Distribution of threatened bird species in the Hunter Region (1998-2009)

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Distribution maps at 10-minute grid scale for the Hunter Region are presented for 42 bird species listed as Vulnerable, Endangered or Critically Endangered (collectively referred to as "threatened") under the *Threatened Species Conservation Act 1995* (NSW). The maps are based on data for the Region extracted from the database of the Birds Australia Atlas project. This is the first time that maps of Atlas data have been produced at such fine scale and they reveal a number of records which appear to represent either isolated occurrence or extra-limital occurrence at the micro-scale. A capability for data manipulation and mapping has been developed that substantially enhances our knowledge about the distribution of threatened species in the Region and can be extended to other species in future.

INTRODUCTION

The previous paper in this volume of *The Whistler* (Roderick & Stuart 2010) reviewed the status in the Hunter Region of the 71 species listed under the *Threatened Species Conservation Act 1995* (NSW). This paper provides the distribution maps for 42 of these species based on records from the Birds Australia Atlas project database. Some species were excluded from the analysis because there was either insufficient information to provide a meaningful distribution map for the Hunter Region (e.g. pelagic seabirds, coastal Emu *Dromaius novaehollandiae*) or their distribution was relatively restricted (e.g. Gould's Petrel *Pterodroma leucoptera*, White-eared Monarch *Carterornis leucotis*, some species of shorebirds).

BACKGROUND

The distribution maps are based solely on observations submitted to Birds Australia (BA) over the period 1998 to 2009 through its Atlas project. The first four years of this project involved the active phase of the New Atlas of Australian Birds (Barrett *et al.* 2003). During this phase, the New South Wales Bird Atlassers made their records available for the Atlas project. When the active phase was completed, BA decided to continue the Atlas project indefinitely as a bird monitoring project termed the "Ongoing Atlas" using unchanged survey methods.

Most of the observations submitted to the BA Atlas involve one of two different types of surveys. The predominant method (68% of the surveys for the Hunter Region over the 12 years) involves surveys conducted by either individual or groups of observers who submit observations for an area defined by a central point and a radius of either 500m or 5km. While most of these surveys cover a period of up to one day, it is possible to submit records covering periods of up to one month. The second type of survey involves records collected in an area of 2ha over a period of 20 min. Because of the small site area and short duration this type of survey generates much shorter lists than the larger area surveys. Both types of survey provide valuable information on bird distributions and have been used to generate the distribution maps presented in this paper. However, the differences in survey method do impact on the reporting rates (the frequency that a species is recorded during Atlas surveys, abbreviated below as RRs). This

complicates the analysis of the data. A brief explanation for this follows.

RRs are a convenient means of summarizing the results of large sets of bird observations like those in the BA Atlas database. The interpretation of RRs is complex because the magnitude of a RR is affected not only by changes in the relative abundance of a species, but also by changes in survey type, observer experience and survey effort. Over the 12-year period of Atlas data collection there have been significant variations in observer participation rates, observers and their abilities, survey types and the spatial distribution of survey effort. All of these factors militate against the use of variations in reporting rates as an index of change in bird populations over a period of years. However, under strictly controlled conditions subsets of the Atlas data can be used for this purpose. For example another paper in this volume (Newman 2010) demonstrates changes in the status of the Speckled Warbler *Chthonicola sagittata* at Green Wattle Creek by using long-term sets of either monthly 2ha or 500m area surveys carried out in identical manner by the one observer. However, most of the BA data set has been generated under conditions that are too variable for temporal interpretation, particularly at the 10-minute grid scale. The situation becomes even more difficult when attempting to use RRs to gauge the relative abundance of different species. Nevertheless RRs do provide a very crude indication of the status of species. For instance very common species like the Yellow-faced Honeyeater *Lichenostomus chrysops* and Grey Fantail *Rhipidura albiscapa* have much higher RRs and broader distributions than uncommon species like the Speckled Warbler and Varied Sittella *Daphoenositta chrysoptera*. Species considered to be scarce or even rare like the Olive Whistler *Pachycephala olivacea* and the Rufous Scrub-bird *Atrichornis rufescens* have even lower RRs and more restricted distribution.

The boundaries of the Hunter Region used in the maps presented in this paper are based on the area defined in the Hunter Region Annual Bird Report series (Stuart 1994 to 2010) and are reported at a grid scale of 10 minutes latitude/longitude.

METHODS

The BA data were exported from their main database and supplied as an Excel file. To produce the maps presented in this paper, the Excel data were imported into the geographic information system Arcview 3.3. Once imported, data for each of the threatened species were overlayed onto spatially referenced geographic features such as the boundaries of the Region and important waterways and towns. To aid with the vetting and analysis of the individual species records, an Excel macro was developed that allows the distribution data and reporting rates (for the Region and for the individual cells) for the selected species to be extracted for any individual year or for the complete 12-year period.

There are many records which do not get submitted to the BA Atlas project and some of these have been published in the Hunter Region Annual Bird Reports. No attempt has been made to incorporate these additional observations into the BA Atlas database or into the maps presented here. Indeed, as many of these observations involve incidental sightings as opposed to survey lists, their incorporation into the Atlas would bias the analysis of reporting rates which are an important attribute of the data when assigning variations in abundance to the distribution of individual species. Another difficulty impacting on the decision not to include additional records is the probability that the same data may have been submitted to more than one organisation (e.g. to HBOC or to NSW Bird Atlassers as well). The downside is the omission of some records that may supplement knowledge of distribution.

DISCUSSION

Figure 1 shows the variation in Atlas survey effort. As expected, the effort is biased towards the centres of population, but there is some coverage of the whole Region except in four remote cells. It should be appreciated when examining maps for nocturnal species that BA Atlas surveys, especially 2ha surveys, are predominantly diurnal, and consequently under-record night-birds. These require a specific focus and specialised techniques.

42 species-distribution maps are presented in this paper. Each map indicates the number of records of that species during the 12-year period. RRs have been calculated for individual 10-minute cells for which 20 or more surveys have been made, this being the minimum number considered necessary for the reporting rate to be meaningful.

Some threatened species, while uncommon, remain widely distributed and relatively numerous. For instance the Varied Sittella was reported from 55 percent of the 10-minute grid cells which comprise the Hunter Region. There were 601 records from 7,254 surveys made in the 82 cells where the Varied Sittella occurred. These numbers equate to an average reporting rate of 8.3 percent, and based on work in the central Hunter was declining over the period of this study (Newman 2010). The map

for the Varied Sittella shows how the reporting rate varied across the Region. Areas where the Varied Sittella is present, but with insufficient survey effort to assign a meaningful RR, are also shown.

At the opposite end of the spectrum, the Rufous Scrub-bird has a very limited distribution, being recorded just 20 times and from only four cells. The average reporting rate for the species from the 324 surveys made in those four cells was 6.2 percent.

Space limitations prevent discussion about the 40 other species for which distribution maps have been generated. Readers will note from the maps that many threatened species have a wide distribution in the Hunter Region whilst others have much more restricted ranges.

The maps provided in this paper are the first time that detailed distributions of birds have been produced at the 10-minute grid scale for the Hunter Region, previous publications involving 1-degree grids (Barrett *et al.* 2003, Blakers *et al.* 1984). At the 36-times finer scale, this set of distribution maps shows a number of records which appear to represent either isolated occurrence or extra-limital occurrence at the micro-scale. Such instances have been marked with a "?" in the maps. These records occur outside the core distribution of the species and may involve areas apparently lacking suitable habitat. Although misidentification is always a possibility, the authors are expressing no judgment on these records. HBOC, BA and the New South Wales Bird Atlassers all use data vetting procedures and therefore we have no reason to believe the records are incorrect. However, we question whether they reflect the regular and ongoing occurrence of the species in those areas. Publication of the "?" records is intended to stimulate further investigation.

CONCLUSIONS

The recently acquired capability for data manipulation and mapping has enhanced our knowledge about the threatened species in the Hunter Region. In time, it will do the same for our knowledge about all species, not just the threatened ones. It will also greatly assist in vetting for anomalous records, which then can be investigated more closely. These maps will allow both observers and database custodians to identify records that require verification because of their importance at the 10-minute scale. For vetting and verification to be effective it is desirable that the importance of a record is appreciated at the time of observation, so that appropriate field notes are kept.

In the future it is our intention to extend the analysis of the database to understand what limits the distribution of various species. Clearly the Rufous Scrub-bird is restricted to high altitude areas. Similarly the breeding range of the Flame Robin *Petroica phoenicea* is known to be restricted to high altitude areas, but in contrast to the Rufous Scrub-bird this species moves to lower altitudes in winter. It is intended to extend the analysis to compare the distributions throughout the year and determine the breeding and non-breeding ranges.

An even more adventurous opportunity is to determine reporting rates at short intervals throughout the year to in order to search for evidence of migration through the Region (Griffioen & Clarke 2002).

Although in this paper the Atlas data have been evaluated at a 10-minute grid scale, they are in fact collected at even finer scale around precisely known co-ordinates. This provides a future opportunity to exploit GIS capabilities to overlay the bird distributions with topographical information. In addition to improving the understanding of existing bird distributions, this approach may have applications for monitoring and estimating populations of threatened species in Important Bird Areas (IBA). For this application an exciting possibility is to use the GIS tools predictively to interpolate where to search for specific species in areas of difficult terrain, where there has been no previous survey effort.

We have demonstrated in this paper that the outcomes of the Atlas project have the potential to greatly exceed merely mapping bird distributions. However in order to achieve these future ambitions, we need more data and are dependent on the ongoing participation of volunteers in systematic bird survey effort. We hope that this paper will inspire that contribution, as well as providing an improved basis for informed management decisions involving the conservation of the threatened species of the Hunter Region and their habitats.

ACKNOWLEDGEMENTS

We thank Birds Australia for agreeing to provide records from the BA Atlas database and in particular, the strong support from Andrew Silcocks, the BA Atlas Coordinator, throughout this initiative.

Birds Australia has data exchange arrangements with other organizations including the New South Wales Bird Atlassers and the use of the latter's Hunter Region records is gratefully acknowledged.

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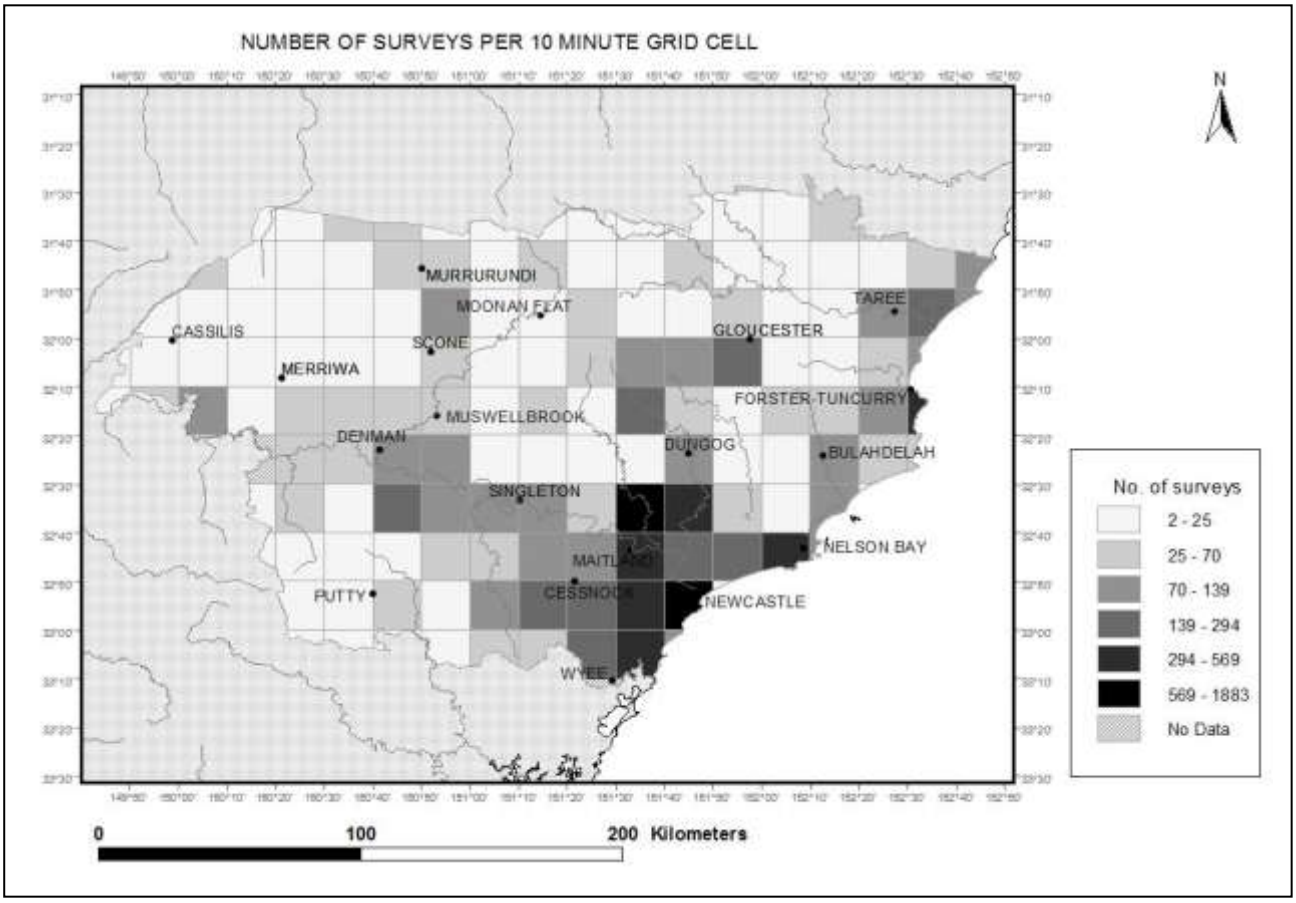
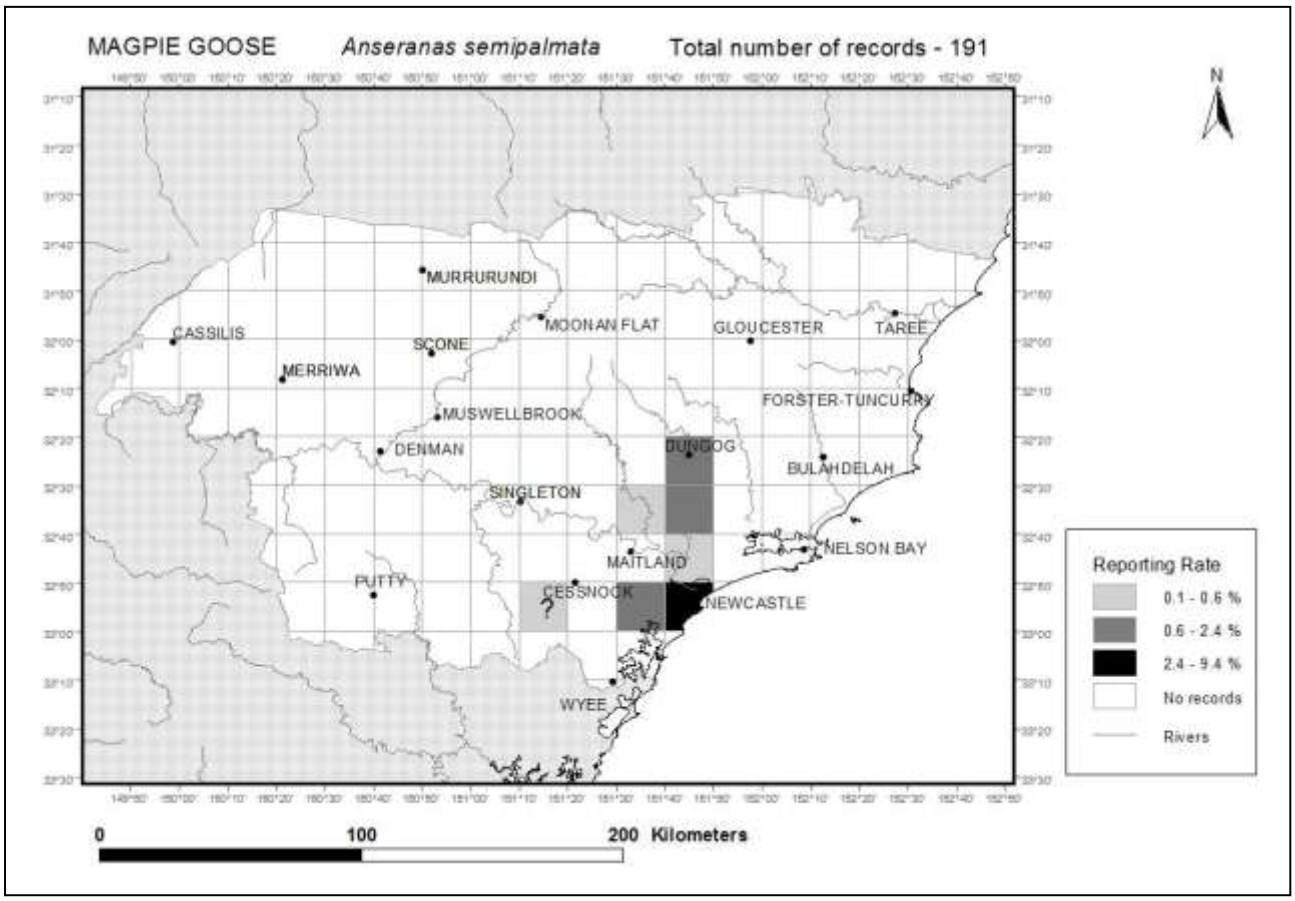
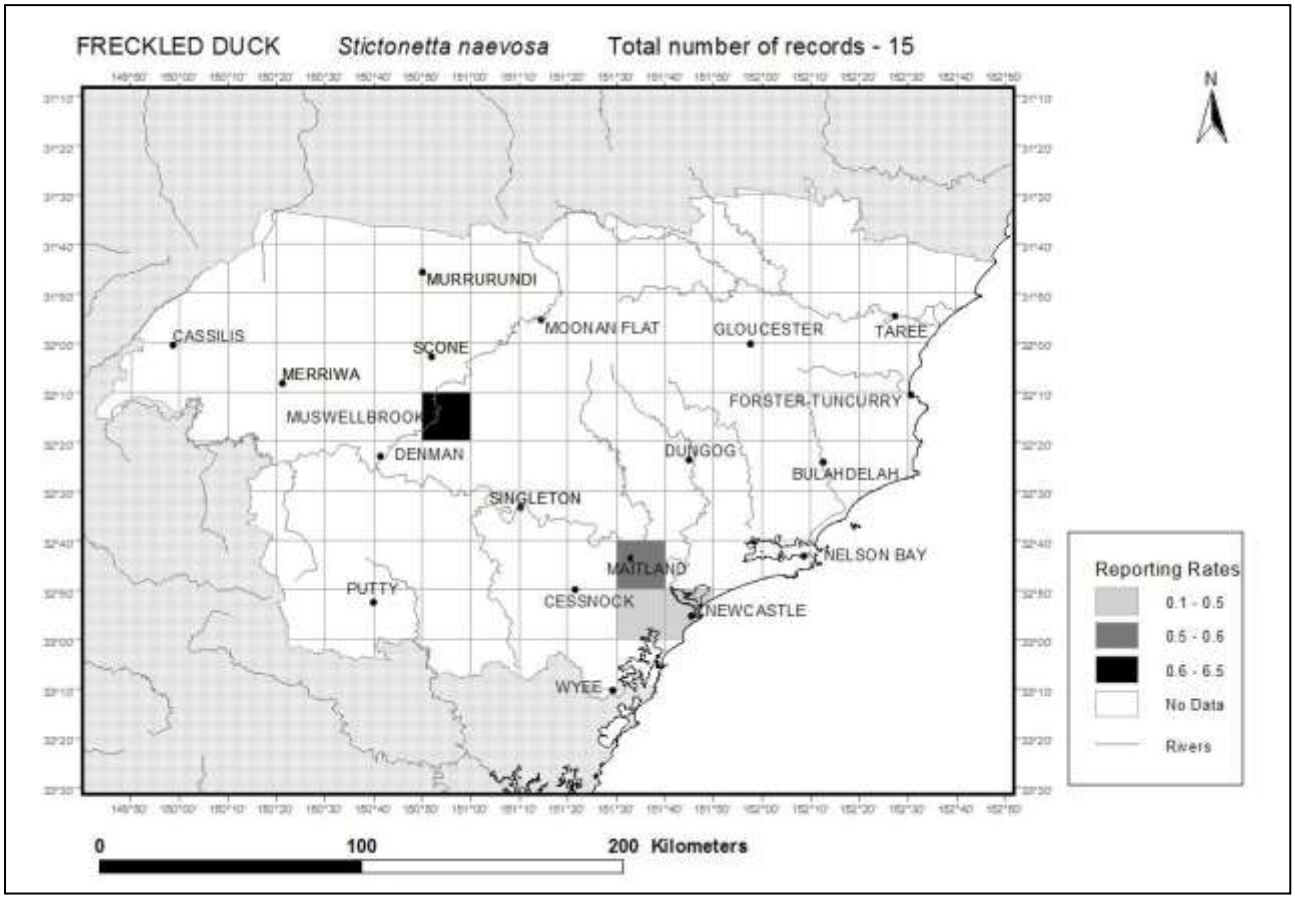
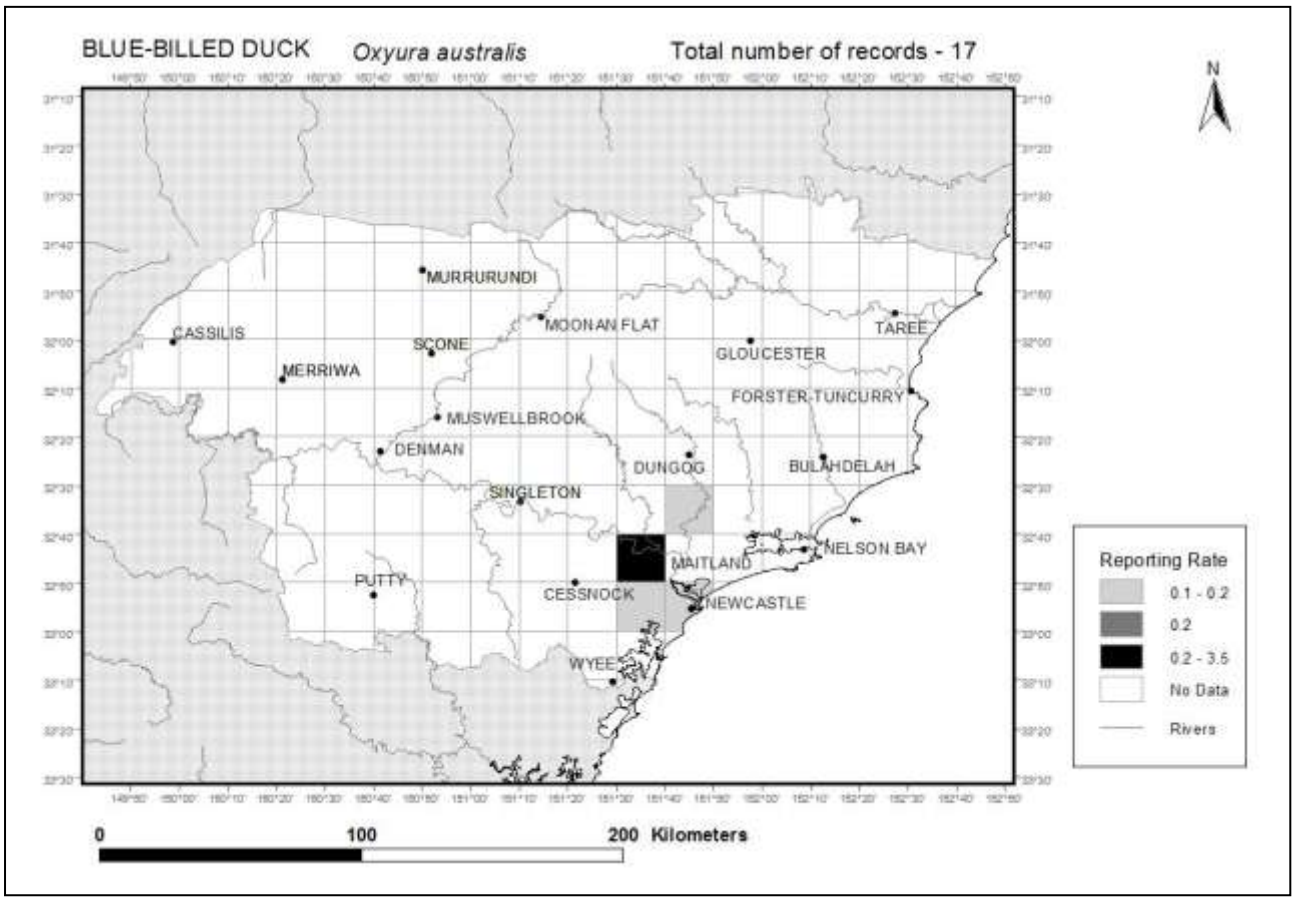
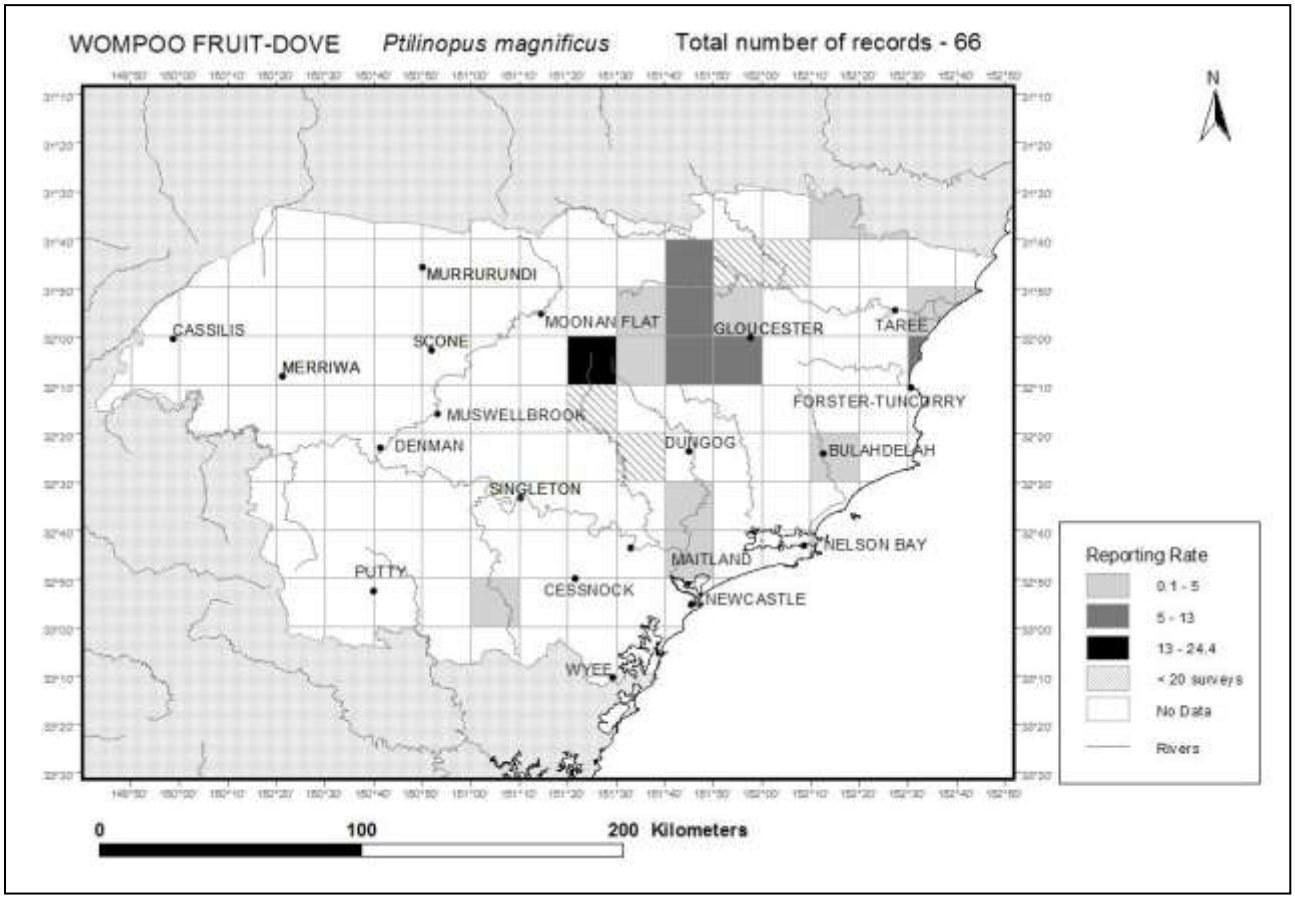


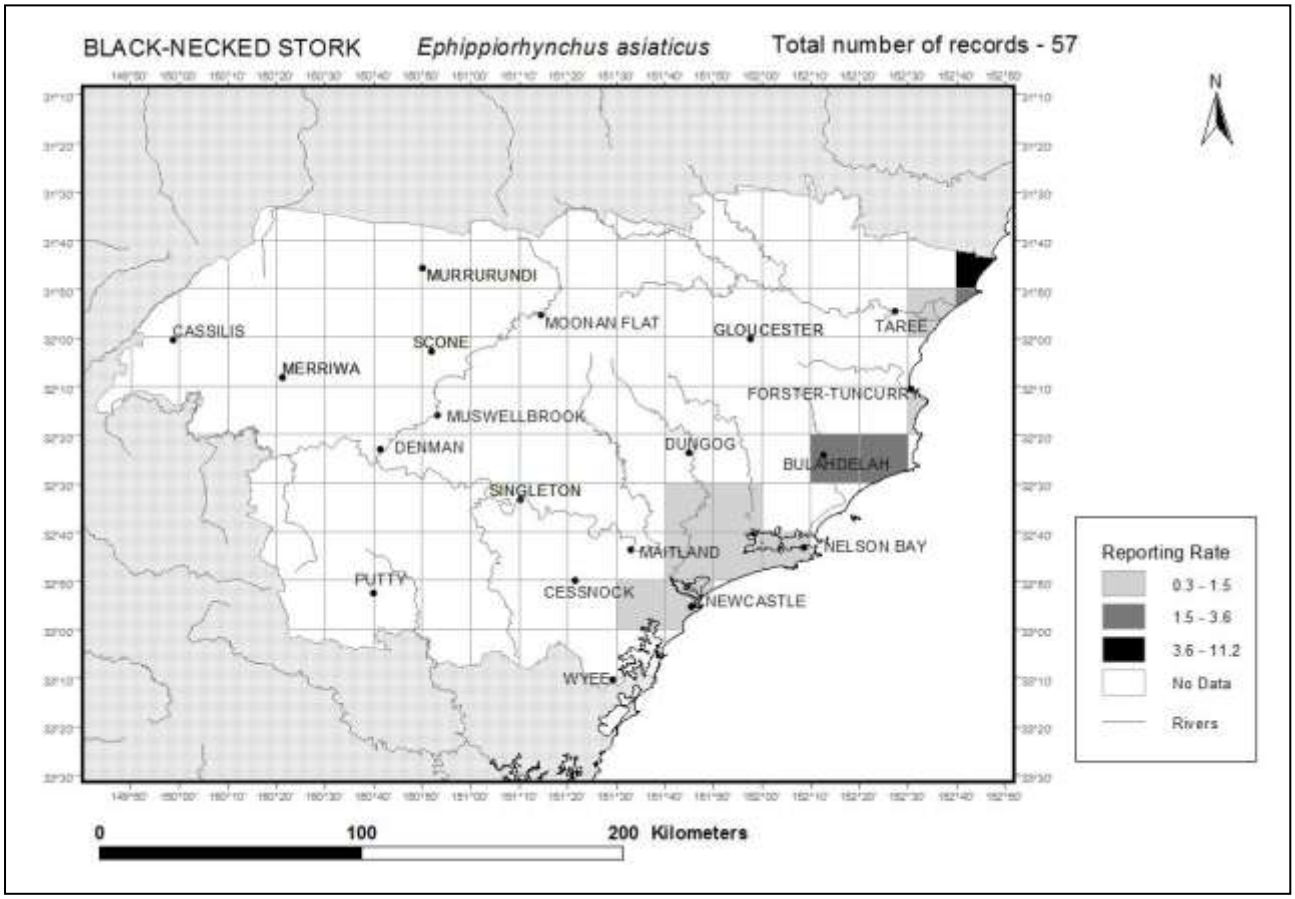
Figure 1. Birds Australia Atlas survey effort in the Hunter Region

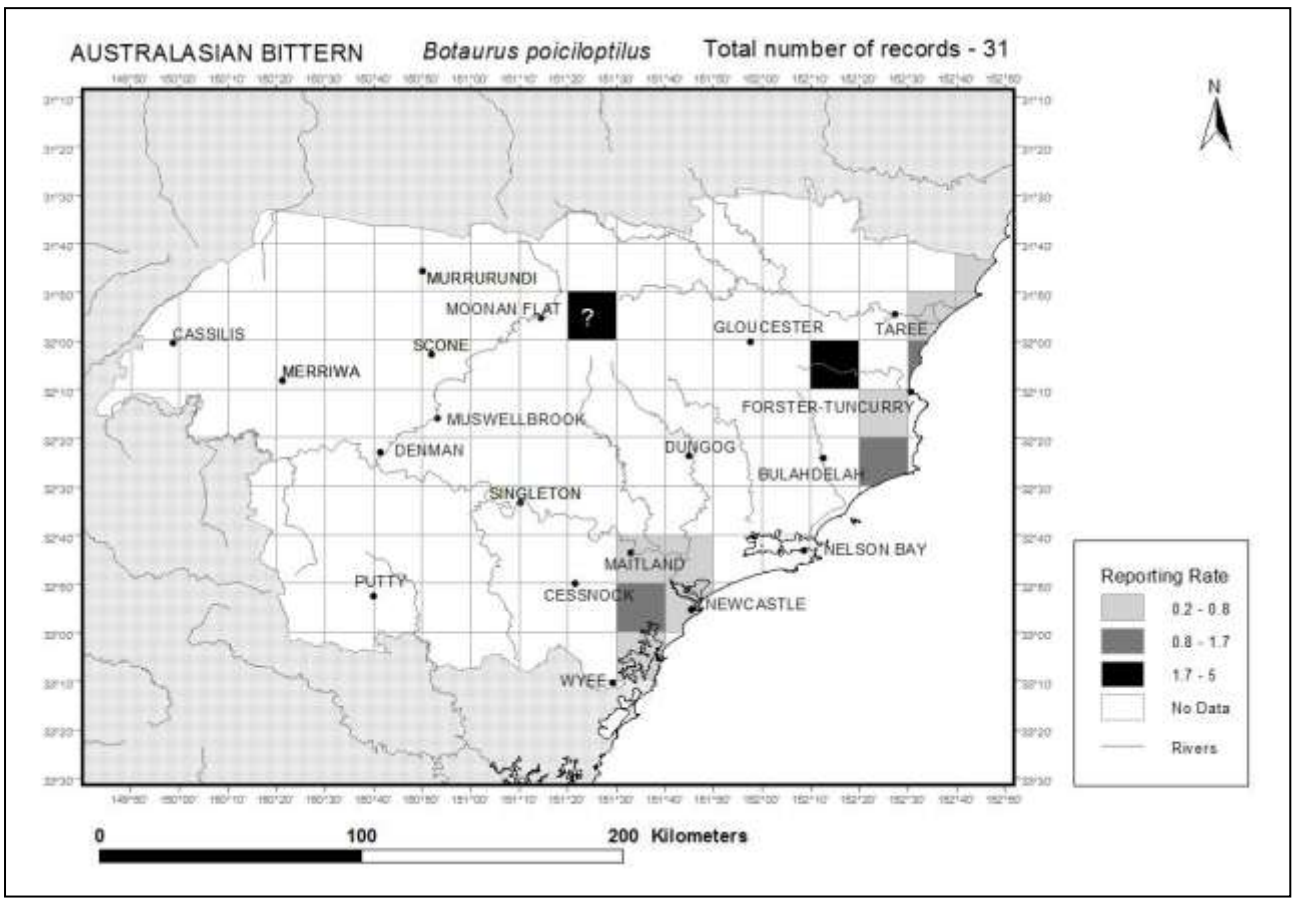

MAGPIE GOOSE
Anseranas semipalmata
Total number of records - 191
N
MURRURUNDI
CASSILIS
SCONE
MOONAN FLAT
GLOUCESTER
TAREE
MERRIWA
MUSWELLBROOK
FORSTER-TUNCURRY
DENMAN
DUNGOG
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
PUTTY
CESSNOCK
NEWCASTLE
WYEE
Reporting Rate
0.1 - 0.6 %
0.6 - 2.4 %
2.4 - 9.4 %
No records
Rivers
0
100
200 Kilometers

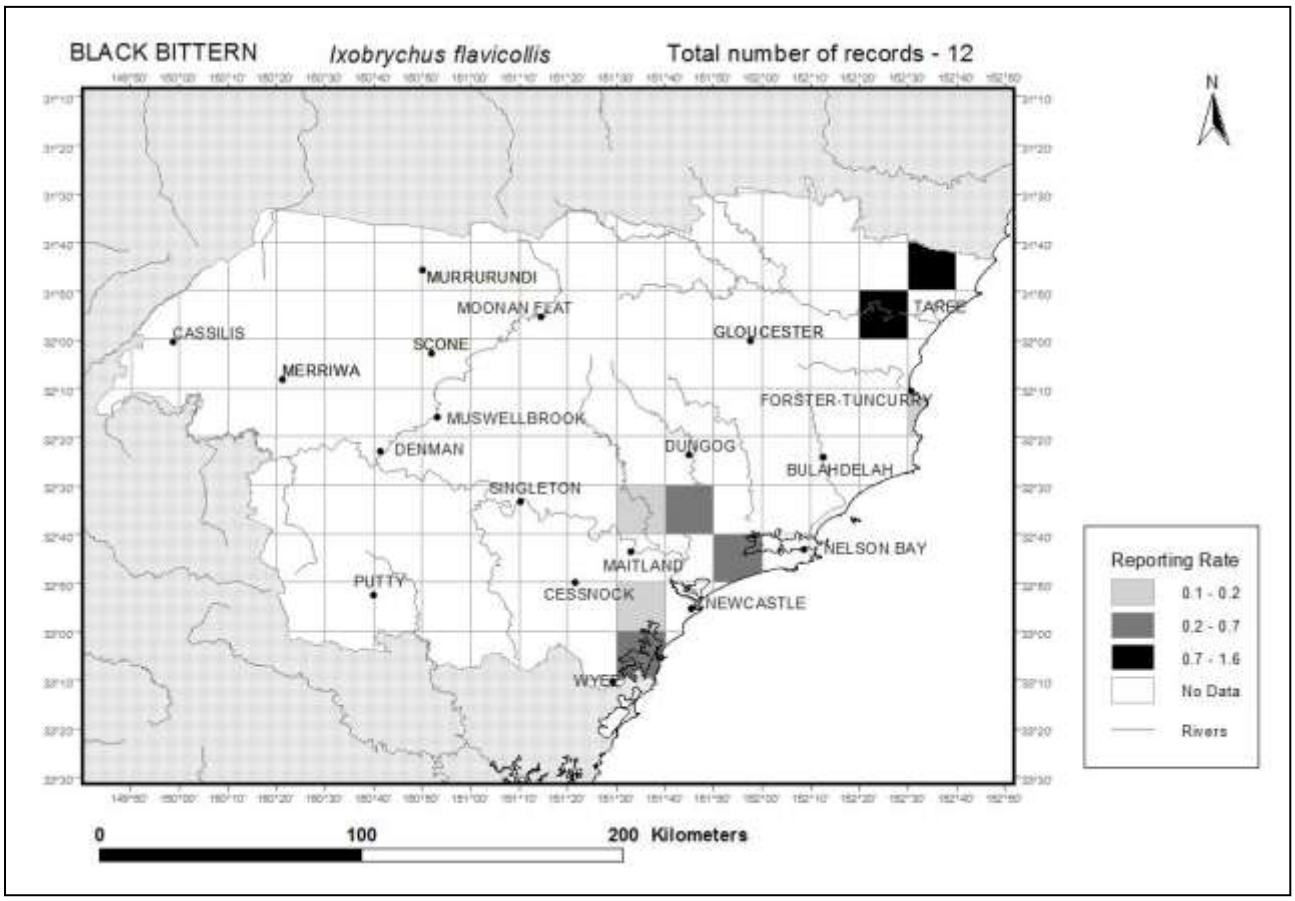

FRECKLED DUCK
Stictonetta naevosa
Total number of records - 15
N
MURRURUNDI
CASSILIS
SCONE
MOONAN FLAT
GLOUCESTER
TAREE
MERRIWA
MUSWELLBROOK
FORSTER-TUNCURRY
DENMAN
DUNGOG
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
PUTTY
CESSNOCK
NEWCASTLE
WYEE
Reporting Rates
0.1 - 0.5
0.5 - 0.6
0.6 - 6.5
No Data
Rivers
0
100
200 Kilometers

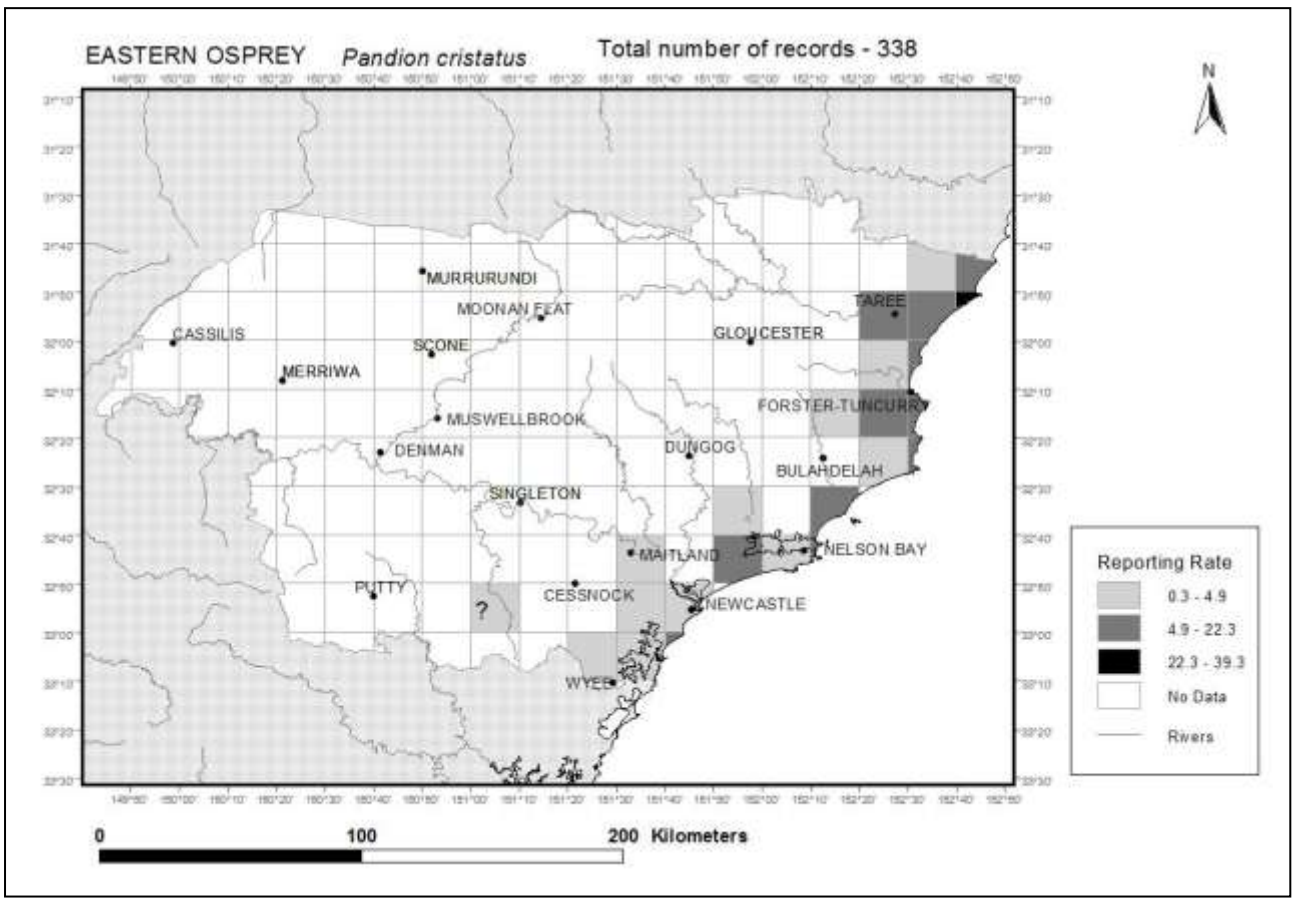

BLUE-BILLED DUCK
Oxyura australis
Total number of records - 17
N
MURRURUNDI
CASSILIS
SCONE
MOONAN FLAT
TAREE
GLOUCESTER
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DENMAN
DUNGOG
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
PUTTY
CESSNOCK
NEWCASTLE
WYEE
Reporting Rate
0.1 - 0.2
0.2
0.2 - 3.5
No Data
Rivers
0
100
200 Kilometers

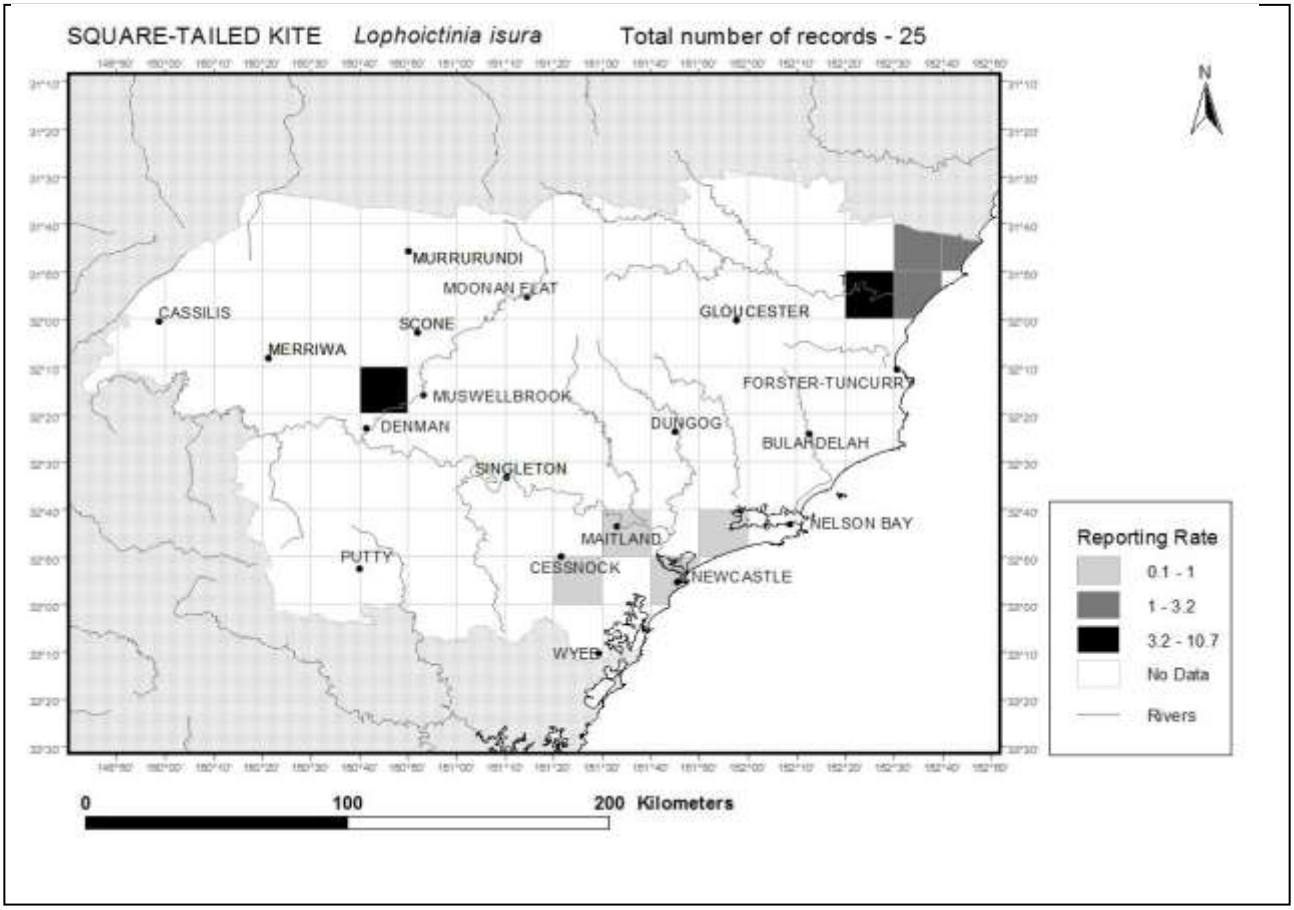

WOMPOO FRUIT-DOVE
Ptilinopus magnificus
Total number of records - 66
N
MURRURUNDI
CASSILIS
MOONAN FLAT
GLOUCESTER
TAREE
SCONE
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DENMAN
DUNGOG
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
PUTTY
CESSNOCK
NEWCASTLE
WYEE
Reporting Rate
0.1 - 5
5 - 13
13 - 24.4
< 20 surveys
No Data
Rivers
0
100
200 Kilometers

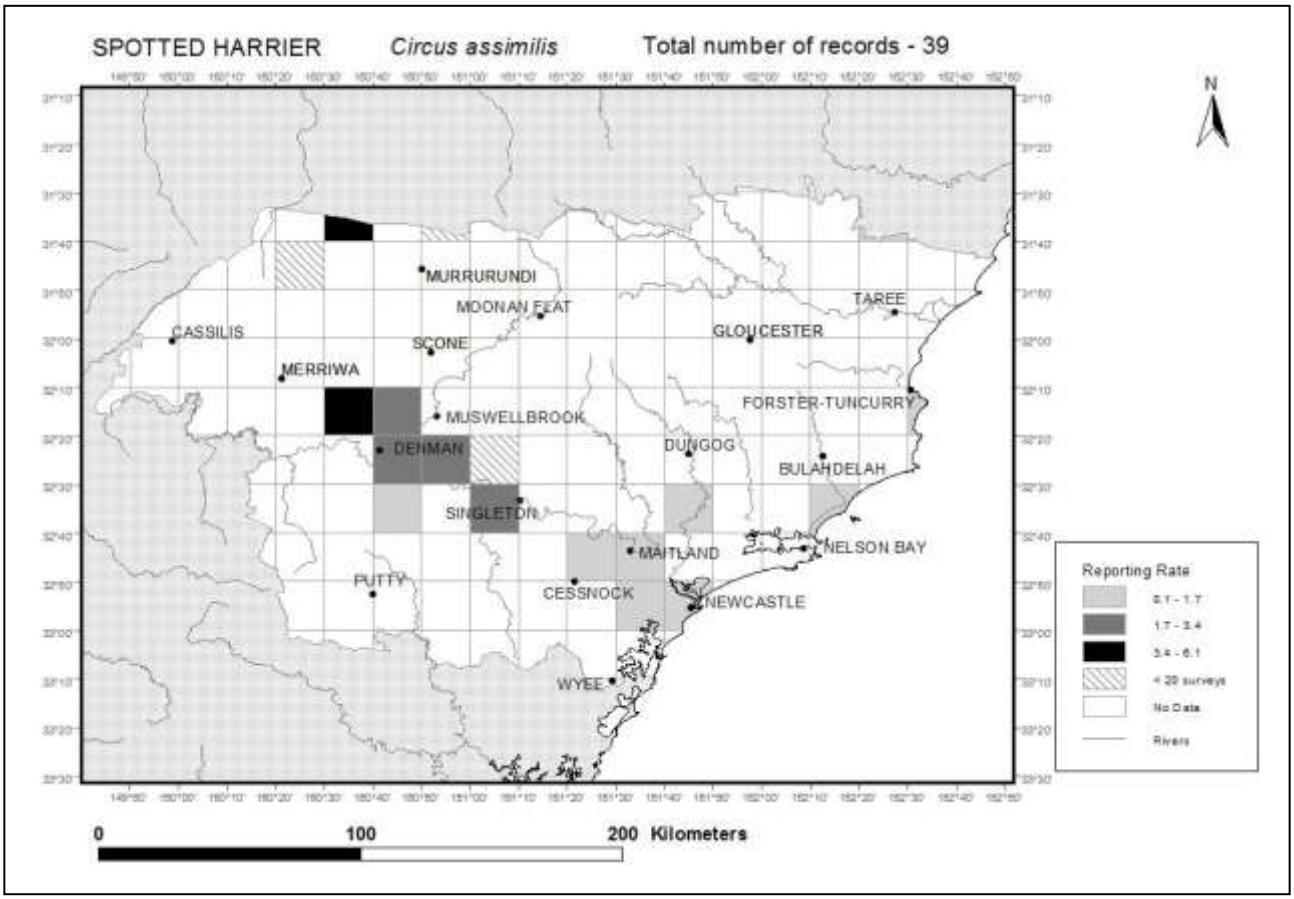

BLACK-NECKED STORK
Ephippiorhynchus asiaticus
Total number of records - 57
N
MURRURUNDI
MOONAN FLAT
CASSILIS
SCONE
GLOUCESTER
TAREE
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DENMAN
DUNGOG
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
PUTTY
CESSNOCK
NEWCASTLE
WYEE
Reporting Rate
0.3 - 1.5
1.5 - 3.6
3.6 - 11.2
No Data
Rivers
0
100
200 Kilometers

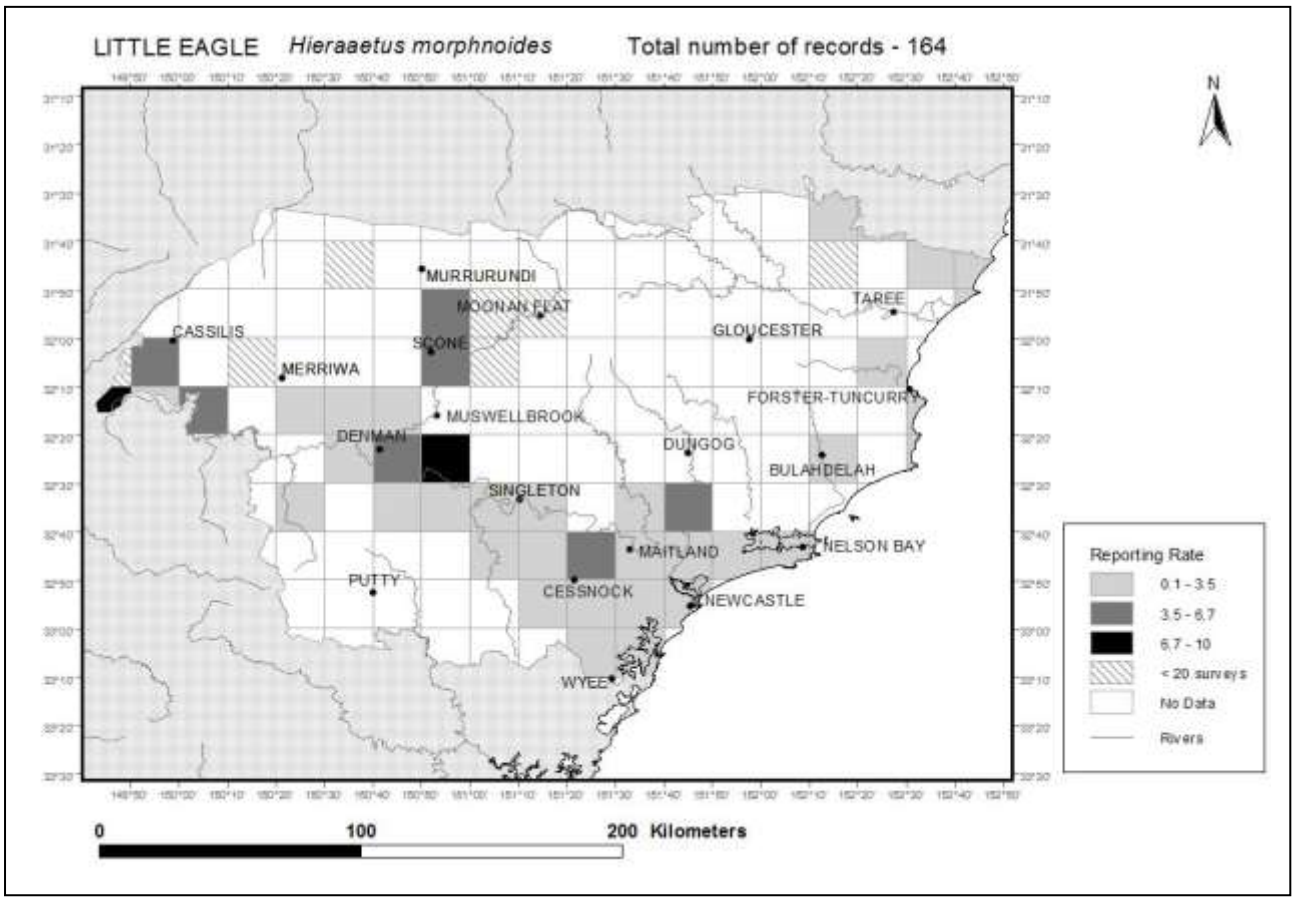

AUSTRALASIAN BITTERN
Botaurus poiciloptilus
Total number of records - 31
N
MURRURUNDI
MOONAN FLAT
?
CASSILIS
SCONE
GLOUCESTER
TAREE
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DENMAN
DUNGOG
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
PUTTY
CESSNOCK
NEWCASTLE
WYEE
Reporting Rate
0.2 - 0.8
0.8 - 1.7
1.7 - 5
No Data
Rivers
0
100
200 Kilometers

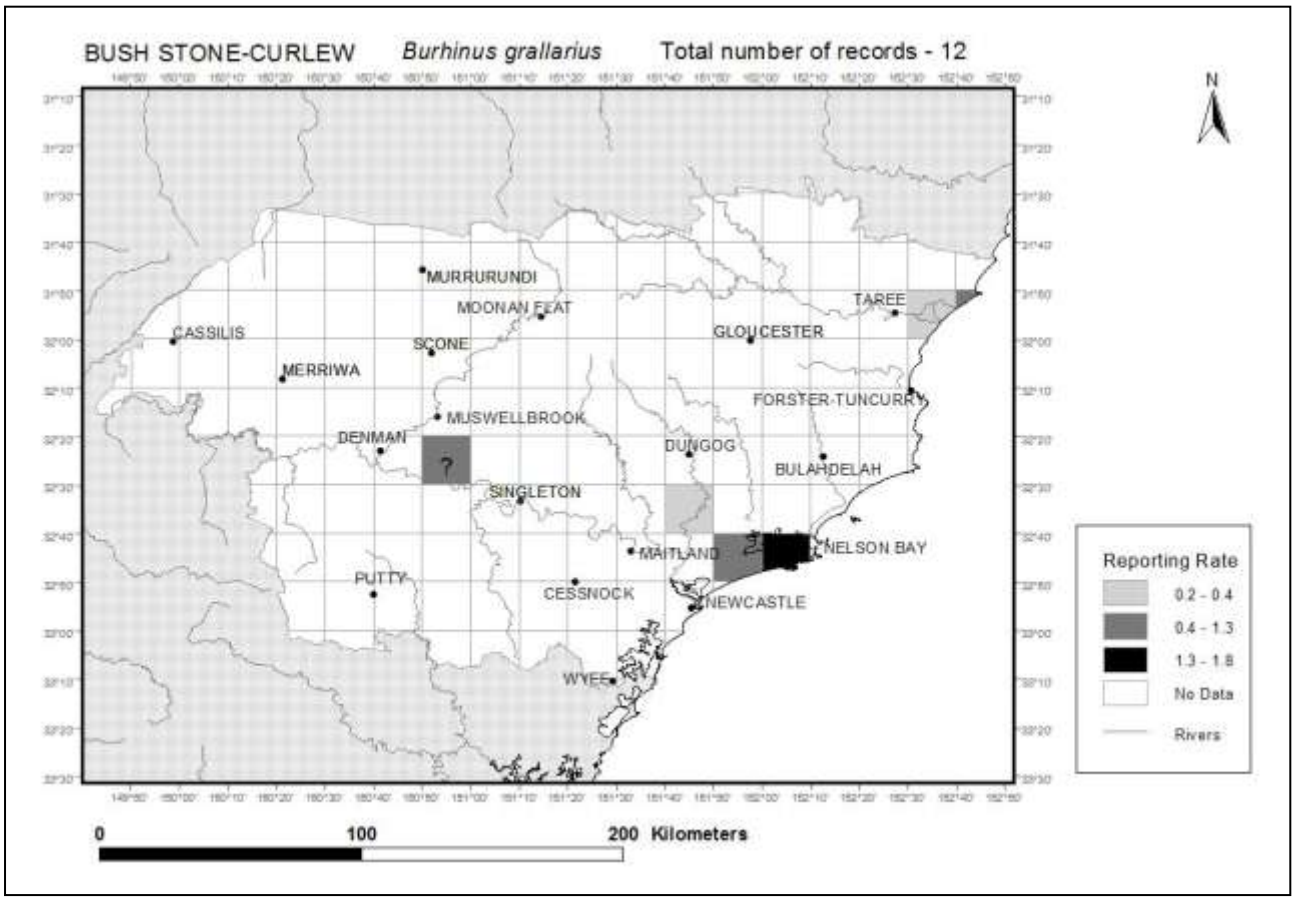

BLACK BITTERN
Ixobrychus flavicollis
Total number of records - 12
N
MURRURUNDI
MOONAN FLAT
CASSILIS
SCONE
GLOUCESTER
TAREE
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DENMAN
DUNGOG
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
PUTTY
CESSNOCK
NEWCASTLE
WYEE
Reporting Rate
0.1 - 0.2
0.2 - 0.7
0.7 - 1.6
No Data
Rivers
0
100
200 Kilometers

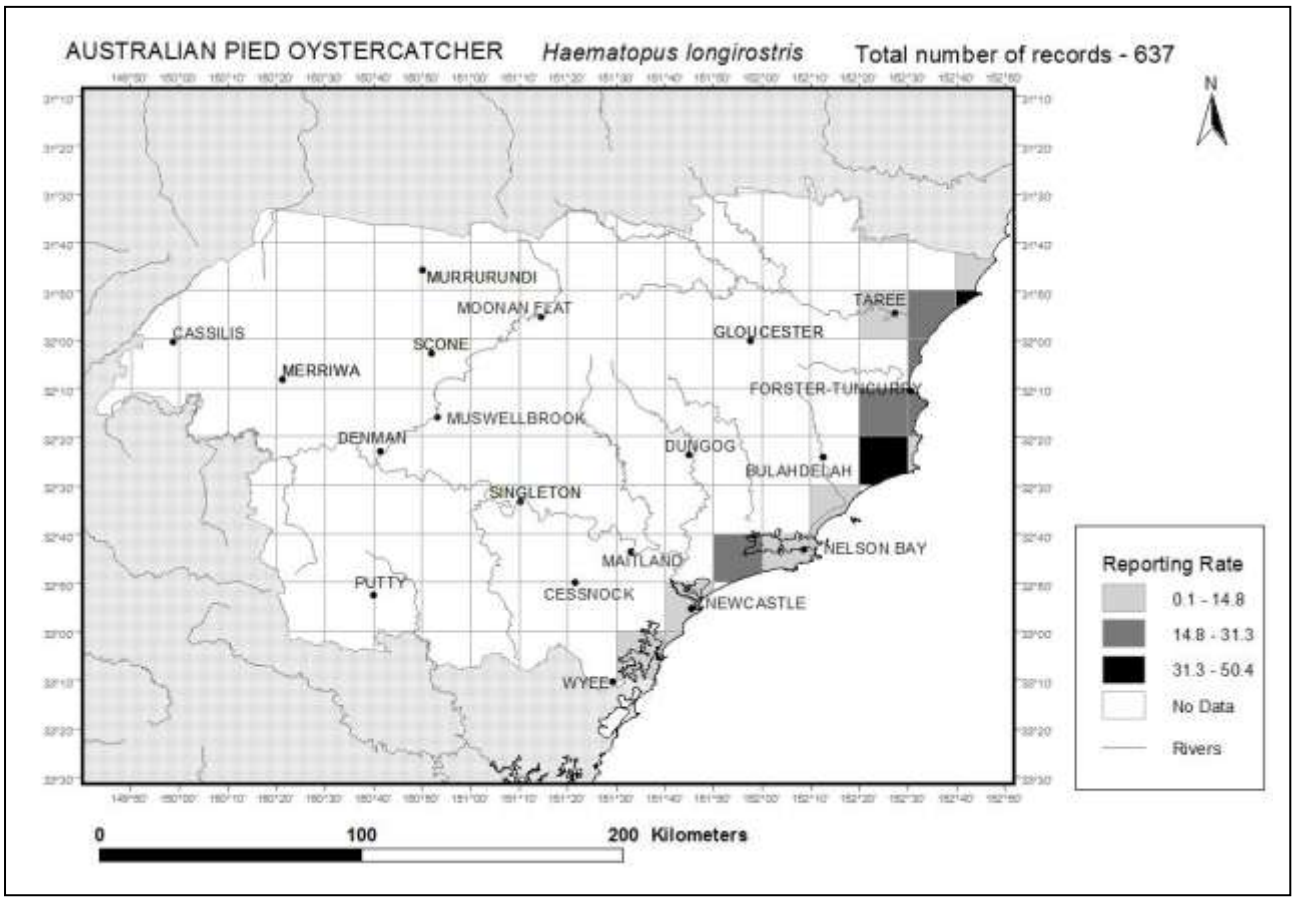

EASTERN OSPREY
Pandion cristatus
Total number of records - 338
N
MURRURUNDI
MOONAN FLAT
TAREE
CASSILIS
GLOUCESTER
SCONE
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DENMAN
DUNGOG
BULAHDELAH
SINGLETON
MAITLAND
NELSON BAY
PUTTY
?
CESSNOCK
NEWCASTLE
WYEE
Reporting Rate
0.3 - 4.9
4.9 - 22.3
22.3 - 39.3
No Data
Rivers
0
100
200 Kilometers

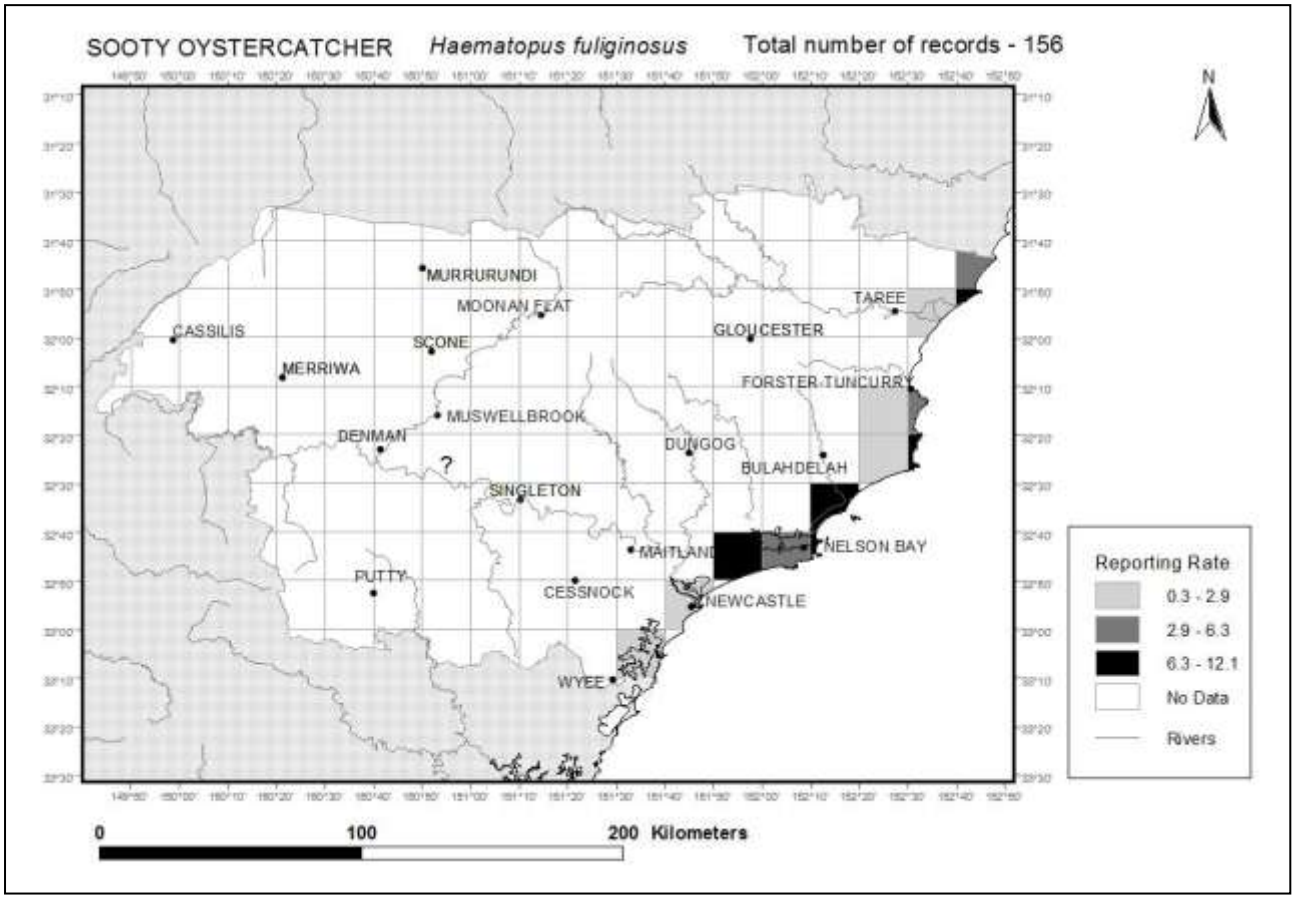

SQUARE-TAILED KITE *Lophoictinia isura* Total number of records - 25
N
MURRURUNDI
MOONAN FLAT
CASSILIS
SCONE
GLOUCESTER
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DUNGOG
DENMAN
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
PUTTY
CESSNOCK
NEWCASTLE
WYEE
Reporting Rate
0.1 - 1
1 - 3.2
3.2 - 10.7
No Data
Rivers
0
100
200 Kilometers

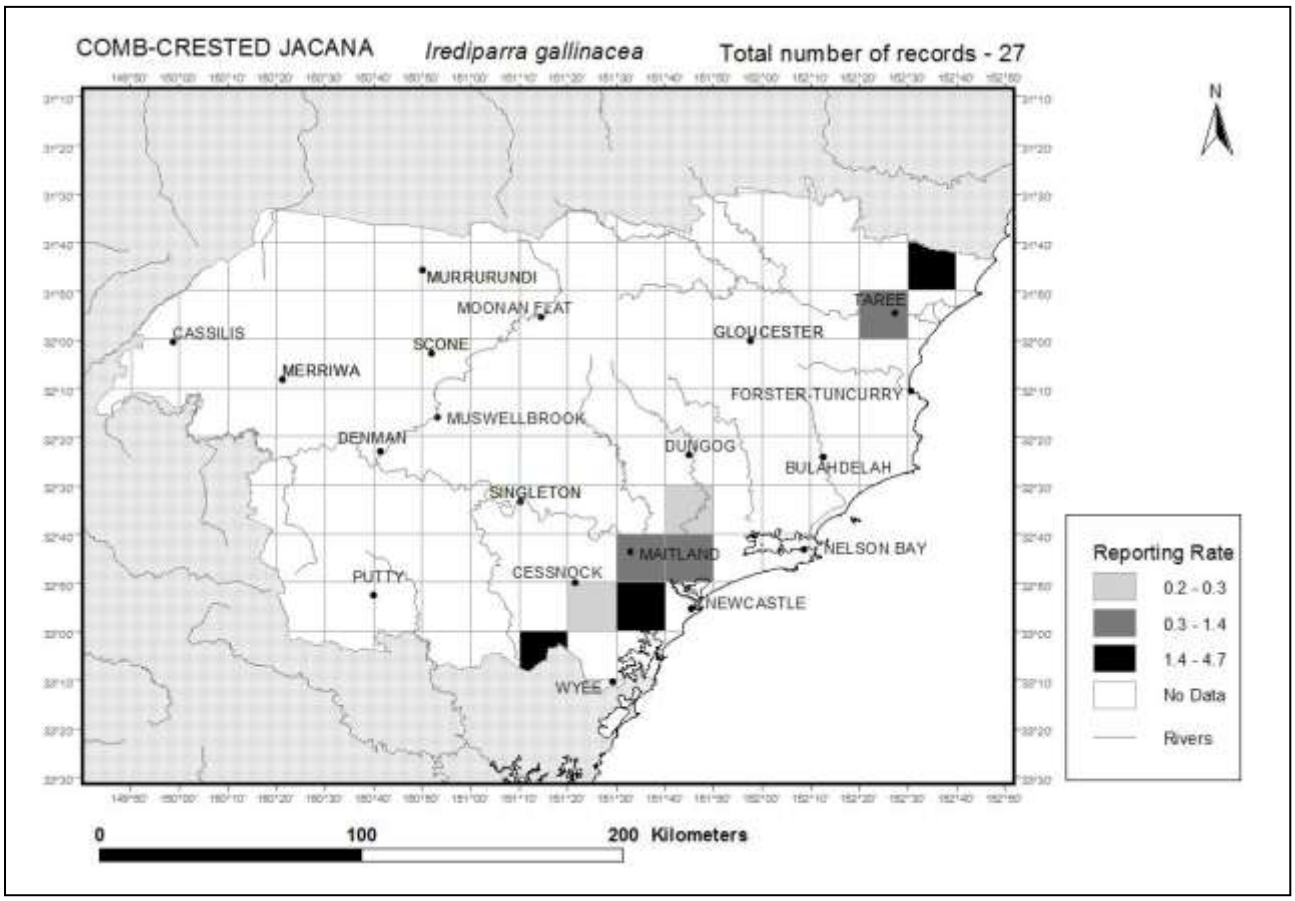

SPOTTED HARRIER *Circus assimilis* Total number of records - 39
N
MURRURUNDI
MOONAN FLAT
TAREE
CASSILIS
SCONE
GLOUCESTER
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DENMAN
DUNGOG
BULAHDELAH
SINGLETON
MAITLAND
NELSON BAY
PUTTY
CESSNOCK
NEWCASTLE
WYEE
Reporting Rate
0.1 - 1.7
1.7 - 3.4
3.4 - 6.1
< 20 surveys
No Data
Rivers
0
100
200 Kilometers

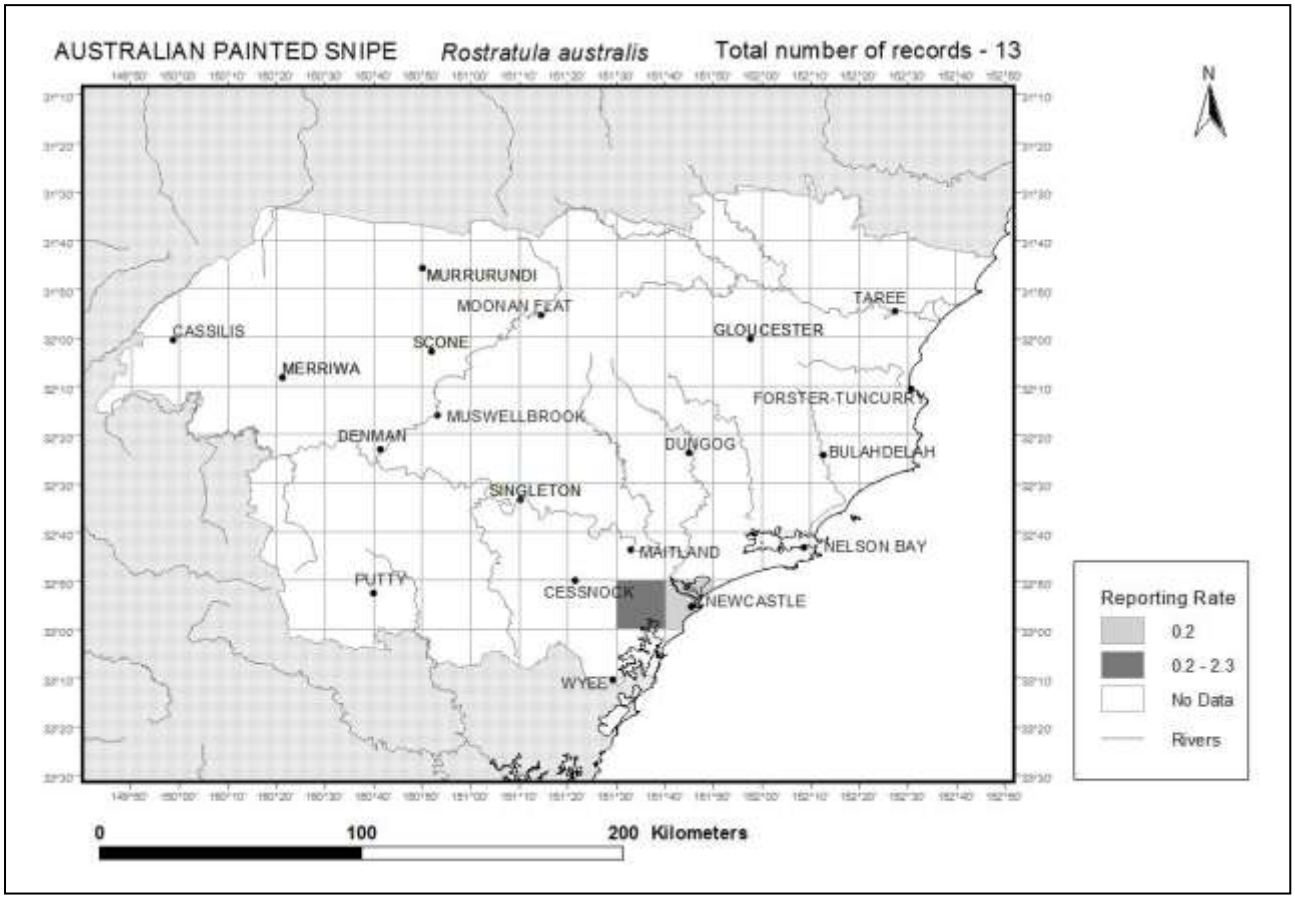

LITTLE EAGLE *Hieraaetus morphnoides* Total number of records - 164
N
MURRURUNDI
MOONAN FLAT
CASSILIS
SCONE
TAREE
GLOUCESTER
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DENMAN
DUNGOG
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
PUTTY
CESSNOCK
NEWCASTLE
WYEE
Reporting Rate
0.1 - 3.5
3.5 - 6.7
6.7 - 10
< 20 surveys
No Data
Rivers
0
100
200 Kilometers

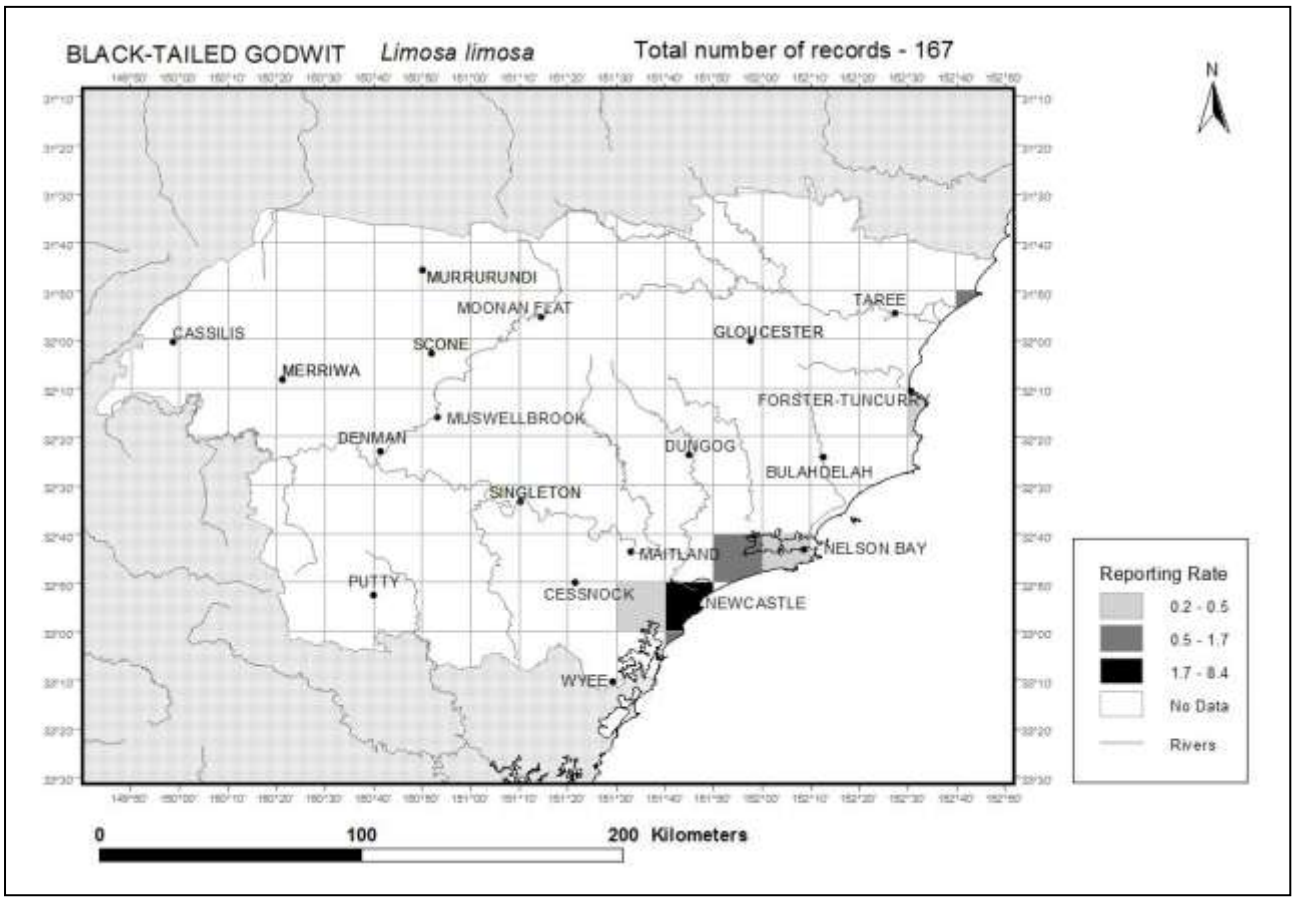

BUSH STONE-CURLEW *Burhinus grallarius* Total number of records - 12
N
MURRURUNDI
MOONAN FLAT
TAREE
CASSILIS
GLOUCESTER
SCONE
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DENMAN
?
DUNGOG
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
PUTTY
CESSNOCK
NEWCASTLE
WYEE
Reporting Rate
0.2 - 0.4
0.4 - 1.3
1.3 - 1.8
No Data
Rivers
0
100
200 Kilometers

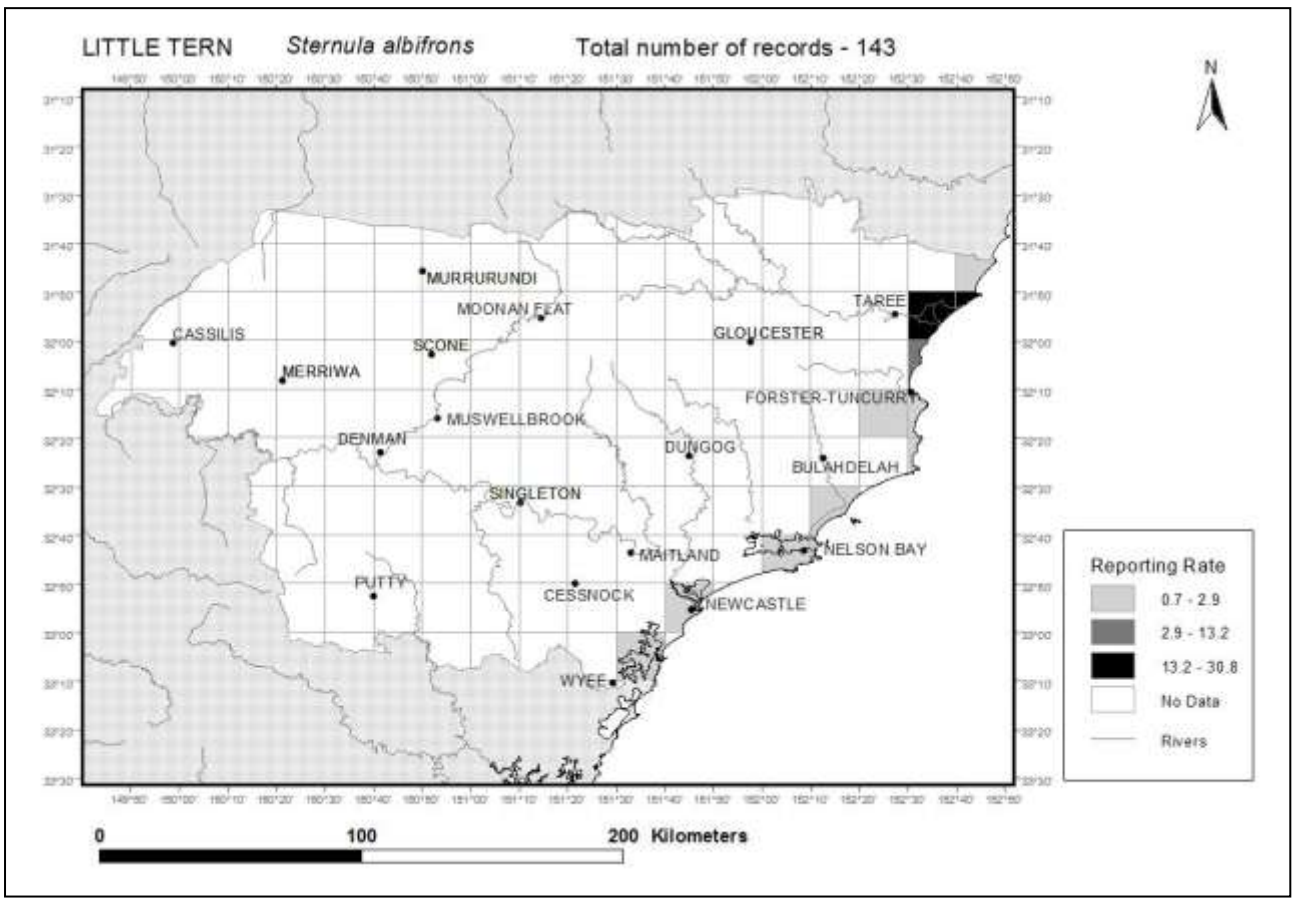

AUSTRALIAN PIED OYSTERCATCHER
Haematopus longirostris
Total number of records - 637
N
MURRURUNDI
MOONAN FLAT
CASSILIS
SCONE
GLOUCESTER
TAREE
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DENMAN
DUNGOG
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
PUTTY
CESSNOCK
NEWCASTLE
WYEE
Reporting Rate
0.1 - 14.8
14.8 - 31.3
31.3 - 50.4
No Data
Rivers
0
100
200 Kilometers

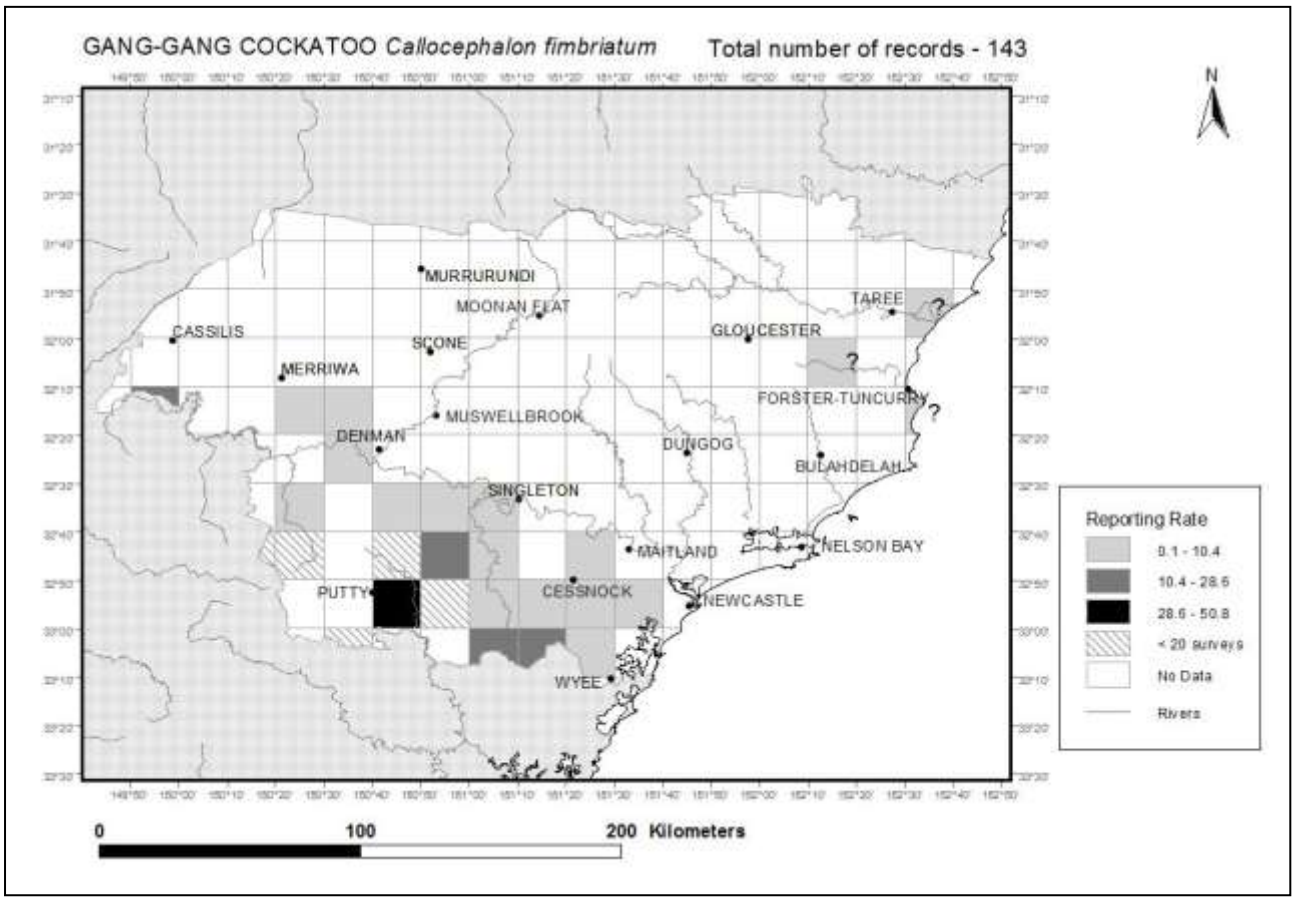

SOOTY OYSTERCATCHER
Haematopus fuliginosus
Total number of records - 156
N
MURRURUNDI
MOONAN FLAT
CASSILIS
SCONE
GLOUCESTER
TAREE
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DENMAN
?
DUNGOG
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
PUTTY
CESSNOCK
NEWCASTLE
WYEE
Reporting Rate
0.3 - 2.9
2.9 - 6.3
6.3 - 12.1
No Data
Rivers
0
100
200 Kilometers

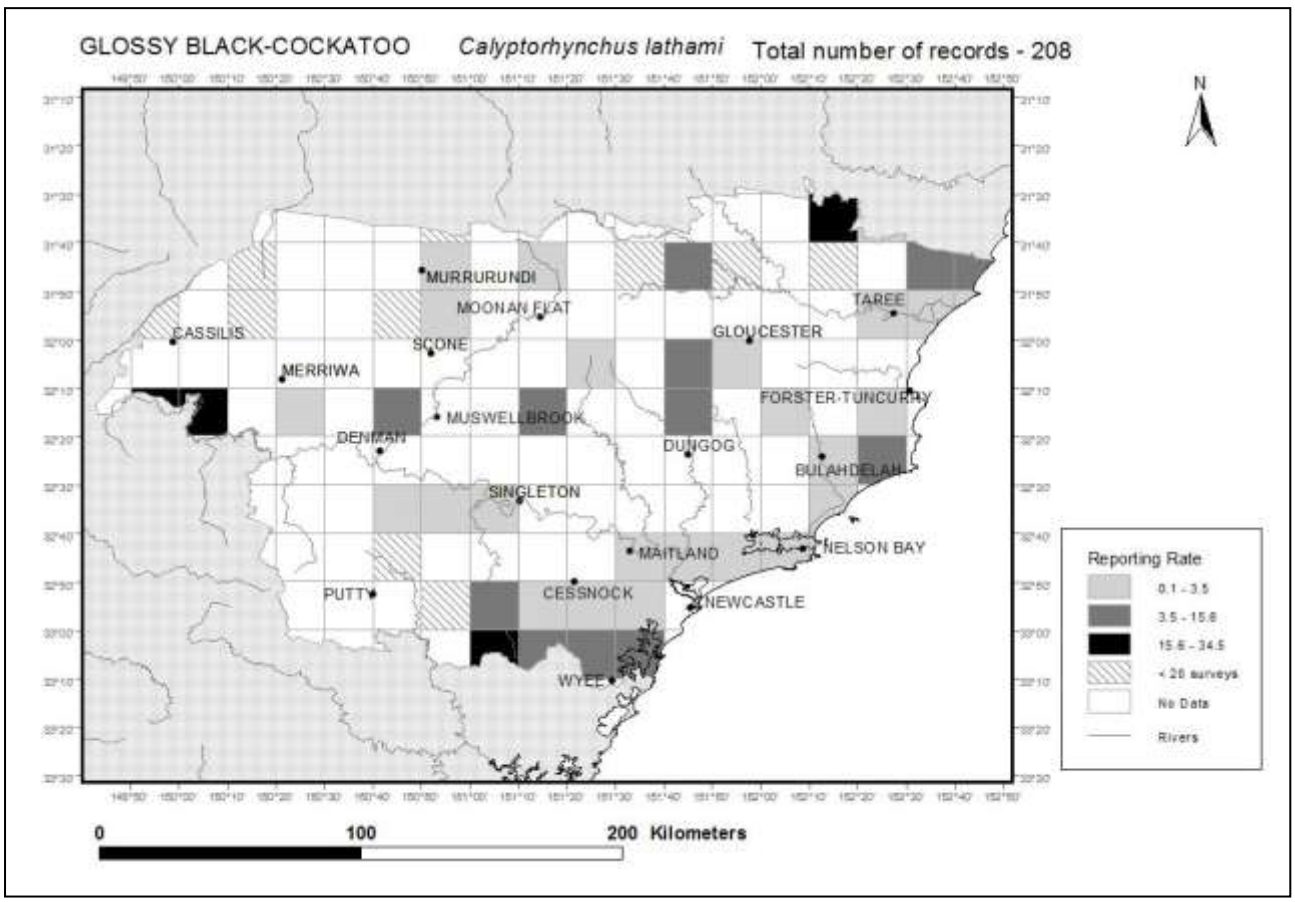

COMB-CRESTED JACANA
Irediparra gallinacea
Total number of records - 27
N
MURRURUNDI
MOONAN FLAT
CASSILIS
SCONE
GLOUCESTER
TAREE
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DENMAN
DUNGOG
BULAHDELAH
SINGLETON
MAITLAND
NELSON BAY
PUTTY
CESSNOCK
NEWCASTLE
WYEE
Reporting Rate
0.2 - 0.3
0.3 - 1.4
1.4 - 4.7
No Data
Rivers
0
100
200 Kilometers

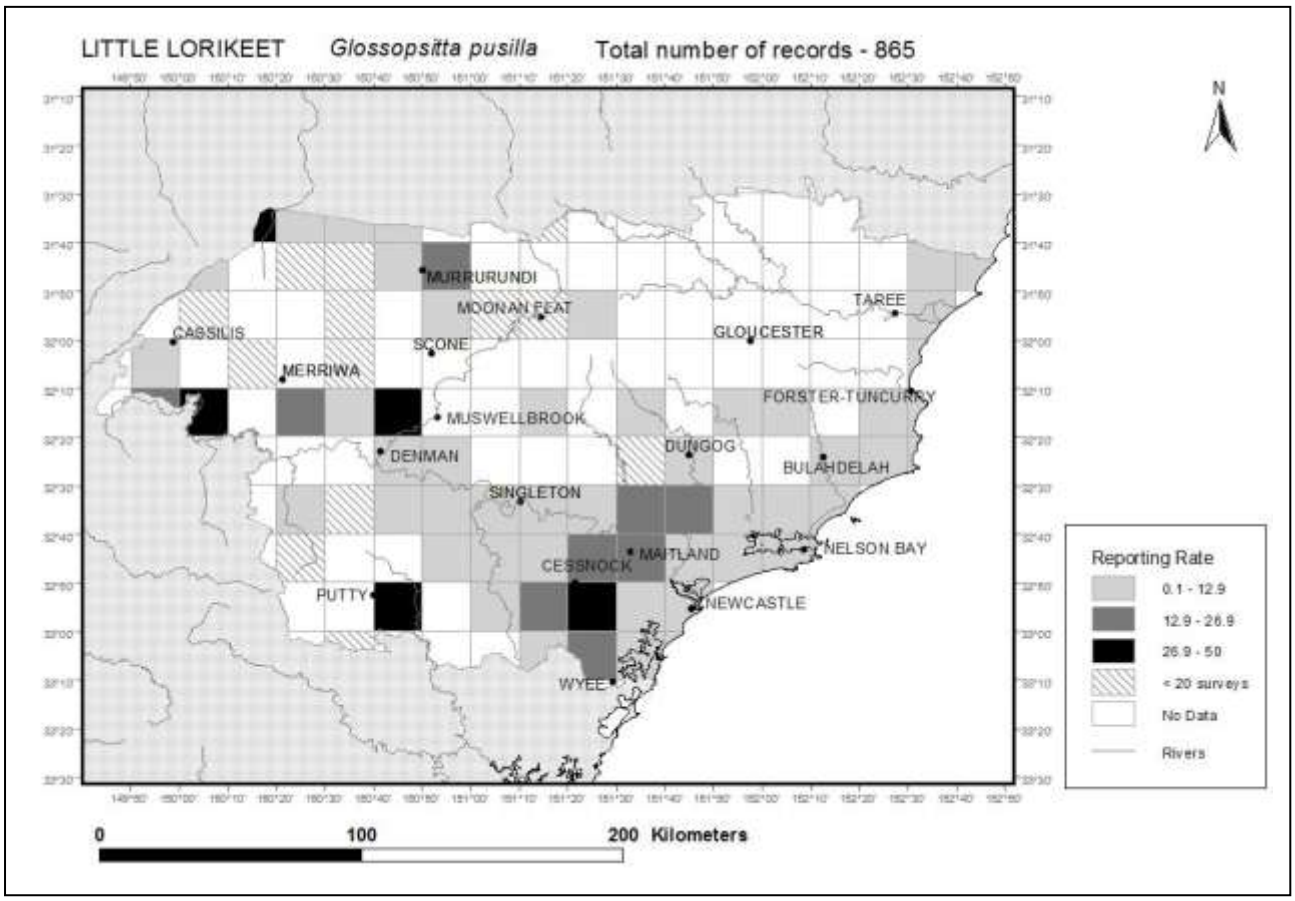

AUSTRALIAN PAINTED SNIPE
Rostratula australis
Total number of records - 13
N
MURRURUNDI
MOONAN FLAT
TAREE
CASSILIS
GLOUCESTER
SCONE
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DENMAN
DUNGOG
BULAHDELAH
SINGLETON
MAITLAND
NELSON BAY
PUTTY
CESSNOCK
NEWCASTLE
WYEE
Reporting Rate
0.2
0.2 - 2.3
No Data
Rivers
0
100
200 Kilometers

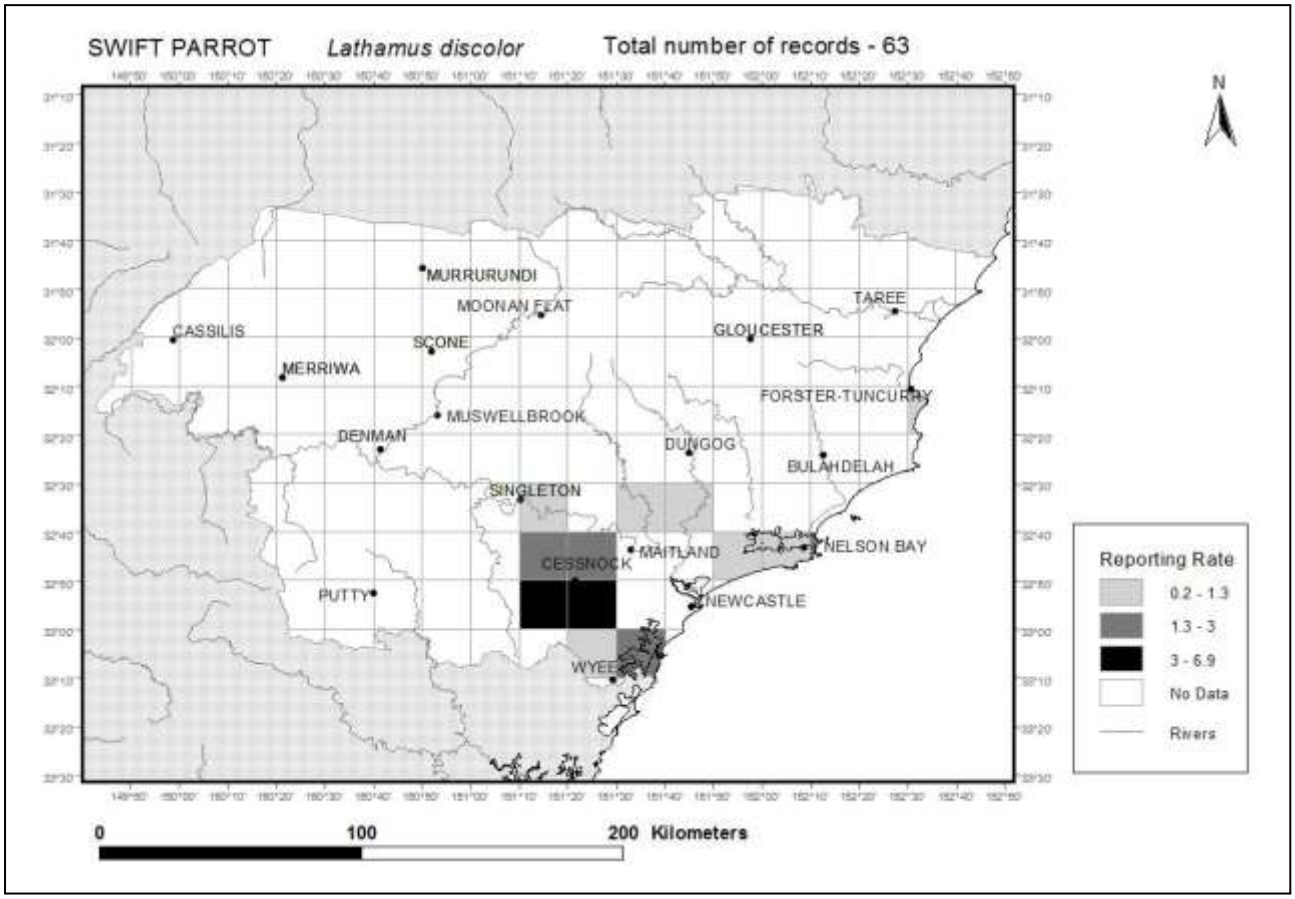

BLACK-TAILED GODWIT *Limosa limosa*
Total number of records - 167
N
MURRURUNDI
MOONAN FLAT
CASSILIS
SCONE
GLOUCESTER
TAREE
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DENMAN
DUNGOG
BULAHDELAH
SINGLETON
MAITLAND
NELSON BAY
PUTTY
CESSNOCK
NEWCASTLE
WYEE
Reporting Rate
0.2 - 0.5
0.5 - 1.7
1.7 - 8.4
No Data
Rivers
0
100
200 Kilometers

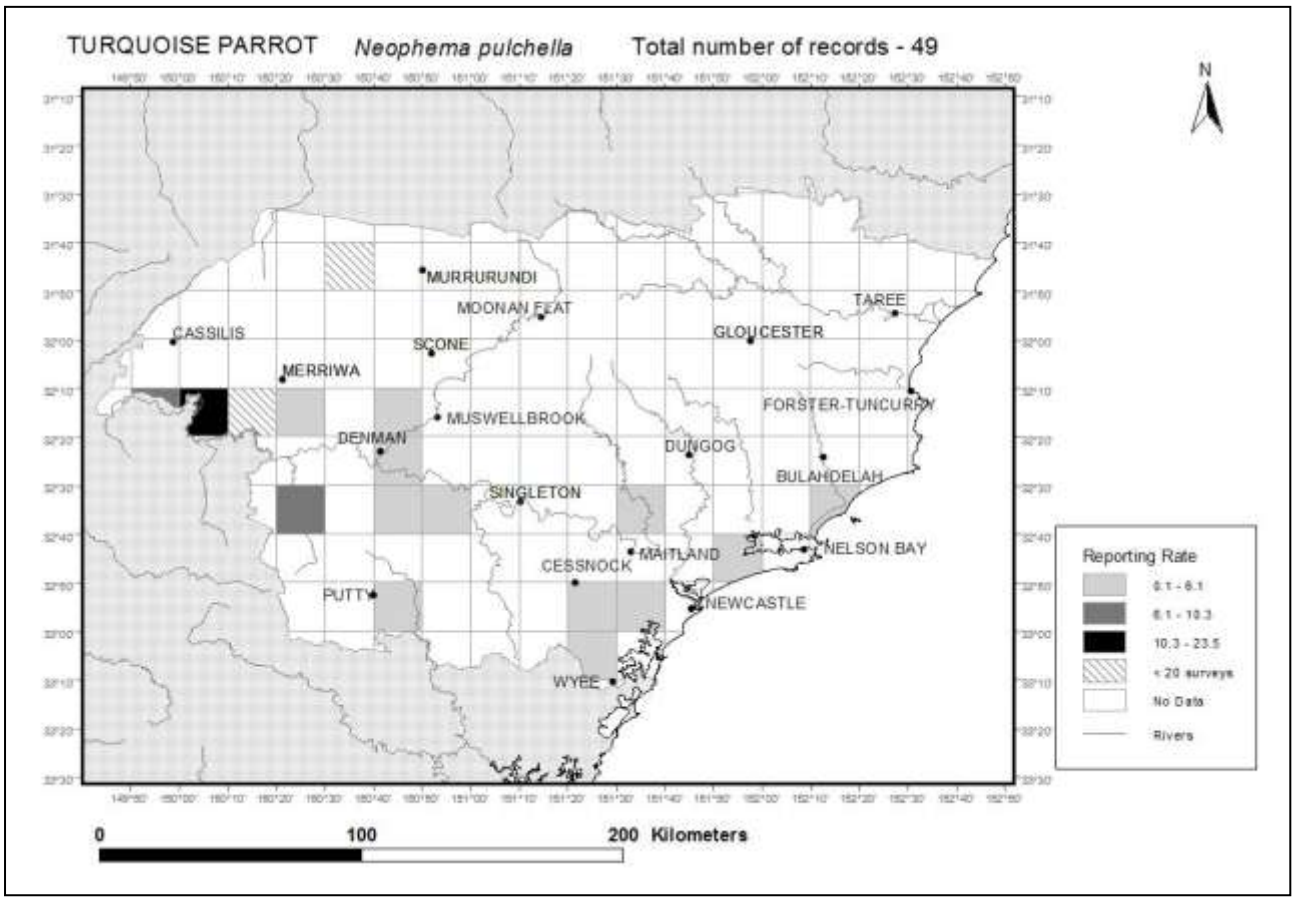

LITTLE TERN *Sternula albifrons*
Total number of records - 143
N
MURRURUNDI
MOONAN FLAT
CASSILIS
SCONE
GLOUCESTER
TAREE
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DENMAN
DUNGOG
BULAHDELAH
SINGLETON
MAITLAND
NELSON BAY
PUTTY
CESSNOCK
NEWCASTLE
WYEE
Reporting Rate
0.7 - 2.9
2.9 - 13.2
13.2 - 30.8
No Data
Rivers
0
100
200 Kilometers

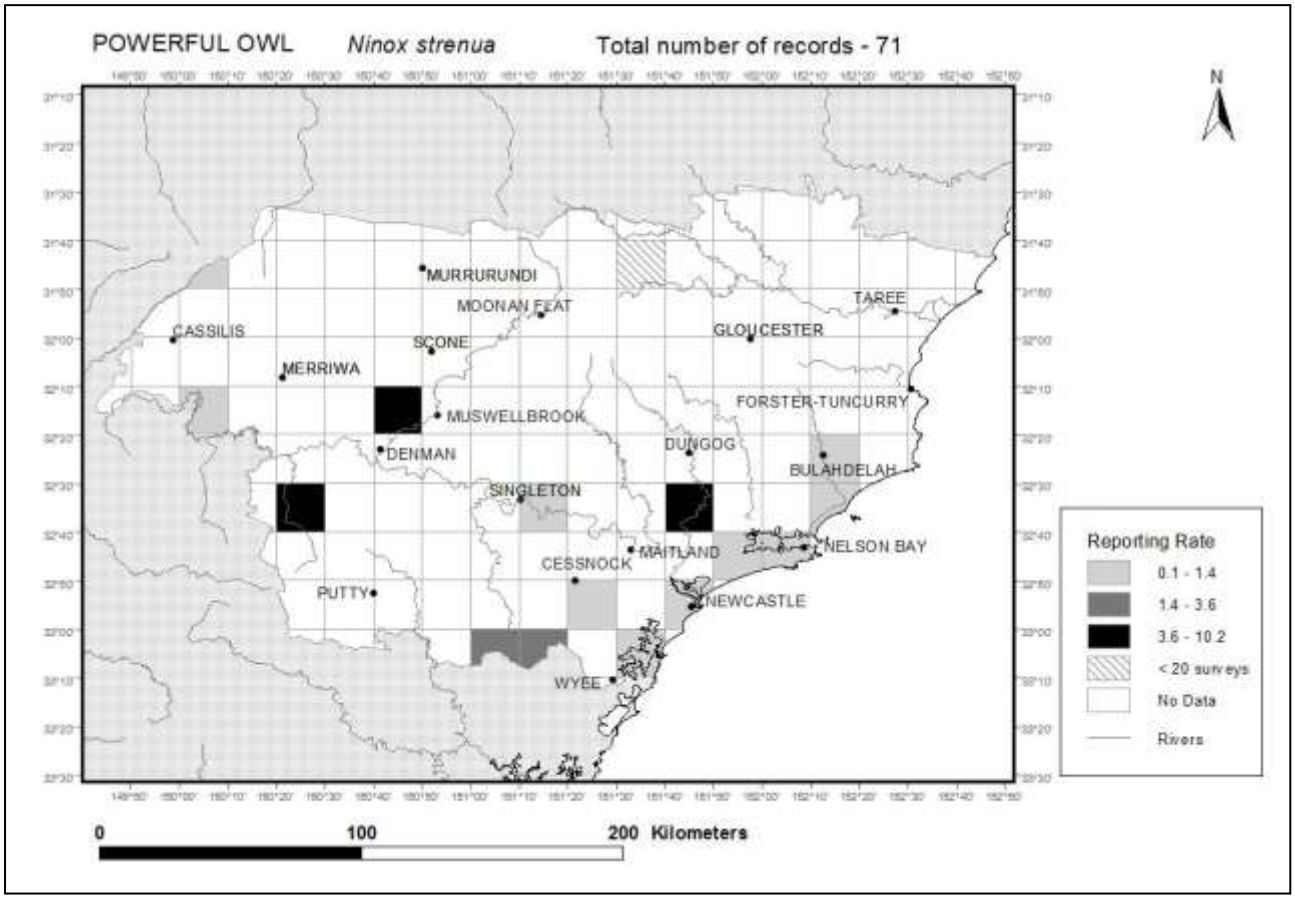

GANG-GANG COCKATOO *Callocephalon fimbriatum*
Total number of records - 143
N
MURRURUNDI
MOONAN FLAT
CASSILIS
SCONE
GLOUCESTER
TAREE
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DENMAN
DUNGOG
BULAHDELAH
SINGLETON
MAITLAND
NELSON BAY
PUTTY
CESSNOCK
NEWCASTLE
WYEE
Reporting Rate
0.1 - 10.4
10.4 - 28.6
28.6 - 50.8
< 20 surveys
No Data
Rivers
0
100
200 Kilometers

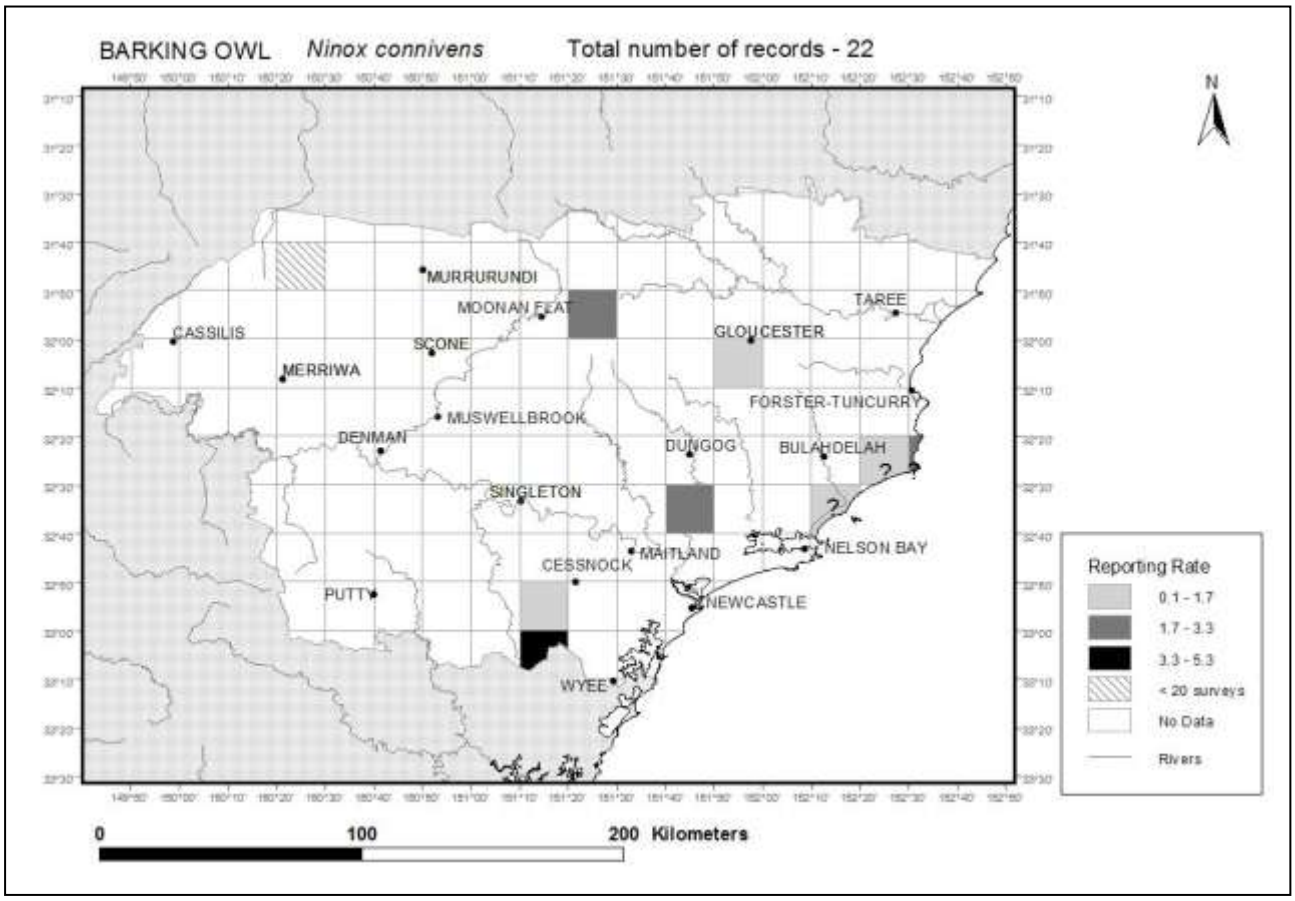

GLOSSY BLACK-COCKATOO *Calyptorhynchus lathami*
Total number of records - 208
N
MURRURUNDI
MOONAN FLAT
CASSILIS
SCONE
GLOUCESTER
TAREE
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DENMAN
DUNGOG
BULAHDELAH
SINGLETON
MAITLAND
NELSON BAY
PUTTY
CESSNOCK
NEWCASTLE
WYEE
Reporting Rate
0.1 - 3.5
3.5 - 15.6
15.6 - 34.5
< 20 surveys
No Data
Rivers
0
100
200 Kilometers

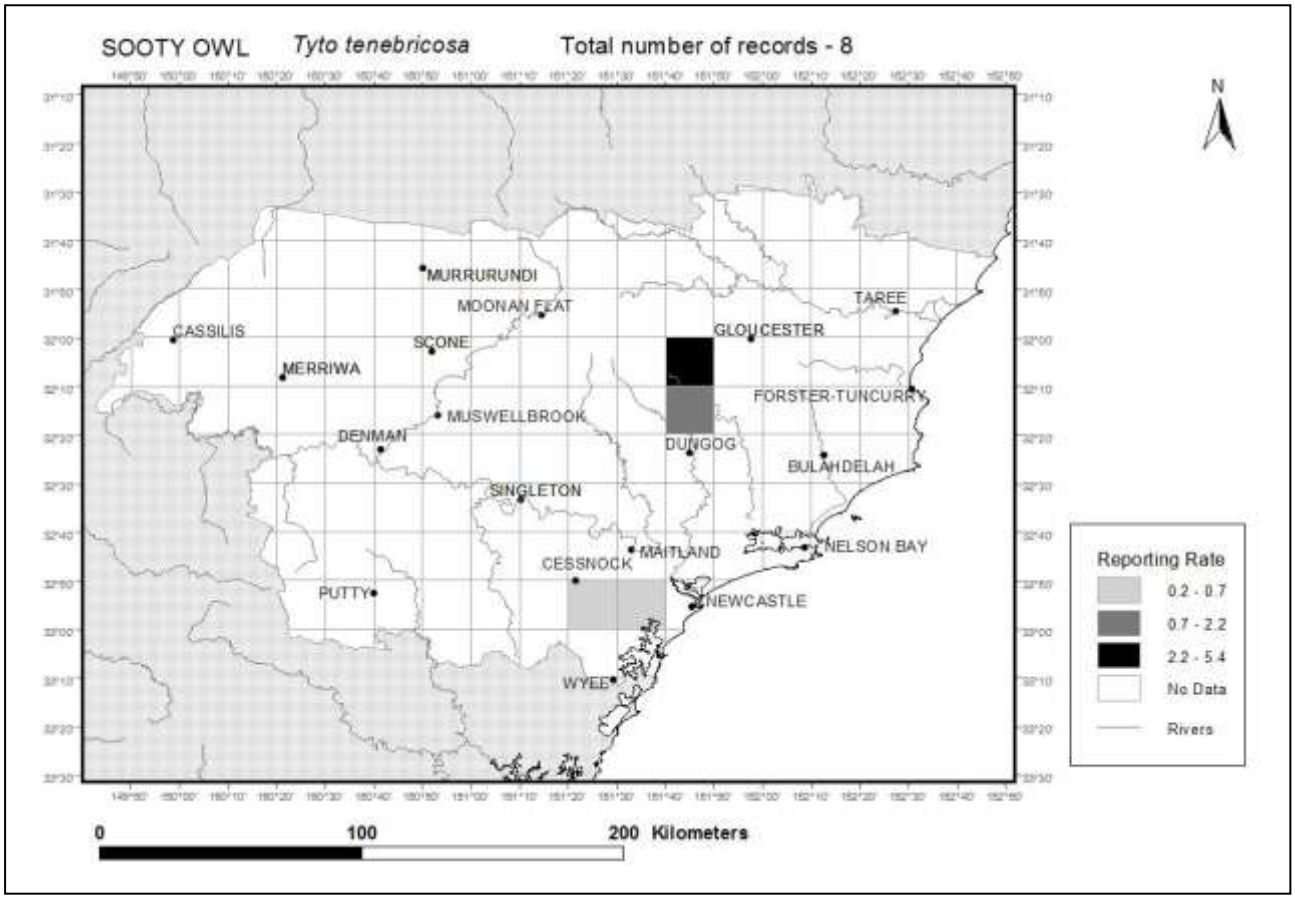

LITTLE LORIKEET
Glossopsitta pusilla
Total number of records - 865
N
MURRURUNDI
MOONAN FEAT
TAREE
CASSILIS
GLOUCESTER
SCONE
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DUNGOG
DENMAN
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
CESSNOCK
PUTTY
NEWCASTLE
WYEE
Reporting Rate
0.1 - 12.9
12.9 - 26.9
26.9 - 50
< 20 surveys
No Data
Rivers
0
100
200 Kilometers

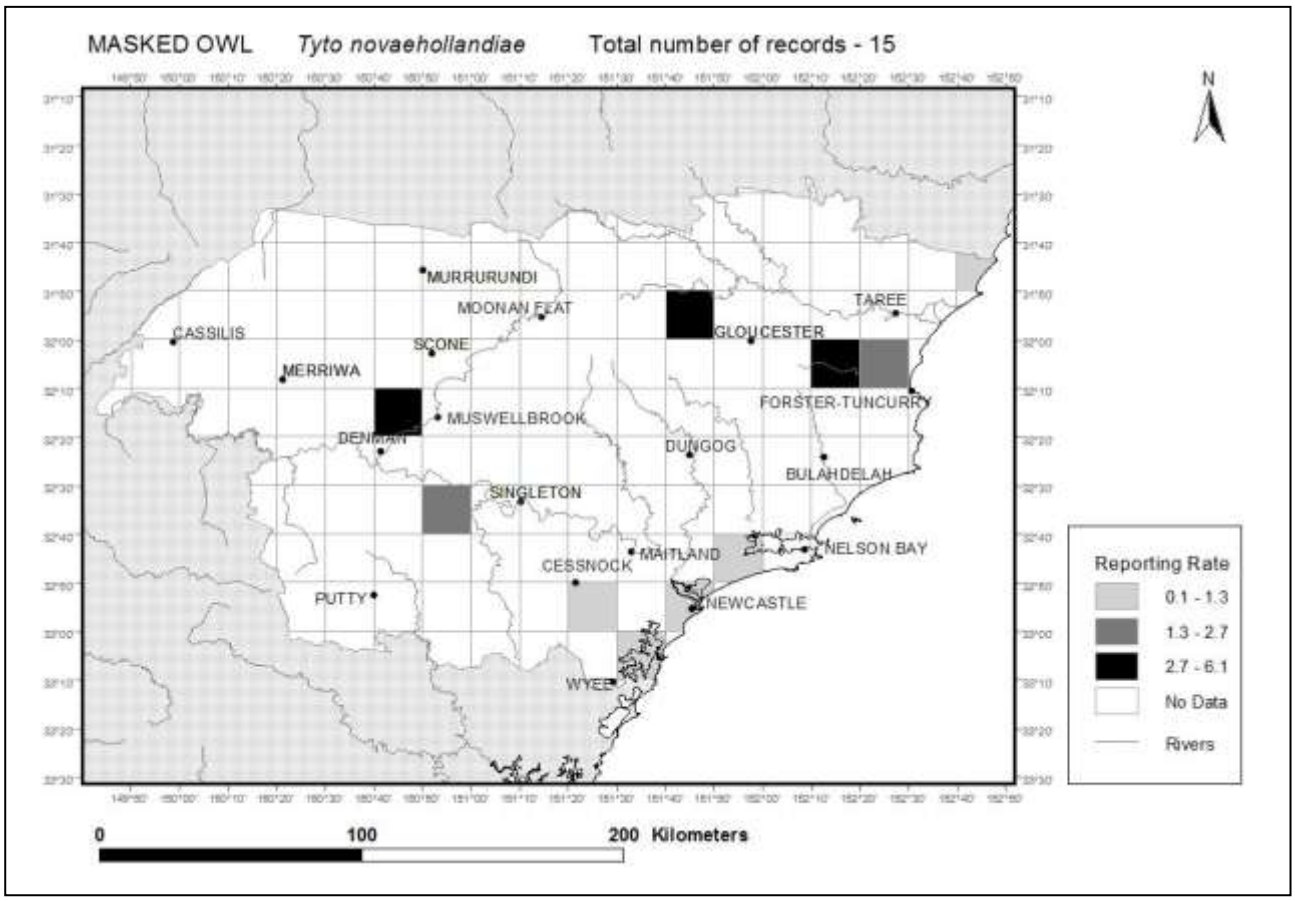

SWIFT PARROT
Lathamus discolor
Total number of records - 63
N
MURRURUNDI
MOONAN FEAT
TAREE
CASSILIS
GLOUCESTER
SCONE
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DENMAN
DUNGOG
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
CESSNOCK
PUTTY
NEWCASTLE
WYEE
Reporting Rate
0.2 - 1.3
1.3 - 3
3 - 6.9
No Data
Rivers
0
100
200 Kilometers

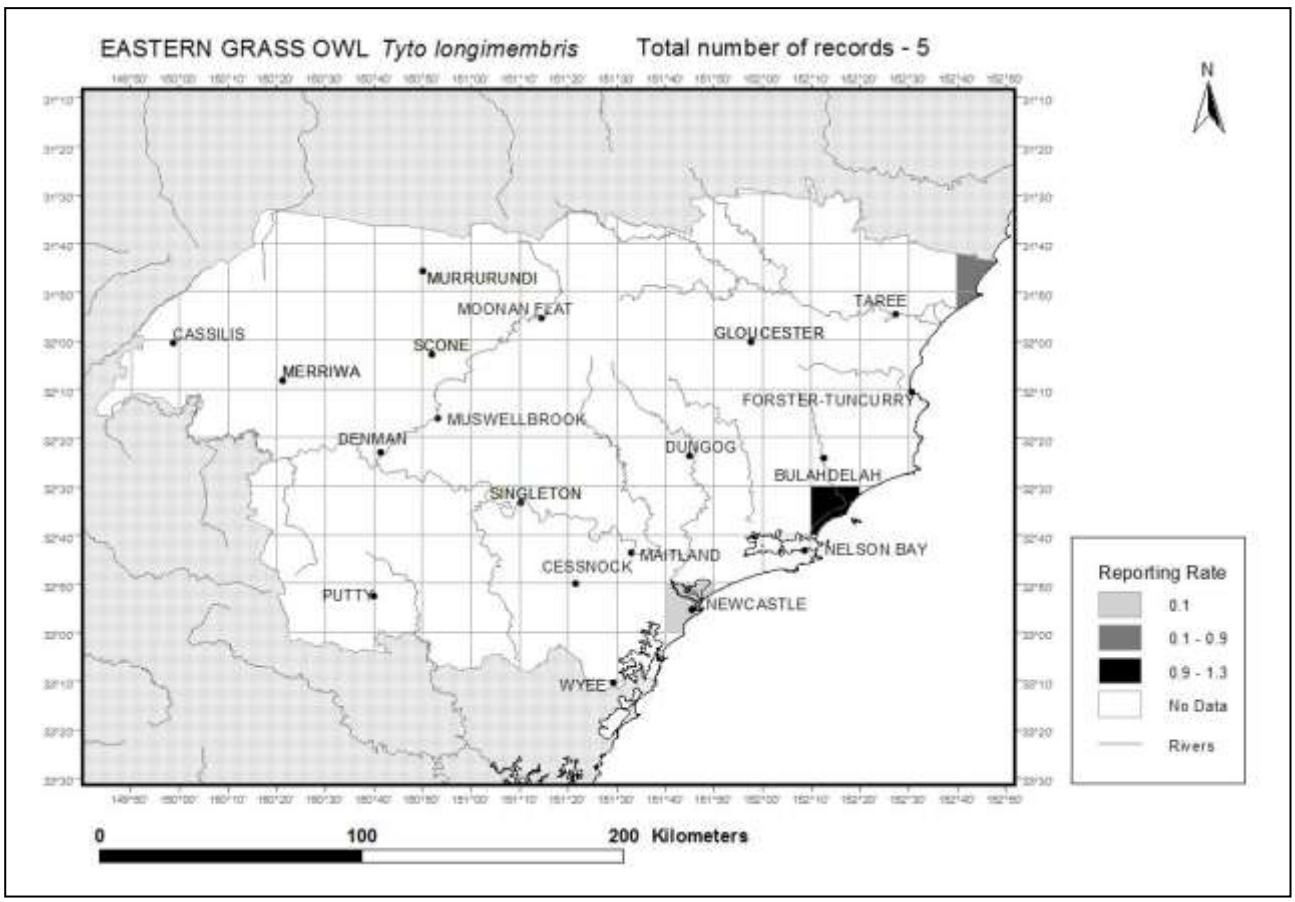

TURQUOISE PARROT
Neophema pulchella
Total number of records - 49
N
MURRURUNDI
MOONAN FLAT
CASSILIS
SCONE
GLOUCESTER
TAREE
MERRIWA
MUSWELLBROOK
FORSTER-TUNCURRY
DENMAN
DUNGOG
BULAHDELAH
SINGLETON
MAITLAND
NELSON BAY
CESSNOCK
PUTTY
NEWCASTLE
WYEE
Reporting Rate
0.1 - 6.1
6.1 - 10.3
10.3 - 23.5
< 20 surveys
No Data
Rivers
0
100
200 Kilometers

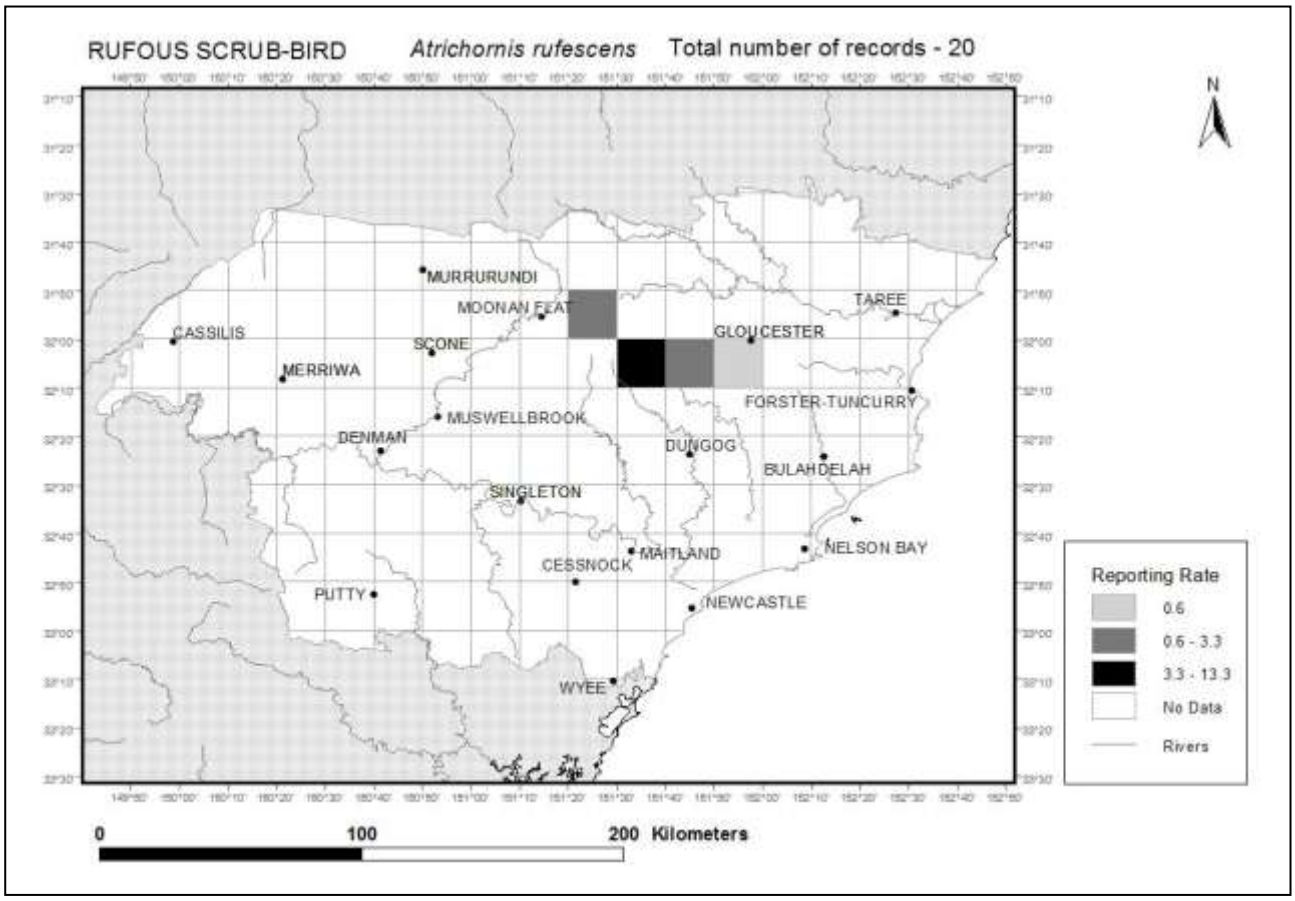

POWERFUL OWL
Ninox strenua
Total number of records - 71
N
MURRURUNDI
MOONAN FLAT
CASSILIS
SCONE
GLOUCESTER
TAREE
MERRIWA
MUSWELLBROOK
FORSTER-TUNCURRY
DENMAN
DUNGOG
BULAHDELAH
SINGLETON
MAITLAND
NELSON BAY
CESSNOCK
PUTTY
NEWCASTLE
WYEE
Reporting Rate
0.1 - 1.4
1.4 - 3.6
3.6 - 10.2
< 20 surveys
No Data
Rivers
0
100
200 Kilometers

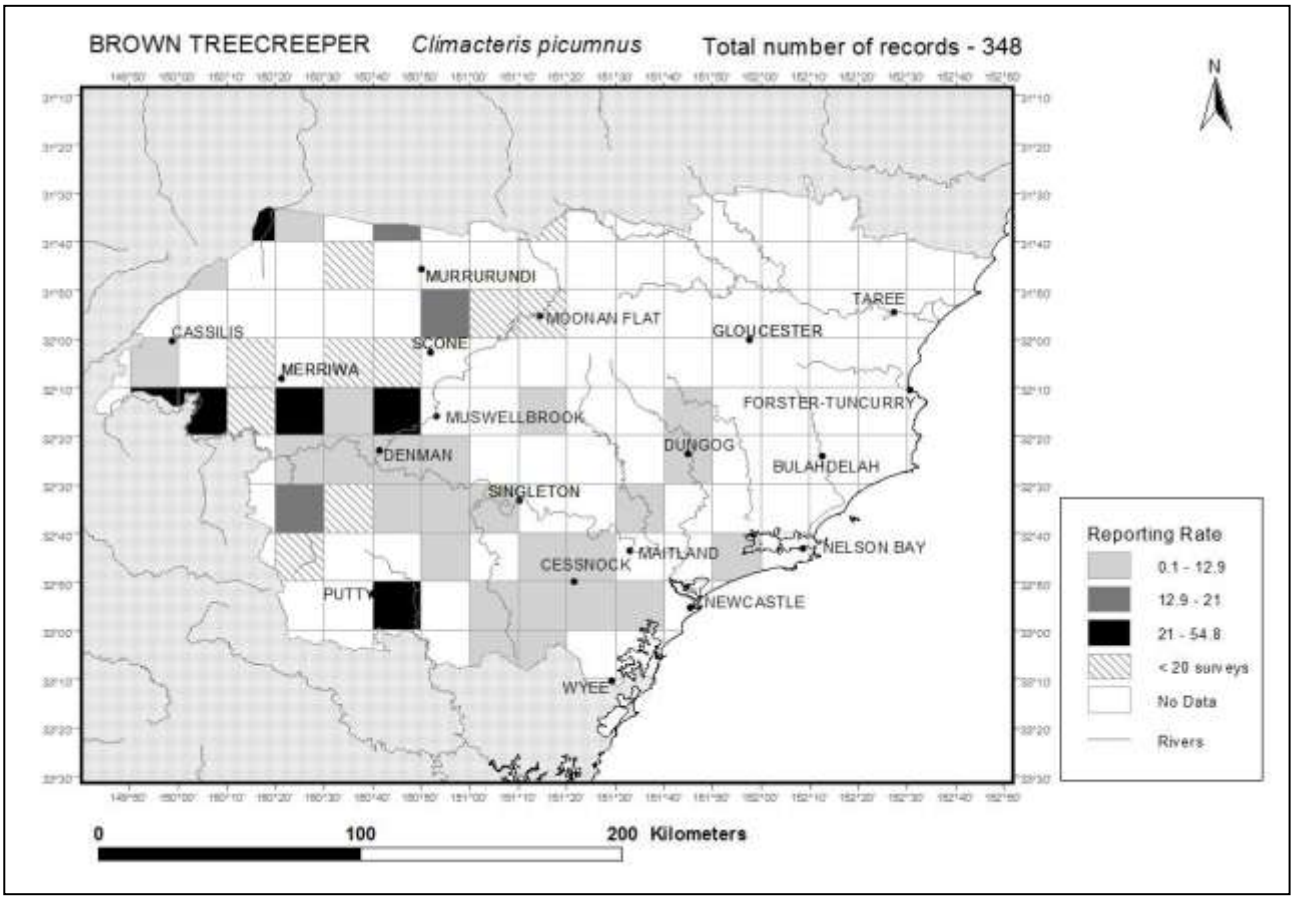

BARKING OWL
Ninox connivens
Total number of records - 22
N
MURRURUNDI
MOONAN FEAT
TAREE
CASSILIS
SCONE
GLOUCESTER
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DENMAN
DUNGOG
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
CESSNOCK
NEWCASTLE
PUTTY
WYEE
Reporting Rate
0.1 - 1.7
1.7 - 3.3
3.3 - 5.3
< 20 surveys
No Data
Rivers
0
100
200 Kilometers

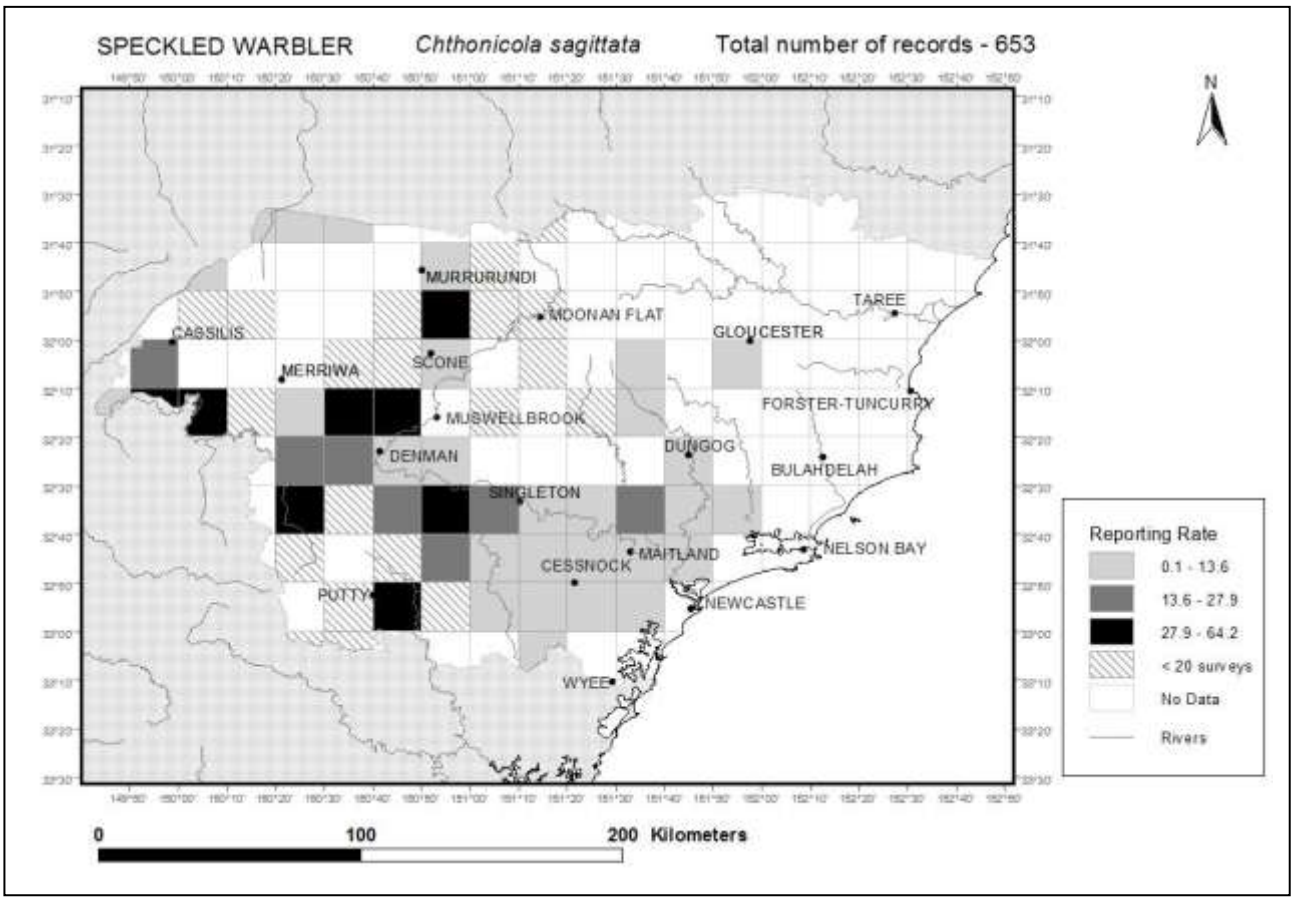

SOOTY OWL
Tyto tenebricosa
Total number of records - 8
N
MURRURUNDI
MOONAN FEAT
TAREE
CASSILIS
SCONE
GLOUCESTER
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DENMAN
DUNGOG
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
CESSNOCK
NEWCASTLE
PUTTY
WYEE
Reporting Rate
0.2 - 0.7
0.7 - 2.2
2.2 - 5.4
No Data
Rivers
0
100
200 Kilometers

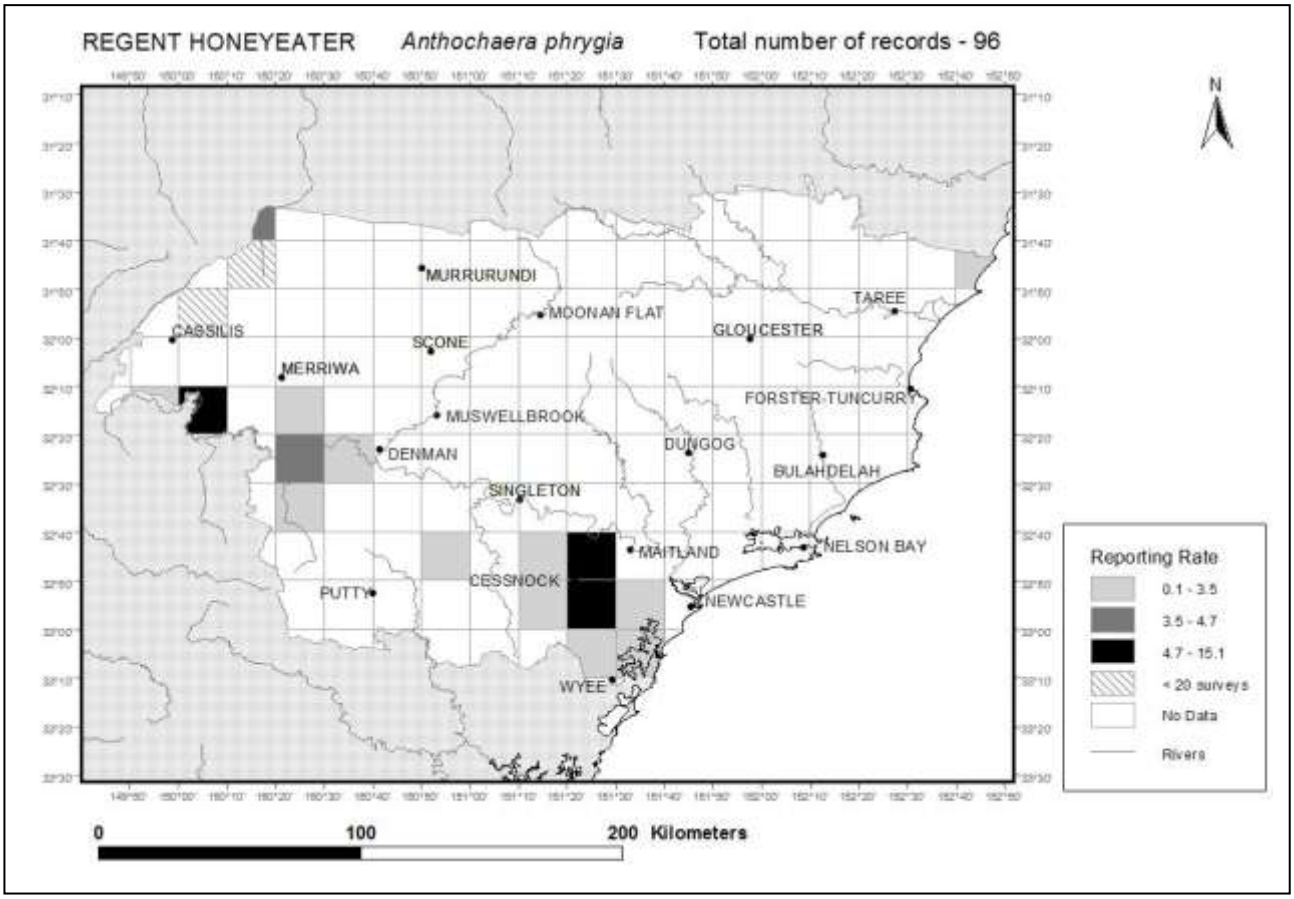

MASKED OWL *Tyto novaehollandiae* Total number of records - 15
N
MURRURUNDI
MOONAN FEAT
TAREE
CASSILIS
GLOUCESTER
SCONE
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DENMAN
DUNGOG
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
CESSNOCK
PUTTY
NEWCASTLE
WYEE
Reporting Rate
0.1 - 1.3
1.3 - 2.7
2.7 - 6.1
No Data
Rivers
0
100
200 Kilometers

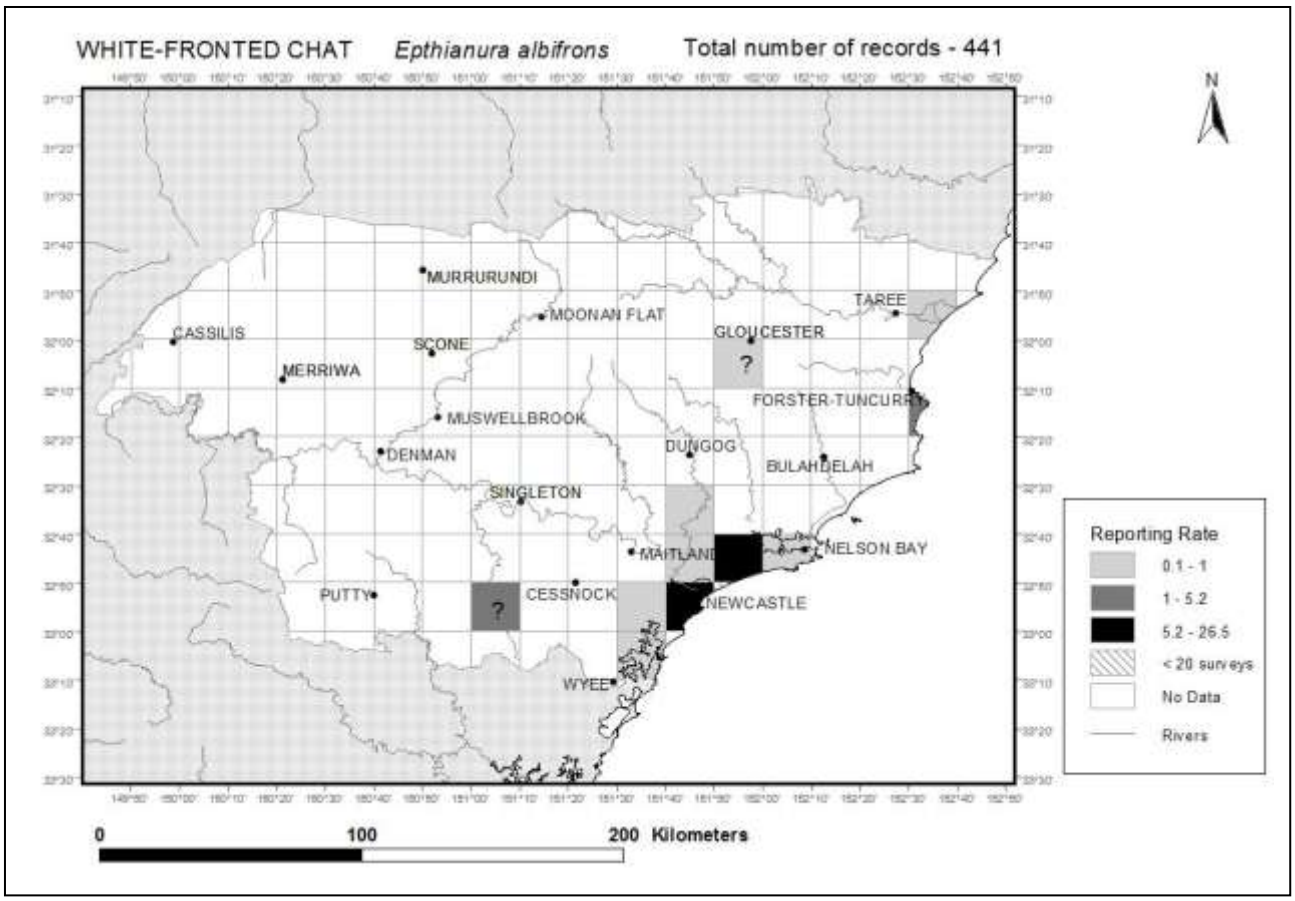

EASTERN GRASS OWL *Tyto longimembris* Total number of records - 5
N
MURRURUNDI
MOONAN FEAT
TAREE
CASSILIS
GLOUCESTER
SCONE
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DENMAN
DUNGOG
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
CESSNOCK
PUTTY
NEWCASTLE
WYEE
Reporting Rate
0.1
0.1 - 0.9
0.9 - 1.3
No Data
Rivers
0
100
200 Kilometers

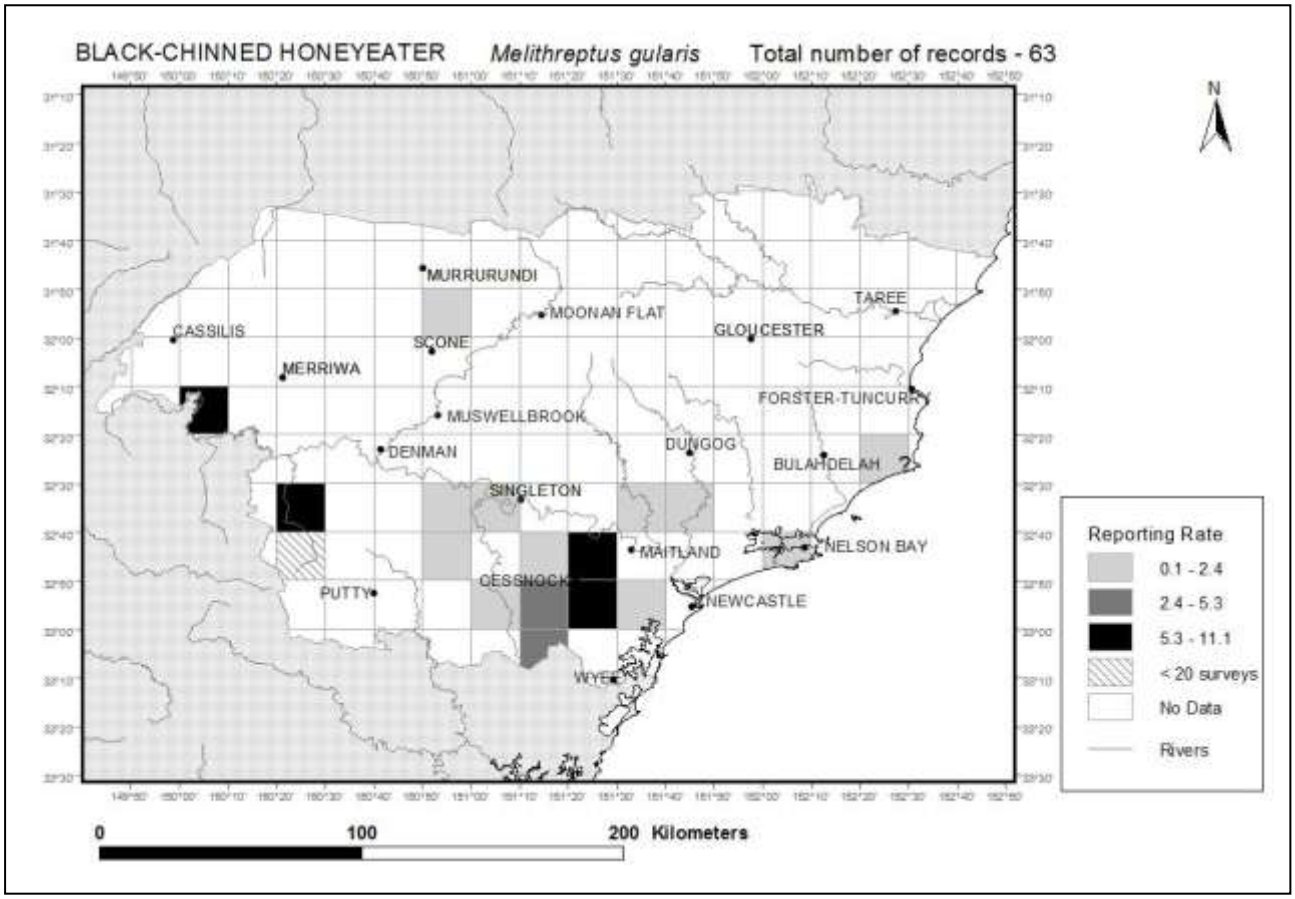

RUFOUS SCRUB-BIRD
Atrichornis rufescens
Total number of records - 20
N
MURRURUNDI
MOONAN FLAT
TAREE
CASSILIS
GLOUCESTER
SCONE
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DENMAN
DUNGOG
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
CESSNOCK
PUTTY
NEWCASTLE
WYEE
Reporting Rate
0.6
0.6 - 3.3
3.3 - 13.3
No Data
Rivers
0
100
200 Kilometers

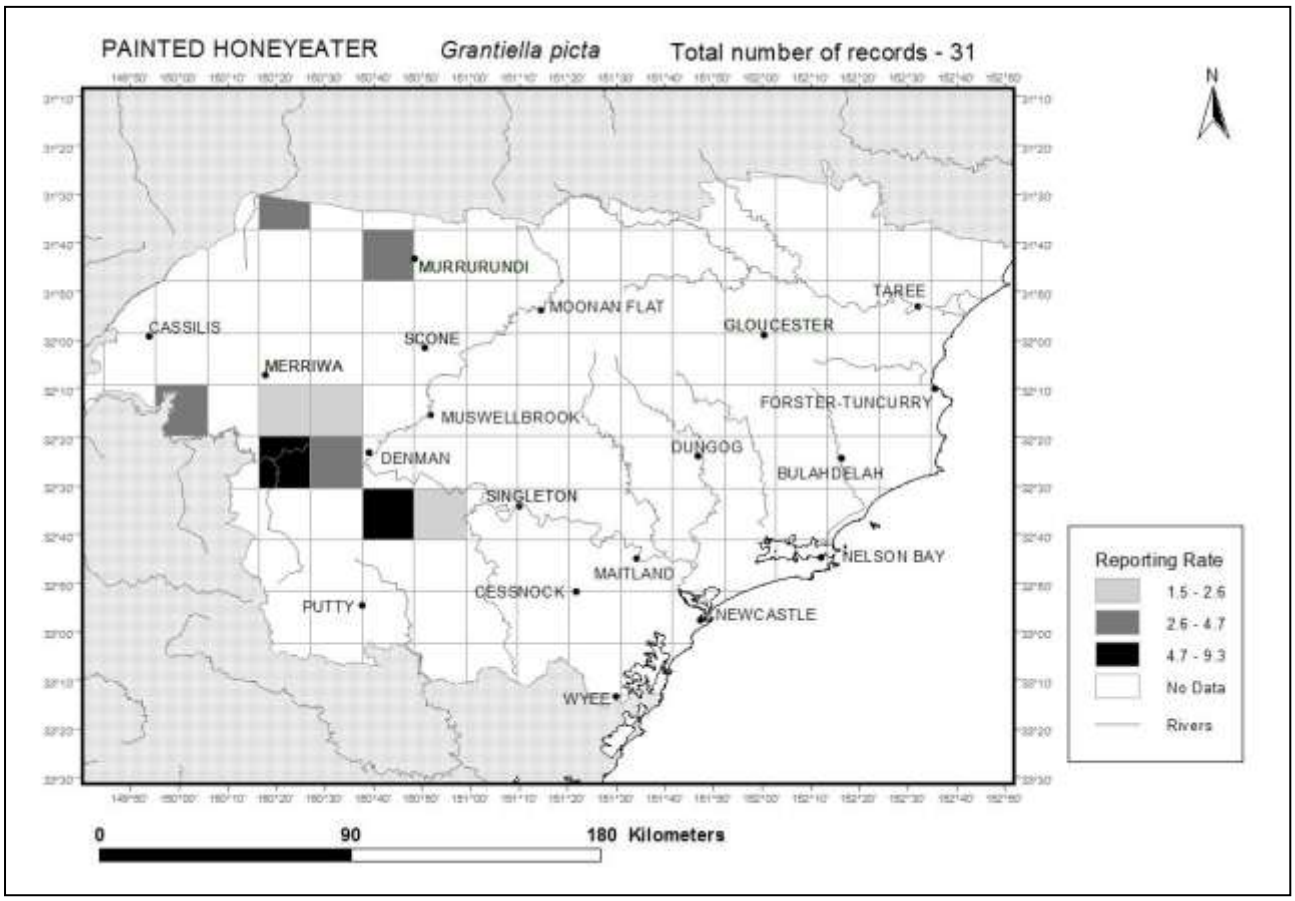

BROWN TREECREEPER
Climacteris picumnus
Total number of records - 348
N
MURRURUNDI
MOONAN FLAT
TAREE
CASSILIS
GLOUCESTER
SCONE
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DENMAN
DUNGOG
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
CESSNOCK
PUTTY
NEWCASTLE
WYEE
Reporting Rate
0.1 - 12.9
12.9 - 21
21 - 54.8
< 20 surveys
No Data
Rivers
0
100
200 Kilometers

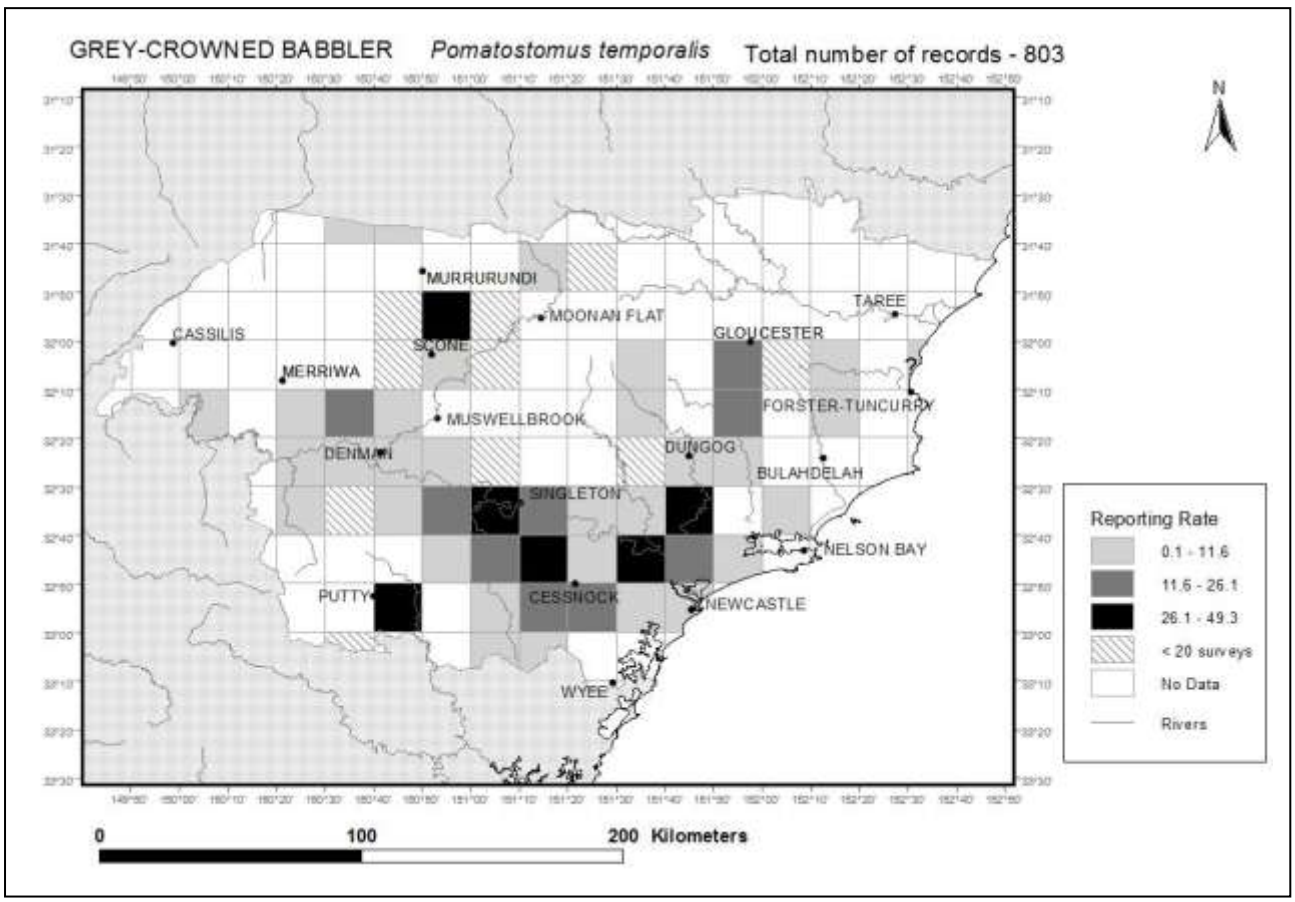

SPECKLED WARBLER
Chthonicola sagittata
Total number of records - 653
N
MURRURUNDI
MOONAN FLAT
TAREE
CASSILIS
GLOUCESTER
SCONE
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DUNGOG
DENMAN
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
CESSNOCK
POTTY
NEWCASTLE
WYEE
Reporting Rate
0.1 - 13.6
13.6 - 27.9
27.9 - 64.2
< 20 surveys
No Data
Rivers
0
100
200 Kilometers

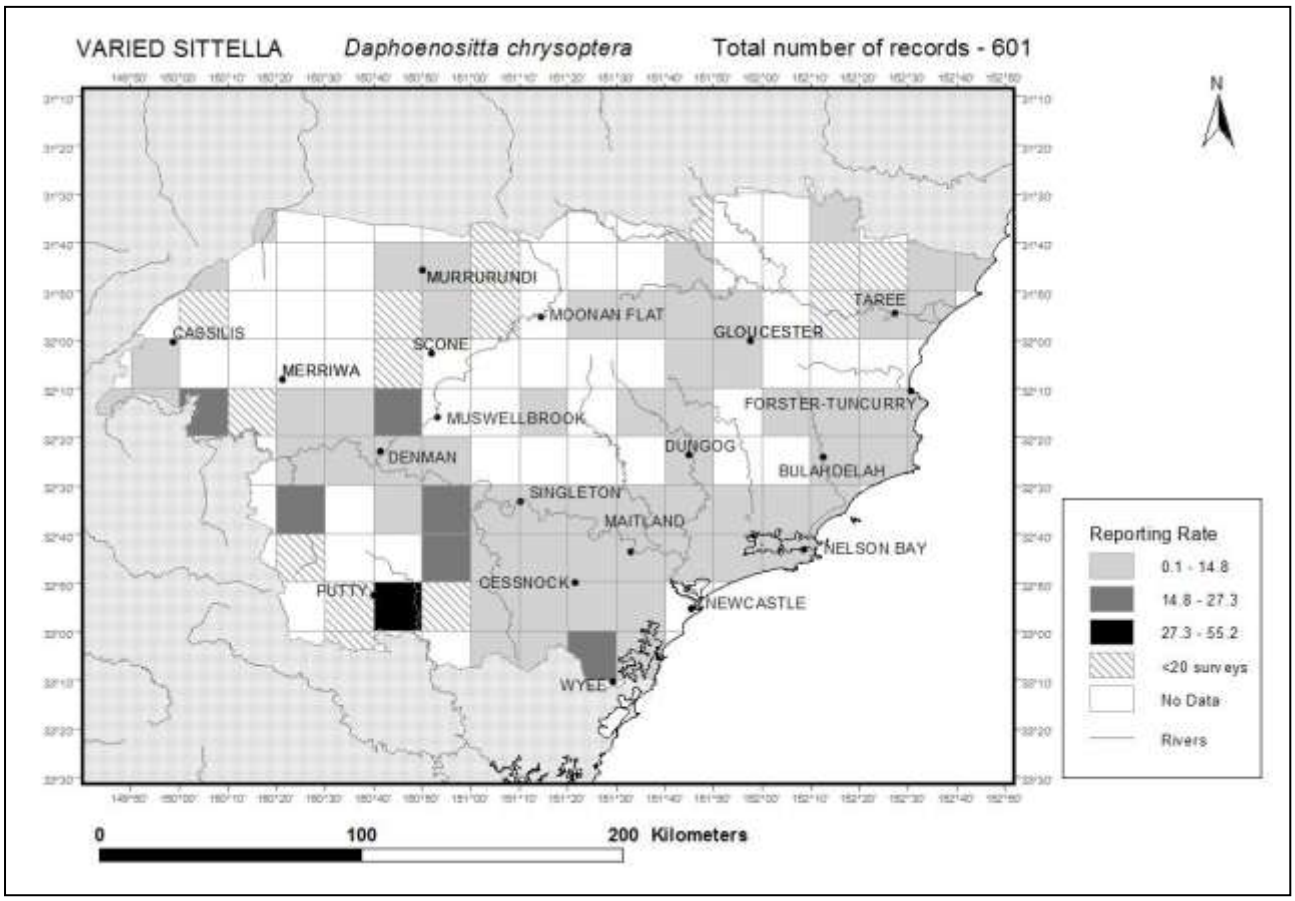

REGENT HONEYEATER
Anthochaera phrygia
Total number of records - 96
N
MURRURUNDI
MOONAN FLAT
TAREE
CASSILIS
GLOUCESTER
SCONE
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DUNGOG
DENMAN
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
CESSNOCK
POTTY
NEWCASTLE
WYEE
Reporting Rate
0.1 - 3.5
3.5 - 4.7
4.7 - 15.1
< 20 surveys
No Data
Rivers
0
100
200 Kilometers

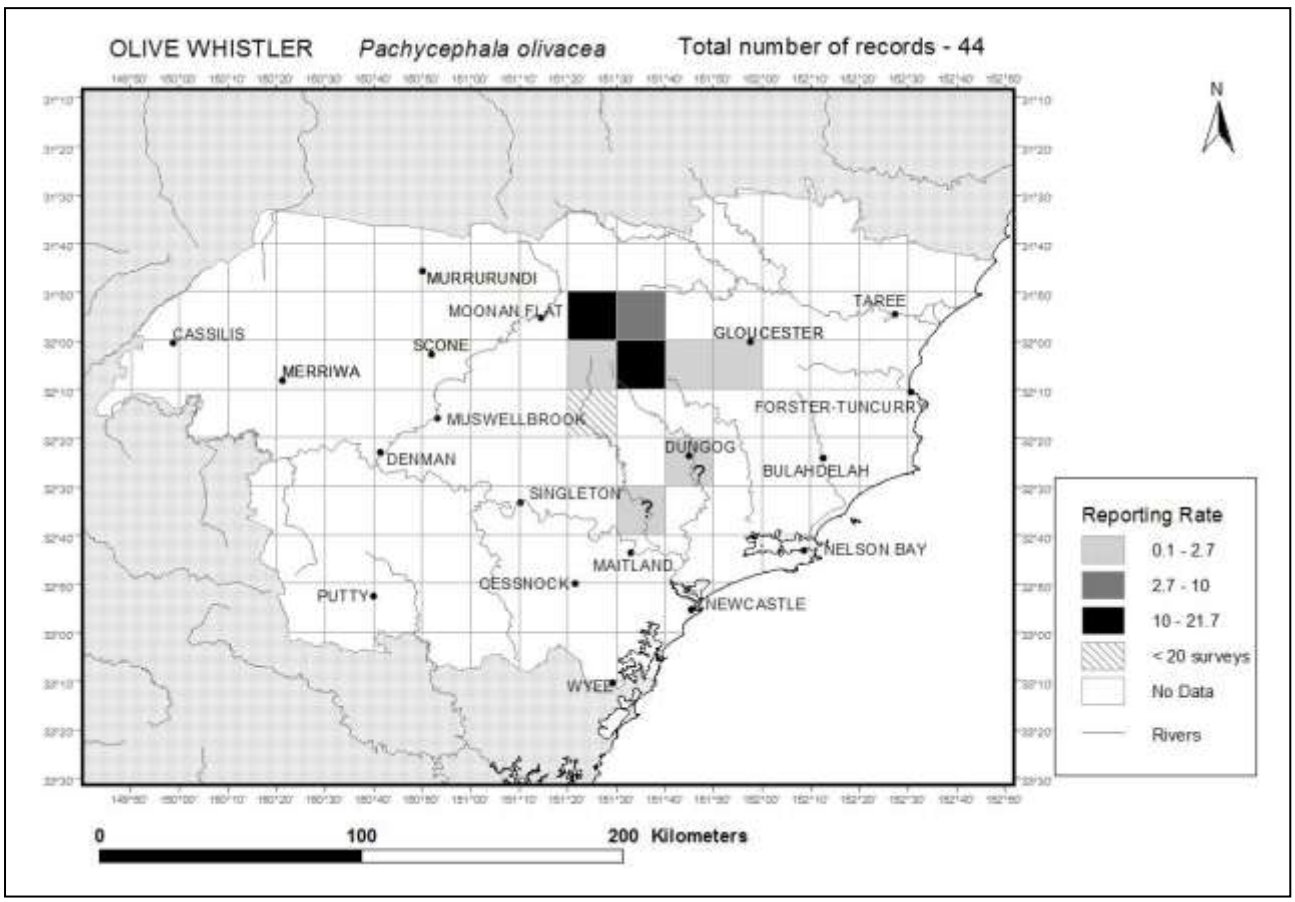

WHITE-FRONTED CHAT
Epthianura albifrons
Total number of records - 441
N
MURRURUNDI
MOONAN FLAT
TAREE
CASSILIS
SCONE
GLOUCESTER
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DUNGOG
DENMAN
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
PUTTY
CESSNOCK
NEWCASTLE
WYEE
Reporting Rate
0.1 - 1
1 - 5.2
5.2 - 26.5
< 20 surveys
No Data
Rivers
0
100
200 Kilometers

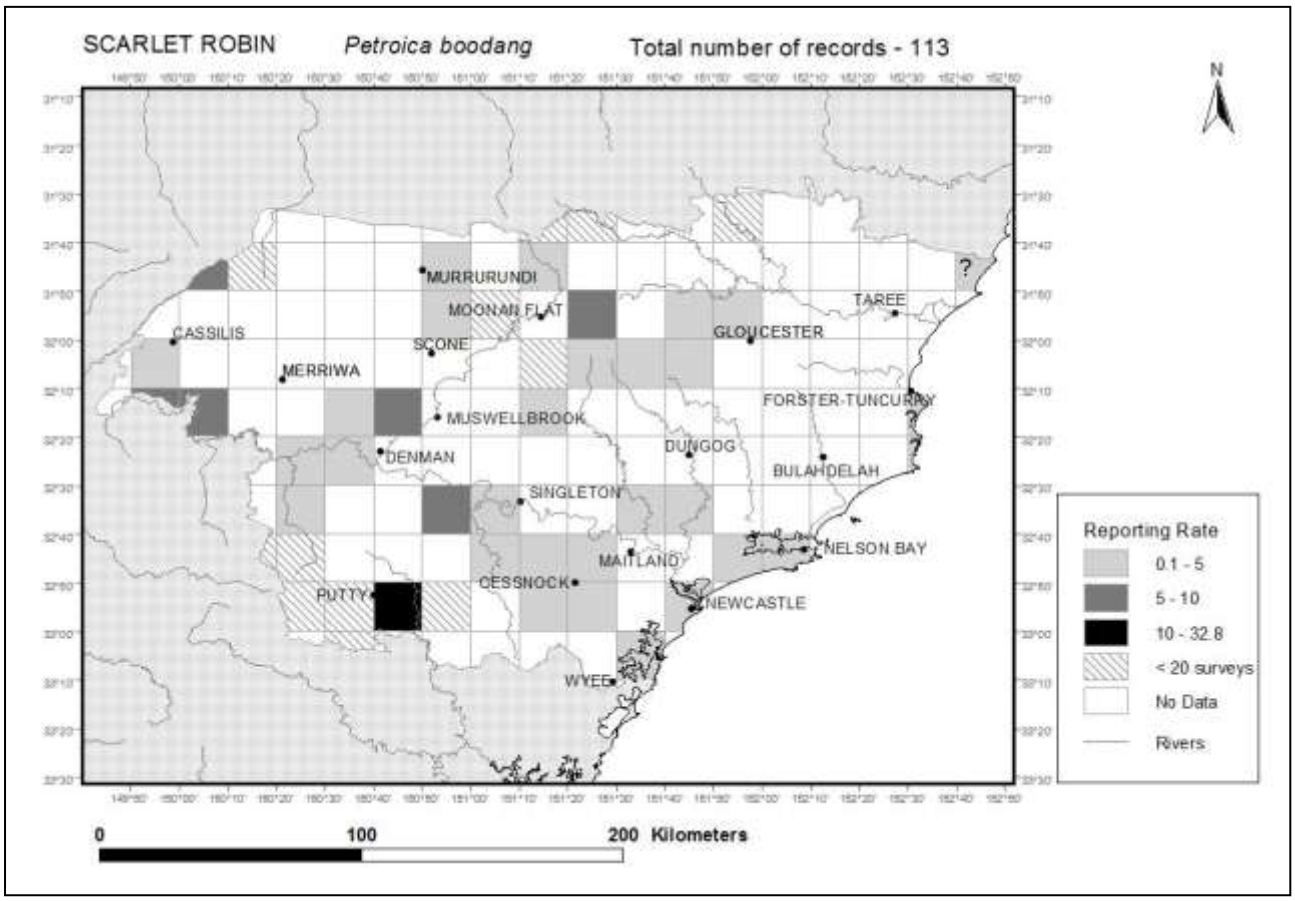

BLACK-CHINNED HONEYEATER
Melithreptus gularis
Total number of records - 63
N
MURRURUNDI
MOONAN FLAT
TAREE
CASSILIS
SCONE
GLOUCESTER
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DUNGOG
DENMAN
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
CESSNOCK
PUTTY
NEWCASTLE
WYEE
Reporting Rate
0.1 - 2.4
2.4 - 5.3
5.3 - 11.1
< 20 surveys
No Data
Rivers
0
100
200 Kilometers

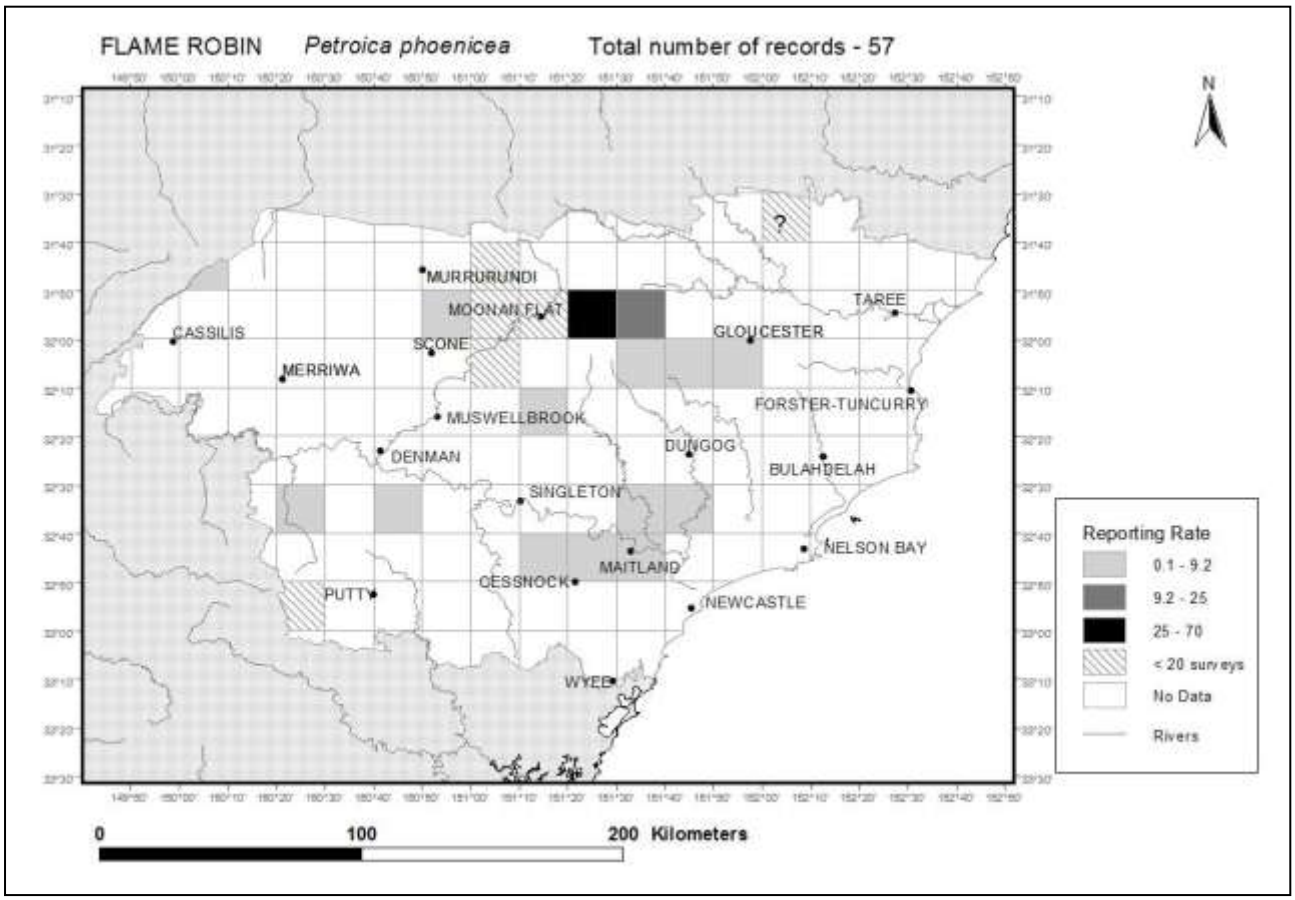

PAINTED HONEYEATER
Grantiella picta
Total number of records - 31
N
MURRURUNDI
MOONAN FLAT
TAREE
CASSILIS
SCONE
GLOUCESTER
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DUNGOG
DENMAN
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
CESSNOCK
PUTTY
NEWCASTLE
WYEE
Reporting Rate
1.5 - 2.6
2.6 - 4.7
4.7 - 9.3
No Data
Rivers
0
90
180 Kilometers

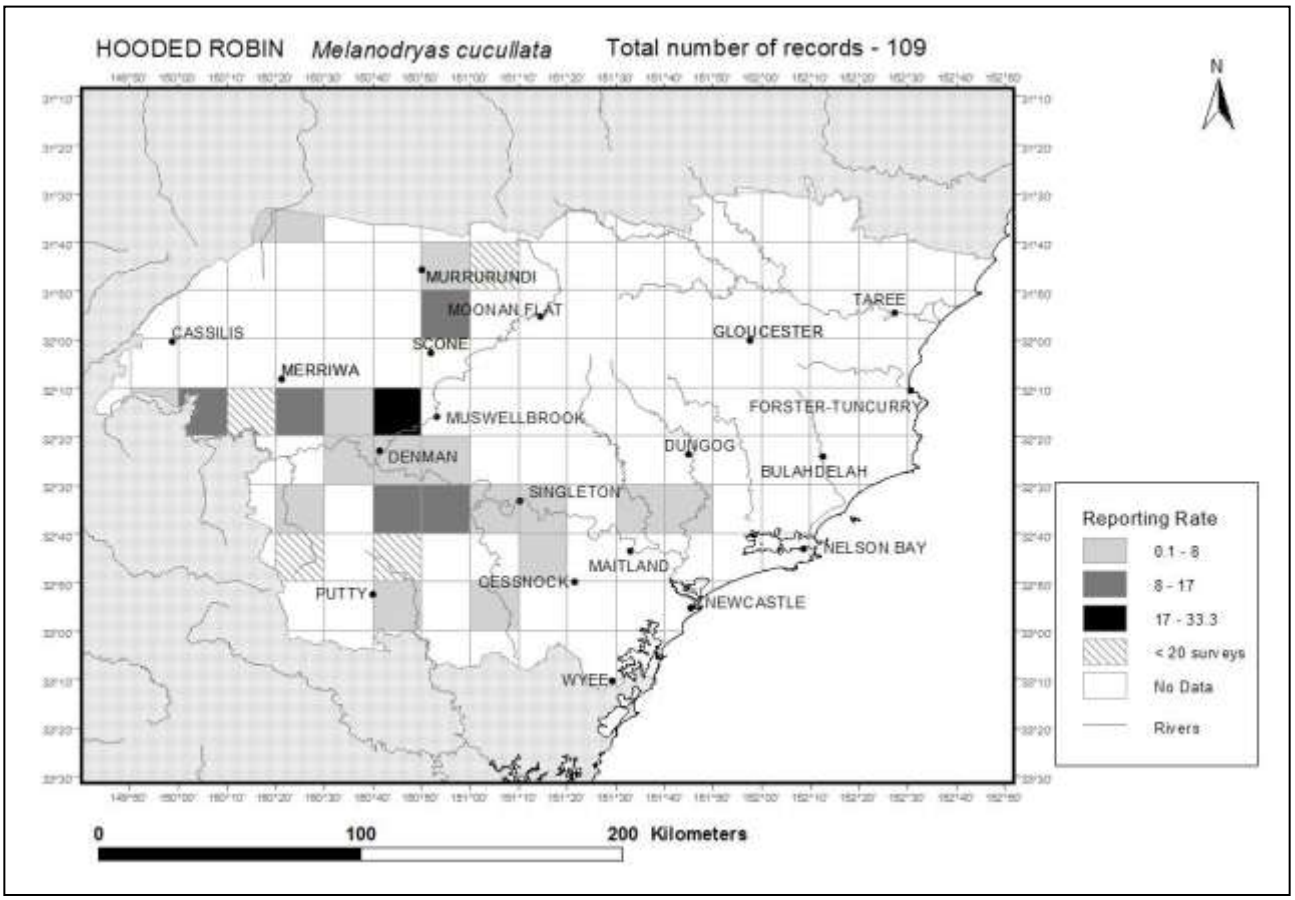

GREY-CROWNED BABBLER
Pomatostomus temporalis
Total number of records - 803
N
MURRURUNDI
MOONAN FLAT
TAREE
CASSILIS
SCONE
GLOUCESTER
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DENMAN
DUNGOG
BULAHDELAH
SINGLETON
NELSON BAY
PUTTY
CESSNOCK
NEWCASTLE
WYEE
Reporting Rate
0.1 - 11.6
11.6 - 26.1
26.1 - 49.3
< 20 surveys
No Data
Rivers
0
100
200 Kilometers

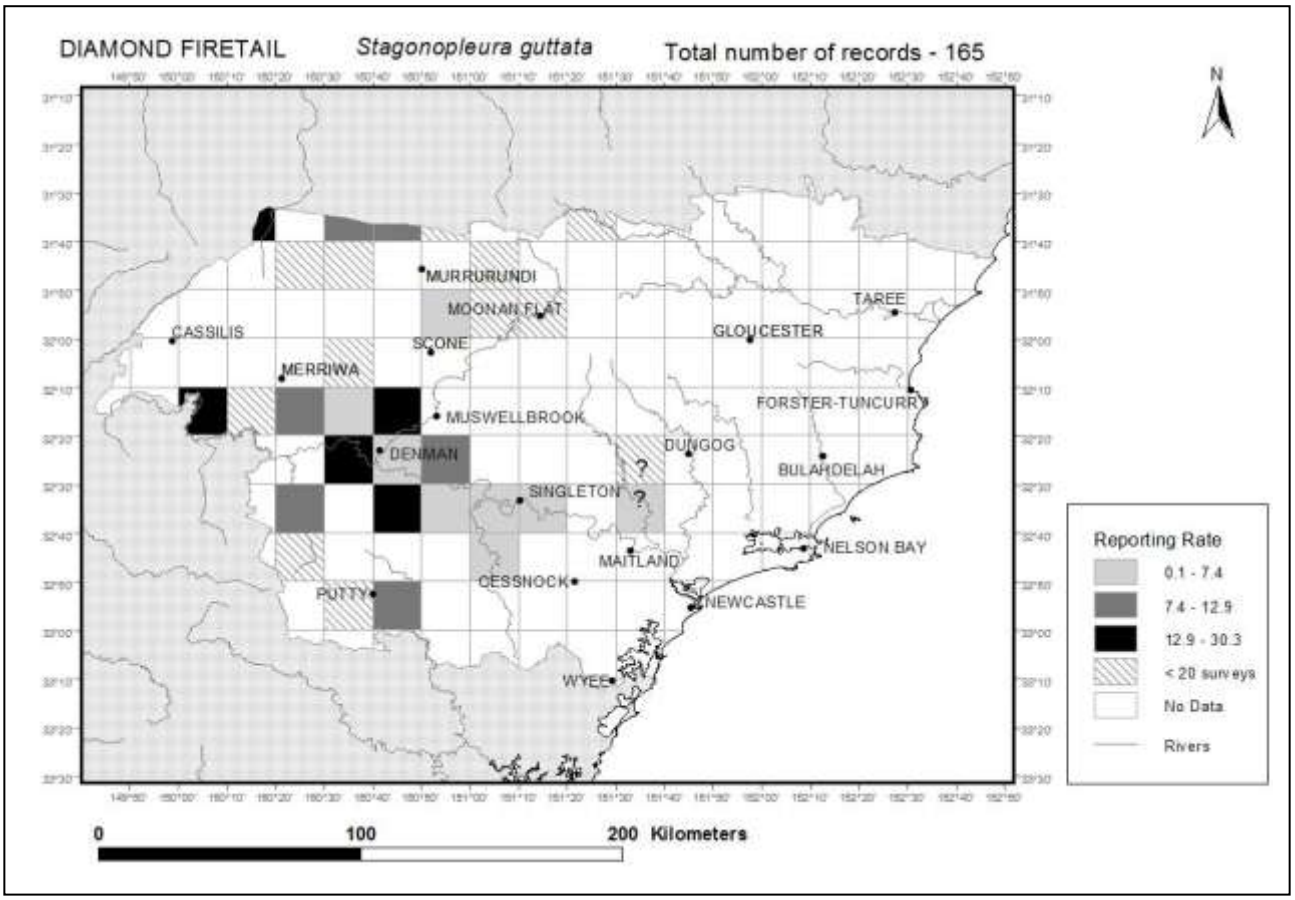

VARIED SITTELLA
Daphoenositta chrysoptera
Total number of records - 601
N
MURRURUNDI
MOONAN FLAT
TAREE
CASSILIS
SCONE
GLOUCESTER
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DUNGOG
DENMAN
BULAHDELAH
SINGLETON
MAITLAND
NELSON BAY
CESSNOCK
PUTTY
NEWCASTLE
WYEE
Reporting Rate
0.1 - 14.8
14.8 - 27.3
27.3 - 55.2
<20 surveys
No Data
Rivers
0
100
200 Kilometers


OLIVE WHISTLER
Pachycephala olivacea
Total number of records - 44
N
MURRURUNDI
MOONAN FLAT
TAREE
CASSILIS
SCONE
GLOUCESTER
MERRIWA
FORSTER-TUNCURRY
MUSWELLBROOK
DUNGOG
DENMAN
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
CESSNOCK
PUTTY
NEWCASTLE
WYEE
Reporting Rate
0.1 - 2.7
2.7 - 10
10 - 21.7
< 20 surveys
No Data
Rivers
0
100
200 Kilometers


SCARLET ROBIN
Petroica boodang
Total number of records - 113
N
MURRURUNDI
MOONAN FLAT
CASSILIS
SCONE
GLOUCESTER
TAREE
MERRIWA
MUSWELLBROOK
FORSTER-TUNCURRY
DUNGOG
DENMAN
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
CESSNOCK
PUTTY
NEWCASTLE
WYEE
Reporting Rate
0.1 - 5
5 - 10
10 - 32.8
< 20 surveys
No Data
Rivers
0
100
200 Kilometers


FLAME ROBIN
Petroica phoenicea
Total number of records - 57
N
MURRURUNDI
MOONAN FLAT
CASSILIS
SCONE
GLOUCESTER
TAREE
MERRIWA
MUSWELLBROOK
FORSTER-TUNCURRY
DUNGOG
DENMAN
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
CESSNOCK
PUTTY
NEWCASTLE
WYEE
Reporting Rate
0.1 - 9.2
9.2 - 25
25 - 70
< 20 surveys
No Data
Rivers
0
100
200 Kilometers


HOODED ROBIN Melanodryas cucullata
Total number of records - 109
N
MURRURUNDI
MOONAN FLAT
CASSILIS
SCONE
GLOUCESTER
TAREE
MERRIWA
MUSWELLBROOK
FORSTER-TUNCURRY
DUNGOG
DENMAN
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
CESSNOCK
PUTTY
NEWCASTLE
WYEE
Reporting Rate
0.1 - 8
8 - 17
17 - 33.3
< 20 surveys
No Data
Rivers
0
100
200 Kilometers


DIAMOND FIRETAIL Stagonopleura guttata
Total number of records - 165
N
MURRURUNDI
MOONAN FLAT
CASSILIS
SCONE
GLOUCESTER
TAREE
MERRIWA
MUSWELLBROOK
FORSTER-TUNCURRY
DUNGOG
DENMAN
BULAHDELAH
SINGLETON
NELSON BAY
MAITLAND
CESSNOCK
PUTTY
NEWCASTLE
WYEE
Reporting Rate
0.1 - 7.4
7.4 - 12.9
12.9 - 30.3
< 20 surveys
No Data
Rivers
0
100
200 Kilometers