Biota Environmental Sciences

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Albany Mounts Western Ringtail Possum Population Assessment

The City of Albany commissioned Biota Environmental Sciences (Biota) to undertake a population assessment of Western Ringtail Possums on Mounts Clarence, Adelaide and Melville to support an assessment by the Federal Department of Environment and Energy (DoEE) of proposed works in those reserves.

Background

Western Ringtail Possum

The Western Ringtail Possum (*Pseudocheirus occidentalis*) is a nocturnal, arboreal marsupial found in the south-west corner of Western Australia. The species is patchily distributed coastally from the southern Swan Coastal Plain to the Albany region, and inland in the forests of the Upper Warren region near Manjimup (Woinarski et al. 2014).

Western Ringtail Possum populations have declined markedly in recent decades, with a decline of >95 % reported from the Upper Warren region, and an inferred population-wide decline of >80 % (Wayne et al. 2012, Woinarski et al. 2014). As a result of these declines, the species is now listed as Critically Endangered at both state and federal level. The primary threats to the species are a drying climate and increased extreme weather events as a result of climate change, inappropriate fire regimes, habitat loss and fragmentation, logging, and predation by introduced cats and foxes (Woinarski et al. 2014).

The latest published population estimate for the species is 3,400 adult individuals across the species' range in 2015 (TSSC 2018). However, extensive recent survey work by Biota Environmental Sciences has indicated that the population is likely to be significantly greater than this estimate. Our work thus far has produced an estimate of approximately 17,200 individuals, including subadults, in larger remnant bush blocks across the species' range (Biota in prep.). This estimate is conservative, as it does not account for individuals in urban, peri-urban and agricultural areas.

Study areas

The two study areas, Mounts Clarence and Adelaide (together considered a single study area), and Mount Melville, are located within the City of Albany, on the south coast of Western Australia approximately 390 km south-east of Perth. Both locations are underlain by

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porphyritic granite and felsic gneiss (Fitzsimons and Buchan 2005), which have resisted erosion and formed the characteristic mounts seen today. The vegetation in most areas is dominated by jarrah (*Eucalyptus marginata*) and marri (*Corymbia calophylla*) woodland, interspersed with other species such as sheoak (*Allocasuarina fraseriana*), peppermint (*Agonis flexuosa*) and *Eucalyptus staeri*. Areas of shrubland and thickets of *Hakea*, *Gastrolobium* and *Spyridium* are patchily distributed through both study areas where they are prevalent on shallow soils surrounding exposed granite and also in the eastern coastal section of Mount Clarence. Disturbed areas such as cleared grass and parklands, and a variety of infrastructure were present in both study areas. In addition, both areas are traversed by a number of cleared trails used for recreational purposes.

Methods

Western Ringtail Possum density estimates and density surface models were generated using distance sampling, a robust and widely-used statistical method that has been employed by Biota to estimate Western Ringtail Possum densities at contextual sites throughout south-western Australia. Biota's approach was to use line-transect distance sampling. Transects were walked at a steady pace, usually approximately one kilometre per hour, and the perpendicular distance from the transect was recorded for any Western Ringtail Possum sighted. By collating these perpendicular distances, the decline in the number of possum detections away from the transect was modelled, providing a probability of detection that was used to estimate the number of possums not seen. In this way, the number of observations is corrected to account for the missed individuals, providing an estimate of density and abundance for each area. Details on the distance sampling methodology can be found in Thomas *et al.* (2010).

Survey timing & personnel

The field survey was undertaken by Dr Stewart Ford, John Graff and Brandon King over five nights from 28th April to 4th May 2019, operating under Department of Biodiversity, Conservation and Attractions (DBCA) Regulation 17 Licence No. BA27000005. Data analysis was undertaken by Stewart Ford and Roy Teale.

Survey design

Line transects were drawn up across both study areas at 75 m intervals, running north-south across Mounts Clarence and Adelaide (Figure 1) and east-west across Mount Melville (Figure 2). The transect spacing of 75 m is consistent with that used in similar surveys conducted at other sites in the Albany region and elsewhere in the species range, and is designed to maximise potential coverage of the study area while minimising the likelihood of overlapping observations from multiple transects (that is, the same possum being detectable from multiple adjacent transects). A sufficient number of observations and spatial coverage to complete the analysis was obtained by walking alternate transects on Mounts Clarence and Adelaide (i.e. an effective spacing of 150 m between completed transects). All transects on Mount Melville were required to be completed due to the smaller size of that study area.

Field survey

Transects were then walked by a single zoologist, using a high-powered head torch to locate possums. The location of each observation was recorded using GPS capable of providing accuracy <1.5 m. The following data were also collected for each observation

- observer;
- time;
- number of individuals;
- cue: seen (eyeshine), seen (no eyeshine), heard or silhouette; and
- tree/shrub species individual was observed in.

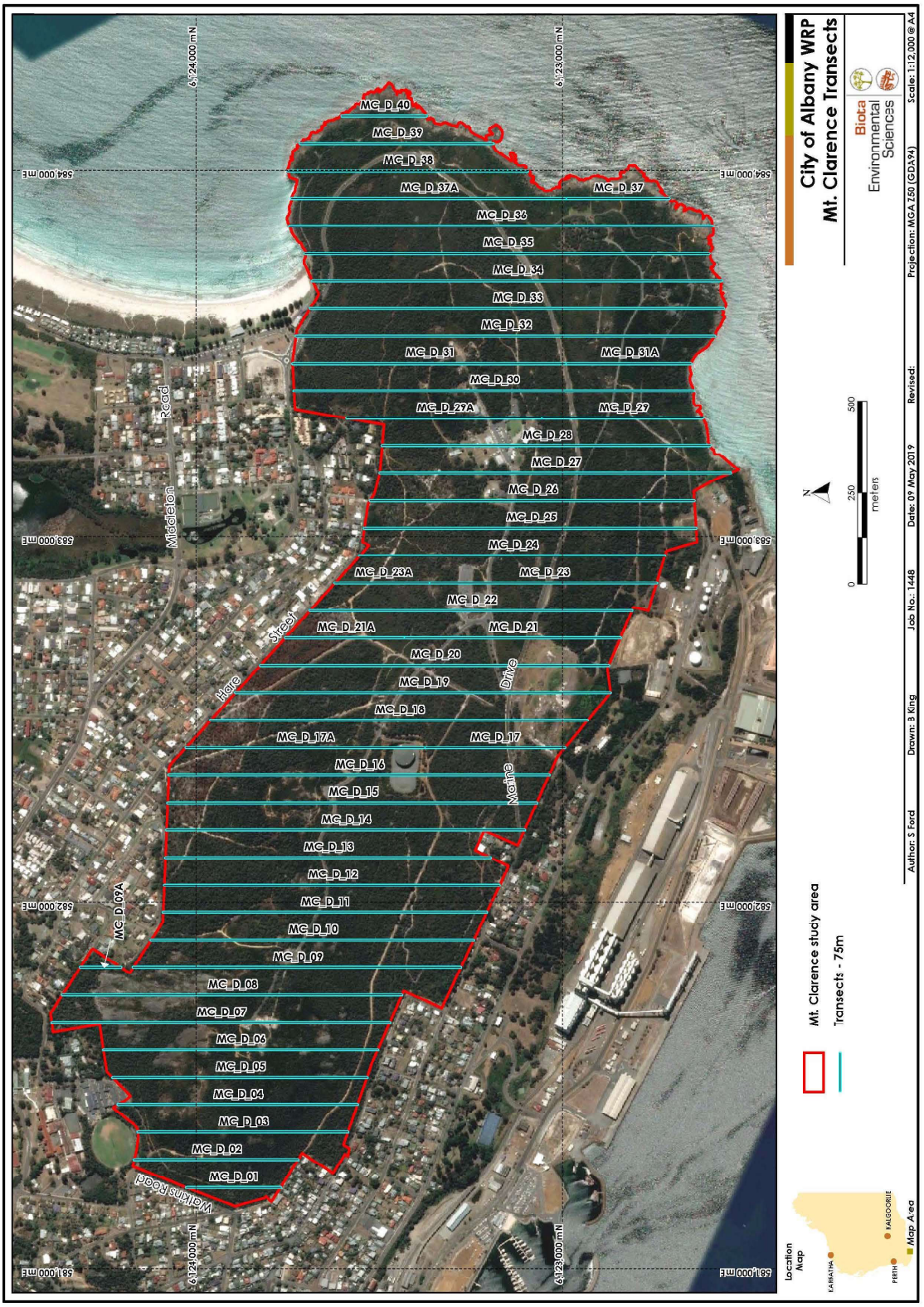

Figure 1: Transect design for Mounts Clarence and Adelaide

Figure 2: Transect design for Mount Melville

Data analysis

Perpendicular distances from the transect to each observation were calculated from the GPS points obtained. These data were then analysed using the 'Distance' (Miller 2013) package in R statistical software (v. 3.5.2, R Core Team 2018). Probability Detection Functions (PDFs) were modelled based on the histogram of perpendicular distance measurements.

Histograms were right truncated as necessary to achieve better model fit, optimally at the distance at which detection probability was 0.15 as recommended by Buckland et al. (2001), but other truncation distances were tested as part of the model selection phase. Akaike's Informative Criterion (AIC) is a quantitative method of model selection and was used to select between potential models (Buckland et al. 2001). Candidate models were also compared using visual inspection of their fit to histograms of the perpendicular distance, goodness of fit quantile-quantile (Q-Q) plots, Kolmogorov-Smirnov (K-S) and Cramér-von Mises (CvM) test statistics (Buckland et al. 2004). The half-normal and hazard rate keys were used for modelling the PDF, with or without adjustment terms (Buckland et al. 2001). Variation in the PDF caused by observers (factor covariate: observer) and study area (factor covariate: study area) were modelled. The selected model was then used to estimate the density and abundance of Western Ringtail Possums within each study area; only the results from the preferred model are discussed here.

In addition to conventional distance sampling, density surface models were fitted to both surveyed regions following Miller *et al*. (2013), using the 'dsm' package (Miller et al. 2019) in R statistical software. Site-specific detection functions were used (for details see below). The spatial models incorporated a simple smooth of latitude and longitude with no covariates.

Stratification by vegetation type and clipping of areas of infrastructure and unsuitable habitat have not been incorporated into this analysis. In addition, the transect lengths and area used for analysis are based on a two-dimensional model of the study areas and thus does not take into account the effect of the significant changes in elevation across the study areas. Neither of these factors are expected to have a significant impact on the results obtained.

Results

On Mounts Clarence and Adelaide, 96 observations totalling 113 individual possums were obtained from 17.3 km of transects surveyed (Figure 3). On Mount Melville, 56 observations including 69 individual possums were obtained from 10.8 km of transects surveyed (Figure 4). Sufficient observations were thus available to model each site independently. The best overall model fit for the Mount Clarence and Adelaide data was a hazard rate key with observer as a covariate on the detection process (truncation = 25 m, n = 96m, CvM p = 0.71; Figure 5). The best overall model fit for the Mount Melville data was a half-normal key with no adjustment terms and no covariate on the detection process (truncation = 25 m, n = 54, CvM p = 0.66; Figure 5).

Analysing the data using conventional distance sampling (CDS) gave density estimates of 4.13 ± 1.22 possums per hectare on Mounts Clarence and Adelaide, and 2.45 ± 0.56 possums per hectare on Mount Melville (Table 1).

This in turns gives population estimates of 1,100 ± 326 possums on Mount Clarence and Adelaide, and 238 ± 55 possums on Mount Melville (Table 2).

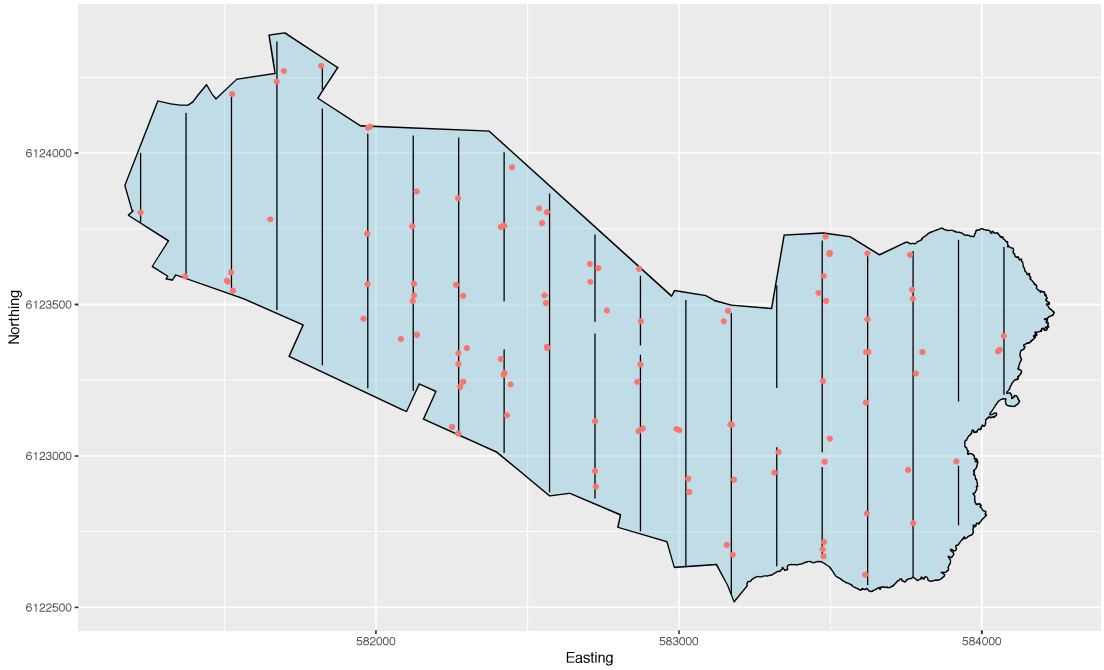

Figure 3: **Transects walked and location of Western Ringtail Possum observations on Mounts Clarence and Adelaide**

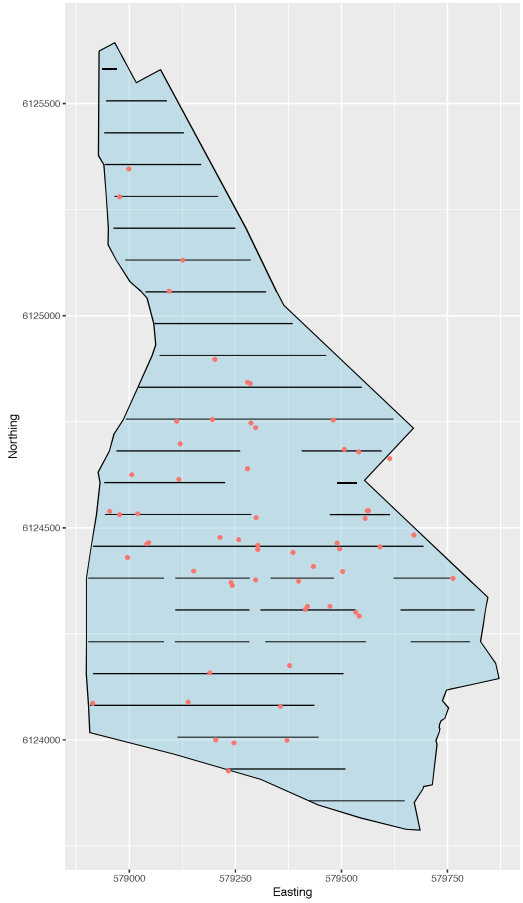

Figure 4: **Transects walked and location of Western Ringtail Possum observations on Mount Melville**

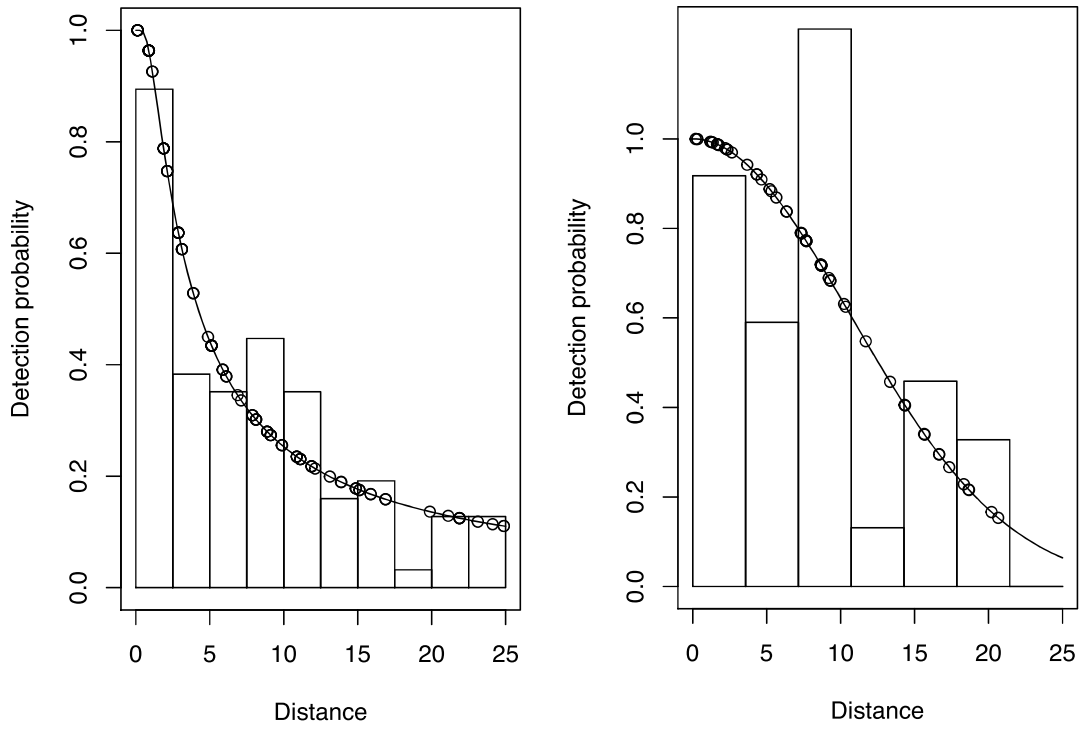

Figure 5: **Probability density functions modelled for Mount Clarence and Adelaide (left) and Mount Melville (right) data**

Table 1: **CDS estimates of population density and population size for Mounts Clarence and Adelaide**

Parameter	Estimate	Standard Error	% Covariance	95% Confidence Interval
Density (/ha)	4.13	1.22	29.6	2.33 – 7.34
Number of individuals	1,100	326	296	619 – 1,954

Table 2: **CDS estimates of population density and population size for Mount Melville**

Parameter	Estimate	Standard Error	% Covariance	95% Confidence Interval
Density (/ha)	2.45	0.56	22.9	1.56 – 3.84
Number of individuals	238	54	22.9	151 – 374

Density surface models were also prepared for both study sites. Densities on Mounts Clarence and Adelaide were highest through the central section of the reserve, and lowest towards the western end (Figure 6). Densities on Mount Melville were highest in the centre of the reserve, and lowest in the south-eastern section (Figure 7). The population estimates obtained using this method were consistent with those obtained using conventional distance sampling, with an estimate of 1,099 possums on Mounts Clarence and Adelaide, and 217 possums on Mount Melville (Table 3).

Table 3: **Comparison of population estimates obtained by CDS and DSM methods**

Site	CDS Population Estimate	DSM Population Estimate
Mounts Clarence and Adelaide	1,100	1,099
Mount Melville	238	217

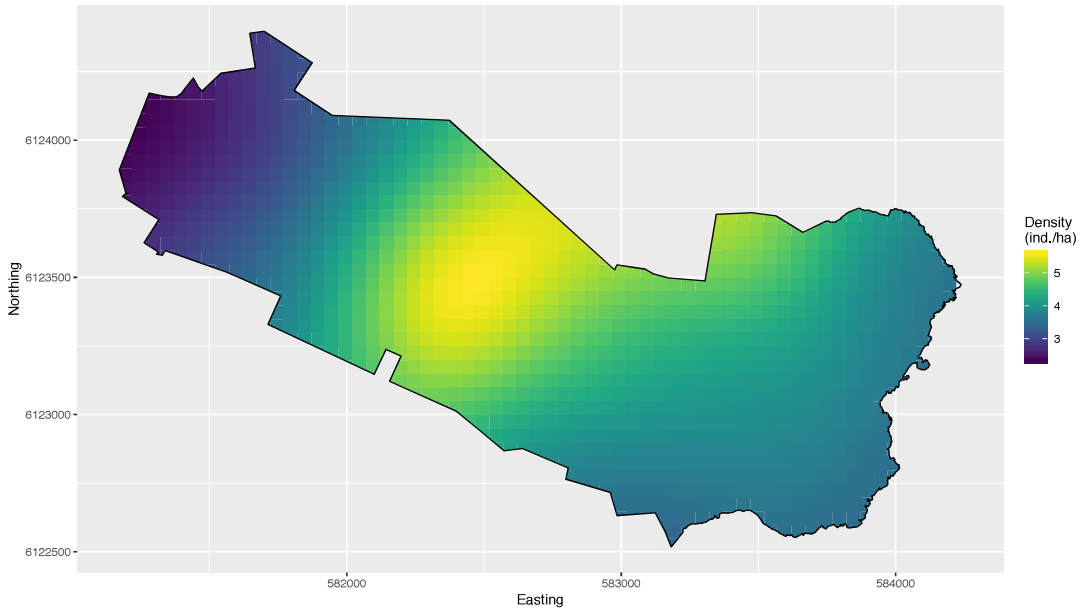

Figure 6: Density surface model for Western Ringtail Possums on Mounts Clarence and Adelaide

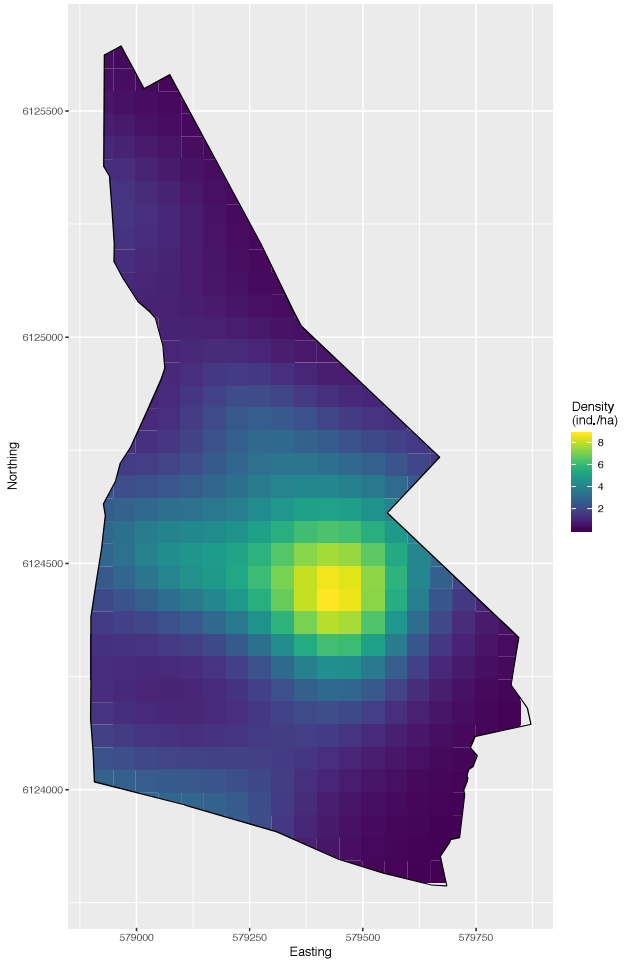

Figure 7: Density surface model for Western Ringtail Possums on Mount Melville

Discussion

The population estimates for Western Ringtail Possum for the two study sites obtained during the current assessment (1,100 ± 326 for Mounts Clarence and Adelaide, and 238 ± 54 for Mount Melville) are higher than those obtained by distance sampling undertaken in the same areas by the Oyster Harbour Catchment Group and analysed by Biota, which produced population estimates of 767 ± 201 for Mounts Clarence and Adelaide, and 156 ± 39 for Mount Melville (Biota 2018). Coverage of the study area was considerably more comprehensive during the current assessment, which should lead to a more accurate population estimate, especially when taking into account the observed spatial variation in possum densities across both study areas.

Densities on the mounts are comparable with the densities estimated for traditionally recognised strongholds for Western Ringtail Possum such as Tuart Forest National Park (Ludlow State Forest) east of Busselton, which has an estimated density of 3.89 possums per hectare in the northern section and 3.36 possums per hectare in the southern section (Biota in prep.). This indicates that the mounts provide high quality habitat for Western Ringtail Possums. However, the results suggest that densities of possums across the two sites are not uniform. The most important areas for possums appeared to be the mid-section of the Mounts Clarence and Adelaide area and the centre of the Mount Melville area.

The densities of Western Ringtail Possum on the Albany mounts are also relatively high compared to estimated densities at other large reserves surveyed in the Albany area, which range from 0.06 to 3.62 possums per hectare (Biota in prep.). These estimates have all been obtained in the last 12 months using the same methodology used in this assessment, so differences in methodology and temporal variation in possum populations are unlikely to explain these differences. The reasons for this variation are not yet well understood, but are hypothesised to involve extent of suitable habitat within each reserve, past disturbance levels (fire and logging frequency and intensity), and distance from the coast.

The estimated populations from the mounts are higher than the combined 2015 Albany-subpopulation estimate of 500 adult individuals (TSSC 2018), though the estimates for the mounts provided here include both adults and sub-adults, rather than just adults. Population estimates based on distance sampling work conducted by Biota in 2018-19 (including the current assessment) indicate that the population in the region is over 3,000 individuals, including sub-adults (Biota in prep.). This estimate is still conservative, as it does not include urban, peri-urban or agricultural areas in the region, nor some reserves such as Two People's Bay and Waychinicup, which are reported to hold significant populations of Western Ringtail Possums (Department of Parks and Wildlife 2017).

It should be noted that the estimates provided here do not incorporate stratification by vegetation type, or clipping of areas of unsuitable habitat. However, the area of unsuitable habitat in both study areas is proportionally low, and possums were found across most vegetation types in the study areas, so it is unlikely that the estimates provided here will vary significantly with the incorporation of these factors. Similarly, transect length and area calculations are based on a two-dimensional model of the study area, so the effects of changes in elevation on transect lengths and the area covered have not been taken into account. The change in elevation means that the actual lengths of transect walked are longer than the two-dimensional length, which would result in a slight decrease in the calculated possum density. However, the area covered would increase, meaning there would be little or no change in the calculated population.

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Yours sincerely,

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