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# Insights into Hunter Region birdlife using BirdLife Australia Atlas project data

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The Hunter Region has been classified into 60 mapping areas based on biodiversity and geographical/ topological commonalities. Using data from the BirdLife Australia Atlas project, a Reporting Rate was calculated for each species recorded within each bio-geographic sub-region. Maps have been generated showing Reporting Rate ranges in the sub-regions. These maps complement a previously described approach for showing species distribution within the region. They provide an easily assimilated overview of the general distribution of a species within the region, in particular where the strongholds are and the areas where the species is uncommon. As such, they should prove very useful for a range of educational purposes and as a guide for the vetting of records.

To illustrate the capability of the new approach, maps have been generated for five species with varying distributions within the region: Wonga Pigeon *Leucosarcia melanoleuca*, Crescent Honeyeater *Phylidonyris pyrrhopterus*, Little Eagle *Hieraaetus morphnoides*, Western Gerygone *Gerygone fusca* and Brown Gerygone *Gerygone mouki*.

A method for generating timelines for migratory species using Atlas data has also been developed. The timelines indicate the likelihood of the species being present in the Region on any given date. To illustrate the capability, timeline charts are presented for two species, the White-fronted Tern *Sterna striata* and the Common Tern *Sterna hirundo*. These are generally considered to be winter and summer visitors respectively to the region. The timeline chart for Common Tern reveals that it over-winters at least on occasions.

## INTRODUCTION

The current BirdLife Australia (BLA) Atlas project ("the Atlas") commenced in 1998. The first four years (termed the New Atlas) resulted in a published important reference resource for Australian ornithology (Barrett *et al.* 2003). This included a comparison with the Field Atlas (Blakers *et al*. 1984) conducted 20 years earlier. The NSW Bird Atlas (Cooper *et al.* 2015) continued the Field Atlas in NSW. The BLA Atlas data established by the New Atlas has continued to be built in the Ongoing Atlas project. The BLA Atlas differs from previous atlases (Blakers *et al*. 1984; Cooper *et al*. 2015) by using "point" based surveys (i.e. defined by latitude and longitude) and defined ranges of survey effort (e.g. incidental records, 2ha:20 minute surveys and area surveys; Barrett *et al*. 2003).

Many members of Hunter Bird Observers Club (HBOC) are regular contributors to the Atlas and the club actively promotes participation by local birdwatchers. Records from HBOC's field program (outings, camps, focussed surveys) are submitted to the Atlas (involving almost 1,500 surveys).

Commencing 2010, HBOC has received from BLA an annually updated export of all the Atlas records from the Hunter Region since 1998, when the New Atlas phase commenced. Since 2010 Hunter Region Annual Bird Reports have contained summaries relating to the region's resident species and regular visitors (Stuart 2011). For each species, the main Atlas information presented has been:

- Reporting Rate since 1998 which provides an indication of how common (or detectable) it is within its regional distribution.
- The percentage of 10-minute grid cells for which there have been records. This provides an indication of the extent of its distribution.
- For the current year, the number of Atlas records, the Reporting Rate and the number of 10-minute grid cells in which there were records. This allows comparison between the current year and the long-term situation.

The Hunter Region Atlas data have also been analysed in several studies of species or groups of species, for example Williams (2013), Newman & Lindsey (2014), Newman (2015). However, the Atlas database's potential seemed under-utilised. It is based upon over 30,000 surveys in the Hunter Region, comprising more than half a million records of individual species. Thus, it has the potential to be a powerful resource for analysis and education.

In this paper, we describe two new approaches for analysing Hunter Atlas data. One innovation is a method for generating species distribution maps; the other involves producing timelines for when migratory species are present.

## METHODS

A Google Earth polygon file is available that precisely defines the Hunter Region boundaries (D. Williams unpublished). A copy of the shapefile is located at http://www.hboc.org.au/resources/hunter-region.kml. BLA extracted every Atlas record falling within the polygon boundary, and supplied them as an Excel file.

Standard mathematical manipulations within the Excel software program were used to produce species timelines. The number of Atlas records for a given species for each week of the year was determined, and then the cumulative frequency distribution of weekly records throughout the calendar year. One of two possible origins was selected – 1 January or 1 July (for winter and summer migrants respectively). Time periods were then classified according to whether their mean numbers of weekly records were within 1, 1.5, 2, 2.5 or >2.5 standard deviations from the overall weekly mean.

To generate distribution maps, the Atlas data were imported into the software program ESRI ArcGIS where they could be overlaid with relevant bio-geographic information which was generated as follows. Using ESRI ArcGIS, the Hunter Region was divided into a set of 60 bio-geographic mapping areas ("polygons"). The selection of each polygon boundary involved careful analysis, with the need to balance several factors:

- Presence of a dominant habitat type within the polygon, also taking into account the extent of clearing of vegetation for residential, industrial or agricultural purposes. Some consideration was also given to other geographical factors including topography, geology/soils, vegetation, and river catchment;
- Sufficient Atlas surveys had been conducted in the polygon – a criterion selected was that there be a minimum of 50 surveys conducted in a polygon (only three of the 60 polygons have less than 80 surveys and most have several hundred);
- If the data set for a polygon was dominated by surveys from a small number of locations, the habitat type at all of these was representative of the overall polygon.

The Atlas records include precise latitude and longitude co-ordinates for each survey, and so they were able to be assigned to the polygon within which they were collected. Then for each species in each polygon, a Reporting Rate index (RR) was calculated:

$$RR = N_R/N_S$$

where $N_R$ is the number of records for the species in the polygon;
and $N_S$ is the total number of surveys in the polygon (including all survey types).

It should be emphasised that the above RR differs from the RR usually used (e.g. in the Annual Bird Reports; Stuart 2011), in that records from incidental surveys are included. Uncommon species are more likely to be reported from an incidental survey, potentially leading to a degree of over-reporting for them. This is balanced by the desirability, for distribution maps, of capturing all known records, especially for uncommon species.

## RESULTS

### Species distribution mapping

Informative distribution maps were generated by plotting the RRs (as ranges) within each polygon by choropleth mapping, a frequently used method which uses either different colours or a graduated colour scale in order to show value levels in defined areas on a map. Through trial and error, it proved effective to use four ranges of RR (<0.02, 0.02-0.10, 0.10-0.30 and >0.30). Different choropleth range selections might be appropriate in certain circumstances and this would be easily enacted. The lowest range highlighted extremes in the range of a species, and also was useful for mapping the distribution of uncommon species with relatively few records in the Atlas database. For polygons with fewer than three records, those records perhaps require more careful scrutiny and so they were not included into the mapping. At the limits of a species' range (i.e. RR < 0.02) there is a need for further investigation in terms of increased survey effort and validation of records, particularly in polygons with less than three records of a species.

By way of example, **Figure 1** illustrates the distribution map for Wonga Pigeon *Leucosarcia melanoleuca*. The map shows that the most likely places within the Hunter Region to record Wonga Pigeon are in parts of the Upper Manning, Barrington Southern Slopes and the Wollemi/Yengo Massif, and to the west of Port Stephens and Great Lakes. By contrast, it would be very unusual to find Wonga Pigeons at locations within the Hunter Valley, Merriwa Plateau or Liverpool Plains. For convenience for the above discussion and similar ones, the Hunter Region was also divided into 15 sub-regions, as shown in **Figure 2**. These sub-regions also have common bio-geographic factors and initially were trialled as the basis for choropleth map generation. However, for species with specialised habitat requirements, they were found to be insufficiently detailed. The sub-region boundaries have been retained in the maps as they assist orientation. **Figure 2** includes latitude and longitude graticules for the Hunter Region, which is approximately centred on 32.5ºS 151.5ºE.

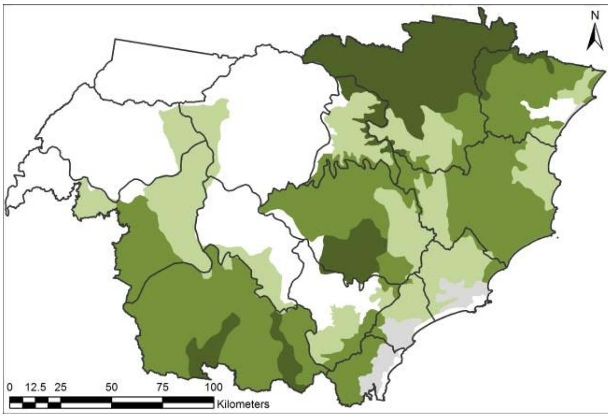



**Figure 1.** Distribution map for Wonga Pigeon

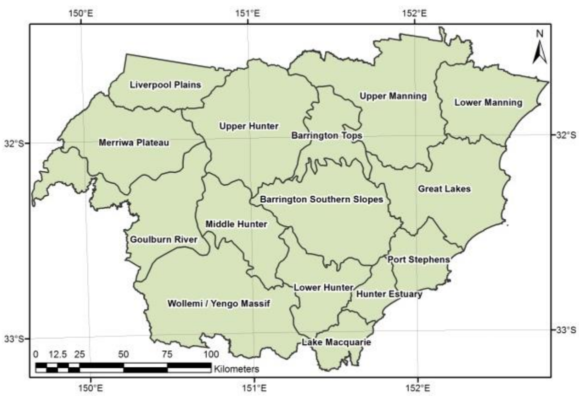


**Figure 2.** Hunter Region sub-regions

## Timelines for migratory species

Data from the Atlas were analysed to generate timelines indicating when each migratory species was likely to be present in the region. Two examples of species timelines are shown in **Figures 3** and **4**, for the White-fronted Tern *Sterna striata* and the Common Tern *Sterna hirundo*. These are considered to be winter and summer visitors respectively to the region (Stuart 2016).


**Figure 3.** Timeline for White-fronted Tern


**Figure 4.** Timeline for Common Tern

## DISCUSSION

### Species distribution mapping

Maps were generated for four additional species, in order to demonstrate a range of applications of the method. An example of a species with a narrow regional distribution is given in **Figure 5**, for the Crescent Honeyeater *Phylidonyris pyrrhopterus*. **Figure 5** confirms the general view (Stuart 2016) that the local range for this species is limited to the higher altitude area of the Barrington Tops and Gloucester Tops. In contrast, the Little Eagle *Hieraaetus morphnoides*, as an apex predator, is an example of a species having wide distribution and low abundance, such that it is recorded only intermittently. The distribution in **Figure 6** suggests the Little Eagle avoids higher altitude areas.

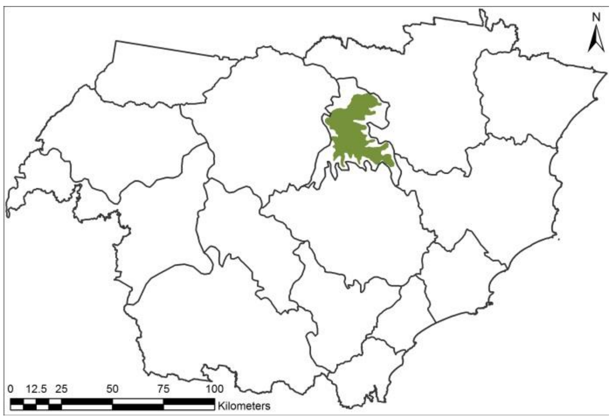


**Figure 5.** Distribution map for Crescent Honeyeater

**Figures 7** and **8** compare the distributions of Western Gerygone *Gerygone fusca* and Brown Gerygone *G. mouki*. These two species are similar in appearance and potentially can be a source of identification confusion for some observers. The Western Gerygone is generally considered to be an inland species (Stuart 2016). **Figure 7** confirms this, with all records originating from the west of the region and in particular from the Liverpool Plains. In contrast, the distribution for Brown Gerygone (**Figure 8**) is predominantly in the east and central parts of the region. The western records are limited to areas around the Coolah Tops. The two species have almost mirror image distributions within the region, which mapping demonstrates very effectively.

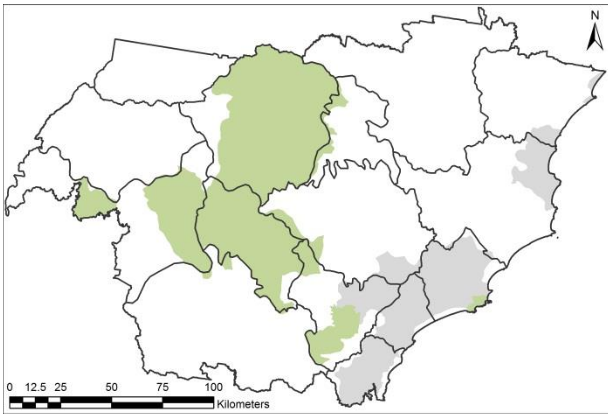


**Figure 6.** Distribution map for Little Eagle

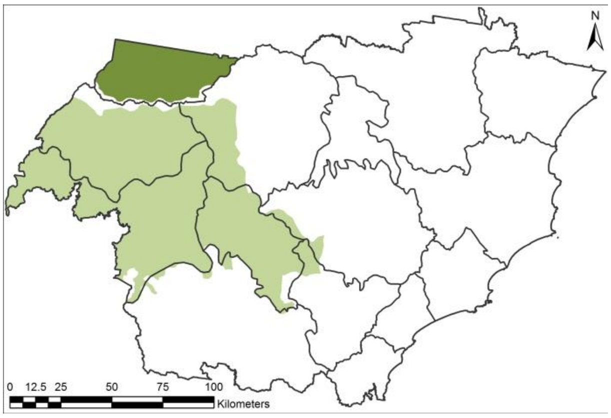


**Figure 7.** Distribution map for Western Gerygone

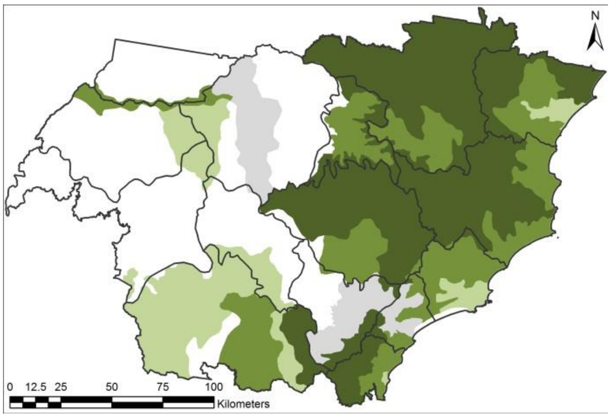


**Figure 8.** Distribution map for Brown Gerygone

Seasonal distribution maps also can be readily generated. The accompanying paper in this issue (Stuart & Williams 2016) presents summer and winter distribution maps for the migratory Rose Robin *Petroica rosea*.

## Comparisons with other mapping approaches

Most maps of species distributions show the Hunter Region at a very broad scale, for example involving 1-degree grids (Blakers *et al.* 1984, Barrett *et al.* 2003). As such, they contribute little to local understandings. Newman *et al.* (2010) developed a more finely detailed approach, producing maps for 42 NSW threatened species in the Hunter Region based on a grid scale of 10 minutes latitude / longitude. Cooper *et al*. (2015) provide distributional information based on the presence of a species at a 10-minute scale, but only show variations in RR at the 1-degree scale. A limitation of the approach used by Newman *et al*. (2010) was that varying survey effort in adjacent 10-minute grid cells sometimes introduced statistical anomalies, which suggested changes in RR that may not have been real. For data-rich common species, this should become less of an issue. The approach used in this paper provides a degree of smoothing which should be beneficial in limiting the impact of anomalies.

Whitehead *et al.* (2015) used records from the NSW Wildlife Atlas plus vegetation, climate and topography data to develop predictive models of species distributions (and thence, identifying high priority areas for conservation). The NSW Wildlife Atlas has a smaller data set than does the BLA Atlas and is arguably less well vetted.

The approach to mapping described in this paper involves a form of predictive modelling. A key assumption is that if a species was recorded at some readily accessible location, it is about equally as likely to be present in adjoining areas of suitable habitat which are less accessible (e.g. on private property). If the other sites are relatively close by, this assumption should generally be valid.

The flexibility of the adopted approach will also enable additional factors to be taken into account, such as RR calculation adjustments based on the proportions of each survey type (2ha, area and incidental) and the seasonal distribution of records within each polygon.

## Timelines for migratory species

The comparison of weekly number of records to the mean number of weekly records indicates the likelihood that a species will be present in the region on any given date. It is not a measure of abundance, merely of presence/absence. It is suggested that the ranges are interpreted in the following empirical terms: dark green SD <1.0 from the mean weekly average, birds are regularly present; medium green SD 1.0-1.5 usually present; light green SD 1.5-2.0 sometimes present; grey SD 2.0-2.5 occasionally present; white SD > 2.5 rarely present.

The timeline chart for White-fronted Tern, **Figure 3**, shows that these birds are regularly present from early July to mid-September, usually recorded in May and September and sometimes in April and October. They occasionally are recorded in March, but rarely so in January-February or November-December. From the timeline, observers may discern that records of White-fronted Tern in the periods January-April and October-December are noteworthy and important (and that extra care is therefore needed to correctly identify the species at such times).

For the Common Tern (**Figure 4**), birds are regularly present between January and mid-March and in November-December, and are usually present in late March and in October. However, there are records of them throughout almost all of April to September, albeit far less frequently than in the other six months. Thus while the White-fronted Tern has the characteristics of a winter migrant, the Common Tern is revealed to over-winter at least on occasions, though with a summer influx.

In generating species timelines, two notes of caution need to be recognised:

- A species needs to be already considered a migrant before applying a timeline analysis to it. Some species, which are resident in the region, become less detectable in winter (e.g. they call less frequently) and it may appear that they are absent when in fact they are not. Understanding these variations is another potential application of the method.
- The use of a cumulative frequency approach (rather than the frequency for each individual week) assists to smooth anomalies within the recorded data. However, for less common species (i.e. with fewer records in the database) this may become a limitation.

## CONCLUSIONS

Species distribution maps were able to be generated using Atlas records coupled with detailed bio-geographic information. Where the regional distribution was already reasonably well understood, the maps have agreed with general understandings. This gives confidence that they will also be useful in helping develop perspectives about less well understood species.

The Hunter Region hosts many migratory species. Most are “summer migrants” but some are not. Every migratory species has arrival and departure dates which are broadly consistent most years, but those dates can differ substantially from those for other species. Timelines were able to be generated from Atlas data to depict the probability that a migratory species will be present on any given date.

The potential of both these approaches in educating birdwatchers as to where and when a species is most likely to be found within the Hunter Region (and, conversely, when records could be considered anomalous) is obvious. It is intended that future Hunter Region Annual Bird Reports will include distribution maps for common species and timelines for migratory species. The availability of this information should assist in vetting records.

When sufficient data becomes available, both the distribution maps and timeline charts may be applied to comparisons between different sets of years, to provide insights into changes over time. Also, the timeline analyses potentially may be applied to sub-regions, generating additional insights.

## ACKNOWLEDGEMENTS

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