Identification of potential echidna roadkill hotspots in south-east Queensland

Authored by:
Andrew Mackey
BioGeo
Franklin Street, Annerley, Brisbane QLD 4103
Andrew.mackey@BioGeo.com.au

Reviewed by:
Matt Cecil and Peter Ogilvie
Wildlife Preservation Society Queensland
Suite 1, Level 1 30 Gladstone Road, Highgate Hill, Brisbane QLD 4101
wpsq@wildlife.org.au

1. Introduction

BioGeo was asked by the Wildlife Preservation Society of Queensland (WPSQ) to investigate uses and practical applications for observational data of echidna sightings across Queensland. The data stemmed from an initiative named Echidna Watch, which was set up to encourage the public to record sightings of echidnas via an online questionnaire, with the aim to gather information on their distribution and abundance. As a result, WPSQ obtained a dataset that detailed the occurrence coordinates of echidna's over several years and across the state.

Given that the data largely contained observations close to population centres, roads, tracks and highways, we therefore attempted to use the data to help develop a GIS based roadkill hotspot model to identify suitable locations for wildlife movement and mitigation measures. We also linked those "hotspots" to specific regions in order to identify those administrative regions that would most benefit from such measures, and whom to approach for funding their installation.

General observations in respect to seasonal, latitudinal, and regional differences are also discussed, as well as limitations and caveats to this study and the dataset, and recommendations for recording observations and subsequent analysis.

2. Methods

Sources of data

The data retrieved contained recorded sightings from 642 observations between mid-2012 and 2018; however, only 295 contained a precise location, address, or coordinates. We therefore supplemented these data by obtaining equivalent observational records from the Global Biodiversity Information Facility (GBIF). In doing so, we selected only recorded sightings between 2013-2018, and those located within Queensland, totalling 241 records (536 combined). As GBIF provides a repository for species observations from a broad range of sources, we made checks to ensure that observations were not duplicated.

Additionally, we obtained a dataset from Department of Natural Resources, Mines and Energy (Queensland Government) named - State Digital Road Network (SDRN), which contains all known baseline roads and tracks for Queensland. This dataset represents street centrelines across the state with attribution data including street name, road classification, route numbers (State and National), and unique identifiers. We limited our analysis to only freeways/motorways, highways, secondary roads, local connector roads and busways, and excluded bikeways, 4WD tracks and construction lines as these were deemed irrelevant (e.g. unlikely to be the sites of collisions).

Administrative areas (suburb boundaries) were also obtained as a shapefile (SHP file) via the Diva-GIS data download page (http://www.diva-gis.org/gdata).

The combined echidna observation dataset (WPSQ and GBIF data combined), and the SDRN were plotted and a map generated using QGIS 3.10 with a UTM zone 56S projection. Observations and SDRN data were colour coded to highlight seasonal differences and road types along with a simple outline of administration boundaries (Figure 1).

Figures as static PDFs and their legends are contained within this document (under Section 6) but georeferenced PDF documents that allow the user to toggle layers (and base maps) independently and zoom to specific areas within the document are supplied separately.

Spatial analysis

To identify sections of road with the highest number of observations (i.e. "hotspots"); we first divided the lines and polylines from the SDRN dataset into 100m long road segments. Second, we created a 250m buffer either side of the centrelines and ran a query to count the observations within each road buffer segment. The roads were segmented in order to isolate specific stretches of road to pinpoint areas for mitigation strategies. Third, we ran a query (and applied a

spatial join) to count the number observations within each QLD administration boundary. We define a hotspot as any 100m road segment that contains two or more observations within its 250m buffer, either side of its respective centreline.

To describe regionally and geographically the distribution of observations across Queensland, we performed spatial joins between the observational dataset and that of administrative areas (suburb boundaries), and 25km sq. grid squares.

3. Results

A total of 47 hotspots were identified with 38 containing two observations, seven with three observations, and one each containing four and five observations (Table 1 and Figure 2). Figure 3 pinpoints hotspots with ≥ 3 observations along with ground level images courtesy of Google Maps Street View (Google). Tin Can Bay Road had by far the largest number of hotspots (12) with one single stretch containing five observations, while Beenleigh Redland Bay Road was the site of the second largest hotspot with four observations.

Table 1 - Road segments defined as echidna hotspots (e.g. ≥ 2 observations within 250m of a 100m segment of road). Road segments with ≥ 3 observations are highlighted bold.

Road name	Admin area	Number of hotspots				
Hotspots categorised by no. of observations		**2**	**3**	**4**	**5**	**Total**
Tin Can Bay Road	Cooloola (ex. Gympie)	9	**2**		**1**	12
Springwood Road	Springwood	5				5
Mary Valley Road	Cooloola (ex. Gympie)	3	**2**			5
Toohey Road	Tarragindi & Salisbury/Nathan	5				5
New England Highway	Crow's Nest - Pt B	1	**2**			3
Beenleigh Redland Bay Road	Carbrook-Cornabia	1	**1**	**1**		3
Tanah Street West	Maroochy - Coastal North	3				3
Lyndale Street	Daisy Hill-Priestdale/Shailer Park	2				2
Mount Cotton Road	Carbrook-Cornabia	2				2
Rafting Ground Road	Brookfield (Inc. Brisbane Forest Park)	1				1
Charles Street	Birkdale	1				1
Highfields Road	Crow's Nest - Pt A	1				1
Cedar Pocket Road	Cooloola (ex. Gympie)	1				1
Meringandan Road	Crow's Nest - Pt A	1				1
Yandina Coolum Road	Maroochy	1				1
Aerie Court	Springwood	1				1
	Totals	**38**	**7**	**1**	**1**	**47**

Spatial distribution

Most of the observations were within or close to population centres with a bias towards metropolitan Brisbane and more broadly to South East Queensland (e.g. >74% of the observations found at around -28°) (Table 2).

Table 2 - Observations (number and %) divided into latitudinal segments

Latitude*	No. of Observations	% of observations
-30	29	5.4
-28	397	**74.1**
-26	30	5.6
-24	17	3.2
-22	14	2.6
-20	19	3.5
-18	29	5.4
-16	1	0.2

**Based on data rounded to the nearest whole coordinate*

Regional distribution - administrative areas (suburb boundaries)

Cooloola (excl. Gympie) had by far the largest number of observations (51) followed by Gatton (28), Beaudesert - Pt A (23) and Crow's Nest (part A and B) (22). A level below, Carbrook-Cornubia, Pine Rivers and Brookfield (incl. Brisbane Forest Park) contained 13,11 and 10 observations, respectively (Table 3 and Figure 4).

Table 4 - Observations QLD administration area

Administration area	No. Observations
Cooloola (excl. Gympie)	51
Gatton	28
Beaudesert - Pt A	23
Carbrook-Cornubia	13
Crow's Nest - Pt B	12
Pine Rivers Bal	11
Brookfield (incl. Brisbane Forest Park)	10
Crow's Nest - Pt A	10
Maroochy - Buderim	8
Noosa Bal	8
Banana	7
Beaudesert - Pt C	7

Geographical distribution

The grid cells with highest number of observations where located around Brisbane (south-west of Brisbane = 51, south-east Brisbane = 46, and north-west Brisbane = 39) (Figure 5). Notable clusters in the south-east of Brisbane were in the vicinity of Indooroopilly, St. Lucia, Tarragindi, and Corinda and Sherwood, which include observations from urban areas close to the Brisbane River (south-east Brisbane). In the south-west, clusters were also noted in and around Springwood/Slacks

Creek and Carbrook-Cornubia, and around Albany Creek to the north-east of Brisbane (Figure 4 inset: South East Queensland).

There were also relatively high numbers in the grid south of Toowoomba (26), with clusters close to Mount Ridgely and Mount Campbell, and the area of Cooloola to the north-west of Gympie where the clusters were largely contained within the predefined hotspots (e.g. along Tin Can Bay Road).

Seasonal distribution

The seasonality of the data shows a greater number of sightings during the autumn and winter months (27% and 38%, respectively); particularly between May and September (~63%). Only 35% of the sightings were recorded across the spring and summer months combined (Table 4).

Table 4 - % of observations by month and season

Month	% of
January	4.9
February	3.7
March	4.9
April	8.0
May	14.0
June	14.6
July	11.9
August	11.8
September	10.3
October	6.7
November	4.1
December	5.2

Season	% of
Winter	38.2
Autumn	26.9
Spring	21.1
Summer	13.8

4. Discussion

Hotspot locations

Most of the observations contained within hotspots were recorded on or immediately adjacent to the roads and were possibly records of roadkill or echidnas attempting to cross (although this data was not recorded). Given the higher numbers at these locations, the open surroundings, and proximity to National Parks, forests, plantations, bushland, or meadows, it is perhaps not surprising that these stretches are highlighted.

However, although the numbers of observations are higher at these locations, they are somewhat modest. The reason why this would be is possibly down to when echidnas are most active. In hot climates echidnas typically restrict their movements to between dusk and dawn due to their sensitivity to temperatures above 30ºC (Augee et al. 2006). Because the recorded observations will be naturally biased towards daytime sightings (due to visibility and/or more “eyes” on the ground), the numbers here are likely underrepresented.

Therefore, we would suggest that before these areas are earmarked for mitigation strategies (such as tunnel crossings), they are instead targeted for further investigation incorporating night-time activities. This could be easily be achieved by installing motion sensor activated cameras at these locations along with other random points to provide background comparisons. In the interim, however, the highlighted hotspots would undoubtedly be good candidates for signage (warning drivers to slow down), which would likely benefit a range of species in addition to echidnas.

Seasonal distribution

Although found throughout Australia and in widely differing climates, echidnas are most active when temperatures fall between 16-20°C (Abensperg-Traun and Boer 1992; Augee et al. 2006; Wildlife-Queensland 2011). In south east Queensland, where most of the observations were recorded, this optimal range is consistent with evening-night-time temperatures in summer but daytime temperatures in winter (or at least up to mid-morning or from late afternoon-early evening). Therefore, it seems logical that there is a bias in the data to the cooler months, where there would be a higher probability of daytime encounters between echidnas and the public.

Spatial distribution

Unsurprisingly the observations closely correlate with populations centres, given that the data represents recordings by the public, albeit within bushland within or on the fringes of towns and cities. However, the data also shows specific pockets of bushland within Brisbane where echidnas are present and could be targeted as areas for protection.

Caveats and limitations

There are a number of caveats to using these data to determine potential roadkill hotspots: (1) the observations are not necessarily of roadkill sightings; (2) the roads have not been viewed on the ground; and (3) we have used an arbitrary and uniform buffer (of within 250m) to determine what we define “close proximity”; which is clearly very simplistic and neglects any differences among roads and their accessibility to small ground dwelling echidna’s. There were also limited data or data that had to be discarded because the observations were not precise enough to generate accurate coordinates.

Conclusion

In summary, our study has identified a number of road segments that may benefit (following further investigation) from mitigation measures. It also outlines a method for identifying road hotspots from observational data that could be applied to wildlife generally, and we would welcome the opportunity to apply our method to other sets of data.

5. References

Abensperg- Traun M, Boer ESD (1992) The foraging ecology of a termite- and ant- eating specialist, the echidna Tachyglossus aculeatus (Monotremata: Tachyglossidae). J Zool 226:243–257. doi: 10.1111/j.1469-7998.1992.tb03837.x

Augee M, Gooden B, Musser A (2006) Echidna: extraordinary egg-laying mammal. CSIRO Publishing.

Wildlife-Queensland (2011) Short-beaked Echidnas Land for Wildlife Queensland: Note A6.

6. Figures (overleaf)

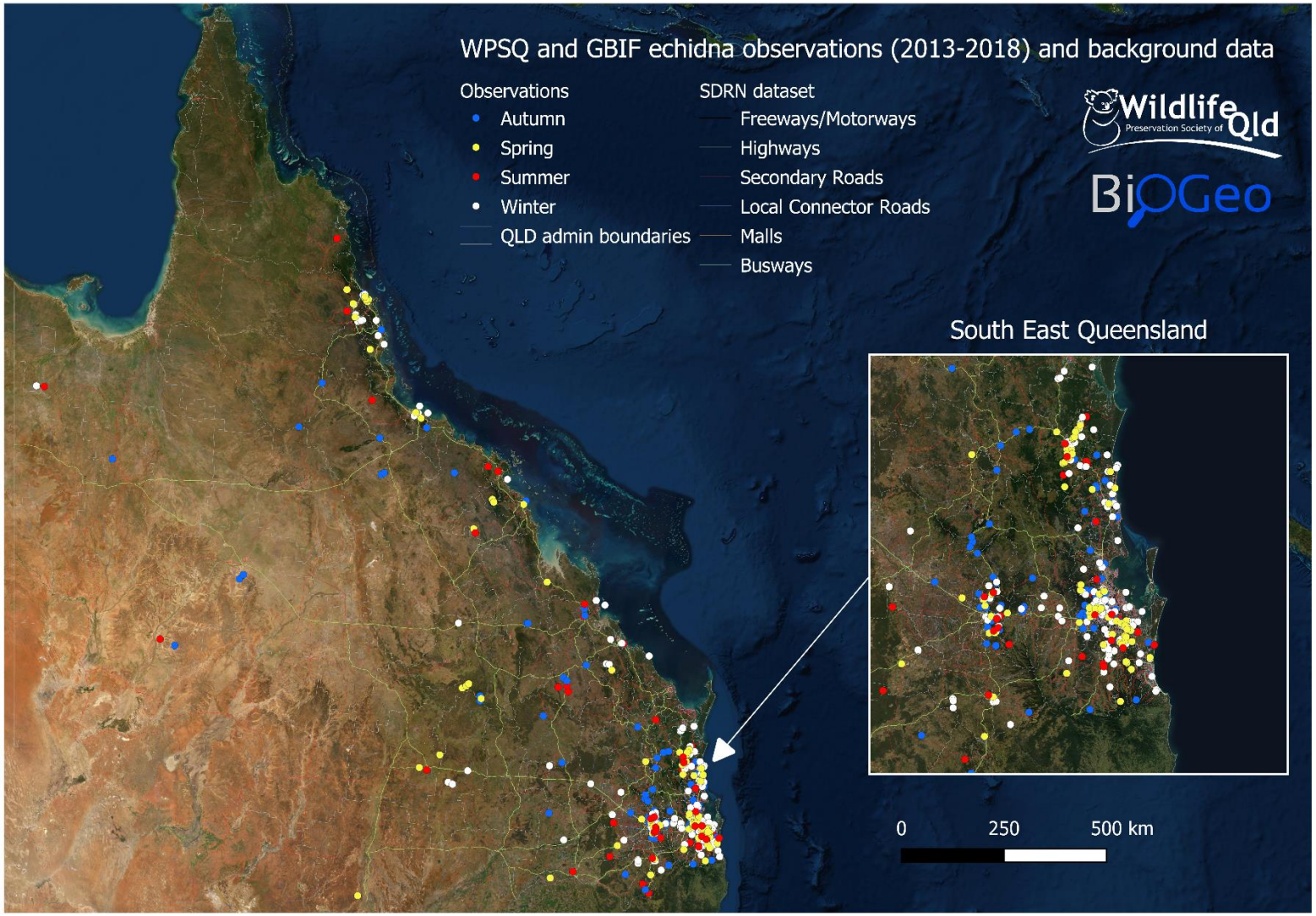

Figure 1 – WPSQ and GBIF echidna observations (2013-2018) and background data. The combined echidna observation dataset and the by number of observations counted within each respective 250m buffer (blue-red colour ramp). SDRN road network colour coded to highlight seasonal differences and road types along with a simple outline of administration boundaries.

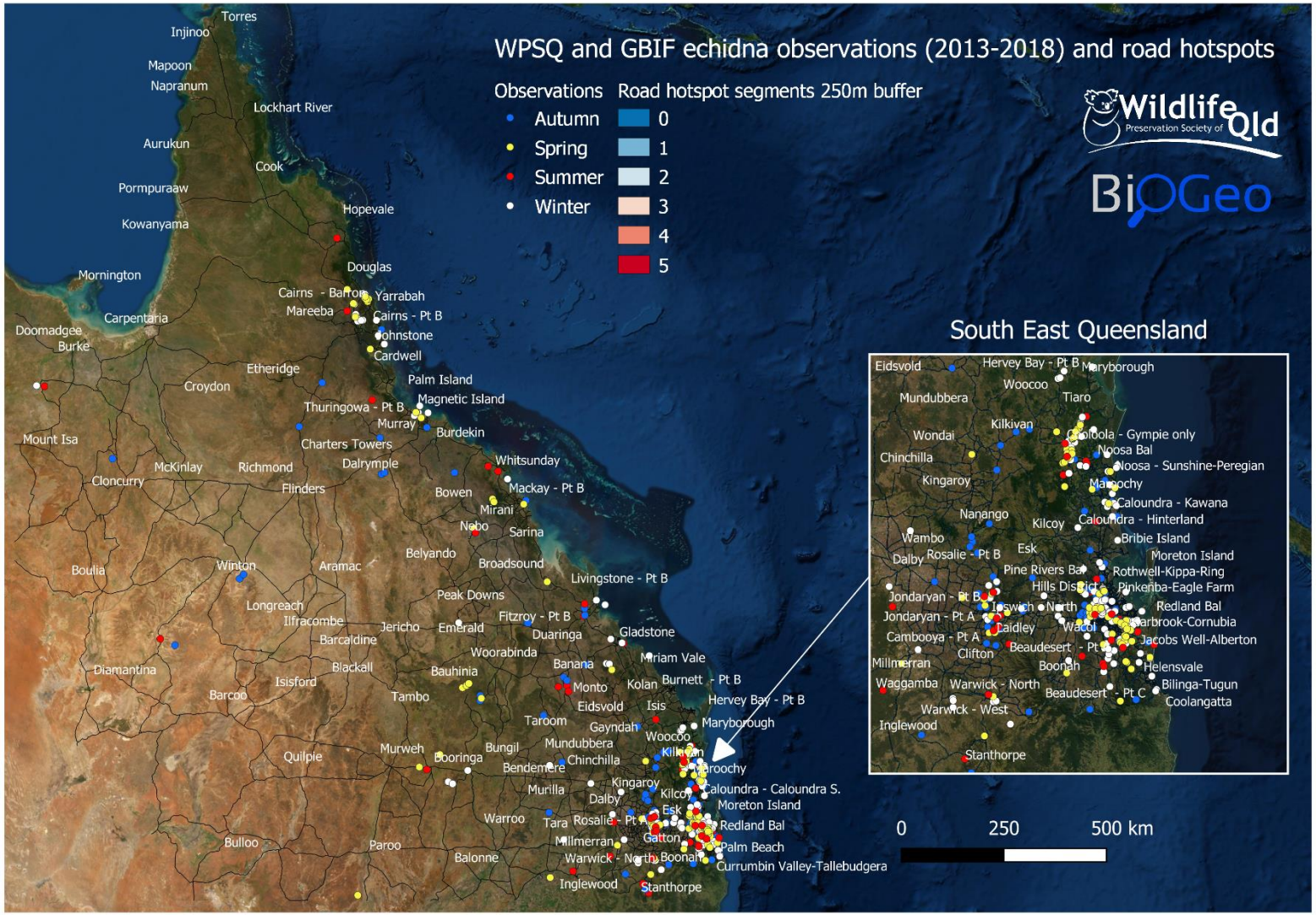

Figure 2 - WPSQ and GBIF echidna observations (2013-2018) and road hotspots. SDRN data divided into 100m road segments coloured number of observations.

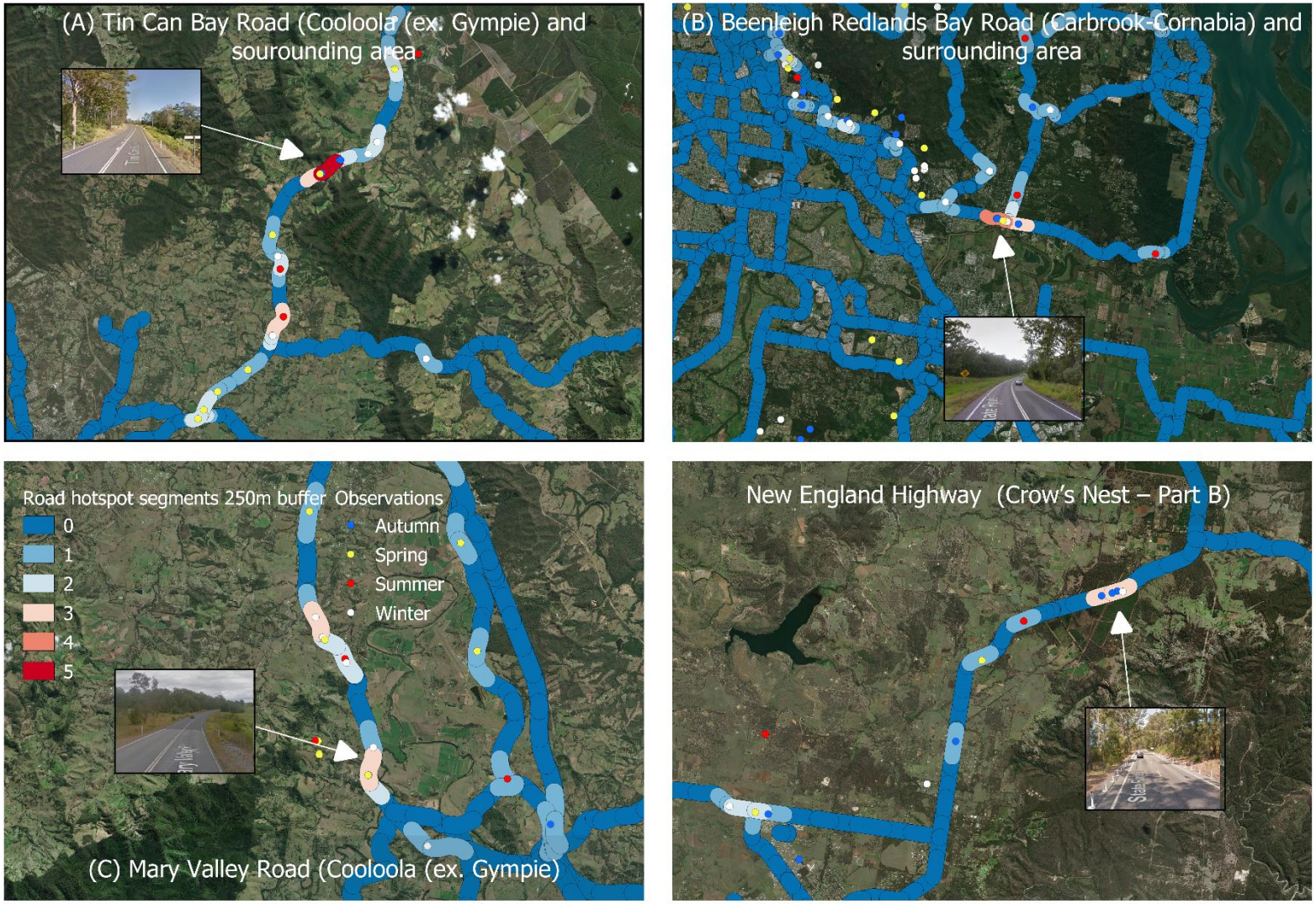

Figure 3 - Hotspots with ≥ 3 observations along with ground level images courtesy of Google Maps Street View (Google).

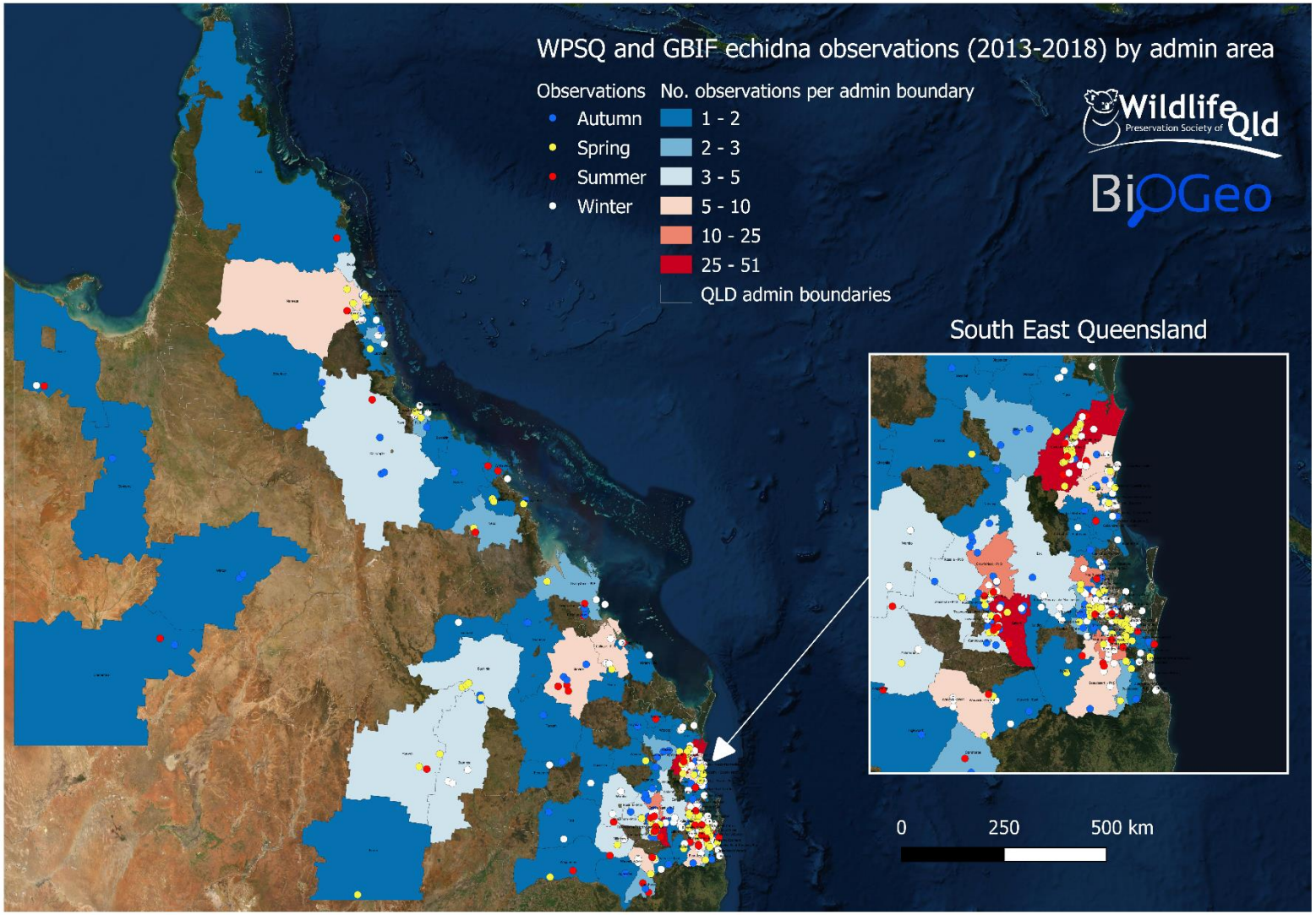

Figure 4 - The combined echidna observation dataset (WPSQ and GBIF data combined) by admin area. Count of observations within administrative areas (suburb boundaries) (blue-red colour ramp).

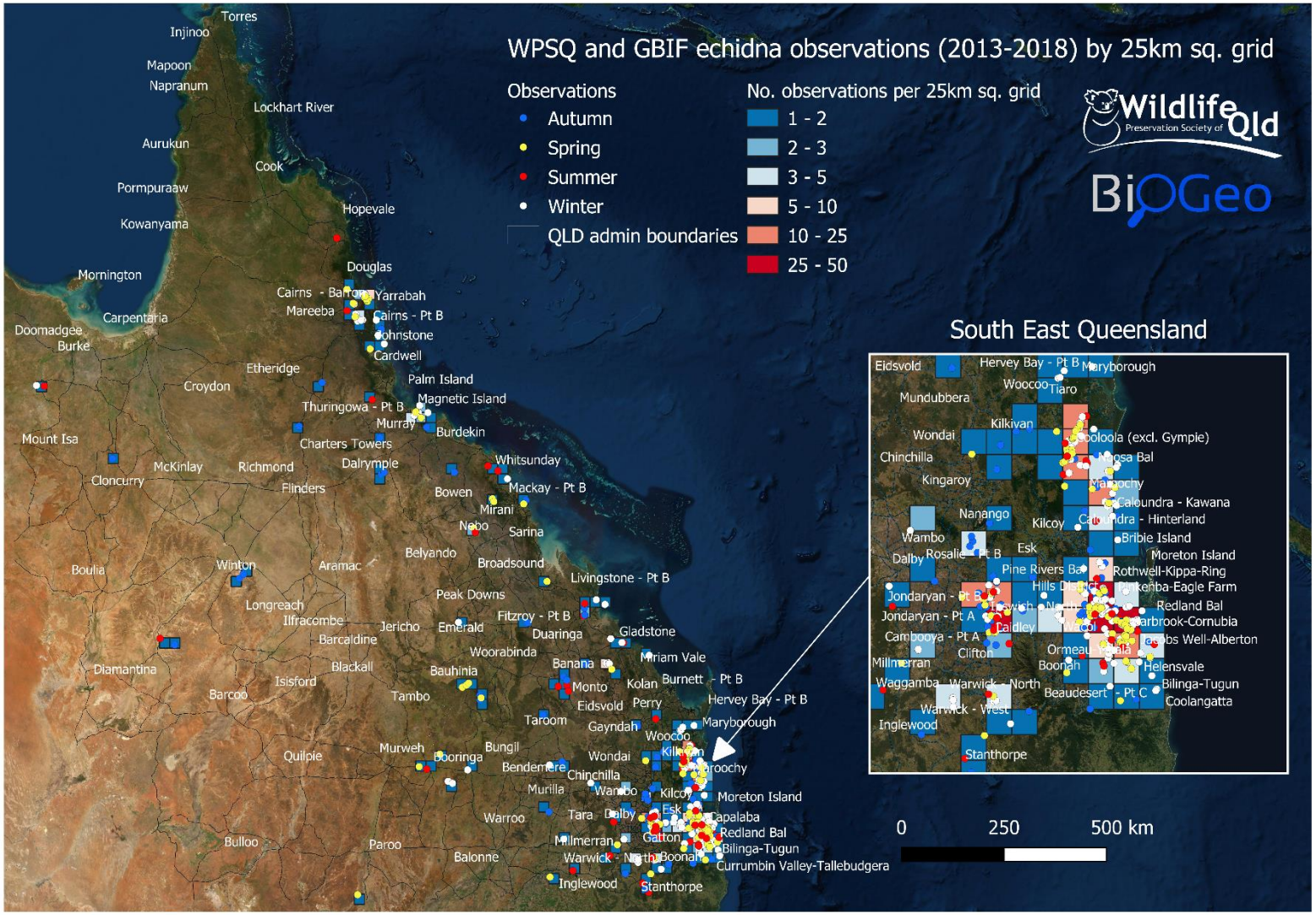

Figure 5 - The combined echidna observation dataset (WPSQ and GBIF data combined) by 25km sq. grid cell (blue-red colour ramp).