coordinates entered manually as degree, minutes, and seconds or as Eastings/Northings was converted by the administrator to decimal degrees using Google Maps. Records entered on-line or via the paper form were identified by different codes.

At intervals over the survey period records in the Gang-gang database were analysed through an EXCEL program specifically written to summarise observation details, to map locations and to check for those records lying outside the COG area of interest.

2.1.2 Muster observations

The aim of this survey was to gather information on the frequency of sightings at specific locations. In this way it was possible to determine whether Gang-gangs were always present or sometimes or never present.

Over a seven-day period during the summer (19-25 February, 2014), autumn (21-27 May), winter (21-27 August), spring (20-26 November) and summer (19-25 February 2015) from a set point and out to a distance of 100m for each day of the period, the maximum number of Gang-gangs observed at any one time of the day was recorded. The protocol was similar to the Garden Bird Survey (GBS) that has been run by COG over the past 35 years except for a maximum number per day rather than a maximum number per week. For a detailed description of the GBS see Veerman (2002). An emphasis was placed on asking observers to return a form for each week even though no Gang-gangs had been seen. Those sites where observations were recorded for a single day only were ignored in any calculations.

A Muster record was the maximum number of Gang-gangs seen at any one time during each day of the designated week. Separate forms were made available for each Muster period on the COG website, in the monthly newsletter or at the COG monthly meetings. For a copy of the form see Appendix II.

2.2 Secondary Gang-gang observations

Secondary observations were those where it was possible to infer the presence of Gang-gangs from observers' personal bird lists. As a recreational activity observers make lists of birds they see or hear. Often this may involve an outing conducted by COG. These daily lists were submitted in various ways. The importance of these records is that it allowed inference of where birds were not present.

Observations could be submitted directly through the COG on-line data entry system or on paper forms, referred to as the COG General Observations Form, see http://canberrabirds.org.au/wp-content/uploads/2012/05/COG_Observation_Record_July_2012.pdf, and again available from the COG website or at COG meetings. Although these lists were not formally part of the Gang-gang survey they provided a most valuable record of where Gang-gangs had been and had not been observed.

Under an agreement with BirdLife Australia (BLA) bird observations collected and sent to BLA from within the COG areas of interest are shared with COG. Records are received once a year around October/November. In addition, observations sent to eBird were also shared to the COG database. Due to the different sources of data great care was taken to check for duplicate records.

All observations submitted directly to the COG database either directly or via other sources such as BLA or eBird collected over the survey period were extracted. For each bird list irrespective of source a single record was created that provided details on date of observation, location, coordinates, observer and number of Gang-gangs recorded. A zero was recorded if none were seen. A bird list was recognised as a set of records of different species recorded by the same observer at the same location over the same time. This record was then manually entered to the Gang-gang EXCEL database. In the case of eBird 'shared' lists, each list within a group from an outing was assigned a single record under the name of the observer who originally 'shared' the list. The numbers of Gang-gangs observed was taken as the largest number seen by members of the group.

2.3 Data analysis

Geo-coordinate data were received in various formats. The standard format set by ALA was decimal degrees. All non-standard locations were converted and records in the Gang-gang database edited manually.

With the large number of observations received it was not possible to confirm the accuracy of the geo-coordinates although where it was obvious that the written description did not match the coordinates the observer was contacted and if necessary the record amended. For those observations with a written site description but no coordinates the record was amended with geo-coordinates taken from Google Maps or Google Earth.

Any observations outside the COG area of interest were identified and not included in any analysis.

Specific records collected during the March 2014 and June 2014 quarterly COG woodland surveys were not included in the secondary records because of the concentration of the number of records from within small areas and because records from the September and December 2014 woodland surveys had not been received at the time of analysis.

For mapping purposes all casual records were allocated a suburb. For those observations within an urban Canberra Nature Park the nearest suburb to the sighting was assigned to the observation. All locations outside the urban boundary were allocated as rural. For the secondary observations, depending on location, the suburb was allocated as rural, Canberra Nature Park or urban.

On completion of all analyses the contents of the Gang-gang database will be loaded to the ALA host and added to their database.

All bird names are taken after Christidis and Boles, 2008.

2.4 Communications

A major aim of the project was to involve the general public to report any sightings of the Gang-gang. For this to happen good communications was essential and so a part-time communicator was appointed to promote the project and to provide regular feedback to survey participants. Information on the progress of the project was provided in the monthly COG newsletter made available on the COG website. A brochure was produced and made available as widely as possible. Presentations about the project were given to various groups and an on-line query address was set up to respond to queries from the general public. For a more detailed description of the communication activities see The Gang-gang Citizen Science Survey- Community engagement and evaluation report. COG publication, 2016, a companion report to this document.

3. RESULTS

3.1 Number of observations

A total of 7189 primary observations were received on Gang-gang activity over the 12 month period. There were 4634 records from the Casual survey with 313 observers contributing on-line and 81 through paper forms. Some observers reported their observations both ways. For the Muster survey 222 observers provided 2555 sightings, see Table 1. In addition to the primary observations there were 6160 secondary observations giving a total of 13,329 Gang-gang records for analysis.

Table 1. Summary of number of observers and primary and secondary Gang-gang observations collected March 2014 to February 2015.

Primary observations				
	Casual observations		No. records	No. observers
		On-line records	4078	313
		Paper records	556	81
		Total	4634	
	Muster observations			
		Paper records	2555	222
Secondary observations				
		Total	6140	
Total records			13329	

Note: observers may have contributed to some or all of the surveys

3.1.1 Primary observations

The majority of casual observations were received on-line (88%). Ninety-six percent of the casual observations and all of the muster observations were from urban Canberra whilst 20% percent of secondary records were from within Canberra Nature Park, and 26% were from rural sites with the remainder from urban sites.

3.1.1.1 Muster observations

The number of sites involved in the Muster survey varied from 45 in February 2014 to 139 in May 2014 with an average of 80 sites over the five Muster surveys, see Figure 2. The low number of participants in February 2014 is not surprising given the launch of the project and its associated publicity did not occur until mid-March 2014.

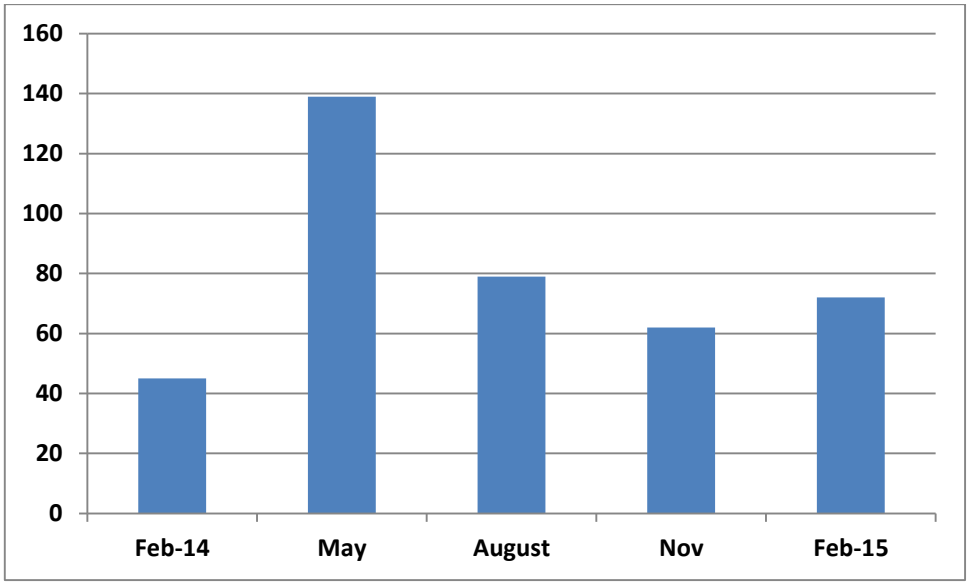


Figure 2. Number of Muster sites for each survey period

The Muster sites came from a variable number of suburbs ranging from 26 in February 2014 to 56 in May 2014, see Figure 3. The average number of suburbs for each survey period was 40

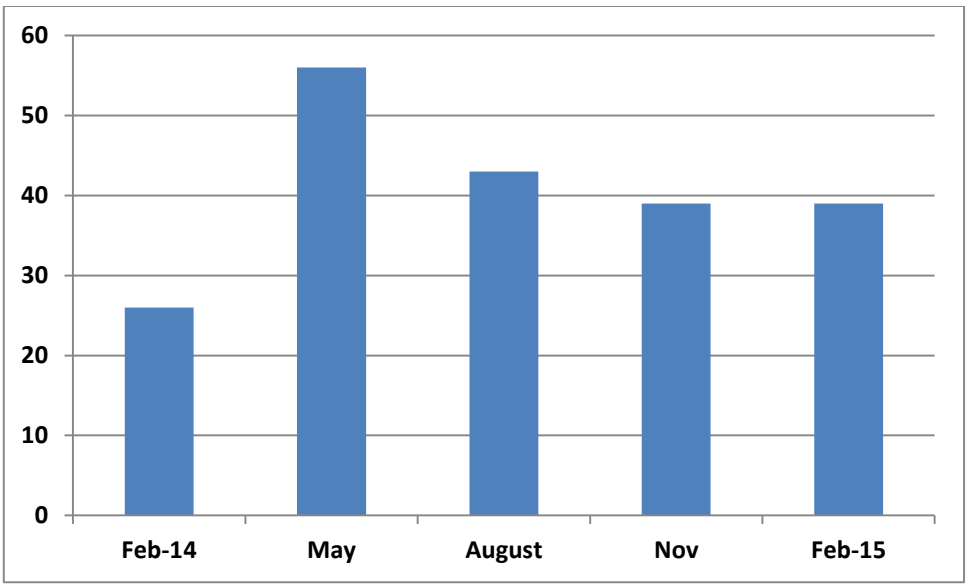


Figure 3. Number of suburbs covered for each Muster survey period

3.1.1.2 Casual observations

For casual records the number of observations remained similar at around 400 records per month, apart from an increase during May, until October when there was a decline from then until the end of the survey, see Figure 4.

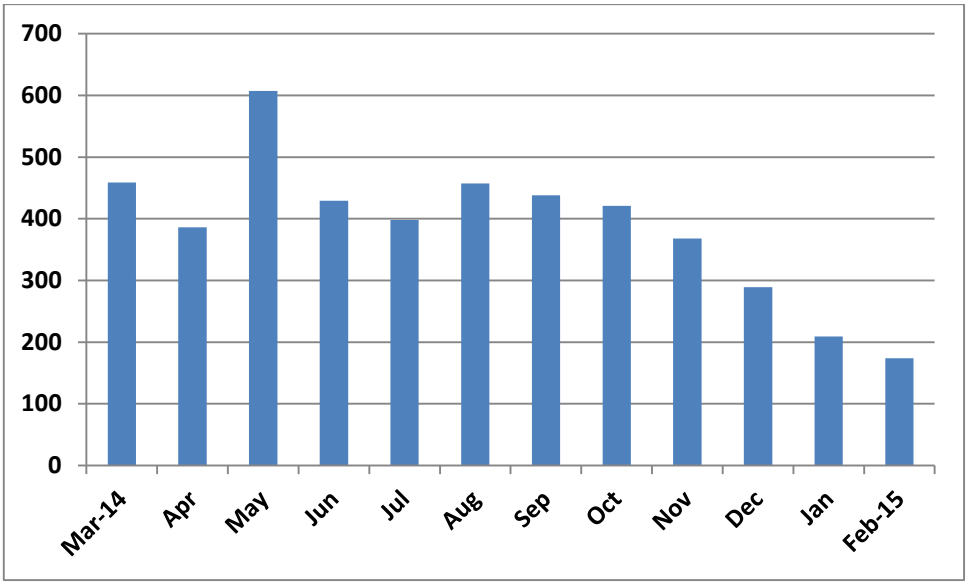


Figure 4. Number of casual observations received each month

The number of suburbs from which records were collected remained similar throughout the survey with an average of 37 suburbs per month, very similar to the average of 40 suburbs per survey for the Muster survey, see Figure 5. The number of observers participating in the survey increased from the start of the survey to a maximum of 134 individual observers in May with a decline through to the end of the survey.

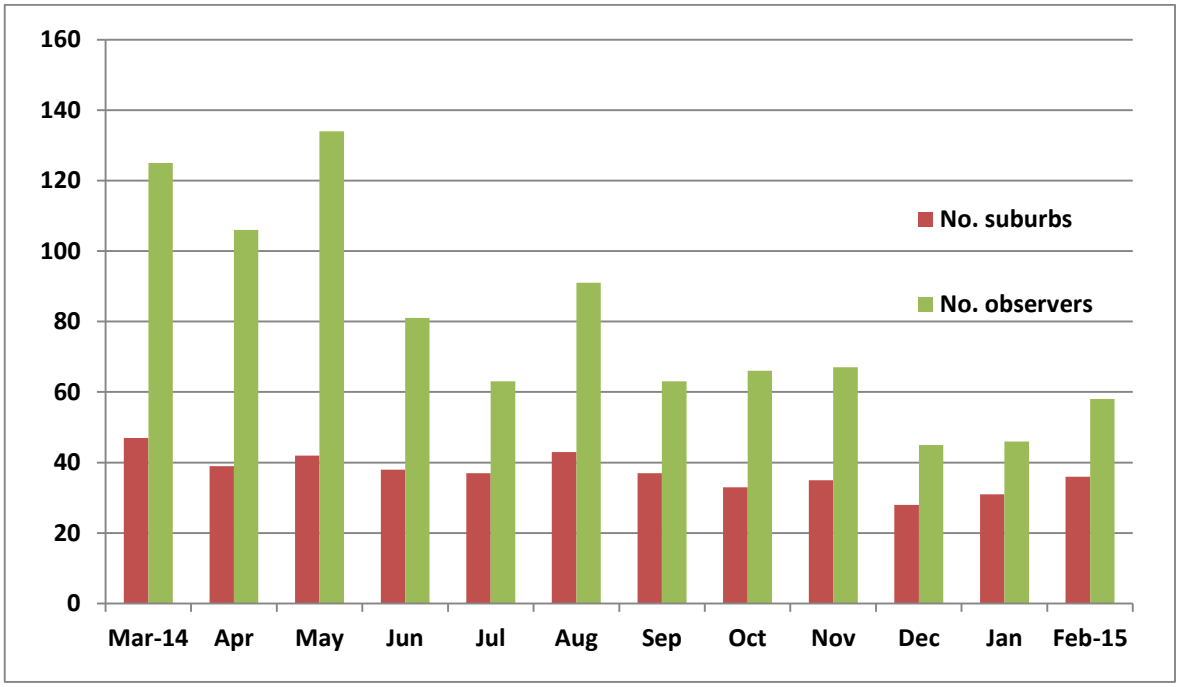


Figure 5. Number of observers and number of suburbs covered for each month of the Casual survey

The number of records submitted by individual observers varied considerably. Most observers submitted between one and four records with one observer submitting over 500 records, see Figure 6.

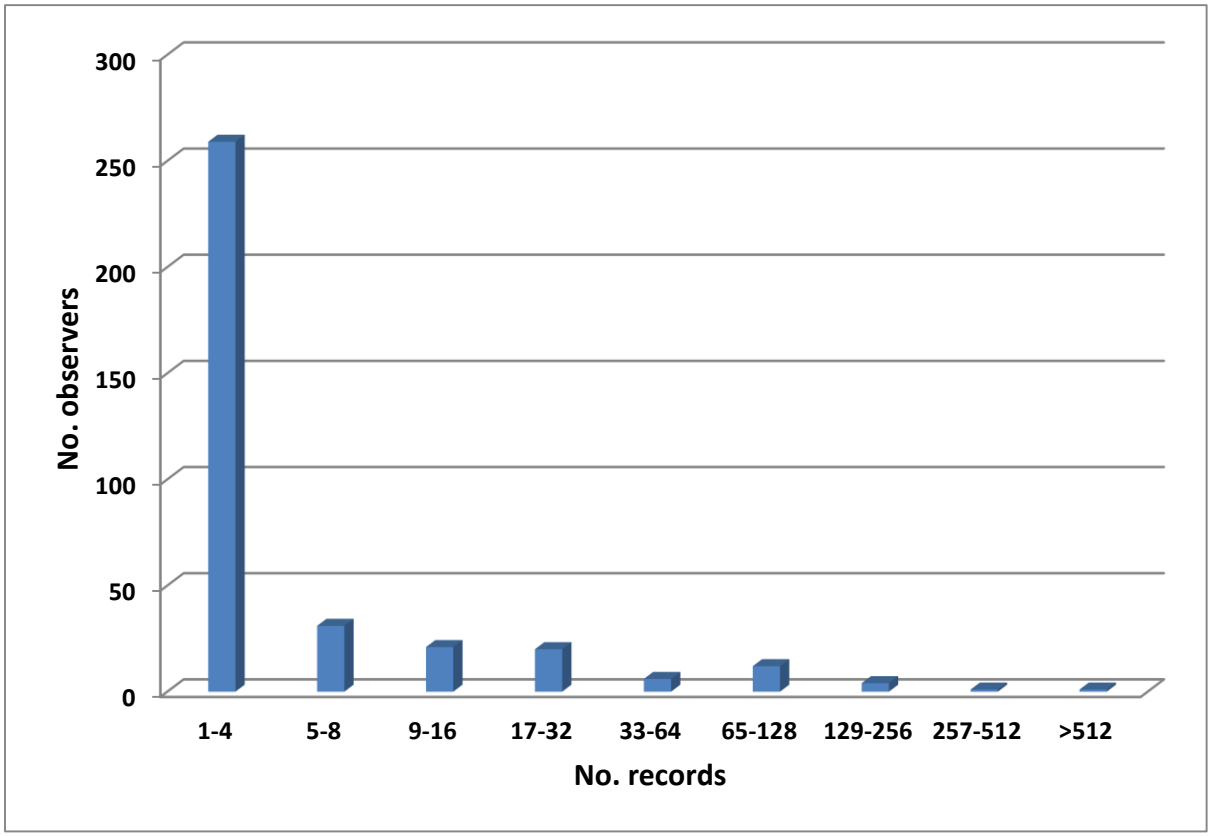


Figure 6. Number of records submitted by observers

There were some observers who submitted observations throughout the survey whilst others, who may have contributed a few or many observations, provided records for a short period only.

3.1.2 Secondary observations

Overall the total number of secondary observations remained constant up until July. From then on the number increased possibly due to an increase in the number of observations submitted to the Cornell University bird database eBird through a variety of apps. In addition, the COG bird blitz conducted over 25-26th October 2014 contributed a large number of observations, see Figure 7.

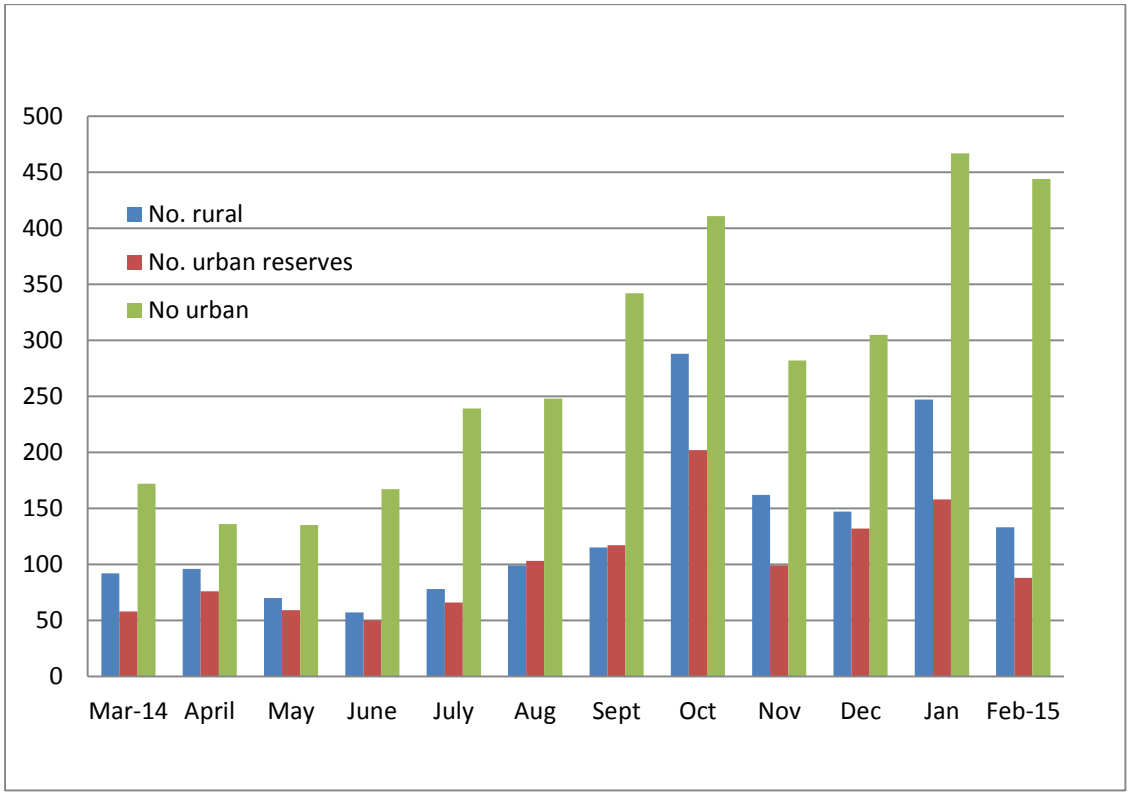


Figure 7. Number of secondary observations per month from urban, urban reserves and rural locations

Of the 6140 secondary observations, 7.7% recorded the presence of Gang-gangs whilst the remaining 92.3% records reported no Gang-gangs. Of the 476 secondary observations where Gang-gangs were recorded the majority were from urban areas with a peak in August 2014, see Figure 8. A similar peak was noted with observations from the urban reserves with observations from rural area showing no particular pattern. The increase in urban and reserve sightings may be due to increased visibility prior to the onset of the breeding season but this is not reflected in observations from rural areas possibly due to the small number of observations.

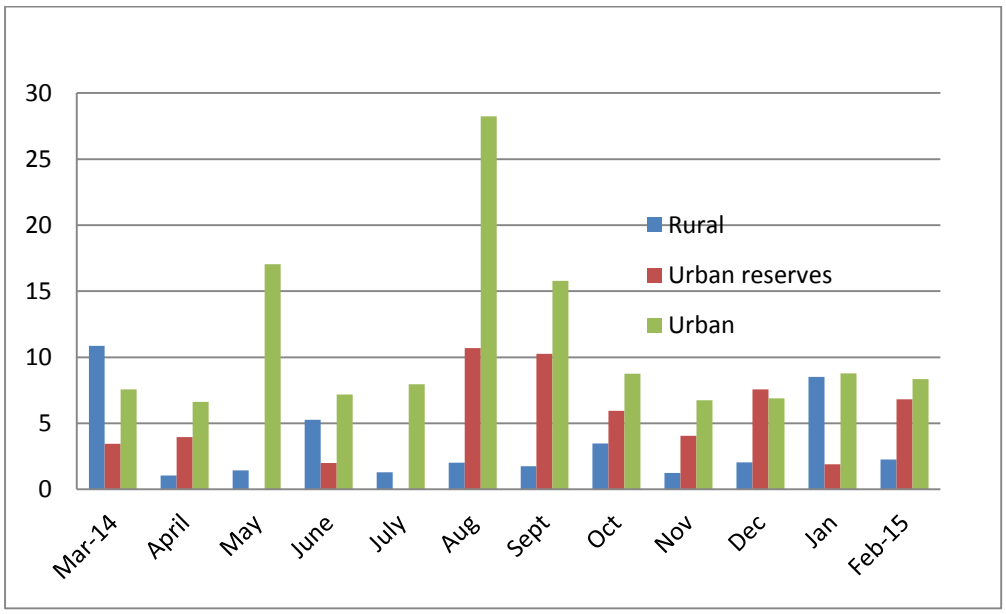


Figure 8. Number of secondary observations with Gang-gang sightings per month from urban, urban reserves and rural locations

3.2 Distribution

3.2.1 Primary observations

3.2.1.1 Muster observations

Due to the protocol of the Muster survey, where the maximum number of birds observed each day was recorded, it is possible to identify those suburbs in which Gang-gangs were most likely to be observed and those suburbs in which they were less likely to be observed. Because of the variation in the number of sites per suburb for each survey it is not possible to identify differences between seasons but by combining all observations it becomes obvious in which suburbs Gang-gangs are more likely to be observed, see Figure 9.

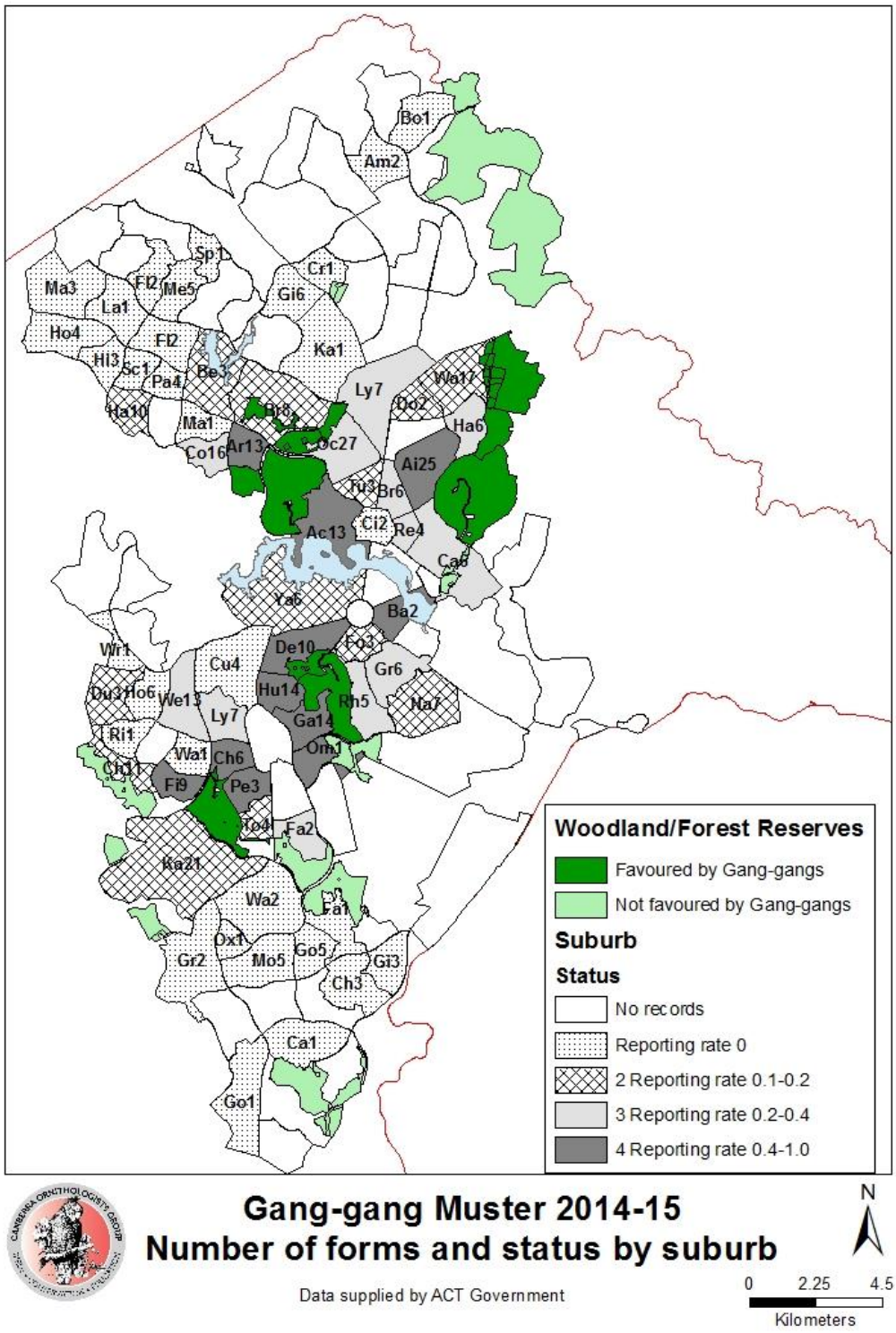


Figure 9. Reporting rate per day of Gang-gangs derived from the Muster survey
Note: Suburbs are identified from the first two letters of the suburb name followed by the number of records for each suburb. Those suburbs where no sites were observed are not identified.

Those suburbs that are most likely to report Gang-gangs are those bordering the Canberra Nature Reserves of Mt Majura and Mt Ainslie Forest/Woodland Reserve, Gossan Hill Forest Reserve, Bruce and O'Connor Ridges Forest Reserve, Black Mountain Forest Reserve, Aranda Bushland Forest Reserve to the north of Lake Burley Griffin and Red Hill Woodland Reserve and Mt Taylor Woodland

Reserve to the south. Some of the suburbs with a high reporting rate had a small number of submitted forms and therefore may not reflect the correct measure of frequency. Observations from O'Malley for instance where from a single site over a single seven-day period and Gang-gangs were observed over five days giving a reporting rate of 0.71 per day. There were 34 suburbs, virtually all some distance from the favoured Reserves, where no Gang-gangs were reported.

The suburbs with the greatest number of records were O'Connor (27) followed by Ainslie (25) and Kambah (21).

3.2.1.2 Casual observations

The distribution of casual observations within the COG area of interest is shown in Figure 10 whilst Figure 11 shows the same observations but in more detail around urban ACT and urban NSW. The figures show a very similar picture to that from the Muster survey with similar locations with the highest number of observations

As examination of the distribution of records for the four seasons of the year March to May (autumn), June to August (winter), September to November (spring) and December to February (summer) shows a similar distribution patterns irrespective of season, see Figures 12-15.

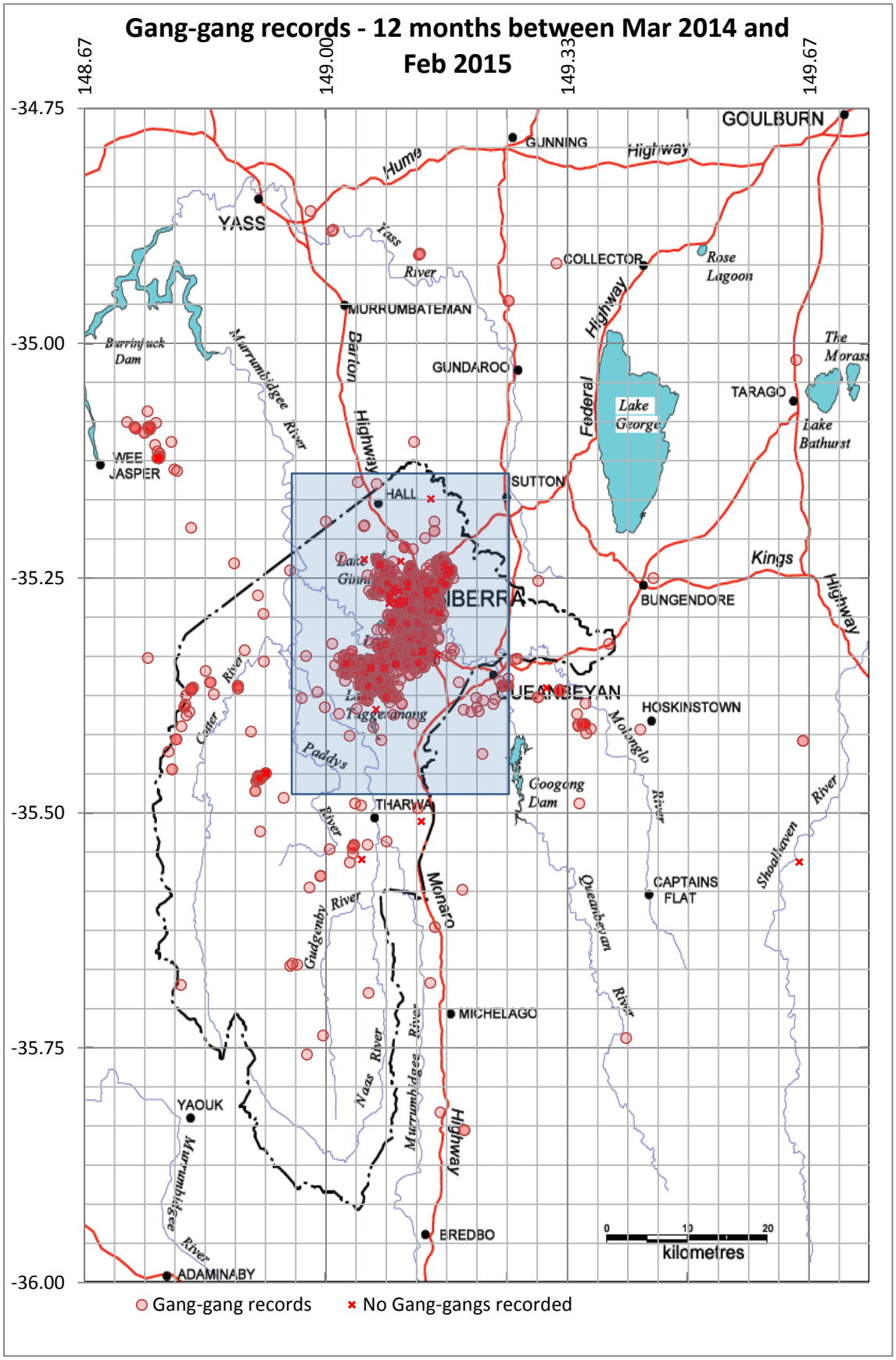


Figure 10. The location of Casual Gang-gang observations collected throughout the survey period from the COG area of interest. Note: The darker the dot the more records from that location

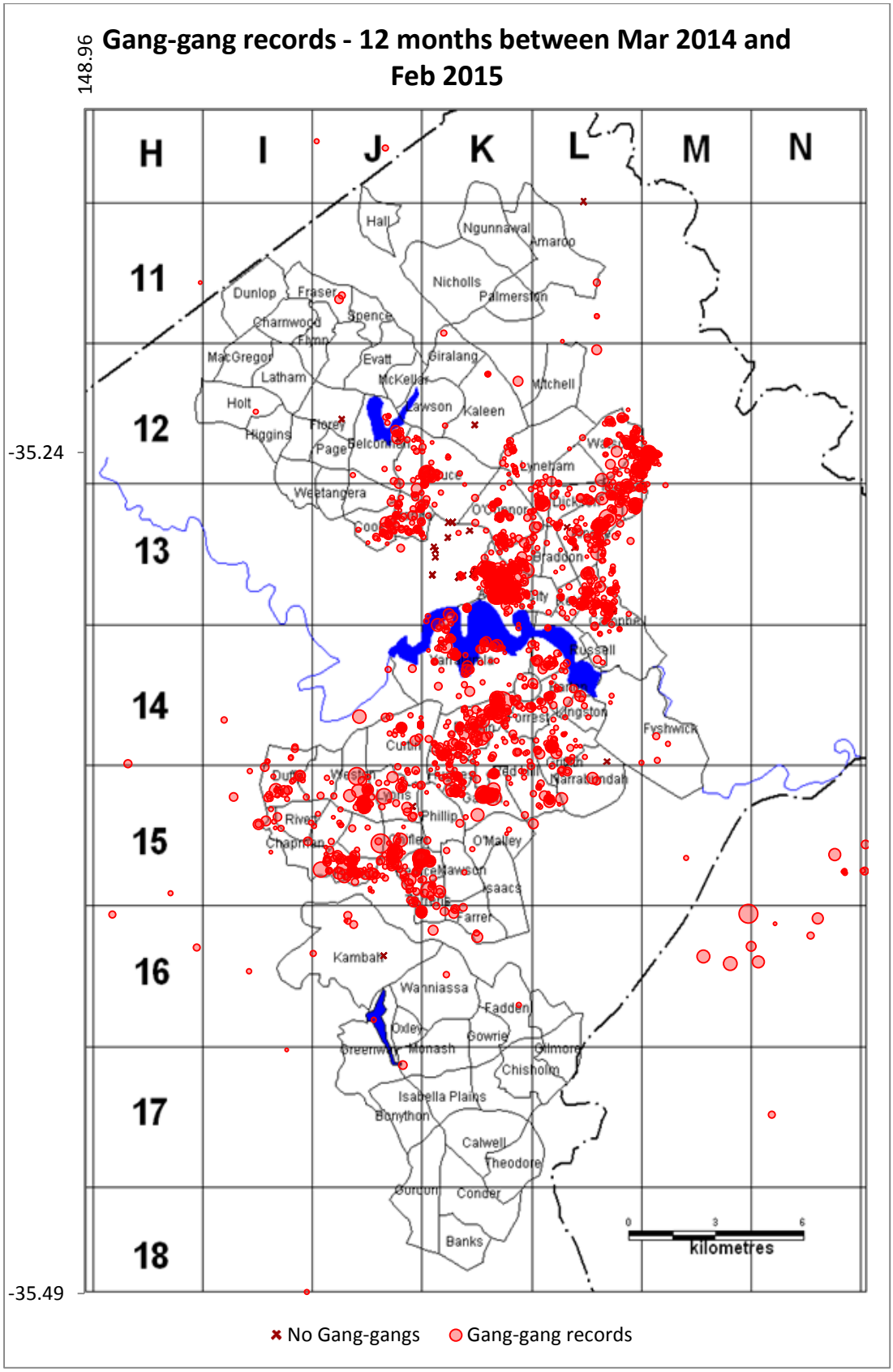


Figure 11. The location of Casual Gang-gang observations collected throughout the survey period from urban ACT and urban NSW. Note: The darker the dot the more records and the larger the dot the greater number of individuals from that location

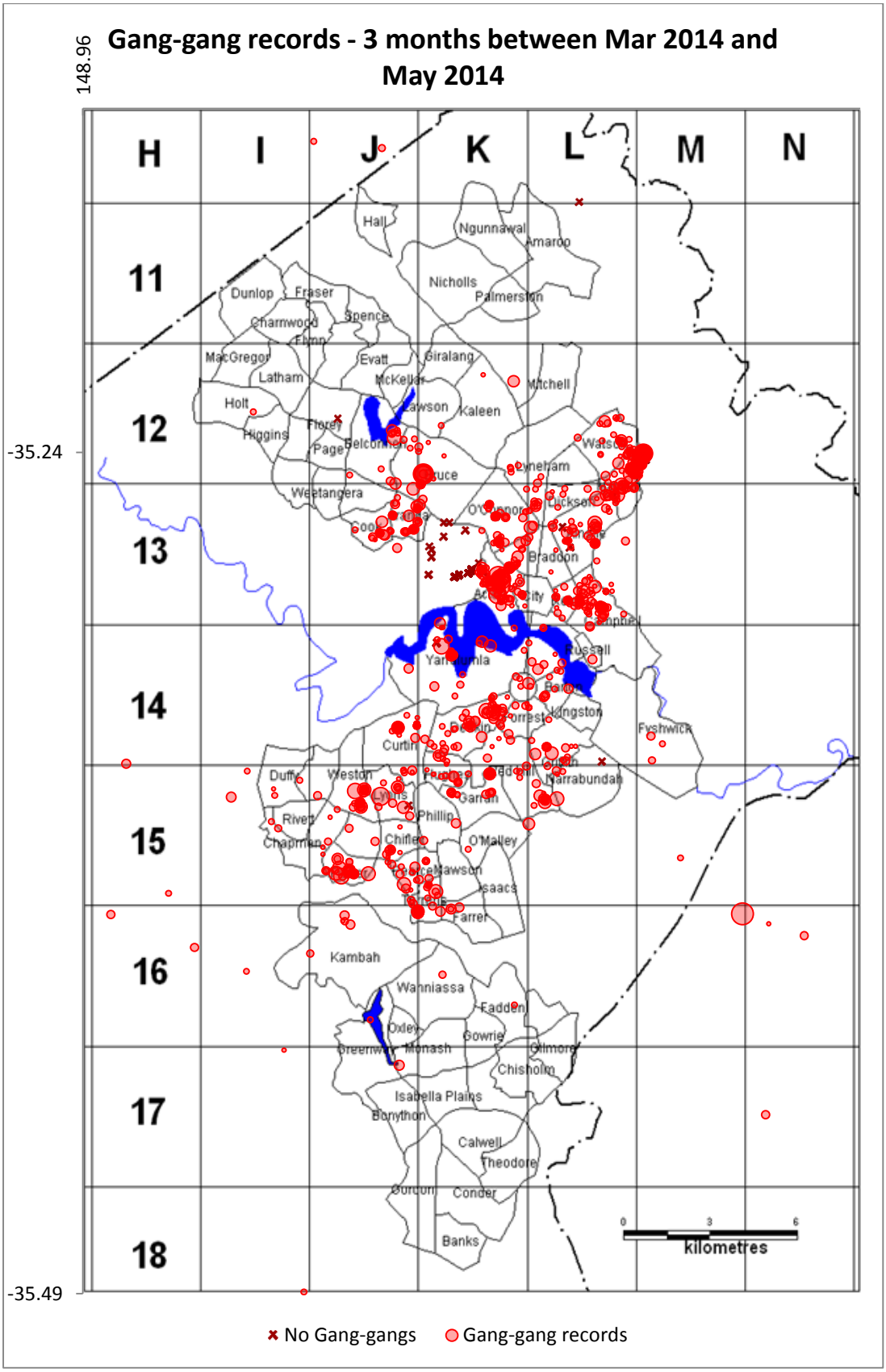


Figure 12. The location of Casual Gang-gang observations collected over the autumn period, March to May 2014. Note: The darker the dot the more records and the larger the dot the greater number of individuals from that location

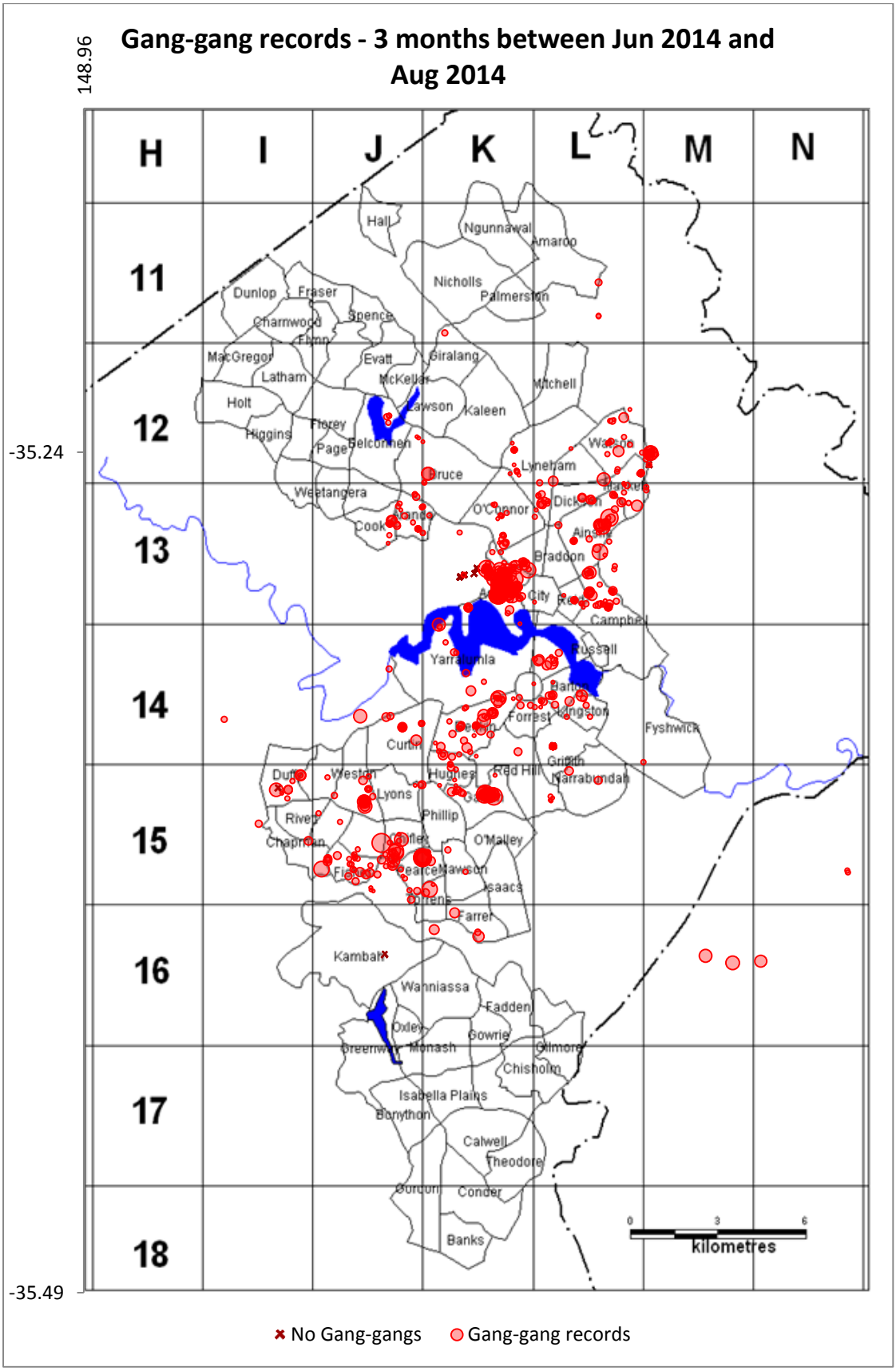


Figure 13. The location of Casual Gang-gang observations collected over the winter period, June to August 2014. Note: The darker the dot the more records and the larger the dot the greater number of individuals from that location

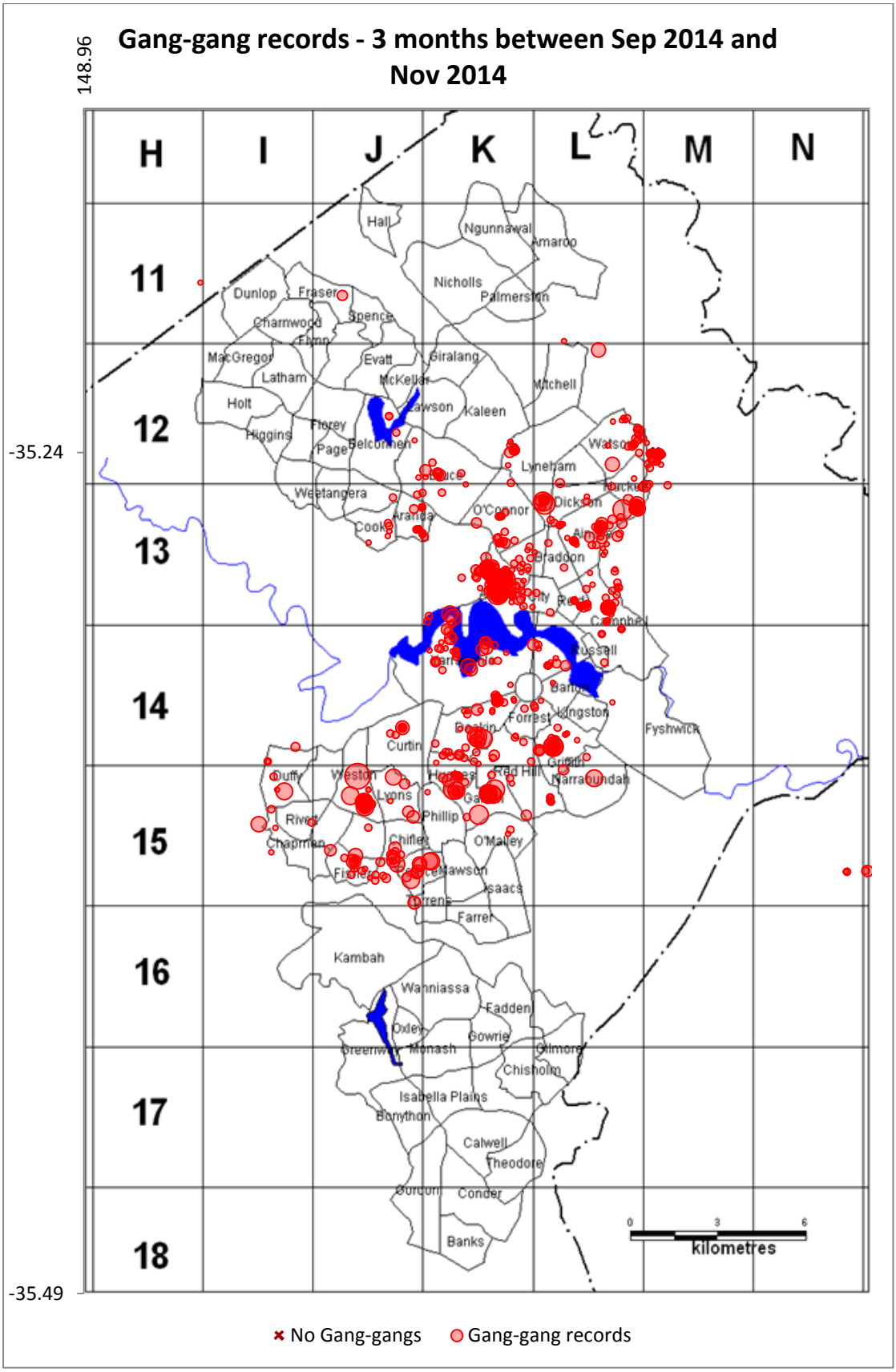


Figure 14. The location of Casual Gang-gang observations collected over the spring period, September to November 2014. Note: The darker the dot the more records and the larger the dot the greater number of individuals from that location

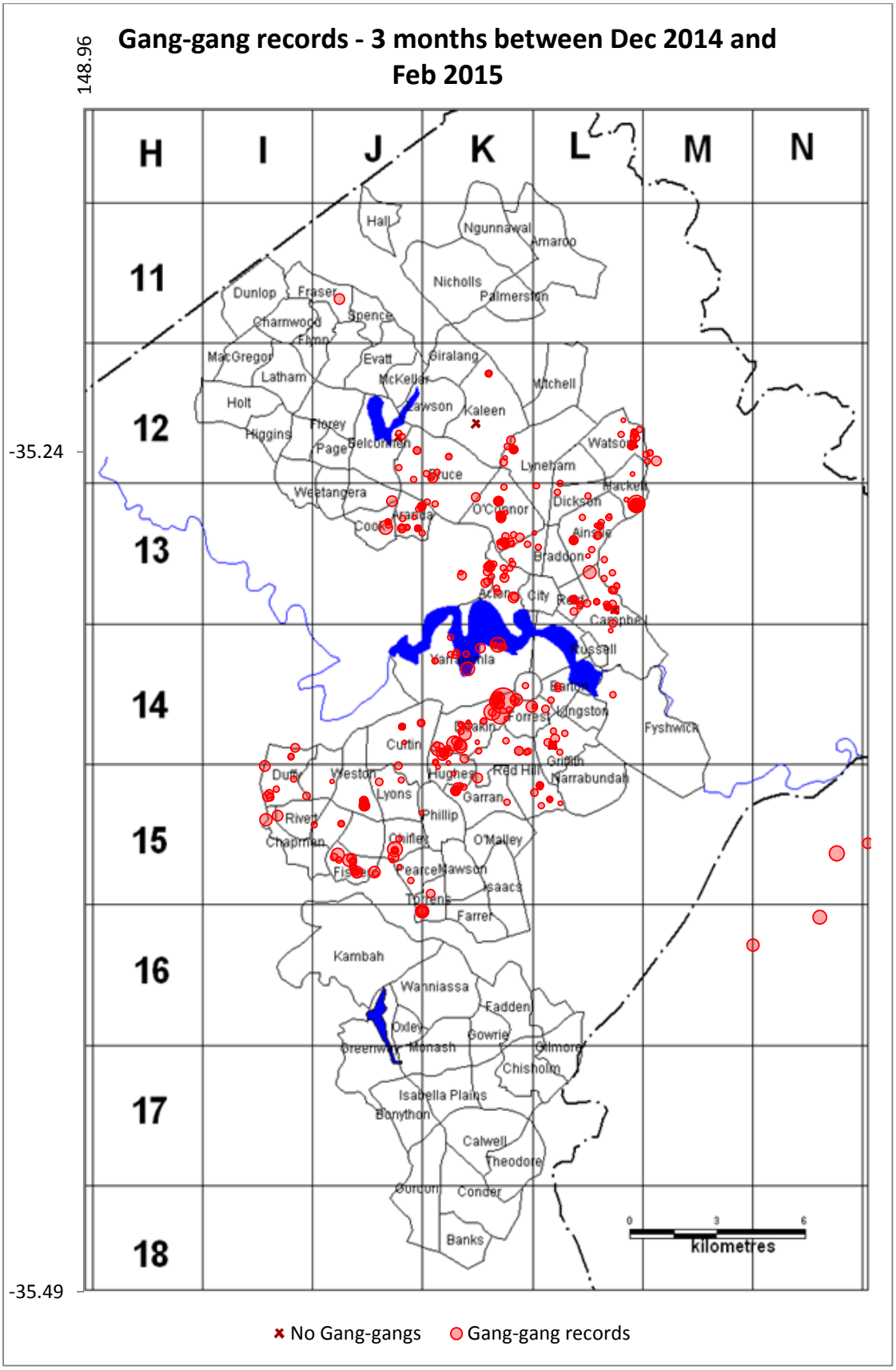


Figure 15. The location of Casual Gang-gang observations collected over the summer period, December 2014 to February 2015. Note: The darker the dot the more records and the larger the dot the greater number of individuals from that location

3.2.2 Secondary observations

These observations allow locations to be plotted where observers have visited irrespective of whether Gang-gangs were recorded or not. Figure 16 indicates very good coverage of urban ACT, reasonable coverage within rural ACT and urban NSW but a poor coverage of rural NSW over the 12 month survey period.

All sightings of Gang-gangs from primary and secondary observations are shown in Figure 17. Although the distribution very much reflects the distribution of observers, Gang-gangs were recorded throughout the area of interest particularly in urban Canberra and in the Brindabella Ranges, Namadgi National Park and north of Googong Dam. Although not shown, Gang-gangs were reported from similar locations throughout the year with no obvious apparent increase in sightings in the Namadgi/ Brindabella Ranges during the spring and summer months.

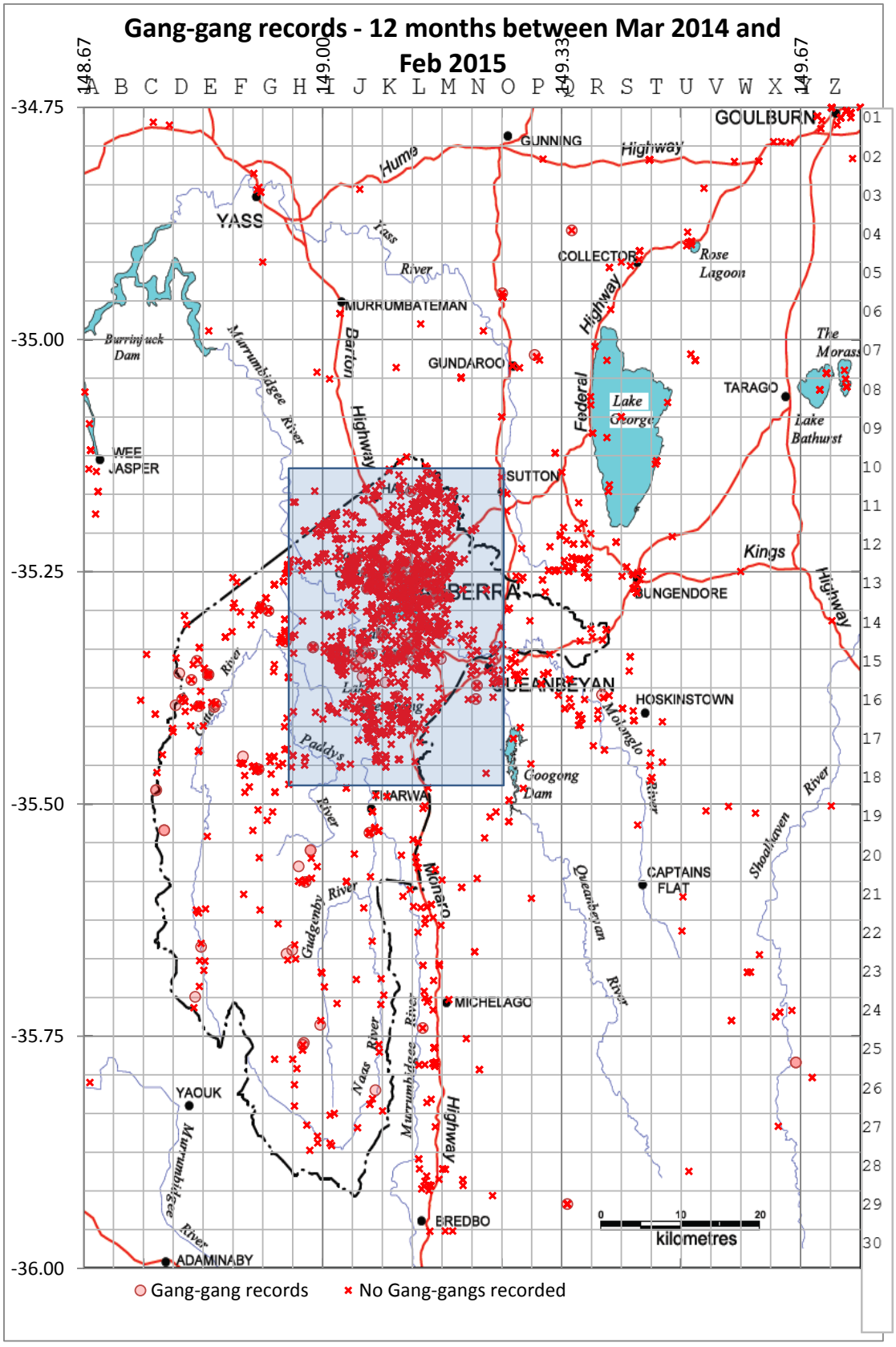


Figure 16. The location of secondary Gang-gang observations collected throughout the survey period from the COG area of interest. Note: An ‘x’ indicates locations where Gang-gangs were not recorded whilst a dot indicates where gang-gangs were observed. The darker the dot the more records from that location

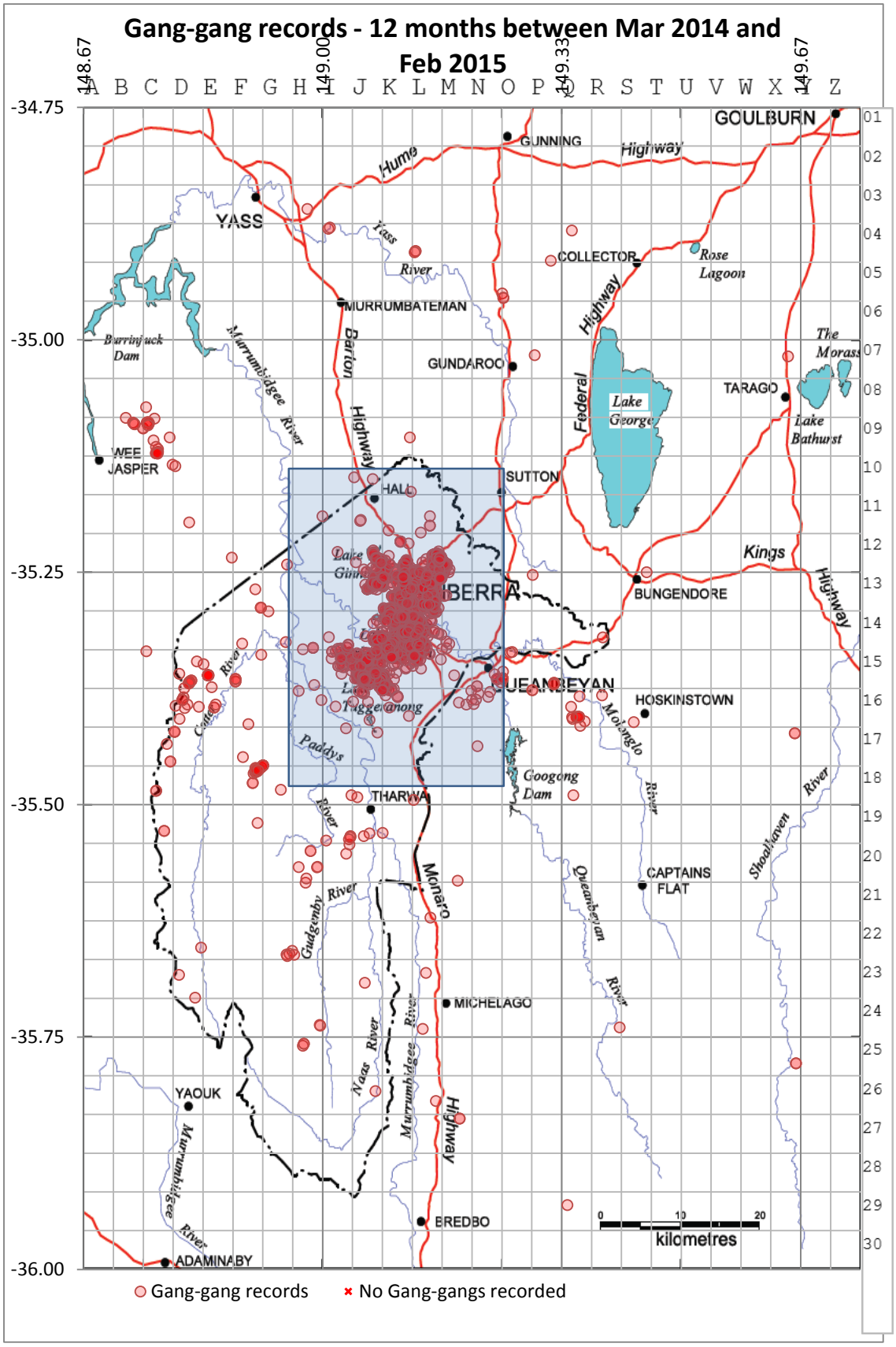


Figure 17. The location of both primary and secondary Gang-gang observations collected throughout the survey period from the COG area of interest. Note: The darker the dot the more records from that location

3.3 Fluctuation in numbers of Gang-gangs

Although it is not possible to give an estimate of the number of Gang-gangs in the ACT region it is possible to get an idea of fluctuations in abundance from year to year and between seasons.

From long-term data collected by the Canberra Ornithologists Group it is possible to plot the annual reporting rate between 1995 and 2014, see Figure 18. The reporting rate is defined as the proportion of record sheets that contain Gang-gang sightings. Over the 20 year period although there appears to be fluctuations in the reporting rate there does not appear to be any general increase or decrease. The reporting rate for the secondary observations can be compared with the long-term dataset and at 7.7% was slightly higher than the long-term data but not surprising given the focus on the species. The reporting rate of 24%, see later Table 2, from the Muster survey is much higher than expected and possibly reflects a tendency for those with Gang-gangs in their gardens to participate in the survey. Note that it is not possible to provide a reporting rate from the casual data because the records only consist of positive sightings.

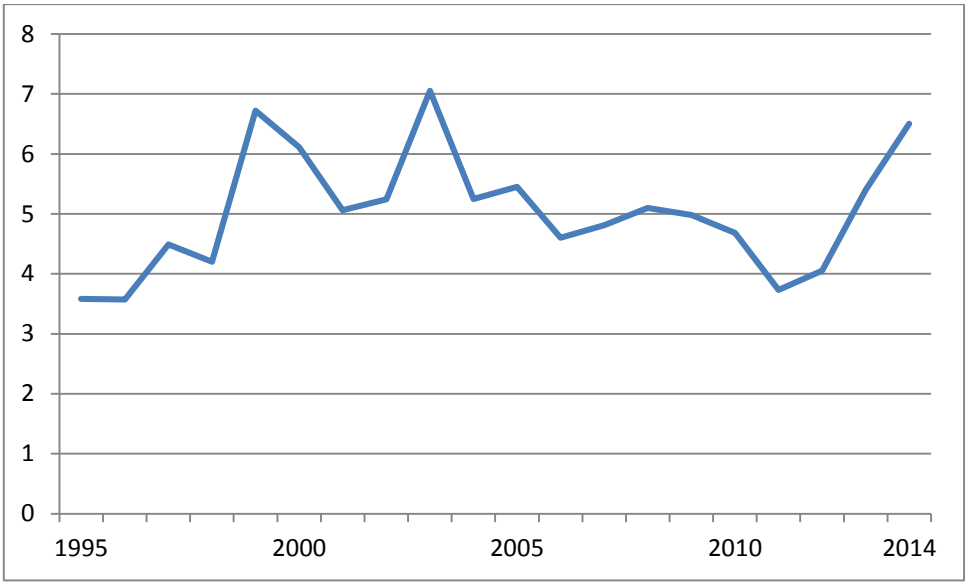


Figure 18. Gang-gang reporting rate (%) taken from COG database records 1995-2014

3.3.1 Primary observations

3.3.1.1 Muster observations

The summary statistics for the Muster survey are shown in Table 2. For a more detailed description of the statistics used see Canberra Bird Notes Volume 40, No. 1, pp101-102. The February 2014 Muster survey was held just after the launch of the project in mid-February. Although it is likely that most members of COG would have been aware of the survey it is unlikely that the general public would have been. This is reflected in the low number of participants for this first survey and may reflect a greater number of experienced survey participants when compared with the following surveys. Conversely, a surge of interest was shown in the May survey due to an increase in publicity and interest after the launch.

The average number of birds per site remained relatively constant until the spring survey when there was a large reduction. Interestingly this was not reflected in either the reporting rate or in the frequency but was reflected in the group size. This indicates that although there were less Gang-gangs about, they were just as likely to be seen as at other times on the year. This reduction in abundance (A) agrees with the long-term data from the COG Garden Bird Survey (Canberra Ornithologists Group, 2009) with a decrease between October and November.

Table 2. Gang-gang Muster survey summary statistics.

	Feb-14	May	Aug	Nov	Feb-15
Number of sites	45	139	79	62	72
Number of suburbs	26	56	43	39	39
Abundance- (A)	1.31	1.2	1.42	0.54	0.71
Reporting rate- (R)	0.29	0.22	0.26	0.22	0.22
Frequency- (F)	0.6	0.38	0.45	0.43	0.48
Group size- (G)	4.5	5.68	5.4	2.43	3.31

A-Number of birds per site, R- Proportion of days reported, F-Proportion of sites with birds, G-Average maximum number of birds seen per day

3.3.1.2 Casual observations

It should be noted that from the Casual data it is not possible to estimate the abundance (A) or reporting rate (R) because nil sightings are not reported. The average group size per month indicates an increase over the autumn and winter months followed by a decrease during the spring, see Figure 19. This pattern is similar to that shown from the Muster observations, see Table 2.

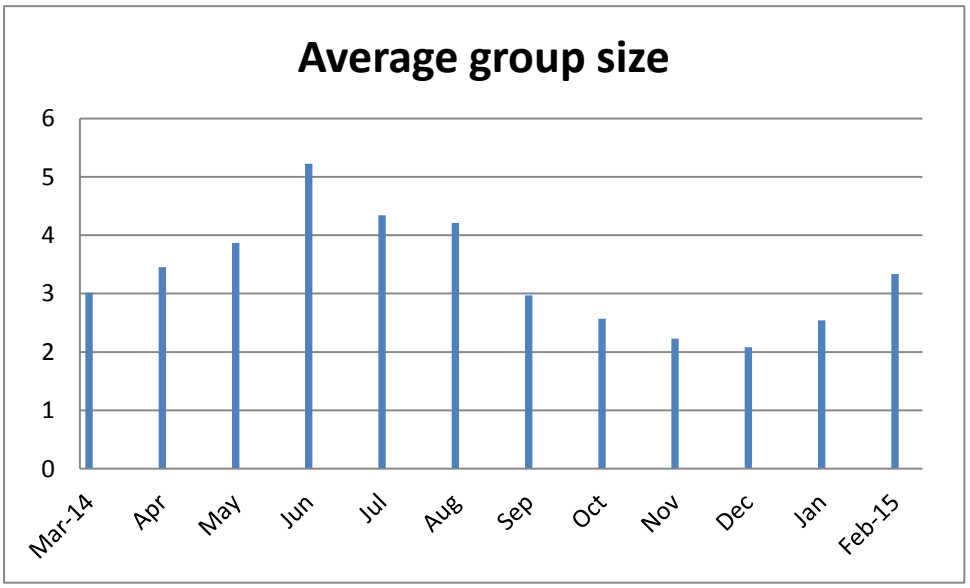


Figure 19. Average group size of Gang-gangs reported from the Casual survey over a 12 month period from March 2014

3.4 Ratio of sex and age

3.4.1 Adult sex ratio

In addition to the number of Gang-gangs seen it was possible to record in the Casual survey the ratio of adult males to adult females. Throughout the survey period the ratio was similar with slightly more males than females being reported, see Figure 20

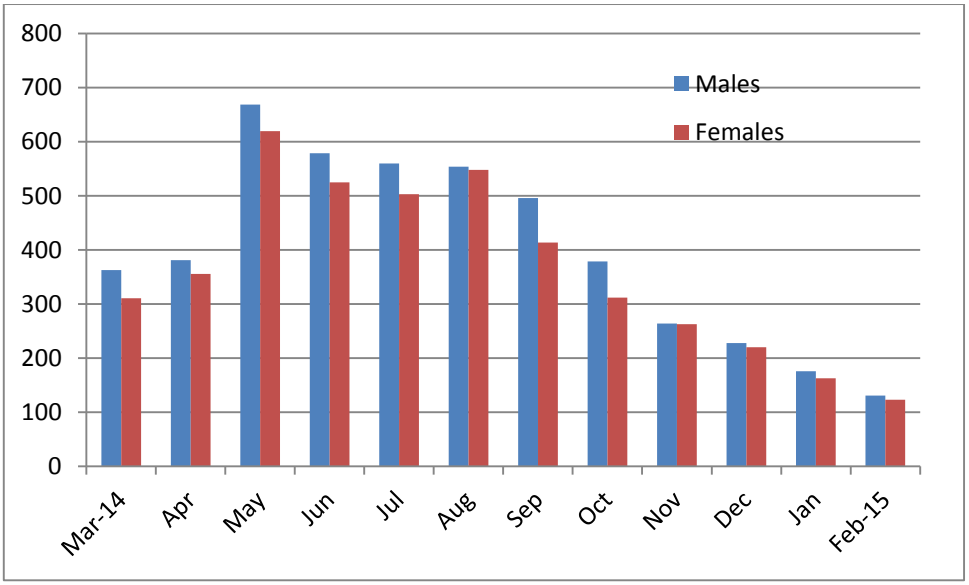


Figure 20. Total numbers of adult males and adult females for each month of the survey period.

3.4.2 Adults to young ratio

The ratio of adult birds to young was also reported. Young birds were taken to be birds with juvenile or immature plumage. The differences between female adult plumage and female juvenile plumage are slight and easily overlooked. Females develop the adult plumage from the juvenile plumage and so show no immature (Higgins, 1999). The difference between adult male plumage and young male plumage is more pronounced due to the emergence of red coloured plumage around the head. It is recognised therefore that the ratio of adult birds to young birds may be skewed as some adult female birds may have been young females. Young were reported throughout the year with an increase from June through to September, see Figure 21.

An increase in the proportion of young to adults over the winter period is either due to an increase in young looking birds or a decrease in the number of adults. Although difficult to explain it is possible that young males are recorded as adult females. As the males develop the red plumage around the head over the winter they become obviously young males rather than adult females. This would lead to an apparent increase in young sightings and a decrease in adult (female) sightings.

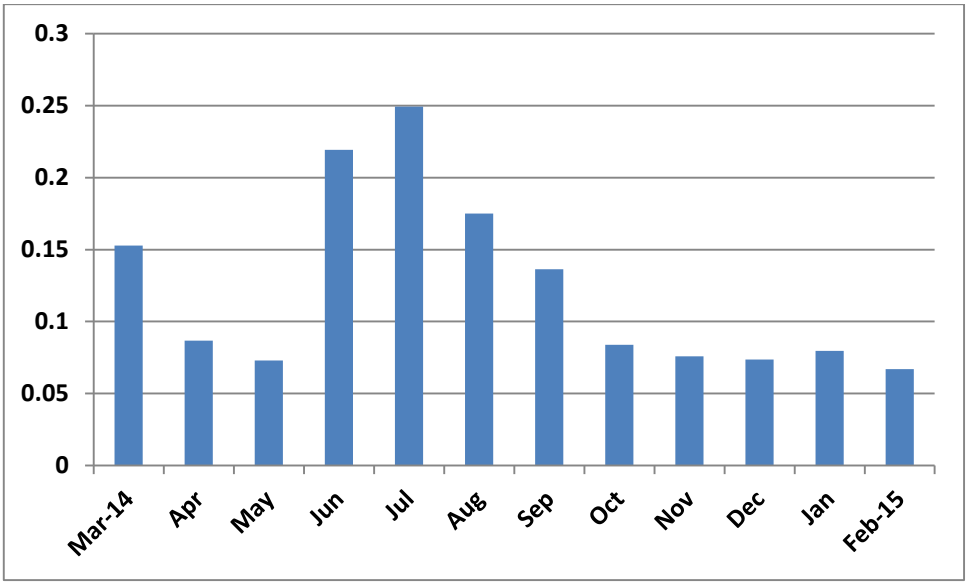
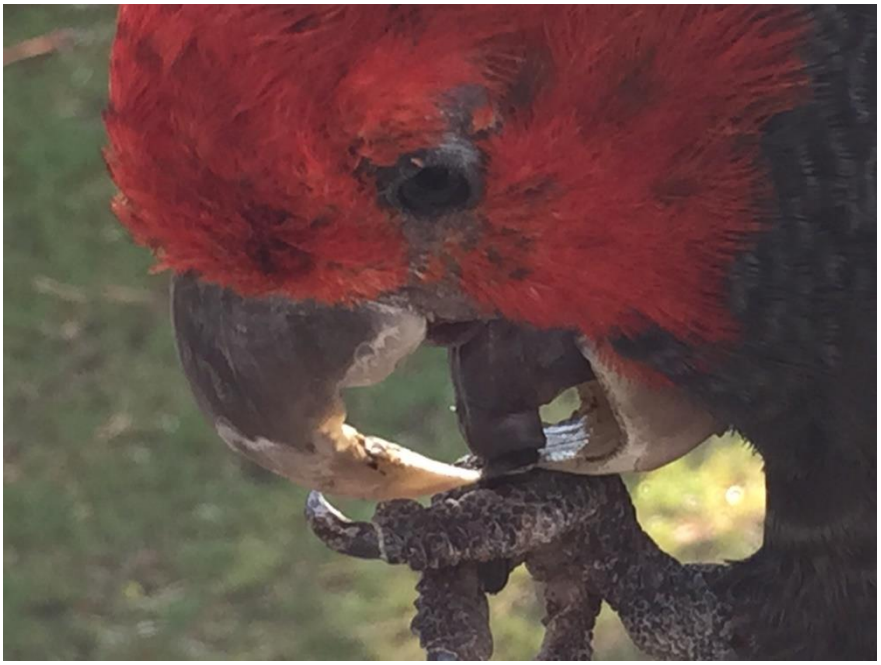


Figure 21. Proportion of young to adults Gang-gangs

3.5 Plumage

Leonard (2012) noted two instances of Avian Beak and Feather Disease (ABFD) in urban Canberra. Over the 2014 survey there two reports of possible ABFD, see Figure 22. Birds were reported with 'weepy' eyes and in a couple of cases birds appeared to be blind in one eye. Often photos were submitted to the project indicating a partial loss of feathering around the eyes. Whether this is the result of feeding in dense and prickly vegetation or whether it is associated with some problem such as ABFD is unknown. Any future study on the Gang-gang that involves handling birds should include a protocol to detect ABFD such as swabbing or taking blood samples.



Karen Watson

Figure 22. Male Gang-gang with possible Avian Beak and Feather Disease. *Note elongated bill and slight feather loss around the eye.*

From as early as September 2014 observations were submitted of breeding behaviour for the 2014-15 breeding season. These observations were based on sightings of young birds accompanying adults and were assumed by observers to be evidence of successful breeding during that season. As with most cockatoos, egg-laying starts around end of September/early October (Higgins, 1999). Given it takes four weeks for incubation and up to eight weeks to fledge, young will not appear until around the New Year. It takes up to four years for a male to acquire a completely set of red plumage around the head. The photo below, see Figure 23, shows a bird in juvenile plumage with the barring on the feathers and a partly red head. This photo was taken on 24 October and so the bird would have fledged around January 2014 or earlier. For this bird to be a young of the 2014-15 breeding season the clutch would have had to be laid end July 2014. A confident sighting of successful breeding would be of young looking birds begging near an appropriate sized tree hollow and cannot be based on plumage.

Chris Davey

Figure 23. Young male Gang-gang in juvenile plumage. Photo taken 24 October 2014

3.6 Behaviour

3.6.1 Breeding

Records from the COG General Observations database go back to July 1981. Since then there have been 63 breeding records submitted. Of these just under 50% are of birds inspecting hollows whilst 33% of records are of dependent young. There are four records of birds seen leaving or entering a nest and none involved repeated observations.

During the 2014-15 survey there were 147 records of breeding behaviour from urban Canberra with 99 collected over the breeding season between September and January, see Table 3. There were three rural records, all came from the Brindabella Ranges, two of which refer to the same hollow. The majority of observations were of birds inspecting or entering or leaving hollows, with a few observations of birds copulating.

For a distribution of the hollow inspecting sites during the breeding season see Figure 24 for the location of breeding observations within the COG area of interest and Figure 25 for a more detailed view of locations within the urban area.

Table 3. Number of breeding observations within each suburb between March 2014 and February 2015 and during the breeding season September 2014 to January 2015

	Number of inspecting hollow records	
Suburb*	Overall	September - January
Acton inc ANBG	27	13
Ainslie	8	3
Aranda	8	2
Bruce	6	6
Campbell	8	7
Cook	1	0
Curtin	1	1
Deakin	17	14
Fisher	3	3
Forrest	1	1
Garran	1	1
Greenleigh	3	2
Hackett	30	22
Hughes	1	1
Kambah	1	1
Lyneham	1	1
Lyons	1	1
McKellar	1	0
Narrabundah	1	0
North Lyneham	1	1
O'Malley	2	2
Parkes	1	0
Pearce	2	2
Red Hill	5	1
Reid	5	4
Rural	3	3
Watson	8	8
Weston	1	0
Yarralumla	2	2
	150	102
* includes neighbouring Reserves		

Included in the urban records are sites at Hackett, Deakin and O'Malley at which birds were observed regularly entering hollows. In one case it was observed that at dusk the female was the bird that took over incubation duties (C. Davey *pers. obs*.). This observation confirms sightings that suggest it is the female that incubates overnight (Higgins, 1999).

Despite regular observations none of the three sites produced young with two appearing to fail, possibly due to heavy rain in early December 2014. There was a single breeding event recorded at the Australian National Botanic Gardens where recently fledged begging young were observed next to a tree hollow and hence is the only breeding confirmation in urban Canberra during the survey.

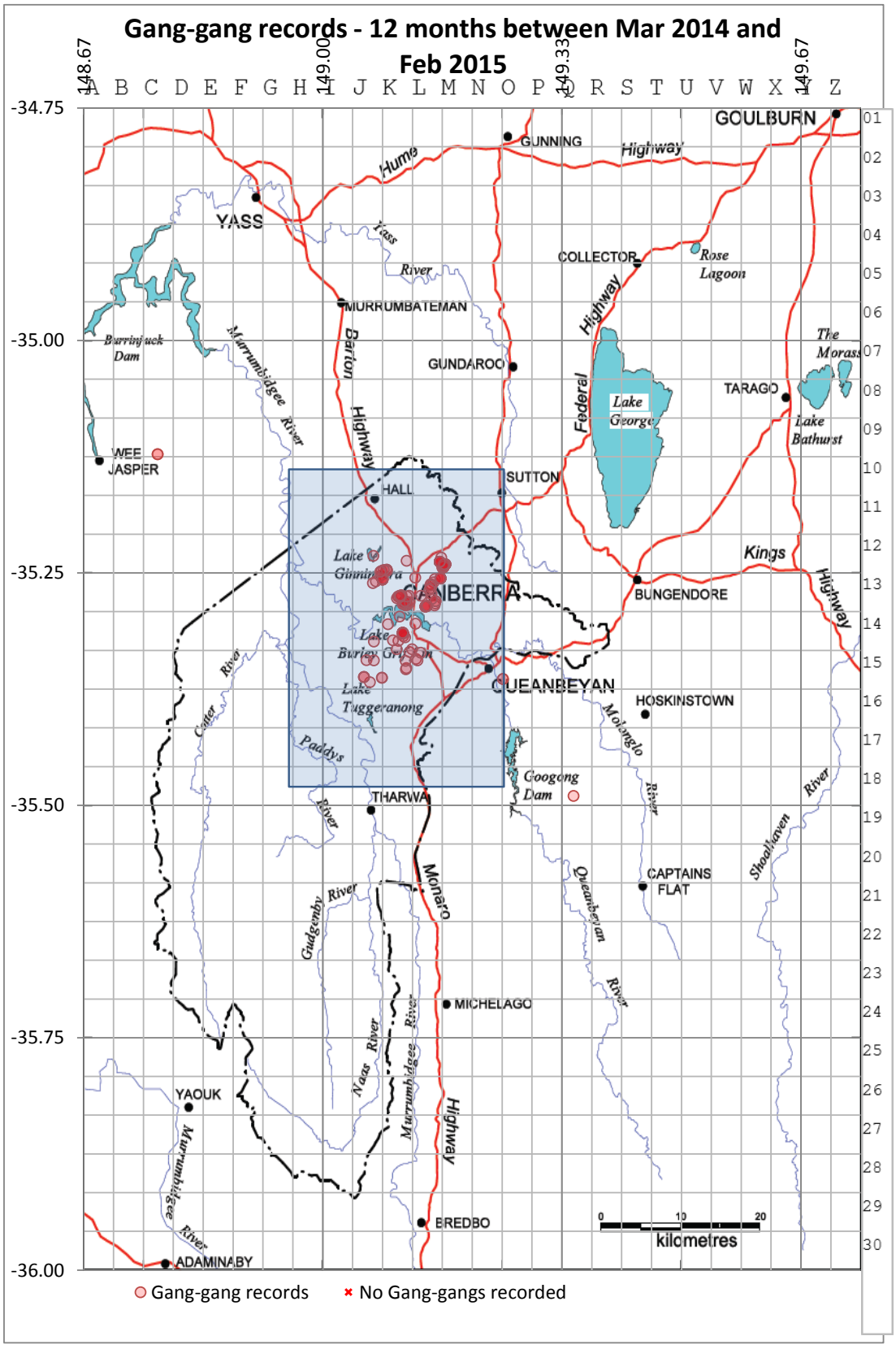


Figure 24. Location of breeding observations within the COG area of interest, March 2014 to February 2015. Note: The darker the dot the more records from that location

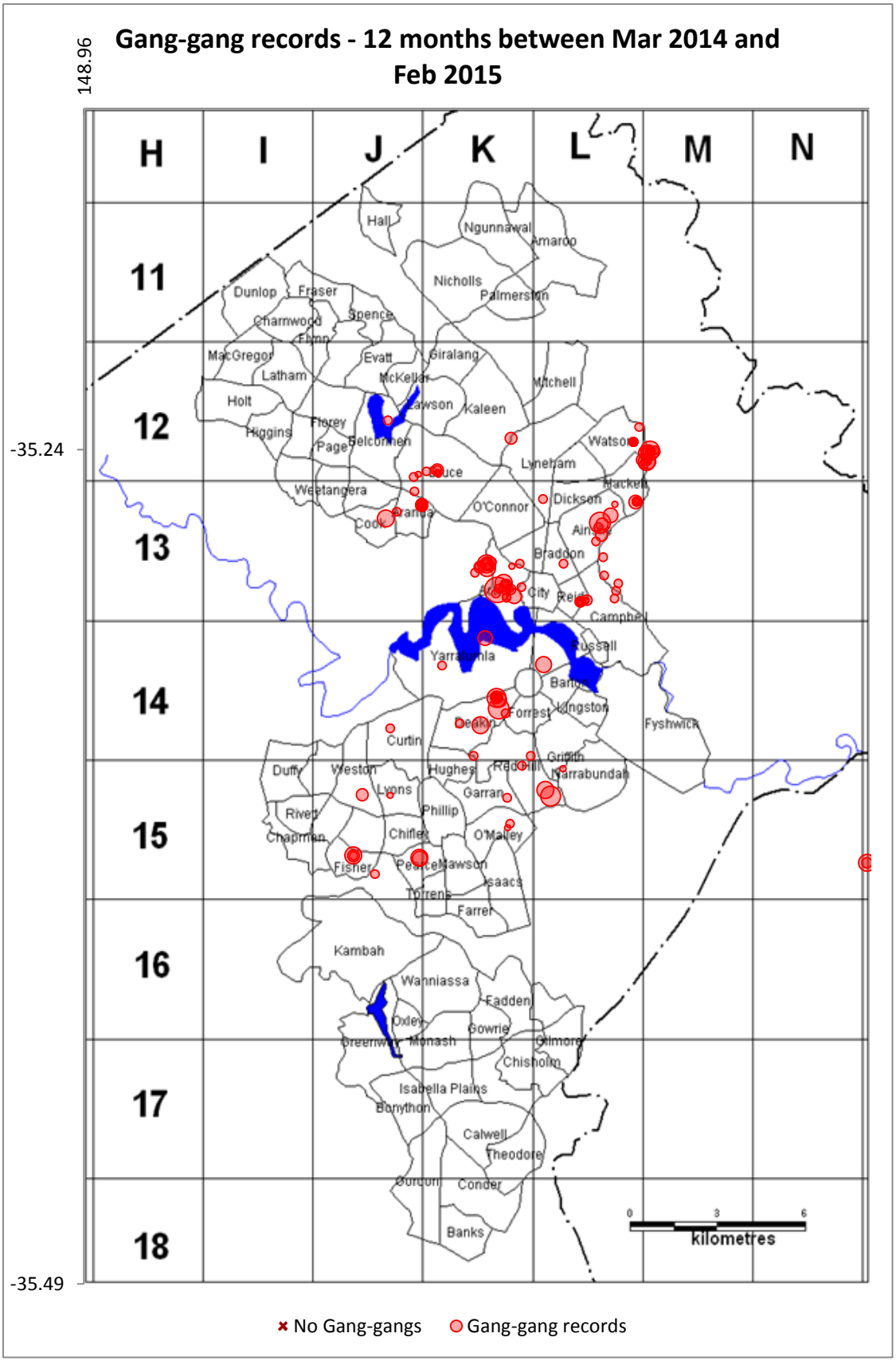


Figure 25. Location of breeding observations from the urban areas within the COG area of interest, March 2014 to February 2015. Note: The darker the dot the more records and the larger the dot the greater number of individuals for each location

Many of the sites involved hollows in vertical or near vertical pipes rather than in a spout or directly from the tree trunk, see Figure 26. These observations confirm those referred to in Higgins (1999) where 'hollows (are) often vertical or steeply sloping'. These sites could be most susceptible to flooding.

Chris Davey

Figure 26. Typical vertical pipe often inspected by Gang-gangs for a possible breeding site

3.6.2 Interactions

There were 100 observations of thirteen bird species interacting with Gang-gangs. These observations do not involve interactions around a feed dish. The most common species that the Gang-gang interacted with was the Pied Currawong *Strepera graculina* (29% of records) with interactions appearing to occur throughout the year. The Sulphur-crested Cockatoo *Cacatua galerita* was the next most common (20% of records) with the majority of observations between March and May. The Noisy Miner *Manorina melanocephala*, with 17% of records, and the Galah *Eolophus*

roseicapillus with 12% of records, were the next most common. The other occasional records involved the Magpie-lark *Grallina cyanoleuca,* Corella *Cacatua sp.,* Common Myna *Sturnus tristis*, Red Wattlebird *Anthochaera carunculata,* Australian Wood Duck *Chenonetta jubata*, Australian Magpie *Cracticus tibicen*, Noisy Friarbird *Philemon corniculatus,* White-winged Chough *Corcorax melanorhamphos* and a Satin Bowerbird *Ptilonorhynchus violaceus.* In virtual all cases, where indicated in the record, it was other species that initiated the interaction.

3.6.3 Food

Not including feeding from a feed bowl, there were 367 observations of Gang-gangs feeding on various native and introduced plant species. Gang-gangs were reported feeding on Myrtaceae, Proteaceae, Mimosaceae, Pines/Conifers and many introduce plant species; a total of 26 Eucalypts, one Melaleuca, two Proteaceae, six Mimosaceae, 21 non-native species, a Casuarina and three conifer/pine species, see Appendix III for a list of species. Most of the Eucalyptus species were only occasionally reported but of note was how frequently forest mountain species were recorded from urban Canberra including plantings of Southern Blue Gum *E. bicostata*, Maiden's Gum *E. maidenii*, Tasmanian Blue Gum *E. gobulus,* Sydney Blue Gum *E. saligna*, Mountain Ash *E. regnans*, Alpine Ash *E. delegatensis*, Snow Gum *E. pauciflora*, Narrow-leaved Peppermint *E. robertsonii* and Manna Gum *E. viminalis*; approximately 50% of the eucalyptus records, not including 76 records listed as 'Eucalyptus'.

Of the non-native plantings Liquidamber, Hawthorn and Pistachio were the most frequently reported accounting for 68% (77 of the 113) of the non-native plant records. The period when Gang-gangs were reported feeding on these plants was limited to between December and June. There was a single record of Gang-gangs feeding on Pyracantha and only four records of birds feeding on Cotoneaster, again between the period December to June.

The most common Gymnosperm was reported as 'Conifer', 9% of all plant records.

3.6.4 Provision of feed

Although the survey did not require observers to indicate whether they put out seed for Gang-gangs, it was possible either from general comments or in reply to what birds were feeding on to obtain some information on hand feeding of birds. If a respondent for any one observation during a month indicated that they were putting out seed then it was assumed that there was hand feeding at that site for all observations during that month. There was no obligation to mention hand feeding so it can be assumed that any analysis would understate the practice.

There were 36 observers from 20 suburbs who indicated in at least one observation that they were putting out feed either for birds in general or specifically for Gang-gangs, see Table 4. On average per month 27% of records were from sites at which seed was being put out but this varied considerably between months from a low of 7% in February 2015 to an average of around 36% between July and December, see Figure 27.

Table 4. Number of sites per suburb where hand feeding was reported

Suburb	No.sites	Suburb	No.sites
Ainslie	4	Griffith	1
Aranda	2	Hackett	1
Bruce	3	Hughes	1
Campbell	2	Kingston	1
Cook	2	Mawson	1
Curtin	1	N. Lyneham	1
Deakin	1	O'Connor	2
Farrer	1	Pearce	3
Fisher	1	Reid	1
Garran	3	Weston	4

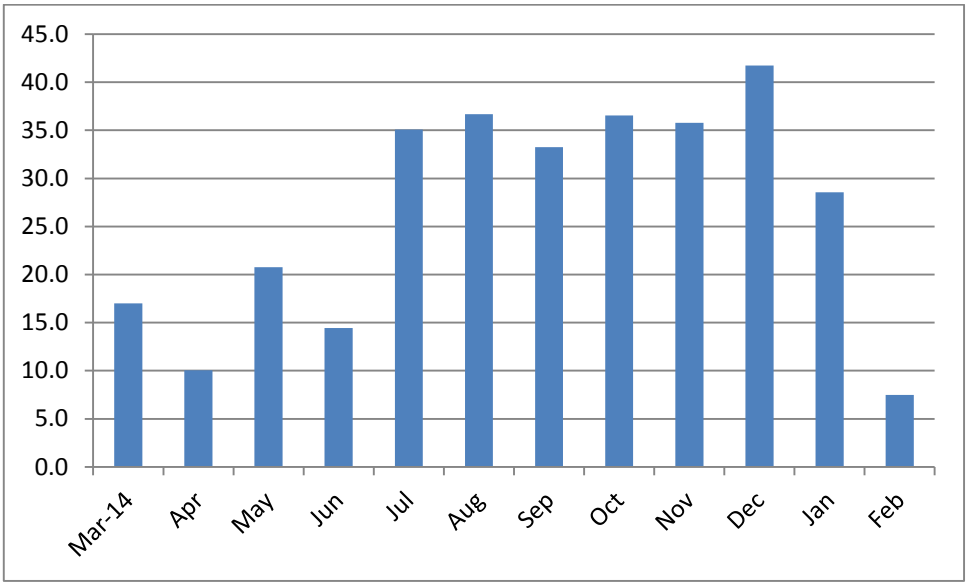


Figure 27. Percentage of records per month where hand feeding was reported.

4. Discussion

The survey, conducted over a 12 month period indicates that the Gang-gang has an interesting and non-random distribution within the local area. Although the survey reported from the area of interest covered by the Canberra Ornithologists Group, the number of Casual observations (96%) from the urban area far outnumbered that from the rural areas. This is not surprising and reflects more the distribution of observers rather than the distribution of Gang-gangs. For the secondary observations 74% of observations were from urban or urban nature reserve locations.

Within the urban area of Canberra the Gang-gang is much more likely to be reported in some areas than others. This is confirmed by the two primary surveys; the Casual and the Muster surveys. Not surprisingly a similar picture is also seen in the secondary records. This pattern was similar to that reported by John Leonard (Canberra Bird Notes 38, pp 205-207).

A challenge with a citizen science project and non-random distribution is that those who never see the species in their area do not submit negative records and those who see birds in the area most of the time soon get exhausted with submitting observations. Even so, the fact that all three surveys showed a similar pattern suggests that the maps showing the distribution pattern on the Gang-gang in urban Canberra is correct. The Muster survey was particularly useful in confirming the distribution pattern because of the negative information.

The data were collected using a range of survey methodologies and exhibit a high level of spatial and temporal variation in observer effort. The spatial variability of effort was due to the uneven distribution of observers within the area of interest and this is not surprising given the urban-rural mix of the survey area. The temporal variation in survey was shown in various ways. Most observers provided between one and four observations whilst some provided many more, in one case more than 512 observations. Some observers reported Gang-gangs from many locations whilst others reported birds on many occasions from a single location. Although the number of observations and the number of records declined from November onwards the spatial effort pattern remained similar throughout the survey and so is unlikely to affect any temporal variation in the distribution pattern.

The temporal pattern from the Muster survey indicates that despite a decrease in abundance during the spring-summer months the reporting rate remains similar throughout the year. This change in abundance is confirmed from the long-term dataset obtained from the COG Garden Bird Survey, see Canberra Ornithologists Group (2009).

The survey was initiated with the celebration in 2014 of 50 years of COG's activity within the local ACT region. The survey was initially planned to run for the calendar year but instead started in March 2014. The COG bird reporting period follows the financial year. This is reflected in both the Garden Bird Survey and in the production of the Annual Bird Report. The miss-match between the timing of the Gang-gang survey and the COG reporting period was not ideal. For instance the secondary data set was not available until October/November 2015. Any future COG initiated citizen science survey should coincide with the COG reporting year.

The Canberra Ornithologists Group has over the years conducted a few long-running surveys, in particular the Garden Bird Survey (GBS). The Muster survey followed the protocol set by the GBS specifically to obtain information on the frequency of observations of Gang-gangs. The Muster survey did not allow for the collection of similar information provided by the Casual observations.

There was therefore confusion by some contributors over the recording of information by those involved in the Muster survey and in the GBS and for those involved in the Muster and the Casual surveys. There will always be confusion where two surveys such as the Muster and the GBS are collecting similar information over different time periods and where two surveys, such as the Casual and the Muster surveys, are running at the same time but collecting different information. The Gang-gang survey possibly attempted to collect too much information and could have concentrated on more specific aims but this would have greatly reduced participation by the general public.

Leonard (2013) hazards a guess that over the winter period the population was in the order of 150 individuals in urban Canberra with groups faithful to certain suburbs. This survey has provided a picture of the temporal and spatial variation in the sightings of Gang-gangs but does not provide any information on abundance. The survey did not provide any information on movement patterns and without this information it is not possible to determine the number of Gang-gangs within the local region. The survey has however provided much needed back-ground information on the distribution and behaviour of Gang-gangs but a more detailed study, possibly with marked birds, is now needed to determine movement patterns within the urban area and between urban and rural areas.

A lack of confirmed breeding is a disappointment but not surprising. Although there were many observations of birds inspecting prospective nest hollows, and in some cases showing some faithfulness to a particular site, as with movement patterns, a more detailed study is required to determine breeding success.

Cockatoos in general are gregarious, noisy and difficult to miss. During the breeding season once a nest site has been established pairs become quiet, change over at incubation can be quick and begging calls only become loud once the young have left the nest. It is therefore not easy to locate and monitor breeding sites unless the hollow is located where daily observations are possible. Most of the sites where hollow inspection was observed were either not monitored regularly or no further activity was observed. In many cases, galahs were subsequently seen to occupy the sites.

Species that breed in tree hollows and become quiet and inconspicuous when nesting require more detailed observations than can be supplied by a citizen science project. Even so the project does provide very useful information for the basis of such a study.

Gang-gangs were seen to be interested in many types of tree hollows; hollows directly into the main tree trunk or associated with spouts but of particular interest where those sites in hollow vertical or near vertical ‘pipes’; a most unlikely site given the probability of flooding. Our observations confirm those in Higgins (1999) which states that the nest site may be in ‘hollow often vertical or steeply sloping’. How successful breeding would be for this unlikely site is unknown but could indicate nest site competition from other hole-nesting species that do not appear to be interested in this type of site. As with dead spouts the ‘pipes’ should not be removed but remain an important part of the tree structure.

From the reports on feeding birds it is obvious that Gang-gangs utilize a wide range of food items which become available at different time of the year. Of interest is the large number of observations of birds associated with different species of Blue Gum. This may not be surprising given the similar natural distribution between Gang-gangs and the Blue Gum group of Eucalypts.

The survey did not intend to obtain information on hand feeding but many observers mentioned birds coming to feeders. Gang-gangs are not a shy species and appear to very quickly take to hand feeding. The prevalence of hand feeding by the general public is unknown but is likely to be high and

the effects on the numbers and distribution of Gang-gangs is unknown. We recognise that the hand feeding of birds is a very popular past time and will continue but to reduce the reliance of birds on artificially provided food it is suggested that feed be limited and put out in the afternoon only and removed at night. This will ensure that birds seek naturally available food at first light when they are most hungry.

Gang-gangs in Canberra appear to be very localised around the foothills and surrounding suburbs of Mt. Majura, Mt. Ainslie, Black Mountain, Red Hill and Mt. Taylor. What factors determine why Gang-gangs are reported from different habitats such as forested Black Mountain and the woodlands of Red Hill yet are not reported in similar habitats such as the woodlands between Red Hill and Mulligans Flat is unknown but factors such as habitat, tree hollows, suburb plantings and hand feeding may all play a part. A study on the movement patterns is required for it is possible that the birds are very localised with little movement between areas. If so, their numbers could be most susceptible to changes in nature reserve management or habitat loss from urban development.

5. Acknowledgements

We wish to acknowledge a grant from the 2014-15 ACT Environment Grant program, the Atlas of Living Australia, the following COG members, Steve Wallace for data analysis and mapping, Nicki Taws for mapping, Julian Robertson for COG website support, Anne Carrick and Michael Robbins for data entry and checking, Stuart Rae for the production of the brochure, Paul Fennell and Jaron Bailey for data downloads from the COG database and to all members of the public for their contributions.

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7. Appendices

Appendix I. Casual observations record form

Gang- gang Data Sheet

Queries - please email ggquery@canberrabirds.org.au .

Post completed sheets to - **Gang-gang Survey PO Box 301, Civic Square, ACT 2608**

Please fill in separate sheet for each different start time/date

Date: **Time started:** **Time spent observing:**

Location:

And if possible the GPS co-ordinates Lat: Decimal (degrees) Long: Decimal degrees

OBSERVER – CONTACT DETAILS

Name:

Telephone Mobile

Email address

Were Gang-gangs seen or heard

NUMBER OF BIRDS in total and if possible

Males: Females: Young: Undetermined:

BEHAVIOUR (tick if observed)

Flying Perching Feeding Begging Courtship Enter/inspecting hollow

Feeding (describe vegetation if possible, whether feeding on flower, seeds, introduced/native plant)

Interaction with other bird species (describe)

Other observations/comments

Data sheets can be placed in red box at Canberra Ornithologist Group (COG) meetings. For details of meetings see http://canberrabirds.org.au/ and click on 'Meetings'

For map of study area see http://canberrabirds.org.au/Maps/MapCOGAoI.pdf

Appendix II. An example of the Muster observation form

Gang-gang Cockatoo Survey

Quarterly Muster February 2015

An asterisk (*) means essential information.

Name of Observer*	
Location* (address)	
Email* OR Phone number*	

INSTRUCTIONS: Choose a location where you usually spend time every day. Each day, record the **largest number** of Gang-gangs **near** your location at any **one time**. Birds can be perched or in flight. Use a separate form for each location if reporting from two or more e.g. school, work as well as home.

Gang-gangs	Thursday 19 Feb	Friday 20 Feb	Saturday 21 Feb	Sunday 22 Feb	Monday 23 Feb	Tuesday 24 Feb	Wednesday 25 Feb
Largest number or **zero (0)** if none sighted							
Comments (if able) Feeding, nesting, sex and ages							

Notes:
Please send in any forms with **zero (0) sightings** for the Muster week including all zeros, as this is valuable data.
Cross out the day if you were away from the site for the whole day
If involved in the COG Garden Bird Survey (GBS) please complete this Muster Form and GBS chart.

RETURN FORM:

Gang-gang Survey PO Box 301 Civic Square, ACT 2608	OR **Scan** this form and email to ggquery@canberrabirds.org.au OR place in the Red Box at the COG monthly meetings OR online using web form at canberrabirds.org.au/

Muster Terms:
'Largest Number' - the most Gang-gang you observe at any one time. Example: two Gang-gangs fly over in the morning, and you see one Gang-gang feeding in the afternoon, Report 2 Gang-gangs, don't count the extra bird.

'Near' - within a radius of 100 metres of your location. Example: At your home, this is about 4 houses either side of your house along the street, and to the next street over both behind and in front of your house.

'One time' - a period of a few minutes.

Any questions please email: ggquery@canberrabirds.org.au

Appendix III.

List of plant species on which Gang-gangs were reported feeding. Names taken from Costermans, 2009.

Vegetation
Myrtaceae
Eucalyptus
Blue Gum
E. bicostata (Southern Blue Gum)
E. maidenii (Maiden's Gum)
E. globulus (Tasmanian Blue Gum)
E. saligna (Sydney Blue Gum)
E. blakelyi (Blakely's Red Gum)
E. macrorhyncha (Red Stringybark)
E. regnans (Mountain Ash)
E. delegatensis (Alpine Ash)
E. pauciflora (Snow Gum)
E. elata (River Peppermint)
E. robertsonii (Narrow-leaved Peppermint)
E. goniocalyx (Long-leaved Box)
E. moluccana (Grey Box)
E. melliodora (Yellow Box)
E. bridgesianna (Apple Box)
E. viminalis (Manna Gum)
E. cinerea (Argyle Apple)
E.??? (Ironbark)
E. radiata
E. mannifera (Brittle Gum)
E. leucoxylon (Yellow Gum)
E. angophoroides
E. cognata
E. saliqua
Corymbia calophylla (Marri)
Melaleuca
Proteaceae
Hakea seed pods
Banksia integrifolia
Banksia
Mimosaceae
Acacia mearnsii
Acacia baileyana
Acacia parripinnula
Acacia
Acacia subulata

Acacia fimbriata
Acacia galls
Introduced plants
Liquidamber
Hawthorn
Elm
Pistachio
Manchurian Pear
Crab Apple
Pyracantha
Cotoneaster
Quercus pallustris (Pin oak)
Populus buds (Poplar)
Plane tree (Platanus sp)
Acorns on ground
Betula pendula (Silver Birch)
Ulmus parvifollia (Chinese Elm)
Melia azedarach (White cedar)
Populus alba (White poplar)
Prunus cerasifera (Cherry Plum)
Lime Tree
Exotic tree buds
Tree with blue/black berries (Privet?)
Sorbus domestica (Service tree)
Sorbus aucuparia(Rowan)
Celtis australis (Southern Nettle tree)
small berries
Pines/conifers
Conifer
Callitris
Cyprus
Casuarinaceae
Casuarina