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Review of biological inputs for the New Zealand Seabird Risk Assessment

New Zealand Aquatic Environment and Biodiversity Report No. 312

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New Zealand Aquatic Environment and Biodiversity Report No. 312. **193 p.**

This report provides a comprehensive overview of biological inputs for assessment of the risk of New Zealand commercial fisheries to New Zealand seabird populations, and was generated as part of Fisheries New Zealand project PRO2019-10. These inputs have been reviewed, updated where necessary and restructured for the updated model formulation.

The risk assessment model developed through PRO2019-10 used a monthly time step. As such, it was necessary to restructure existing biological inputs to be specific to month. Updated month-specific density maps have been generated for the most at-risk species through projects PRO2019-09 and PSB2020-04. These include Gibson's albatross, Antipodean albatross, New Zealand white-capped albatross, Salvin's albatross, Chatham Island albatross, southern Buller's albatross, northern Buller's albatross, black petrel, Westland petrel, white-chinned petrel, flesh-footed shearwater and yellow-eyed penguin. Additionally, monthly estimates of proportions remaining inside the New Zealand Exclusive Economic Zone (NZ EEZ) were also generated for these species, based on available tracking data. These outputs from PRO2019-09 and PSB2020-04 have been incorporated into the biological inputs to the risk assessment model. For the remaining species, monthly density maps were generated from the existing maps, which are specific to breeding status. Month-specific proportions of adults remaining inside the NZ EEZ were also generated, derived from existing breeding status-specific values.

In addition, a new parameter was added to the risk assessment model to account for the proportion of breeding adults that remain at the nest during the breeding season and so are not available for capture. This new parameter was also specific to month, to provide flexibility to account for seasonal variation in the proportion of breeding adults remaining at the nest.

Prior distributions for the number of breeding pairs were reviewed and updated for selected high-risk or highly abundant species, covering the PRO2019-09 and PSB2020-04 species as well as southern royal albatross, northern royal albatross, Campbell black-browed albatross, grey-headed albatross, grey petrel, Buller's shearwater and sooty shearwater. Feedback was solicited from relevant researchers in order to review and improve biological inputs for these selected high-risk or highly-abundant species, focussing on: the proportion of adults breeding; the proportions of breeding adults remaining on nest during the breeding season; the proportions of adults that are inside the NZ EEZ; and the number of breeding pairs.

This biological information is summarised and presented in the current report, and provides inputs for the risk assessment, as detailed in accompanying New Zealand Aquatic Environment and Biodiversity Reports.

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1. INTRODUCTION

The overall objective for Fisheries New Zealand project PRO2019-10 was to review and update the risk assessment for New Zealand seabirds, with risk measured as a consequence of fishing related mortality. As part of this project, the current document provides a summary of the biological inputs that have been collected and reviewed, and which provide inputs to the risk assessment model. Because the scope of project PRO2019-10 covers risk of New Zealand commercial fisheries to New Zealand seabird populations, the biological inputs presented here reflect only New Zealand seabird populations, and do not cover the total global population for species that also breed elsewhere. The primary biological data inputs required for the risk assessment concern the spatial distribution of each of the 71 species, as well as the population size and demographic rates of breeding and survival.

Richard et al. (2017b) provide references for the various population parameters used for the two previous risk assessments (Richard et al. 2017a, 2020). A targeted review and update of these biological inputs has been undertaken, and all changes to biological inputs are described in Section 2. This review has also included spatial density maps of the population, which have been udpated for selected species through Fisheries New Zealand projects PRO2019-09 and PSB2020-04.

Selected parameter-specific tables are provided in Section 3 to facilitate comparison between species. Species-specific summaries are provided in Section 4, including maps of the population density surfaces, to facilitate review of inputs for a specific species.

1.1 Summary of changes to the model structure

There are a number of changes to the seabird risk assessment model structure which required additional, or restructuring of existing, biological inputs for the seabird risk assessment model.

Approximately 98% of necropsied seabirds from 2010-11 to 2016-17 were adults (Richard et al. 2020). As such, the risk assessment model includes only adult seabirds. Richard et al. (2020) assumed that all breeding adults inside the New Zealand Exclusive Economic Zone (NZ EEZ) were vulnerable to capture throughout the breeding season. However, there will be stages during the breeding season where a proportion of breeding adults will remain on nest, for example during incubation, and so will not be vulnerable to capture. As such, we have accounted for breeding adults remaining on nest when calculating overlap between seabird distributions and fishing effort in the breeding season (Section 2.3.1).

Additionally, PRO2019-09 and PSB2020-04 have generated monthly distribution maps, and monthly estimates of proportions of adults remaining inside the NZ EEZ, for selected high-risk and/or high abundance species. We have implemented a month-structured risk assessment model to allow the high resolution outputs from PRO2019-09 and PSB2020-04 to inform the risk assessment model. This also requires converting relevant existing biological inputs to be month-specific, specifically seabird distribution maps (Section 2.3.2) and estimates of proportions remaining inside the New Zealand EEZ (Section 2.3.3). We note that, in contrast to the approach of Richard et al. (2020), the monthly model does not explicitly split breeding and non-breeding adults within the breeding season. Instead the relative proportions of breeding and non-breeding adults are accounted for when creating the month-specific inputs.

1.2 Types of model data

Given structural assumptions concerning the species groups, inputs to the risk assessment model can be categorised as either fixed or estimated. Fixed data inputs include: the probability of an adult being inside the NZ EEZ (P_s^{NZ}), and the probability of an adult being on the nest during breeding (P_s^{nest}), which are both relevant to the proportion of the population that is vulnerable to fishing in any given month. Spatial information, i.e., maps of the species distributions per month, also provides fixed data inputs. On the other hand, population size and rate parameters are provided as prior distributions to reflect uncertainty in our knowledge and because they are treated as estimated parameters during the risk assessment model fit (Edwards et al. 2023).

Prior inputs to the model are defined according to four, two parameter probability distributions: uniform, normal, log-normal, and logit-normal. The input parameters for these distributions are referred to as Parameter *a* and Parameter *b*. Log-normal priors are parameterised so that the mean of the distribution on the natural scale is equal to *a*, and the standard deviation on the log scale is equal to *b*.

uniform:

$$x \sim \mathscr{U}\left(a, b\right)$$

normal:

$$x \sim \mathscr{N}\left(a, (b)^2\right)$$

log-normal:

$$log(x) \sim \mathscr{N}\left(log(a) - 0.5 \cdot (b)^2, (b)^2\right)$$

logit-normal:

$$logit(x) \sim \mathscr{N}\left(logit(a), \frac{b}{a \cdot (1-a)}\right)$$

In reviewing the biological data, we focus first on the fixed data inputs, and then the prior distributions for the population size and rate parameters.

1.3 Methodology

Our review of the biological inputs was targeted and collaborative. In particular we focused on selected high-risk or highly-abundant species: Gibson's albatross, Antipodean albatross, southern royal albatross, northern royal albatross, Campbell black-browed albatross, New Zealand white-capped albatross, Salvin's albatross, Chatham Island albatross, grey-headed albatross, southern Buller's albatross, northern Buller's albatross, grey petrel, black petrel, westland petrel, white-chinned petrel, flesh-footed shearwater, Buller's shearwater, sooty shearwater and yellow-eyed penguin. Feedback was solicited from relevant researchers in order to review and improve biological inputs. This review covered the proportion of adults breeding and proportions of breeding adults on nest during the breeding season (also see Section 2.3.1). Proportions remaining inside the NZ EEZ, i.e., remaining 'in zone', were also sent out for review, focusing on species not covered by PRO2019-09.

2. DATA REVIEW

2.1 Species and species groups

There are 71 seabird species included in the risk assessment model. The species are grouped, and group-specific catchability parameters are estimated during the model fit (Table 1). In principal these groupings should be based on the behaviour of birds around fishing vessels. Great albatrosses, for example, may be more prone to being caught at the surface, whereas medium sized birds that dive for their prey may be more prone to capture within trawl nets. These could represent two distinct catchability groups. In previous assessments, the groupings have also accounted for the overlap of birds with different fishing fleets.

A further consideration for the grouping is that some species should be grouped in the risk assessment model to allow data from infrequently captured species to be shared across species that have a similar affinity for, and behaviour around, fishing vessels. The petrels, for example, have very few observed captures and are therefore grouped, so that a shared catchability parameter can be estimated for all members.

The species groups have been updated (Table 1), adopting a parsimonious approach that attempts to adequately represent behavioural differences between species whilst ensuring adequate capture data per group and avoiding over parameterisation of the model. By grouping species in this way we have assumed that the probability of capture per unit overlap is the same for all species within a group. However, we have also included a species-specific random effect in the model, to account for higher resolution variability in catchability between species (Edwards et al. 2023). In this way, species-specific deviations from the estimated catchability per group are allowed, should they be supported by the data.

2.2 Reference point calculations

Reference points used in the risk assessment require an estimate of the intrinsic growth rate for the popuation under optimal conditions. Previous iterations of the risk assessment have used an allometric relationship between intrinsic growth and other life history parameters, which provides the "demographic-invariant" estimate λ_s^{DI}. In the current, updated risk assessment, we complement this with an alternative estimate based on the Euler-Lotka equation: λ_s^{EL}. This latter approach requires additional input data on fecundity (from the clutch size) and survivorship to age at first breeding. These additional data were included in our review. Full details of how λ_s^{DI} and λ_s^{EL} are estimated are given by Edwards et al. (2023).

2.3 Fixed data inputs

The probability of an adult being on the nest during breeding (P_s^{nest}) and the probability of an adult being inside the NZ EEZ (P_s^{NZ}) are listed in Tables 2 and 3 respectively, as well as within each species-specific section (Section 4). The breeding and non-breeding months per species are listed in Table 4. We consider each of the these data inputs here, along with the spatial distribution maps for each species.

2.3.1 Monthly probabilities of breeding adults on nest

As discussed in Section 1.1, there will be periods within the breeding season where both individuals (e.g., during courtship), one individual (e.g., incubation), or neither (e.g., post-guard), will be at

the nest. This affects the proportion of breeding adults that are vulnerable to capture. Feedback was solicited from relevant researchers in order to best parameterise $P^{\text{nest}}_{s,m}$ for selected species (see Section 1.3). Proposed values for $P^{\text{nest}}_{s,m}$ were generated using information from NZ Birds Online on the timing of different stages of the breeding season (i.e., egg-laying, incubation, guard and post-guard), and species-specific assumptions regarding the numbers per breeding pair remaining at the nest during these stages. Proposed values were distributed to researchers, and updated following feedback. We note that researchers also recommended that a proportion of breeding Salvin's albatross and white-chinned petrel be assumed to remain at the nest towards the end of the non-breeding season.

For the remaining species, it was assumed that one individual remained on nest throughout the breeding season. However, $P^{\text{nest}}_{s,m}$ for light-mantled sooty albatross was set to 0.05 from February to May following feedback from G. Taylor (pers. comm.) reflecting lower rates of attendance at nest post-guard. Additionally, $P^{\text{nest}}_{s,m}$ for Buller's shearwater and flesh-footed shearwater were amended based on feedback (G. Taylor, pers. comm.): $P^{\text{nest}}_{s,m}$ for Buller's shearwater was updated to be 0.5 for the November to January; and, $P^{\text{nest}}_{s,m}$ for flesh-footed shearwater in October and November was updated to 0.2 to reflect time spent in burrows during the courtship and pre-lay period.

The resulting values are included in Table 2.

2.3.2 Monthly distribution maps

The seabird distribution maps used by Richard et al. (2020) were in proportionate numbers per raster grid cell (i.e., the numbers per raster cell, normalised to sum to one), and were provided for use in the current project. The maps of Richard et al. (2020) were specific to breeding status, with a distribution map for breeding adults during the breeding season ($D^{B}_{s,x}$), and a distribution map for both non-breeders during the breeding season and all birds outside the breeding season ($D^{NB}_{s,x}$). A single distribution map ($D^{all}_{s,x}$) was used for both breeders and non-breeders in some cases, including for species that breed throughout the year. Each distribution map provides the proportion by number of species s in raster cell x for birds of the appropriate breeding status. Each distribution map summed to one across raster cells, or zero if the species is absent during the non-breeding season. We noted apparent errors in the location of colonies in the Kermadec Islands for Kermadec petrel and wedge-tailed shearwater, and these were corrected.

Updated distribution maps in numbers per raster grid cell have been generated through PRO2019-09 and PSB2020-04 for 12 species: Gibson's albatross, Antipodean albatross, New Zealand white-capped albatross, Salvin's albatross, Chatham Island albatross, southern Buller's albatross, northern Buller's albatross, black petrel, Westland petrel, white-chinned petrel, flesh-footed shearwater and yellow-eyed penguin. These distribution maps were specific to month, and apply to all adults regardless of breeding status. The distribution maps from PRO2019-09 and PSB2020-04 were used where available, noting that the adults distribution map was used for yellow-eyed penguin. In order to have a consistent structure of distribution maps for all species, it was necessary to restructure the existing distribution maps used by Richard et al. (2020) for the remaining species to match those available from PRO2019-09 and PSB2020-04. We refer to the restructured monthly distribution maps as $D_{s,m,x}$, which provide the proportions by number of adults of species s in raster cell x during month m.

For the species not covered by PRO2019-09 and PSB2020-04 with only one distribution map ($D^{all}_{s,x}$), $D_{s,m,x}$ was set equal to $D^{all}_{s,x}$ for all months. For the remaining species not covered by PRO2019-09 and PSB2020-04, the non-breeder distribution map ($D^{NB}_{s,x}$) was used for months outside the breeding season. For the breeding season, month-specific distribution maps were generated by weighting the breeder ($D^{B}_{s,x}$) and non-breeder ($D^{NB}_{s,x}$) distribution maps appropriately for the proportions of breeding and non-breeding adults remaining inside the NZ EEZ and so available to capture. The monthly distribution map for all adults combined was then:

$$D_{s,m,x} = \begin{cases} \left((1 - P^{\text{nest}}_{s,m}) \cdot P^{B}_{s} \cdot D^{B}_{s,x}\right) + \left(\alpha_s \cdot (1 - P^{B}_{s}) \cdot D^{NB}_{s,x}\right) & \text{for the breeding season} \\ D^{NB}_{s,x} & \text{for the non-breeding season.} \end{cases}$$

Here, P^{B}_{s} refers to the mean of the prior distribution for the proportion of adults breeding, and α_s is the proportion 'in zone' parameter from Richard et al. (2020). The monthly distribution maps ($D_{s,m,x}$) were then clipped to the NZ EEZ, and normalised to sum to one for each species and month combination, unless a species is absent from the EEZ during the month at which point the map sums to zero. The resulting distribution maps then represent the spatial distribution of individuals inside the EEZ that are available to capture for a given month.

The distribution maps were converted to density maps, $d_{s,m,x}$:

$$d_{s,m,x} = D_{s,m,x} / A_{s,x}$$

where $A_{s,x}$ is the area (km^2) of raster cell x for species s. These monthly density maps represent the relative density of individuals available to capture inside the NZ EEZ by month, and were used to calculate the density overlap of fishing events required for the risk assessment model, as described by Edwards et al. (2023). The density of seabirds was assumed to be constant across years, and uniformly distributed within raster grids.

2.3.3 Monthly probabilities of an adult being inside the NZ EEZ

Richard et al. (2020) assumed that all breeders and non-breeders remain inside the NZ EEZ, i.e., 'in zone', during the breeding season, and, a species-specific proportion of the population was assumed to remain in zone outside the breeding season (denoted α_s). As discussed at the Aquatic Environment Working Group (6th June, 2021), we have assumed that α_s also applies to non-breeders during the breeding season, i.e., that non-breeders do not display a tendency to return to the NZ EEZ during the breeding season. Additionally, the parameterisation of proportions in zone required restructuring for use with a monthly time step.

Let $P^{\text{NZ}}_{s,m}$ refer to the probability of adults of species s remaining in zone in month m. Estimates of $P^{\text{NZ}}_{s,m}$ have been generated through PRO2019-09 for 11 of the 12 species listed in Section 2.3.2, i.e., covering all but northern Buller's albatross, and were used where available. An estimate of proportions in zone was not available for Gibson's albatross in December, and Chatham Island albatross in September and October, due to a lack of available tracking data in these months. The proportions of Gibson's albatross in zone in December was assumed to be the same as for January, noting that Gibson's albatross lay eggs from December to January (based on information from NZBirdsOnline). The proportion of Chatham Island albatross in zone in September and October was assumed to be the same as for November, noting that Chatham Island albatross lay eggs from September to October (based on information from NZBirdsOnline) and so proportions in zone are likely to be relatively high.

Carneiro et al. (2020) generated distribution maps for the Antipodes Islands grey petrel population and the Chatham Island northern royal albatross population at a quarterly and 5° resolution, using tracking data. The distribution maps are for immature and adult birds combined. These distribution maps were used to estimate quarterly proportions in zone for adults, assuming a uniform distribution of individuals within 5° cells. The quarterly estimates of P^{NZ} for grey petrel were 0.21 for Jan-Mar, 0.32 for Apr-Jun, 0.19 for Jul-Sep, and 0.02 for Oct-Dec. The estimated distribution of adult northern royal albatrosses by Carneiro et al. (2020) was solely informed by tracking data from breeders. As such, we assumed that the estimated proportions in zone reflected breeding adults only. Proportions in zone for non-breeding adults were set at the lowest quarterly estimate for breeders, assuming that the spatial distribution of non-breeders is less constrained by central place foraging than breeders. The quarterly estimates of P^{NZ} for breeding northern royal albatross were 0.59 for Jan-Mar, 0.23 for Apr-Jun, 0.18 for Jul-Sep, and 0.82 for Oct-Dec. P^{NZ} for non-breeding northern royal albatross was assumed to be 0.18 for all quarters. These proportions were then weighted by the proportions of adults breeding and not breeding in a given year, assumed to be 0.61 and 0.39 respectively (Table 5). This resulted in quarterly estimates of P^{NZ} for adult northern royal albatross of 0.43 for Jan-Mar, 0.21 for Apr-Jun, 0.18 for Jul-Sep, and 0.57 for Oct-Dec. The quarterly estimates of P^{NZ} for northern royal albatross and grey petrel were then mapped to months, assuming that proportions in zone did not vary within quarters. We note that the use of density maps for immature and adult birds is likely to bias estimates of proportions in zone, due to differences in their distributions.

For the remaining species, estimates of $P^{\mathrm{NZ}}_{s,m}$ were generated using the existing α_s from Richard et al. (2020). For species with only one distribution map, including species that breed throughout the year, we assumed all adults remain in zone throughout the year as per Richard et al. (2020), i.e., $P^{\mathrm{NZ}}_{s,m} = 1$. Otherwise:

$$P^{\mathrm{NZ}}_{s,m} = \begin{cases} P^B_s + \alpha_s \cdot (1 - P^B_s) & \text{for the breeding season} \\ \alpha_s & \text{for the non-breeding season.} \end{cases}$$

where the first term of the breeding season expression accounts for breeding adults which are assumed to all remain in zone, and the second term accounts for non-breeding adults. Here, P^B_s refers to the mean of the prior distribution for the proportion of adults breeding.

$P^{\mathrm{NZ}}_{s,m}$ was updated for sooty shearwater and Chatham petrel, based on information from G. Taylor (pers. comm.). $P^{\mathrm{NZ}}_{s,m}$ for sooty shearwater was capped at 0.5 (previously 0.9), to better reflect their regular foraging at the polar front, outside the NZ EEZ. Additionally, $P^{\mathrm{NZ}}_{s,m}$ for sooty shearwater was set to 0.1 in May and September, and 0.5 in October, to reflect the timing of adults leaving and returning to the NZ EEZ. $P^{\mathrm{NZ}}_{s,m}$ for Chatham petrel was set to 0.5 for November to February when they forage over the Louisville Ridge, and set to 0.9 for March to May when they forage at Bollons Seamount during chick rearing. Additionally, $P^{\mathrm{NZ}}_{s,m}$ for Chatham petrel was set to 0 in June, when they are absent from the NZ EEZ.

The resulting estimates of $P^{\mathrm{NZ}}_{s,m}$ are provided in Table 3.

2.3.4 Clutch size

Average clutch sizes per species were required for calculation of the risk assessment reference points (Edwards et al. 2023), since they are a determinant of the fecundity (along with the sex ratio and probability of breeding) needed for caculation of the maximum instrinsic growth rate using the Euler-Lotka method (λ^{EL}_s). These are not listed here. Rather we refer directly to table D-7 of

Richard et al. (2017a): all species were assumed to have a clutch size of one, with the exception of penguins, shags, terns, the subantartic skua and black-backed gull, which were assumed to lay two eggs when breeding.

2.4 Number and rate parameters

Estimated number and rate parameters were specified as prior distributions (Section 1.2). Uniform, normal and log-normal prior distributions are assumed for the number of breeding pairs (N_s^{BP}). In Table 5, Parameters a and b are listed for specifications of these priors, per species. Logit-normal prior distributions constrain $0 < x < 1$ and are assumed for the proportion of adults breeding annually (P_s^B), with parameters listed in Table 6. Uniform prior distributions are assumed for the age at first reproduction (A_s^{curr}; Table 7). Either a uniform or logit-normal distribution is assumed for both current and optimum adult survival rates (S_s^{curr} and S_s^{opt} respectively; Tables 8 and 9). Priors for the egg and juvenile survival multipliers are listed in Tables 10 and 11.

In addition to the prior specifications by parameter given in Tables 5 to 11, summary statistics for derived parameter values are listed in Tables 12 and 13. These were obtained by drawing 10,000 samples from the prior for each parameter and calculaing summary statistics for each.

2.4.1 Updates to prior distributions for number of breeding pairs

The PRO2019-09 project team collated the latest estimates of breeding pairs for colonies for 11 species: Gibson's albatross, Antipodean albatross, New Zealand white-capped albatross, Salvin's albatross, Chatham Island albatross, southern Buller's albatross, northern Buller's albatross, black petrel, Westland petrel, white-chinned petrel, flesh-footed shearwater. These estimates of colony specific breeding pairs were used, along with other information, to generate proposed updated prior distributions for breeding pairs across all New Zealand colonies. A similar exercise was undertaken for other relatively high-risk or high-abundance species, namely northern royal albatross, southern royal albatross, Campbell black-browed albatross, grey-headed albatross, Buller's shearwater, sooty shearwater and yellow-eyed penguin. The prior distributions for breeding pairs were constructed with consideration of the time series of estimates where available, in an attempt to prevent the prior distributions from reflecting the (often unknown) relative proportion of adults breeding during the most recent survey. More recent estimates of breeding pairs were given more "weight" when constructing the prior distributions, particularly for species with apparent trends in population size. The proposed priors were distributed to relevant researchers, and updated if necessary following feedback.

Adams Island accounts for the majority of breeding pairs of Gibson's albatross, with annual estimates of pairs available from 1997 to 2020 based on counts of nests with eggs in survey blocks (Rexer-Huber et al. 2020a). The counts are corrected for survey timing and extrapolated to island-wide totals using the 1997 whole-island count. The remaining breeding pairs of Gibson's albatross at Disappointment Island are surveyed less frequently, most recently in 2014 based on aerial photographs (Baker & Jensz 2014). The mean of the prior distribution was set at the total of the latest estimate of breeding pairs at Adams Island in 2020 (3,861 pairs) and Disappointment Island in 2014 (452 pairs), noting the apparent declining trend at Adams Island in recent years. The coefficient of variation (CV) of the log-normal distribution, i.e., Parameter b in Section 2.4, was set at a level to reflect variability in annual estimates at Adams Island in recent years (CV $= 0.1$).

Antipodes Island accounts for the majority of Antipodean albatross, with annual estimates of pairs available from 1994 to 2020 based on counts of nests with eggs in survey blocks (Elliott & Walker 2020). A low number of pairs breed at Campbell Island (Miskelly et al. 2008), with one pair breeding at Pitt Island in 2021 (media release from DOC). An integrated population model (IPM) estimated the number of breeding pairs on Antipodes Island to be 3,292 pairs (95% CI 2,964 - 3,659) (Richard 2021). The mean of the prior distribution was set at the estimate for Antipodes Island, plus an additional 11 pairs to include pairs at Campbell Island and Pitt Island. The IPM estimate was used to set the CV of the log-normal prior distribution (CV = 0.0537). We note that there was no apparent trend in breeding pair estimates at Antipodes Island over the last 12 years.

The majority of New Zealand white-capped albatross breed at the Auckland Islands, particularly Disappointment Island. Annual estimates of breeding pairs at the Auckland Islands are available for recent years based on aerial photos, e.g., Baker et al. (2020b). A limited number of pairs also breed at the Antipodes Islands. The mean number of breeding pairs for the Auckland Islands was based on the mean of the annual estimates from 2013 to 2017 provided by Baker et al. (2020b) (85,944 pairs), with an additional 75 pairs assumed breeding at the Antipodes Islands. The coefficient of variation of the log-normal distribution was set at a level to reflect variability in annual estimates from the Auckland Islands in recent years (CV = 0.1).

The majority of Salvin's albatross breed on the Bounty Islands, with surveys periodically undertaken based on aerial photos. The most recent surveys at the Bounty Islands were undertaken in 2013 (Baker et al. 2014) and 2018 (Baker & Jensz 2019), with contemporaneous ground counts on Proclamation Island used to account for non-breeders and nests with no eggs. Salvin's albatross also breed on the Snares Western Chain, with whole-island counts of breeders undertaken in 2014 (Sagar et al. 2014). The raw counts of birds ashore in 2018 was higher than in 2013 (60,419 and 53,893 respectively), though the estimated number of breeding pairs was substantially lower (26,955 and 39,995 pairs respectively), due to a reduced proportion of occupied nests with an egg in 2018, as well as a higher proportion of 'loafers'. Baker & Jensz (2019) suggest that the relatively low number of breeding pairs in 2018 may reflect higher rates of nest failures, or late decisions to suspend breeding by large numbers of birds, as a result of adverse environmental conditions. As such, we set the mean of the prior distribution for Salvin's albatross as the sum of the 2013 Bounty Island estimate and the 2014 Snares Western Chain estimate (41,208 pairs). The coefficient of variation was set at 0.18, such that it was unlikely for the number of breeding pairs to be as low as the 2018 estimate, or higher than the raw number of apparently occupied sites in 2018.

Chatham Island albatross breed exclusively on The Pyramid, and full census surveys of the population are regularly undertaken, e.g., see Bell et al. (2017a). The survey estimates are likely to be highly accurate given the survey methodology and the nature of the colony. The mean of the prior distribution was set at the mean of the annual estimates from 1999 to 2016 (5,294 pairs), noting that there was no apparent temporal trend during this period. The coefficient of variation of the log-normal distribution was set at a level to reflect variability in the annual estimates over the time period (CV = 0.015).

Southern Buller's albatross breed at Solander Island, Little Solander Island and Snares Islands. The Solander Islands population has been surveyed periodically, most recently in 2016 (Thompson et al. 2016) using a combination of ground counts, counts from vantage points and photos. Sagar (2014) carried out whole-island counts of the Snares Islands population in 2014. The prior distribution at a population level was generated from colony-specific distributions of breeding pairs, given that the Snares Islands estimates are likely to be more precise given the survey methods. For both

populations, the latest survey estimates were assumed to reflect the 25^{th} percentile of the colony-specific distribution, i.e., assuming that the survey estimates were more likely to be under-estimates than over-estimates. A log-normal distribution with a coefficient of variation of 0.1 was assumed for the Solander Islands population, with a tighter CV of 0.025 assumed for the Snares Islands population. Combining these colony-specific distributions gave a log-normal distribution for the species with a mean of ca. 14,900 breeding pairs and a CV of 0.0429.

Northern Buller's albatross mainly breed at the Chatham Islands on Motuhara (the Forty Fours), Big Sister and Little Sister islands, with a limited number breeding on Rosemary Rock at the Three Kings Islands group (Frost et al. 2018). A full census survey was carried out for the population on Big Sister and Little Sister islands in 2017 (Bell et al. 2018), with a full census survey on Motuhara in 2016 (Bell et al. 2017b). Again, it was assumed that the estimates were more likely to be under-estimates given the survey methods. The sum of breeding pairs from Bell et al. (2017b, 2018) and Frost et al. (2018) was assumed to reflect the 25^{th} percentile of the prior distribution for the species. A relatively tight coefficient of variation was assumed for the log-normal distribution (CV $= 0.025$). The mean of the resulting distribution was ca. 20,300 pairs.

Black petrel colonies on Great Barrier Island were surveyed in 2020/21. Estimates of breeding pairs for high-grade and 'core' medium-grade habitat were 1,532 (95% CI 1,177-1,997) and 3,130 (95% CI 2,225-4,401) pairs respectively (E. Bell, pers. comm.). No breeding burrows were detected during transects in the remaining medium-grade habitat. Black petrel colonies on Little Barrier Island were most recently surveyed in 2015/16 (Bell et al. 2016). The total breeding pairs of black petrel on Great Barrier Island was obtained by summing the latest estimates in high-grade and 'core' medium-grade habitat, resulting in a log-normal distribution with a mean of 4,665 and CV of 0.125. We assumed that there were no breeding pairs in the remaining medium-grade and low-grade habitat. Additionally, we assumed that the survey estimate for Little Barrier Island was half as precise as the total estimate for Great Barrier Island (i.e., a CV of 0.25) given that the survey methodology for the Great Barrier Island was perceived to be more robust. The estimates for Great Barrier Island and Little Barrier Island were then combined to give the distribution of total black petrel breeding pairs, with a mean of 5,286 (CV $= 0.114$).

Waugh et al. (2020) generated an estimate for westland petrel of a minimum of ca. 6,200 breeding pairs in 2019, based on colony-specific burrow density estimates from transects. This estimate was assumed to reflect the 25^{th} percentile of the prior distribution for breeding pairs, and used to construct a log-normal prior. A relatively high CV of 0.3 was assumed, given that the estimates were considered to be order of magnitude only. This resulted in a prior distribution with a mean of 7,965 breeding pairs.

The latest survey estimates of flesh-footed shearwater populations were used to generate the breeding pair prior distribution for the New Zealand population. Survey estimates for the various colonies were: Whatupuke Island and Coppermine - Crowe & Burgin (2021); Ohinau Island - Crowe (2018); Lady Alice Island and Motumahanga Island - Crowe & Bell (2019); West Chicken Island, Titi Island, Green Island and Karewa - Baker et al. (2010); Middle Island - Bell & Boyle (2017); Kauwahaia Island and Te Hanga - Waugh et al. (2014); Middle Trio Island, Korapuki Island and Stack (North of Stanley) - Waugh et al. (2013); and Stanley Island - G. Taylor (pers. comm.). Survey estimates were reported with confidence intervals for the main colonies of flesh-footed shearwater, i.e., all but Motumahanga Island, Middle Trio Island, Korapuki Island, Stack and Kauwahaia Island and Te Hanga. Estimates with reported confidence intervals were combined by generating survey-specific normal distributions from reported means and 95% CIs, and summing across colonies (i.e., assuming estimates were independent). The mean of the distribution was

then increased to account for colonies without reported CIs, and the standard deviation parameter adjusted to preserve the coefficient of variation, giving a normal distribution with a mean of 19,300 pairs ($SD = 2,160$).

The latest estimates of white-chinned petrel populations were used to generate breeding pair distributions for the New Zealand population, covering colonies on Disappointment Island (Rexer-Huber et al. 2017), Adams Island (Rexer-Huber et al. 2020c), Monowai (Rexer-Huber 2017) and the Antipodes Islands (Thompson 2019). The survey-specific reported means and confidence intervals were used to generate survey-specific log-normal distributions, which were then summed together to obtain a distribution for the total New Zealand population. The resulting distribution had a mean of ca. 249,300 breeding pairs and a CV of 0.0889.

Northern royal albatross mainly breed on the Chatham Islands, most recently surveyed in 2020 with estimates of occupied nests based on aerial photos (Frost 2021). There are also a limited number of breeding pairs at Taiaroa Head. A log-normal distribution was assumed for the distribution of total breeding pairs with the mean set equal to the sum of the 2020 estimates for the Chatham Islands (Frost 2021), and available estimates for Taiaroa Head (32 pairs), see discussion by Frost (2018). The coefficient of variation was set at 0.1, reflecting a relatively high level of confidence in the survey of the Chatham Islands colony. We note that the resulting prior distribution covered the range of estimated breeding pairs with corrections for empty nests based on available ground count data collected in earlier years (Frost 2021).

Southern royal albatross mainly breed on Campbell Island, with limited numbers of breeders on Enderby Island and the other Auckland Islands. Colonies on Campbell Island were most recently surveyed from 2004 to 2008, based on a census of nesting adults with adjustments for timing of the surveys (Moore et al. 2012). The number of breeding pairs was estimated to be 8,300 to 8,700 pairs (Moore et al. 2012). We created a log-normal distribution for total breeding pairs of the species, assuming 8,500 pairs on Campbell Island, and a total of 64 breeding pairs on Enderby Island (Baker et al. 2020a) and the other Auckland Islands (Agreement on the Conservation of Albatrosses and Petrels 2009). The coefficient of variation was set at 0.1.

Campbell black-browed albatross and grey-headed albatross breed exclusively on Campbell Island, with the colonies last surveyed in 2019 based on a combination of aerial and ground-based photos (Frost 2020). After adjusting for the timing of the survey, there were an estimated 24,338 and 6,429 pairs of Campbell black-browed and grey-headed albatrosses respectively sitting on nests at the beginning of the breeding season. An estimated 82% of occupied nests of both species had an egg, based on a concurrent ground survey at the Bull Rock south colony (Rexer-Huber et al. 2020b). Breeding pair distributions for both species were obtained by generating distributions of pairs on nests and distributions for proportions of occupied nests with an egg, and taking the product of both to obtain a distribution of nests with eggs, i.e., breeding pairs. The distribution for proportions of occupied nests with an egg for both species was set at $\text{logit}^{-1}\left(\mathcal{N}\left(\text{logit}(0.82), 0.08^2\right)\right)$. Log-normal distributions were assumed for occupied nests, with the mean set at the estimates above. The coefficient of variation was set at 0.075 and 0.0875 for Campbell black-browed and grey-headed albatrosses, respectively. The higher CV for grey-headed albatross reflects a perceived lower confidence in the representativeness of the survey estimate, given it is a biennial breeder and therefore may have greater variation in the proportions of adults breeding between years. The resulting distributions had means of 19,950 and 5,270 and CVs of 0.0765 and 0.0887 for Campbell black-browed and grey-headed albatrosses, respectively.

Yellow-eyed penguin breed at the Auckland Islands and Campbell Island, referred to as the southern population, and the south-east coast of the South Island and Stewart Island, referred to as the northern population. The northern population has been decreasing in recent years, with an estimated 189 pairs on South Island and 44 pairs on Stewart Island in 2020/21 (T. Webster, pers. comm.). Colonies on the Auckland Islands were most recently surveyed in 2017, with an average of 577 pairs from 2015 to 2017 and annual estimates varying from 440 to 802 pairs (Muller et al. 2020). Campbell Island was most recently surveyed in 1992, with an estimated 350 to 540 breeding pairs (Moore et al. 2001). Set net fisheries overlap with the distribution of the northern population, but not the southern population. Separate prior distributions were created for the northern population, and for the total population, to allow separate consideration of risk to the northern population in isolation in the risk assessment model (i.e., by calculating the Population Sustainability Threshold using the breeding pairs of the northern population). This may be more appropriate if all fishing-related mortalities of yellow-eyed penguin are from the northern population. A log-normal distribution for the northern population was assumed. The survey estimates were considered more likely to under-estimate the number of breeding pairs, so the mean was set such that the 25% percentile was equal to 233 breeding pairs, i.e., the 2020/21 estimate for the northern population, with a CV of 0.05. The mean of the distribution for the northern population was 242 pairs. The log-normal distribution for the total breeding pairs of yellow-eyed penguin, for both the southern and northern populations, had a mean equal to 1,210 pairs assuming 577 and 400 pairs for the Auckland Islands and Campbell Island, respectively. The CV was assumed to be 0.1.

The prior for breeding pairs of Whenua Hou diving petrel was updated based on results from recent integrated population modelling (Fischer et al. 2022). The number of adults was estimated to be 209 (95% CI 163–243), with the proportions of adults breeding per year of 0.84. This information was combined to create a normal prior for the number of breeding pairs, with a mean of 87.3 and standard deviation set at 8.52 to preserve the CV of the estimated number of adults.

Buller's shearwater breed exclusively on the Poor Knights Islands. The population was most recently surveyed during the 2016-17 and 2017-18 breeding seasons (Friesen et al. 2021), with an estimated 78,645 active burrows (95% CI 67,176 - 89,178), representing a substantial decrease from earlier estimates of 300,000 to 400,000 pairs. A normal prior for breeding pairs was constructed based on the estimate of active burrows, with a mean of 78,645 pairs and a standard deviation of 5,610.

The Chatham Island Taiko Trust monitors the population of Chatham Island taiko. In the 2021/22 season a total of 41 pairs attempted to breed (J. Fischer, pers. comm.), representing an increase from 15 to 20 pairs a decade ago (e.g., see NZBirdsOnline). It is not clear to what extent the relatively high numbers of breeding pairs in the 2021/22 season reflects a high proportion of adults breeding, or an increase of breeding adults. An assumed proportion of adults breeding of 0.9, coupled with the large increase in breeding pairs in percentage terms, suggests that the latter will be more influential. The log-normal prior distribution for breeding pairs was updated to have a mean of 41, with a CV of 0.1 reflecting the high level of confidence in the estimate of breeding pairs.

No additional information on breeding pairs of sooty shearwater was found, and so prior distributions for breeding pairs were left unchanged.

Finally, Richard et al. (2020) used log-uniform priors for breeding pairs in cases when a minimum and maximum number were reported in the literature. This implicitly assumes that lower values of breeding pairs are slightly more likely than higher values. These were changed to uniform priors, i.e., assuming that all values of breeding pairs in the reported range were equally likely.

Values for Parameters a and b for numbers of breeding pairs are given in Table 5 with summary statistics given in Table 12. The sources detailed above are listed for reference in Table 14. In reporting the number of adults in the population (see Section 4), we calculate the number of adults as approximately equal to $2 \cdot N_s^{BP} / P_s^B$.

2.4.2 Proportions of adults breeding

The mean parameter for proportions of adults breeding in a given year was updated for black petrel and flesh-footed shearwater, with new values of 0.61 (E. Bell, pers. comm.) and 0.8 (P. Crowe, pers. comm.) respectively.

Values for Parameters a and b are given in Table 6 with summary statistics given in Table 12. The sources detailed above are listed for reference in Table 15.

2.4.3 Age at first reproduction

The lower limit for the distribution of age at first reproduction of Antipodean albatross was changed from 10 to 7 based on Richard (2021).

Values for Parameters a and b are given in Table 7 with summary statistics given in Table 12. The sources detailed above are listed for reference in Table 15.

2.4.4 Current and optimal survival rates

The risk assessment model outlined by Edwards et al. (2023) does not require prior distributions for current survival rates (S_s^{curr}), only optimal survival (S_s^{opt}). However, at this stage the existing prior distributions for S_s^{curr} have been left in this report. A number of updated estimates of (S_s^{curr}) were identified during the process of reviewing the biological inputs, and have been also incorporated.

Integrated population modelling of Antipodean albatross estimated mean annual survival rates of adult males and females from 2005 to 2020 to be 0.927 year^{-1} (95% CI 0.887 - 0.961) and 0.882 year^{-1} (95% CI 0.814 - 0.94) respectively (Richard 2021). The updated logit-normal prior distribution for Antipodean albatross was set to have a mean equal to the average of the male and female estimates (0.905) and an appropriately wide 95% CI (Parameter $b = 0.02$).

Estimates of annual survival rates of adult Gibson's albatross from 2015 to 2019 averaged approximately 0.92 year^{-1} (Rexer-Huber et al. 2020a). This was used as the mean of the updated logit-normal prior distribution, with Parameter b also set to 0.02.

The estimated survival rates of New Zealand white-capped albatross at the Auckland Islands from 2015 to 2020 was 0.90 year^{-1} (95% CI 0.86 - 0.93) (Rexer-Huber et al. 2020a). The updated logit-normal prior was set to match the reported mean and 95% CI (a mean of 0.90, $b = 0.018$).

Demographic assessment modelling of black petrel estimated adult survival rates from 2007 to 2016 to be 0.87 year^{-1} (95% CI 0.86 - 0.88) (Zhang et al. 2020). The updated logit-normal prior was set to match the reported mean and 95% CI (a mean of 0.87, $b = 0.005$).

The previous prior distributions for current survival and optimal survival rates of northern giant petrel covered the range 0.81 to 0.96. Survival rates below 0.9 were considered unlikely for the species, given that the New Zealand populations are increasing (G. Taylor, pers. comm.). The prior distributions were updated to uniform distributions between 0.9 to 0.96.

Values for Parameters *a* and *b* are given in Tables 8 and 9 with summary statistics given in Table 13. The sources detailed above are listed for reference in Table 16.

Current and optimal survival rates for Whenua Hou diving petrel were also updated (described in the following section).

2.4.5 Egg and juvenile survival rates

Egg and juvenile survival rate multipliers ($S_s^{egg\,mult}$ and $S_s^{juv\,mult}$ respectively) were needed to calculate the surviorship to first breeding (S_s^A), which is necessary for calculation of intrinsic growth (λ_s^{EL}) using the Euler-Lotka method (Edwards et al. 2023).

The egg and juvenile survivorships are first calculated using survival rate multipliers applied to the optimal adult values:

$$S_s^{egg} = S_s^{opt} \cdot S_s^{egg\,mult}$$

$$S_s^{juv} = S_s^{opt} \cdot S_s^{juv\,mult}$$

Survivorship to the age at first breeding was then calculated using S_s^{opt} and A_s^{curr}:

$$S_s^A = S_s^{egg} \cdot \left(S_s^{juv}\right)^{(A_s^{curr}-1)}$$

Values for Parameters *a* and *b* are given in Tables 10 and 11 for $S_s^{egg\,mult}$ and $S_s^{juv\,mult}$ respectively. These are used to calculate the survivorship to first breeding, listed in Table 13.

2.5 Other updates to biological inputs

A number of changes were made to inputs for yellow-eyed penguin, based on available information from the Department of Conservation and the Yellow-eyed Penguin Trust. The breeding season was changed from Aug-Apr to Sep-Feb, to cover the period from egg-laying (mid-September) through to fledging. Yellow-eyed penguin undergo a catastrophic moult, during which individuals remain on land. Adults moult for approximately 3 to 4 weeks, with moulting taking place in March to April. The number of adult yellow-eyed penguin available to capture by fishing was adjusted to account for moulting birds by reducing the proportions of adults in zone by 40% in both March and April, i.e., assuming that moulting took 3.5 weeks (80% of a month) and that adults were equally likely to be moulting in March and April.

A number of changes were made to Whenua Hou diving petrel, based on outputs from an integrated population model (IPM) (Fischer et al. 2022). Additionally the common and species name were updated to reflect the recent split from South Georgia diving petrel (*Pelecanoides georgicus*) (Fischer et al. 2018). Prior distributions for S_s^{curr} and S_s^{opt} were updated to match estimated survival rates from the IPM, i.e., a median of 0.86 (95% CI 0.83 - 0.91), noting that the previous prior for S_s^{opt} implied lower optimum survival rates. The prior distribution for P_s^B was adjusted to match estimated proportions of adults breeding from the IPM, i.e., a median of 0.83 (95% CI 0.78 - 0.88). Finally, the breeding season was adjusted to be September to January based on Fischer et al. (2021).

3. OVERVIEW OF BIOLOGICAL INPUTS (TABLES 1–16)

Table 1: Species and species groups used in the risk assessment model (continued next page).

Species code	Common name	Scientific name	Catchability group
XAU	Gibson's albatross	*Diomedea antipodensis gibsoni*	Great albatross
XAN	Antipodean albatross	*Diomedea antipodensis antipodensis*	Great albatross
XRA	Southern royal albatross	*Diomedea epomophora*	Great albatross
XNR	Northern royal albatross	*Diomedea sanfordi*	Great albatross
XCM	Campbell black-browed albatross	*Thalassarche impavida*	Mollymawk and Small albatross
XWM	New Zealand white-capped albatross	*Thalassarche cauta steadi*	Mollymawk and Small albatross
XSA	Salvin's albatross	*Thalassarche salvini*	Mollymawk and Small albatross
XCI	Chatham Island albatross	*Thalassarche eremita*	Mollymawk and Small albatross
XGM	Grey-headed albatross	*Thalassarche chrysostoma*	Mollymawk and Small albatross
XBM	Southern Buller's albatross	*Thalassarche bulleri bulleri*	Mollymawk and Small albatross
XNB	Northern Buller's albatross	*Thalassarche bulleri platei*	Mollymawk and Small albatross
XLM	Light-mantled sooty albatross	*Phoebetria palpebrata*	Mollymawk and Small albatross
XNP	Northern giant petrel	*Macronectes halli*	Large petrel
XGP	Grey petrel	*Procellaria cinerea*	Medium petrel
XBP	Black petrel	*Procellaria parkinsoni*	Medium petrel
XWP	Westland petrel	*Procellaria westlandica*	Medium petrel
XWC	White-chinned petrel	*Procellaria aequinoctialis*	Medium petrel
XFS	Flesh-footed shearwater	*Puffinus carneipes*	Medium shearwater
PUPA	Wedge-tailed shearwater	*Puffinus pacificus*	Small shearwater
XBS	Buller's shearwater	*Puffinus bulleri*	Small shearwater
XSH	Sooty shearwater	*Puffinus griseus*	Medium shearwater
XFL	Fluttering shearwater	*Puffinus gavia*	Small shearwater
XPH	Hutton's shearwater	*Puffinus huttoni*	Small shearwater
PUAS	Little shearwater	*Puffinus assimilis*	Small shearwater
XCA	Snares Cape petrel	*Daption capense australe*	Small petrel
XFP	Fairy prion	*Pachyptila turtur*	Prion
XPR	Antarctic prion	*Pachyptila desolata*	Prion
XPV	Broad-billed prion	*Pachyptila vittata*	Prion
PTPY	Pycroft's petrel	*Pterodroma pycrofti*	Small petrel
PTCO	Cook's petrel	*Pterodroma cookii*	Small petrel
PTAX	Chatham petrel	*Pterodroma axillaris*	Small petrel
XMP	Mottled petrel	*Pterodroma inexpectata*	Small petrel
PTCE	White-naped petrel	*Pterodroma cervicalis*	Large petrel
PTNE	Kermadec petrel	*Pterodroma neglecta*	Large petrel
XGF	Grey-faced petrel	*Pterodroma macroptera gouldi*	Large petrel
PTMA	Chatham Island taiko	*Pterodroma magentae*	Large petrel
XWH	White-headed petrel	*Pterodroma lessonii*	Large petrel
PTMO	Soft-plumaged petrel	*Pterodroma mollis*	Small petrel
XDP	Common diving petrel	*Pelecanoides urinatrix*	Small petrel
XSD	Whenua Hou diving petrel	*Pelecanoides whenuahouensis*	Small petrel
XWF	New Zealand white-faced storm petrel	*Pelagodroma marina maoriana*	Small petrel
XWB	White-bellied storm petrel	*Fregetta grallaria grallaria*	Small petrel
XFT	Black-bellied storm petrel	*Fregetta tropica*	Small petrel
PEAL	Kermadec storm petrel	*Pelagodroma albiclunis*	Small petrel
PEMA	New Zealand storm petrel	*Pealeornis maoriana*	Small petrel
XYP	Yellow-eyed penguin	*Megadyptes antipodes*	Penguin
EUIR	Northern little penguin	*Eudyptula minor f. iredalei*	Penguin
EUAL	White-flippered little penguin	*Eudyptula minor f. albosignata*	Penguin
EUMI	Southern little penguin	*Eudyptula minor f. minor*	Penguin
EUCH	Chatham Island little penguin	*Eudyptula minor f. chathamensis*	Penguin
EUFI	Eastern rockhopper penguin	*Eudyptes chrysocome filholi*	Penguin
XFC	Fiordland crested penguin	*Eudyptes pachyrhynchus*	Penguin
EURO	Snares crested penguin	*Eudyptes robustus*	Penguin
EUSC	Erect-crested penguin	*Eudyptes sclateri*	Penguin
XGT	Australasian gannet	*Morus serrator*	Other seabirds
XMB	Masked booby	*Sula dactylatra*	Other seabirds
XPS	Pied shag	*Phalacrocorax varius varius*	Shag
XBC	Little black shag	*Phalacrocorax sulcirostris*	Shag
XKS	New Zealand king shag	*Leucocarbo carunculatus*	Shag
XSI	Otago shag	*Leucocarbo chalconotus*	Shag

Table 1: Continued

Species code	Common name	Scientific name	Catchability group
XFX	Foveaux shag	*Leucocarbo stewarti*	Shag
XCS	Chatham Island shag	*Leucocarbo onslowi*	Shag
LERA	Bounty Island shag	*Leucocarbo ranfurlyi*	Shag
LECO	Auckland Island shag	*Leucocarbo colensoi*	Shag
LECA	Campbell Island shag	*Leucocarbo campbelli*	Shag
XPP	Spotted shag	*Stictocarbo punctatus*	Shag
XPF	Pitt Island shag	*Stictocarbo featherstoni*	Shag
CALO	Subantarctic skua	*Catharacta antarctica lonnbergi*	Other seabirds
XBG	Southern black-backed gull	*Larus dominicanus dominicanus*	Other seabirds
HYCA	Caspian tern	*Hydroprogne caspia*	Other seabirds
GYCA	White tern	*Gygis alba candida*	Other seabirds

Table 2: Proportion of adults on nest by month (continued on next page). Shaded cells are breeding months.

Common name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Gibson's albatross	0.50	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
Antipodean albatross	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
Southern royal albatross	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50
Northern royal albatross	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.50	0.50
Campbell black-browed albatross	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50
New Zealand white-capped albatross	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50
Salvin's albatross	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.50	0.50	0.50	0.50
Chatham Island albatross	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50	0.50
Grey-headed albatross	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50
Southern Buller's albatross	0.50	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Northern Buller's albatross	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50
Light-mantled sooty albatross	0.50	0.05	0.05	0.05	0.05	0.00	0.00	0.00	0.50	0.50	0.50	0.50
Northern giant petrel	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50	0.50
Grey petrel	0.00	1.00	0.50	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00
Black petrel	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.50
Westland petrel	0.00	0.00	0.00	0.00	0.25	0.50	0.50	0.00	0.00	0.00	0.00	0.00
White-chinned petrel	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50
Flesh-footed shearwater	0.50	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.20	0.50
Wedge-tailed shearwater	0.50	0.50	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.50	0.50	0.50
Buller's shearwater	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50
Sooty shearwater	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50
Fluttering shearwater	0.50	0.50	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50	0.50	0.50
Hutton's shearwater	0.50	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50
Little shearwater	0.00	0.00	0.00	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Snares Cape petrel	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50
Fairy prion	0.50	0.00	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Antarctic prion	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50
Broad-billed prion	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Pycroft's petrel	0.50	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50
Cook's petrel	0.50	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50
Chatham petrel	0.50	0.50	0.50	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.50	0.50
Mottled petrel	0.50	0.50	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.50	0.50	0.50
White-naped petrel	0.50	0.50	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.50	0.50	0.50
Kermadec petrel	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Grey-faced petrel	0.50	0.00	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Chatham Island taiko	0.50	0.50	0.50	0.50	0.50	0.00	0.00	0.00	0.50	0.50	0.50	0.50
White-headed petrel	0.50	0.50	0.50	0.50	0.50	0.00	0.00	0.50	0.50	0.50	0.50	0.50
Soft-plumaged petrel	0.50	0.50	0.50	0.50	0.50	0.00	0.00	0.00	0.50	0.50	0.50	0.50
Common diving petrel	0.50	0.00	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Whenua Hou diving petrel	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50
New Zealand white-faced storm petrel	0.50	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50
White-bellied storm petrel	0.00	0.00	0.00	0.50	0.50	0.50	0.50	0.50	0.00	0.00	0.00	0.00
Black-bellied storm petrel	0.50	0.50	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.50	0.50	0.50
Kermadec storm petrel	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50	0.50	0.50	0.50
New Zealand storm petrel	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Yellow-eyed penguin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.50	0.50	0.25
Northern little penguin	0.50	0.50	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50	0.50	0.50
White-flippered little penguin	0.50	0.50	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50	0.50	0.50
Southern little penguin	0.50	0.50	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50	0.50	0.50
Chatham Island little penguin	0.50	0.50	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50	0.50	0.50
Eastern rockhopper penguin	0.50	0.50	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.50	0.50	0.50
Fiordland crested penguin	0.50	0.50	0.50	0.00	0.00	0.00	0.50	0.50	0.50	0.50	0.50	0.50
Snares crested penguin	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50
Erect-crested penguin	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50
Australasian gannet	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50	0.50
Masked booby	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Pied shag	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Little black shag	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50
New Zealand king shag	0.00	0.00	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.00	0.00
Otago shag	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50	0.50

Table 2: Continued

Common name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Foveaux shag	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50	0.50
Chatham Island shag	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50
Bounty Island shag	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50
Auckland Island shag	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50
Campbell Island shag	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50
Spotted shag	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Pitt Island shag	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50
Subantarctic skua	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50
Southern black-backed gull	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50
Caspian tern	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50
White tern	0.50	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50

Table 3: Proportion of adults in zone by month (continued on next page). Shaded cells are breeding months.

Common name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Gibson's albatross	0.67	0.55	0.59	0.46	0.34	0.50	0.39	0.20	0.19	0.23	0.32	0.67
Antipodean albatross	0.61	0.60	0.52	0.44	0.31	0.32	0.42	0.43	0.26	0.20	0.20	0.28
Southern royal albatross	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Northern royal albatross	0.43	0.43	0.43	0.21	0.21	0.21	0.18	0.18	0.18	0.57	0.57	0.57
Campbell black-browed albatross	0.95	0.95	0.95	0.95	0.95	0.50	0.50	0.95	0.95	0.95	0.95	0.95
New Zealand white-capped albatross	0.54	0.77	0.50	0.51	0.53	0.53	0.42	0.44	0.37	0.53	0.62	0.56
Salvin's albatross	0.51	0.23	0.09	0.00	0.03	0.18	0.62	0.87	0.84	0.86	0.85	0.84
Chatham Island albatross	0.72	0.29	0.07	0.00	0.00	0.00	0.02	0.02	0.94	0.94	0.94	0.94
Grey-headed albatross	0.80	0.80	0.80	0.80	0.80	0.20	0.20	0.20	0.80	0.80	0.80	0.80
Southern Buller's albatross	0.36	0.51	0.65	0.86	0.85	0.75	0.71	0.51	0.18	0.00	0.00	0.08
Northern Buller's albatross	0.90	0.90	0.90	0.90	0.90	0.90	0.02	0.02	0.02	0.90	0.90	0.90
Light-mantled sooty albatross	0.68	0.68	0.68	0.68	0.68	0.68	0.20	0.20	0.68	0.68	0.68	0.68
Northern giant petrel	0.97	0.97	0.75	0.75	0.75	0.75	0.75	0.97	0.97	0.97	0.97	0.97
Grey petrel	0.21	0.21	0.21	0.32	0.32	0.32	0.19	0.19	0.19	0.02	0.02	0.02
Black petrel	0.38	0.58	0.45	0.47	0.25	0.00	0.00	0.00	0.00	0.02	0.19	0.27
Westland petrel	0.00	0.00	0.01	0.35	0.69	0.85	0.78	0.63	0.41	0.54	0.41	0.03
White-chinned petrel	0.68	0.40	0.14	0.07	0.09	0.00	0.00	0.00	0.00	0.37	0.65	0.85
Flesh-footed shearwater	0.75	0.80	0.54	0.26	0.01	0.00	0.00	0.00	0.00	0.22	0.81	0.89
Wedge-tailed shearwater	0.90	0.90	0.90	0.90	0.90	0.00	0.00	0.00	0.00	0.90	0.90	0.90
Buller's shearwater	0.90	0.90	0.90	0.90	0.90	0.00	0.00	0.00	0.90	0.90	0.90	0.90
Sooty shearwater	0.50	0.50	0.50	0.50	0.10	0.00	0.00	0.00	0.10	0.50	0.50	0.50
Fluttering shearwater	0.98	0.98	0.80	0.80	0.80	0.80	0.98	0.98	0.98	0.98	0.98	0.98
Hutton's shearwater	0.90	0.90	0.90	0.90	0.02	0.02	0.02	0.02	0.90	0.90	0.90	0.90
Little shearwater	0.05	0.05	0.05	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.05
Snares Cape petrel	0.99	0.99	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.99	0.99
Fairy prion	0.92	0.15	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Antarctic prion	0.92	0.92	0.92	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.92	0.92
Broad-billed prion	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Pycroft's petrel	0.90	0.90	0.90	0.90	0.00	0.00	0.00	0.00	0.00	0.90	0.90	0.90
Cook's petrel	0.90	0.90	0.90	0.90	0.00	0.00	0.00	0.00	0.90	0.90	0.90	0.90
Chatham petrel	0.50	0.50	0.90	0.90	0.90	0.00	0.00	0.00	0.00	0.00	0.50	0.50
Mottled petrel	0.90	0.90	0.90	0.90	0.90	0.00	0.00	0.00	0.00	0.90	0.90	0.90
White-naped petrel	0.90	0.90	0.90	0.90	0.90	0.00	0.00	0.00	0.00	0.90	0.90	0.90
Kermadec petrel	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Grey-faced petrel	0.91	0.10	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Chatham Island taiko	0.92	0.92	0.92	0.92	0.92	0.20	0.20	0.20	0.92	0.92	0.92	0.92
White-headed petrel	0.64	0.64	0.64	0.64	0.64	0.10	0.10	0.64	0.64	0.64	0.64	0.64
Soft-plumaged petrel	0.90	0.90	0.90	0.90	0.90	0.00	0.00	0.00	0.90	0.90	0.90	0.90
Common diving petrel	0.92	0.20	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Whenua Hou diving petrel	0.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.83	0.83	0.83	0.83
New Zealand white-faced storm petrel	0.90	0.90	0.90	0.90	0.00	0.00	0.00	0.00	0.90	0.90	0.90	0.90
White-bellied storm petrel	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Black-bellied storm petrel	0.95	0.95	0.95	0.95	0.95	0.50	0.50	0.50	0.50	0.95	0.95	0.95
Kermadec storm petrel	0.50	0.50	0.50	0.50	0.50	0.95	0.95	0.95	0.95	0.95	0.95	0.95
New Zealand storm petrel	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Yellow-eyed penguin	1.00	1.00	0.60	0.60	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Northern little penguin	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
White-flippered little penguin	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Southern little penguin	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Chatham Island little penguin	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Eastern rockhopper penguin	0.90	0.90	0.90	0.90	0.90	0.05	0.05	0.05	0.05	0.90	0.90	0.90
Fiordland crested penguin	0.95	0.95	0.95	0.50	0.50	0.50	0.95	0.95	0.95	0.95	0.95	0.95
Snares crested penguin	0.90	0.90	0.05	0.05	0.05	0.05	0.05	0.05	0.90	0.90	0.90	0.90
Erect-crested penguin	0.95	0.95	0.95	0.50	0.50	0.50	0.50	0.50	0.95	0.95	0.95	0.95
Australasian gannet	0.92	0.92	0.92	0.20	0.20	0.20	0.20	0.92	0.92	0.92	0.92	0.92
Masked booby	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Pied shag	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Little black shag	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
New Zealand king shag	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Otago shag	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 3: Continued

Common name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Foveaux shag	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Chatham Island shag	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Bounty Island shag	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Auckland Island shag	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Campbell Island shag	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Spotted shag	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Pitt Island shag	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Subantarctic skua	0.95	0.95	0.50	0.50	0.50	0.50	0.50	0.50	0.95	0.95	0.95	0.95
Southern black-backed gull	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Caspian tern	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
White tern	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 4: Breeding / non-breeding months per species (continued on next page).

Common name	Breeding	Non-breeding
Gibson's albatross	Jan,Feb,Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec	–
Antipodean albatross	Jan,Feb,Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec	–
Southern royal albatross	Jan,Feb,Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec	–
Northern royal albatross	Jan,Feb,Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec	–
Campbell black-browed albatross	Aug,Sep,Oct,Nov,Dec,Jan,Feb,Mar,Apr,May	Jun,Jul
New Zealand white-capped albatross	Nov,Dec,Jan,Feb,Mar,Apr,May,Jun,Jul,Aug	Sep,Oct
Salvin's albatross	Sep,Oct,Nov,Dec,Jan,Feb,Mar,Apr	May,Jun,Jul,Aug
Chatham Island albatross	Aug,Sep,Oct,Nov,Dec,Jan,Feb,Mar,Apr,May	Jun,Jul
Grey-headed albatross	Sep,Oct,Nov,Dec,Jan,Feb,Mar,Apr,May	Jun,Jul,Aug
Southern Buller's albatross	Dec,Jan,Feb,Mar,Apr,May,Jun,Jul,Aug	Sep,Oct,Nov
Northern Buller's albatross	Oct,Nov,Dec,Jan,Feb,Mar,Apr,May,Jun	Jul,Aug,Sep
Light-mantled sooty albatross	Sep,Oct,Nov,Dec,Jan,Feb,Mar,Apr,May,Jun	Jul,Aug
Northern giant petrel	Aug,Sep,Oct,Nov,Dec,Jan,Feb	Mar,Apr,May,Jun,Jul
Grey petrel	Feb,Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov	Jan,Dec
Black petrel	Oct,Nov,Dec,Jan,Feb,Mar,Apr,May	Jun,Jul,Aug,Sep
Westland petrel	Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec	Jan,Feb
White-chinned petrel	Nov,Dec,Jan,Feb,Mar,Apr,May	Jun,Jul,Aug,Sep,Oct
Flesh-footed shearwater	Sep,Oct,Nov,Dec,Jan,Feb,Mar,Apr,May	Jun,Jul,Aug
Wedge-tailed shearwater	Oct,Nov,Dec,Jan,Feb,Mar,Apr,May	Jun,Jul,Aug,Sep
Buller's shearwater	Sep,Oct,Nov,Dec,Jan,Feb,Mar,Apr,May	Jun,Jul,Aug
Sooty shearwater	Nov,Dec,Jan,Feb,Mar,Apr,May	Jun,Jul,Aug,Sep,Oct
Fluttering shearwater	Jul,Aug,Sep,Oct,Nov,Dec,Jan,Feb	Mar,Apr,May,Jun
Hutton's shearwater	Sep,Oct,Nov,Dec,Jan,Feb,Mar,Apr	May,Jun,Jul,Aug
Little shearwater	Apr,May,Jun,Jul,Aug,Sep,Oct,Nov	Jan,Feb,Mar,Dec
Snares Cape petrel	Nov,Dec,Jan,Feb	Mar,Apr,May,Jun,Jul,Aug,Sep,Oct
Fairy prion	Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec,Jan	Feb
Antarctic prion	Nov,Dec,Jan,Feb,Mar	Apr,May,Jun,Jul,Aug,Sep,Oct
Broad-billed prion	Jan,Feb,Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec	–
Pycroft's petrel	Oct,Nov,Dec,Jan,Feb,Mar,Apr	May,Jun,Jul,Aug,Sep
Cook's petrel	Sep,Oct,Nov,Dec,Jan,Feb,Mar,Apr	May,Jun,Jul,Aug
Chatham petrel	Nov,Dec,Jan,Feb,Mar,Apr,May,Jun	Jul,Aug,Sep,Oct
Mottled petrel	Oct,Nov,Dec,Jan,Feb,Mar,Apr,May	Jun,Jul,Aug,Sep
White-naped petrel	Oct,Nov,Dec,Jan,Feb,Mar,Apr,May	Jun,Jul,Aug,Sep
Kermadec petrel	Jan,Feb,Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec	–
Grey-faced petrel	Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec,Jan	Feb
Chatham Island taiko	Sep,Oct,Nov,Dec,Jan,Feb,Mar,Apr,May	Jun,Jul,Aug
White-headed petrel	Aug,Sep,Oct,Nov,Dec,Jan,Feb,Mar,Apr,May	Jun,Jul
Soft-plumaged petrel	Sep,Oct,Nov,Dec,Jan,Feb,Mar,Apr,May	Jun,Jul,Aug
Common diving petrel	Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec,Jan	Feb
Whenua Hou diving petrel	Sep,Oct,Nov,Dec,Jan	Feb,Mar,Apr,May,Jun,Jul,Aug
New Zealand white-faced storm petrel	Sep,Oct,Nov,Dec,Jan,Feb,Mar,Apr	May,Jun,Jul,Aug
White-bellied storm petrel	Apr,May,Jun,Jul,Aug	Jan,Feb,Mar,Sep,Oct,Nov,Dec
Black-bellied storm petrel	Oct,Nov,Dec,Jan,Feb,Mar,Apr,May	Jun,Jul,Aug,Sep
Kermadec storm petrel	Jun,Jul,Aug,Sep,Oct,Nov,Dec	Jan,Feb,Mar,Apr,May
New Zealand storm petrel	Jan,Feb,Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec	–
Yellow-eyed penguin	Sep,Oct,Nov,Dec,Jan,Feb	Mar,Apr,May,Jun,Jul,Aug
Northern little penguin	Jul,Aug,Sep,Oct,Nov,Dec,Jan,Feb	Mar,Apr,May,Jun
White-flippered little penguin	Jul,Aug,Sep,Oct,Nov,Dec,Jan,Feb	Mar,Apr,May,Jun
Southern little penguin	Jul,Aug,Sep,Oct,Nov,Dec,Jan,Feb	Mar,Apr,May,Jun
Chatham Island little penguin	Jul,Aug,Sep,Oct,Nov,Dec,Jan,Feb	Mar,Apr,May,Jun
Eastern rockhopper penguin	Oct,Nov,Dec,Jan,Feb,Mar,Apr,May	Jun,Jul,Aug,Sep
Fiordland crested penguin	Jul,Aug,Sep,Oct,Nov,Dec,Jan,Feb,Mar	Apr,May,Jun
Snares crested penguin	Sep,Oct,Nov,Dec,Jan,Feb	Mar,Apr,May,Jun,Jul,Aug
Erect-crested penguin	Sep,Oct,Nov,Dec,Jan,Feb,Mar	Apr,May,Jun,Jul,Aug
Australasian gannet	Aug,Sep,Oct,Nov,Dec,Jan,Feb,Mar	Apr,May,Jun,Jul
Masked booby	Jan,Feb,Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec	–
Pied shag	Jan,Feb,Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec	–
Little black shag	Oct,Nov,Dec	Jan,Feb,Mar,Apr,May,Jun,Jul,Aug,Sep
New Zealand king shag	Mar,Apr,May,Jun,Jul,Aug,Sep,Oct	Jan,Feb,Nov,Dec
Otago shag	Aug,Sep,Oct,Nov,Dec,Jan,Feb,Mar	Apr,May,Jun,Jul
Foveaux shag	Aug,Sep,Oct,Nov,Dec,Jan,Feb,Mar	Apr,May,Jun,Jul

Table 4: Continued

Common name	Breeding	Non-breeding
Chatham Island shag	Sep,Oct,Nov,Dec,Jan,Feb	Mar,Apr,May,Jun,Jul,Aug
Bounty Island shag	Oct,Nov,Dec	Jan,Feb,Mar,Apr,May,Jun,Jul,Aug,Sep
Auckland Island shag	Nov,Dec,Jan,Feb,Mar	Apr,May,Jun,Jul,Aug,Sep,Oct
Campbell Island shag	Nov,Dec,Jan,Feb	Mar,Apr,May,Jun,Jul,Aug,Sep,Oct
Spotted shag	Jan,Feb,Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec	–
Pitt Island shag	Sep,Oct,Nov,Dec,Jan,Feb	Mar,Apr,May,Jun,Jul,Aug
Subantarctic skua	Sep,Oct,Nov,Dec,Jan,Feb	Mar,Apr,May,Jun,Jul,Aug
Southern black-backed gull	Sep,Oct,Nov,Dec,Jan,Feb,Mar	Apr,May,Jun,Jul,Aug
Caspian tern	Sep,Oct,Nov,Dec,Jan	Feb,Mar,Apr,May,Jun,Jul,Aug
White tern	Sep,Oct,Nov,Dec,Jan,Feb,Mar,Apr	May,Jun,Jul,Aug

Table 5: Prior distributions for numbers of breeding pairs (continued on following pages).

Common name	Distribution	Parameter *a*	Parameter *b*
Gibson's albatross	log-normal	4 313	0.100
Antipodean albatross	log-normal	3 303	0.054
Southern royal albatross	log-normal	8 564	0.100
Northern royal albatross	log-normal	4 026	0.100
Campbell black-browed albatross	log-normal	19 950	0.076
New Zealand white-capped albatross	log-normal	85 944	0.100
Salvin's albatross	log-normal	41 208	0.180
Chatham Island albatross	log-normal	5 294	0.015
Grey-headed albatross	log-normal	5 270	0.089
Southern Buller's albatross	log-normal	14 903	0.043
Northern Buller's albatross	log-normal	20 305	0.025
Light-mantled sooty albatross	uniform	6 770	6 900
Northern giant petrel	uniform	2 140	3 140
Grey petrel	uniform	32 000	73 000
Black petrel	log-normal	5 286	0.114
Westland petrel	log-normal	7 965	0.300
White-chinned petrel	log-normal	249 309	0.089
Flesh-footed shearwater	normal	20 674	2 160
Wedge-tailed shearwater	log-normal	50 000	0.300
Buller's shearwater	normal	78 645	5 610
Sooty shearwater	log-normal	5 000 000	0.300
Fluttering shearwater	uniform	100 000	500 000
Hutton's shearwater	log-normal	114 000	0.200
Little shearwater	uniform	115 000	210 000
Snares Cape petrel	log-normal	8 420	0.300
Fairy prion	log-normal	1 500 000	0.100
Antarctic prion	uniform	350 000	1 000 000
Broad-billed prion	log-normal	350 000	0.100
Pycroft's petrel	uniform	2 000	3 000
Cook's petrel	uniform	216 000	419 000
Chatham petrel	log-normal	250	0.200
Mottled petrel	uniform	300 000	400 000
White-naped petrel	log-normal	50 000	0.300
Kermadec petrel	uniform	5 000	7 000
Grey-faced petrel	uniform	200 000	300 000
Chatham Island taiko	log-normal	41	0.100
White-headed petrel	log-normal	200 000	0.300
Soft-plumaged petrel	uniform	1 000	9 999
Common diving petrel	uniform	300 000	2 150 000
Whenua Hou diving petrel	normal	87.300	8.520
New Zealand white-faced storm petrel	uniform	700 000	3 000 000
White-bellied storm petrel	log-normal	1 000	0.300
Black-bellied storm petrel	uniform	50 000	100 000
Kermadec storm petrel	uniform	20	120
New Zealand storm petrel	uniform	20	1 000
Yellow-eyed penguin	log-normal	1 210	0.100
Northern little penguin	uniform	5 000	10 000
White-flippered little penguin	log-normal	2 200	0.200
Southern little penguin	uniform	5 000	10 000
Chatham Island little penguin	uniform	5 000	10 000
Eastern rockhopper penguin	uniform	38 961	58 500

Table 5: Continued

Common name	Distribution	Parameter *a*	Parameter *b*
Fiordland crested penguin	log-normal	3 000	0.300
Snares crested penguin	uniform	24 666	30 672
Erect-crested penguin	uniform	77 000	85 000
Australasian gannet	log-normal	46 004	0.300
Masked booby	log-normal	240	0.200
Pied shag	log-normal	6 400	0.100
Little black shag	log-normal	1 500	0.300
New Zealand king shag	log-normal	187	0.100
Otago shag	uniform	1 230	1 400
Foveaux shag	uniform	840	1 080
Chatham Island shag	log-normal	355	0.100
Bounty Island shag	log-normal	120	0.200
Auckland Island shag	uniform	956	4 098
Campbell Island shag	log-normal	2 000	0.300
Spotted shag	uniform	10 000	30 000
Pitt Island shag	log-normal	338	0.100
Subantarctic skua	uniform	450	470
Southern black-backed gull	uniform	700 000	3 000 000
Caspian tern	log-normal	1 000	0.200
White tern	uniform	60	100

Table 6: Prior distributions for proportion of adults breeding (continued on following pages).

Common name	Distribution	Parameter a	Parameter b
Gibson's albatross	logit-normal	0.600	0.050
Antipodean albatross	logit-normal	0.600	0.050
Southern royal albatross	logit-normal	0.600	0.050
Northern royal albatross	logit-normal	0.610	0.050
Campbell black-browed albatross	logit-normal	0.900	0.050
New Zealand white-capped albatross	logit-normal	0.680	0.050
Salvin's albatross	logit-normal	0.900	0.050
Chatham Island albatross	logit-normal	0.900	0.050
Grey-headed albatross	logit-normal	0.750	0.050
Southern Buller's albatross	logit-normal	0.900	0.050
Northern Buller's albatross	logit-normal	0.900	0.050
Light-mantled sooty albatross	logit-normal	0.600	0.050
Northern giant petrel	logit-normal	0.900	0.050
Grey petrel	logit-normal	0.800	0.050
Black petrel	logit-normal	0.610	0.050
Westland petrel	logit-normal	0.900	0.050
White-chinned petrel	logit-normal	0.900	0.050
Flesh-footed shearwater	logit-normal	0.800	0.050
Wedge-tailed shearwater	logit-normal	0.900	0.050
Buller's shearwater	logit-normal	0.900	0.050
Sooty shearwater	logit-normal	0.900	0.050
Fluttering shearwater	logit-normal	0.900	0.050
Hutton's shearwater	logit-normal	0.900	0.050
Little shearwater	logit-normal	0.900	0.050
Snares Cape petrel	logit-normal	0.900	0.050
Fairy prion	logit-normal	0.900	0.050
Antarctic prion	logit-normal	0.900	0.050
Broad-billed prion	logit-normal	0.900	0.050
Pycroft's petrel	logit-normal	0.900	0.050
Cook's petrel	logit-normal	0.900	0.050
Chatham petrel	logit-normal	0.900	0.050
Mottled petrel	logit-normal	0.900	0.050
White-naped petrel	logit-normal	0.900	0.050
Kermadec petrel	logit-normal	0.900	0.050
Grey-faced petrel	logit-normal	0.900	0.050
Chatham Island taiko	logit-normal	0.900	0.050
White-headed petrel	logit-normal	0.600	0.050
Soft-plumaged petrel	logit-normal	0.900	0.050
Common diving petrel	logit-normal	0.900	0.050
Whenua Hou diving petrel	logit-normal	0.835	0.025
New Zealand white-faced storm petrel	logit-normal	0.900	0.050
White-bellied storm petrel	logit-normal	0.900	0.050
Black-bellied storm petrel	logit-normal	0.900	0.050
Kermadec storm petrel	logit-normal	0.900	0.050
New Zealand storm petrel	logit-normal	0.900	0.050
Yellow-eyed penguin	logit-normal	0.688	0.050
Northern little penguin	logit-normal	0.900	0.050
White-flippered little penguin	logit-normal	0.900	0.050
Southern little penguin	logit-normal	0.900	0.050
Chatham Island little penguin	logit-normal	0.900	0.050
Eastern rockhopper penguin	logit-normal	0.900	0.050

Table 6: Continued

Common name	Distribution	Parameter *a*	Parameter *b*
Fiordland crested penguin	logit-normal	0.900	0.050
Snares crested penguin	logit-normal	0.900	0.050
Erect-crested penguin	logit-normal	0.900	0.050
Australasian gannet	logit-normal	0.900	0.050
Masked booby	logit-normal	0.900	0.050
Pied shag	logit-normal	0.999	0.001
Little black shag	logit-normal	0.900	0.050
New Zealand king shag	logit-normal	0.900	0.050
Otago shag	logit-normal	0.900	0.050
Foveaux shag	logit-normal	0.900	0.050
Chatham Island shag	logit-normal	0.900	0.050
Bounty Island shag	logit-normal	0.900	0.050
Auckland Island shag	logit-normal	0.900	0.050
Campbell Island shag	logit-normal	0.900	0.050
Spotted shag	logit-normal	0.900	0.050
Pitt Island shag	logit-normal	0.900	0.050
Subantarctic skua	logit-normal	0.900	0.050
Southern black-backed gull	logit-normal	0.900	0.050
Caspian tern	logit-normal	0.900	0.050
White tern	logit-normal	0.900	0.050

Table 7: Prior distributions for age at first reproduction (continued on following pages).

Common name	Distribution	Parameter a	Parameter b
Gibson's albatross	uniform	10.00	12.00
Antipodean albatross	uniform	7.00	13.00
Southern royal albatross	uniform	8.50	10.60
Northern royal albatross	uniform	8.50	10.60
Campbell black-browed albatross	uniform	6.00	13.00
New Zealand white-capped albatross	uniform	9.00	15.00
Salvin's albatross	uniform	9.00	15.00
Chatham Island albatross	uniform	9.00	15.00
Grey-headed albatross	uniform	7.00	13.00
Southern Buller's albatross	uniform	9.00	15.00
Northern Buller's albatross	uniform	9.00	15.00
Light-mantled sooty albatross	uniform	9.00	15.00
Northern giant petrel	uniform	6.00	10.00
Grey petrel	uniform	5.00	9.00
Black petrel	uniform	6.21	6.99
Westland petrel	uniform	4.00	9.00
White-chinned petrel	uniform	4.00	9.00
Flesh-footed shearwater	uniform	4.00	9.00
Wedge-tailed shearwater	uniform	3.00	5.00
Buller's shearwater	uniform	4.00	9.00
Sooty shearwater	uniform	5.00	7.00
Fluttering shearwater	uniform	4.00	6.00
Hutton's shearwater	uniform	4.00	6.00
Little shearwater	uniform	4.00	6.00
Snares Cape petrel	uniform	3.00	8.00
Fairy prion	uniform	4.00	5.00
Antarctic prion	uniform	5.00	6.00
Broad-billed prion	uniform	4.00	5.00
Pycroft's petrel	uniform	6.00	7.00
Cook's petrel	uniform	6.00	7.00
Chatham petrel	uniform	6.00	7.00
Mottled petrel	uniform	6.00	7.00
White-naped petrel	uniform	6.00	7.00
Kermadec petrel	uniform	6.00	7.00
Grey-faced petrel	uniform	6.00	7.00
Chatham Island taiko	uniform	6.00	7.00
White-headed petrel	uniform	4.00	7.00
Soft-plumaged petrel	uniform	6.00	7.00
Common diving petrel	uniform	2.00	3.00
Whenua Hou diving petrel	uniform	2.00	3.00
New Zealand white-faced storm petrel	uniform	3.00	5.00
White-bellied storm petrel	uniform	4.00	5.00
Black-bellied storm petrel	uniform	4.00	5.00
Kermadec storm petrel	uniform	3.00	5.00
New Zealand storm petrel	uniform	4.00	5.00
Yellow-eyed penguin	uniform	2.00	4.00
Northern little penguin	uniform	2.00	3.00
White-flippered little penguin	uniform	2.00	3.00
Southern little penguin	uniform	2.00	3.00
Chatham Island little penguin	uniform	2.00	3.00
Eastern rockhopper penguin	uniform	3.00	6.00

Table 7: Continued

Common name	Distribution	Parameter *a*	Parameter *b*
Fiordland crested penguin	uniform	3.00	6.00
Snares crested penguin	uniform	5.00	6.00
Erect-crested penguin	uniform	5.00	6.00
Australasian gannet	uniform	3.00	7.00
Masked booby	uniform	2.00	4.00
Pied shag	uniform	2.00	3.33
Little black shag	uniform	1.00	3.00
New Zealand king shag	uniform	3.00	5.00
Otago shag	uniform	3.00	5.00
Foveaux shag	uniform	3.00	5.00
Chatham Island shag	uniform	3.00	5.00
Bounty Island shag	uniform	3.00	5.00
Auckland Island shag	uniform	3.00	5.00
Campbell Island shag	uniform	3.00	5.00
Spotted shag	uniform	1.00	3.00
Pitt Island shag	uniform	3.00	5.00
Subantarctic skua	uniform	7.62	8.44
Southern black-backed gull	uniform	3.00	5.00
Caspian tern	uniform	2.00	4.00
White tern	uniform	3.00	5.00

Table 8: Prior distributions for current adult survival rate (continued on following pages).

Common name	Distribution	Parameter a	Parameter b
Gibson's albatross	logit-normal	0.920	0.020
Antipodean albatross	logit-normal	0.910	0.020
Southern royal albatross	logit-normal	0.949	0.008
Northern royal albatross	uniform	0.908	0.969
Campbell black-browed albatross	logit-normal	0.945	0.007
New Zealand white-capped albatross	logit-normal	0.900	0.018
Salvin's albatross	logit-normal	0.967	0.010
Chatham Island albatross	logit-normal	0.967	0.010
Grey-headed albatross	logit-normal	0.953	0.009
Southern Buller's albatross	uniform	0.930	0.980
Northern Buller's albatross	uniform	0.930	0.980
Light-mantled sooty albatross	uniform	0.960	0.980
Northern giant petrel	uniform	0.900	0.960
Grey petrel	uniform	0.900	0.970
Black petrel	logit-normal	0.870	0.005
Westland petrel	uniform	0.918	0.975
White-chinned petrel	uniform	0.900	0.970
Flesh-footed shearwater	uniform	0.931	0.940
Wedge-tailed shearwater	uniform	0.889	0.958
Buller's shearwater	logit-normal	0.920	0.030
Sooty shearwater	uniform	0.860	0.979
Fluttering shearwater	uniform	0.889	0.958
Hutton's shearwater	uniform	0.889	0.958
Little shearwater	uniform	0.889	0.958
Snares Cape petrel	uniform	0.771	0.939
Fairy prion	logit-normal	0.840	0.030
Antarctic prion	logit-normal	0.840	0.030
Broad-billed prion	logit-normal	0.840	0.030
Pycroft's petrel	logit-normal	0.940	0.030
Cook's petrel	logit-normal	0.940	0.030
Chatham petrel	logit-normal	0.940	0.030
Mottled petrel	logit-normal	0.940	0.030
White-naped petrel	logit-normal	0.940	0.030
Kermadec petrel	logit-normal	0.940	0.030
Grey-faced petrel	logit-normal	0.940	0.030
Chatham Island taiko	logit-normal	0.940	0.030
White-headed petrel	logit-normal	0.940	0.030
Soft-plumaged petrel	logit-normal	0.940	0.030
Common diving petrel	uniform	0.750	0.870
Whenua Hou diving petrel	logit-normal	0.861	0.018
New Zealand white-faced storm petrel	logit-normal	0.900	0.030
White-bellied storm petrel	logit-normal	0.900	0.030
Black-bellied storm petrel	logit-normal	0.900	0.030
Kermadec storm petrel	logit-normal	0.900	0.030
New Zealand storm petrel	logit-normal	0.900	0.030
Yellow-eyed penguin	logit-normal	0.870	0.030
Northern little penguin	logit-normal	0.830	0.020
White-flippered little penguin	logit-normal	0.830	0.020
Southern little penguin	logit-normal	0.830	0.020
Chatham Island little penguin	logit-normal	0.830	0.020
Eastern rockhopper penguin	logit-normal	0.840	0.011

Table 8: Continued

Common name	Distribution	Parameter *a*	Parameter *b*
Fiordland crested penguin	logit-normal	0.840	0.011
Snares crested penguin	logit-normal	0.840	0.011
Erect-crested penguin	logit-normal	0.840	0.011
Australasian gannet	logit-normal	0.940	0.030
Masked booby	logit-normal	0.850	0.030
Pied shag	uniform	0.859	0.897
Little black shag	uniform	0.859	0.897
New Zealand king shag	uniform	0.859	0.897
Otago shag	uniform	0.859	0.897
Foveaux shag	uniform	0.859	0.897
Chatham Island shag	uniform	0.859	0.897
Bounty Island shag	uniform	0.859	0.897
Auckland Island shag	uniform	0.859	0.897
Campbell Island shag	uniform	0.859	0.897
Spotted shag	uniform	0.859	0.897
Pitt Island shag	uniform	0.859	0.897
Subantarctic skua	uniform	0.910	0.970
Southern black-backed gull	logit-normal	0.810	0.030
Caspian tern	uniform	0.816	0.937
White tern	uniform	0.780	0.830

Table 9: Prior distributions for optimum adult survival rate (continued on following pages).

Common name	Distribution	Parameter a	Parameter b
Gibson's albatross	uniform	0.938	0.985
Antipodean albatross	logit-normal	0.957	0.007
Southern royal albatross	logit-normal	0.949	0.008
Northern royal albatross	uniform	0.908	0.969
Campbell black-browed albatross	logit-normal	0.945	0.007
New Zealand white-capped albatross	logit-normal	0.960	0.010
Salvin's albatross	logit-normal	0.967	0.010
Chatham Island albatross	logit-normal	0.967	0.010
Grey-headed albatross	logit-normal	0.953	0.009
Southern Buller's albatross	uniform	0.930	0.980
Northern Buller's albatross	uniform	0.930	0.980
Light-mantled sooty albatross	uniform	0.960	0.980
Northern giant petrel	uniform	0.900	0.960
Grey petrel	uniform	0.900	0.970
Black petrel	logit-normal	0.950	0.010
Westland petrel	uniform	0.918	0.975
White-chinned petrel	uniform	0.900	0.970
Flesh-footed shearwater	logit-normal	0.940	0.030
Wedge-tailed shearwater	uniform	0.889	0.958
Buller's shearwater	logit-normal	0.920	0.030
Sooty shearwater	uniform	0.860	0.979
Fluttering shearwater	uniform	0.889	0.958
Hutton's shearwater	uniform	0.889	0.958
Little shearwater	uniform	0.889	0.958
Snares Cape petrel	uniform	0.771	0.939
Fairy prion	logit-normal	0.840	0.030
Antarctic prion	logit-normal	0.840	0.030
Broad-billed prion	logit-normal	0.840	0.030
Pycroft's petrel	logit-normal	0.940	0.030
Cook's petrel	logit-normal	0.940	0.030
Chatham petrel	logit-normal	0.940	0.030
Mottled petrel	logit-normal	0.940	0.030
White-naped petrel	logit-normal	0.940	0.030
Kermadec petrel	logit-normal	0.940	0.030
Grey-faced petrel	logit-normal	0.940	0.030
Chatham Island taiko	logit-normal	0.940	0.030
White-headed petrel	logit-normal	0.940	0.030
Soft-plumaged petrel	logit-normal	0.940	0.030
Common diving petrel	uniform	0.750	0.870
Whenua Hou diving petrel	logit-normal	0.861	0.018
New Zealand white-faced storm petrel	logit-normal	0.900	0.030
White-bellied storm petrel	logit-normal	0.900	0.030
Black-bellied storm petrel	logit-normal	0.900	0.030
Kermadec storm petrel	logit-normal	0.900	0.030
New Zealand storm petrel	logit-normal	0.900	0.030
Yellow-eyed penguin	logit-normal	0.870	0.030
Northern little penguin	logit-normal	0.830	0.020
White-flippered little penguin	logit-normal	0.830	0.020
Southern little penguin	logit-normal	0.830	0.020
Chatham Island little penguin	logit-normal	0.830	0.020
Eastern rockhopper penguin	logit-normal	0.840	0.011

Table 9: Continued

Common name	Distribution	Parameter *a*	Parameter *b*
Fiordland crested penguin	logit-normal	0.840	0.011
Snares crested penguin	logit-normal	0.840	0.011
Erect-crested penguin	logit-normal	0.840	0.011
Australasian gannet	logit-normal	0.940	0.030
Masked booby	logit-normal	0.850	0.030
Pied shag	uniform	0.859	0.897
Little black shag	uniform	0.859	0.897
New Zealand king shag	uniform	0.859	0.897
Otago shag	uniform	0.859	0.897
Foveaux shag	uniform	0.859	0.897
Chatham Island shag	uniform	0.859	0.897
Bounty Island shag	uniform	0.859	0.897
Auckland Island shag	uniform	0.859	0.897
Campbell Island shag	uniform	0.859	0.897
Spotted shag	uniform	0.859	0.897
Pitt Island shag	uniform	0.859	0.897
Subantarctic skua	uniform	0.910	0.970
Southern black-backed gull	logit-normal	0.810	0.030
Caspian tern	uniform	0.816	0.937
White tern	uniform	0.780	0.830

Table 10: Prior distributions for egg survival rate multiplier (continued on following pages).

Common name	Distribution	Parameter a	Parameter b
Gibson's albatross	logit-normal	0.8	0.05
Antipodean albatross	logit-normal	0.8	0.05
Southern royal albatross	logit-normal	0.8	0.05
Northern royal albatross	logit-normal	0.8	0.05
Campbell black-browed albatross	logit-normal	0.8	0.05
New Zealand white-capped albatross	logit-normal	0.8	0.05
Salvin's albatross	logit-normal	0.8	0.05
Chatham Island albatross	logit-normal	0.8	0.05
Grey-headed albatross	logit-normal	0.8	0.05
Southern Buller's albatross	logit-normal	0.8	0.05
Northern Buller's albatross	logit-normal	0.8	0.05
Light-mantled sooty albatross	logit-normal	0.8	0.05
Northern giant petrel	logit-normal	0.8	0.05
Grey petrel	logit-normal	0.8	0.05
Black petrel	logit-normal	0.8	0.05
Westland petrel	logit-normal	0.8	0.05
White-chinned petrel	logit-normal	0.8	0.05
Flesh-footed shearwater	logit-normal	0.8	0.05
Wedge-tailed shearwater	logit-normal	0.8	0.05
Buller's shearwater	logit-normal	0.8	0.05
Sooty shearwater	logit-normal	0.8	0.05
Fluttering shearwater	logit-normal	0.8	0.05
Hutton's shearwater	logit-normal	0.8	0.05
Little shearwater	logit-normal	0.8	0.05
Snares Cape petrel	logit-normal	0.8	0.05
Fairy prion	logit-normal	0.8	0.05
Antarctic prion	logit-normal	0.8	0.05
Broad-billed prion	logit-normal	0.8	0.05
Pycroft's petrel	logit-normal	0.8	0.05
Cook's petrel	logit-normal	0.8	0.05
Chatham petrel	logit-normal	0.8	0.05
Mottled petrel	logit-normal	0.8	0.05
White-naped petrel	logit-normal	0.8	0.05
Kermadec petrel	logit-normal	0.8	0.05
Grey-faced petrel	logit-normal	0.8	0.05
Chatham Island taiko	logit-normal	0.8	0.05
White-headed petrel	logit-normal	0.8	0.05
Soft-plumaged petrel	logit-normal	0.8	0.05
Common diving petrel	logit-normal	0.8	0.05
Whenua Hou diving petrel	logit-normal	0.8	0.05
New Zealand white-faced storm petrel	logit-normal	0.8	0.05
White-bellied storm petrel	logit-normal	0.8	0.05
Black-bellied storm petrel	logit-normal	0.8	0.05
Kermadec storm petrel	logit-normal	0.8	0.05
New Zealand storm petrel	logit-normal	0.8	0.05
Yellow-eyed penguin	logit-normal	0.5	0.05
Northern little penguin	logit-normal	0.5	0.05
White-flippered little penguin	logit-normal	0.5	0.05
Southern little penguin	logit-normal	0.5	0.05
Chatham Island little penguin	logit-normal	0.5	0.05
Eastern rockhopper penguin	logit-normal	0.5	0.05

Table 10: Continued

Common name	Distribution	Parameter *a*	Parameter *b*
Fiordland crested penguin	logit-normal	0.5	0.05
Snares crested penguin	logit-normal	0.5	0.05
Erect-crested penguin	logit-normal	0.5	0.05
Australasian gannet	logit-normal	0.8	0.05
Masked booby	logit-normal	0.8	0.05
Pied shag	logit-normal	0.8	0.05
Little black shag	logit-normal	0.8	0.05
New Zealand king shag	logit-normal	0.8	0.05
Otago shag	logit-normal	0.8	0.05
Foveaux shag	logit-normal	0.8	0.05
Chatham Island shag	logit-normal	0.8	0.05
Bounty Island shag	logit-normal	0.8	0.05
Auckland Island shag	logit-normal	0.8	0.05
Campbell Island shag	logit-normal	0.8	0.05
Spotted shag	logit-normal	0.8	0.05
Pitt Island shag	logit-normal	0.8	0.05
Subantarctic skua	logit-normal	0.8	0.05
Southern black-backed gull	logit-normal	0.8	0.05
Caspian tern	logit-normal	0.8	0.05
White tern	logit-normal	0.8	0.05

Table 11: Prior distributions for juvenile survival rate multiplier (continued on following pages).

Common name	Distribution	Parameter a	Parameter b
Gibson's albatross	logit-normal	0.9	0.05
Antipodean albatross	logit-normal	0.9	0.05
Southern royal albatross	logit-normal	0.9	0.05
Northern royal albatross	logit-normal	0.9	0.05
Campbell black-browed albatross	logit-normal	0.9	0.05
New Zealand white-capped albatross	logit-normal	0.9	0.05
Salvin's albatross	logit-normal	0.9	0.05
Chatham Island albatross	logit-normal	0.9	0.05
Grey-headed albatross	logit-normal	0.9	0.05
Southern Buller's albatross	logit-normal	0.9	0.05
Northern Buller's albatross	logit-normal	0.9	0.05
Light-mantled sooty albatross	logit-normal	0.9	0.05
Northern giant petrel	logit-normal	0.9	0.05
Grey petrel	logit-normal	0.9	0.05
Black petrel	logit-normal	0.9	0.05
Westland petrel	logit-normal	0.9	0.05
White-chinned petrel	logit-normal	0.9	0.05
Flesh-footed shearwater	logit-normal	0.9	0.05
Wedge-tailed shearwater	logit-normal	0.9	0.05
Buller's shearwater	logit-normal	0.9	0.05
Sooty shearwater	logit-normal	0.9	0.05
Fluttering shearwater	logit-normal	0.9	0.05
Hutton's shearwater	logit-normal	0.9	0.05
Little shearwater	logit-normal	0.9	0.05
Snares Cape petrel	logit-normal	0.9	0.05
Fairy prion	logit-normal	0.9	0.05
Antarctic prion	logit-normal	0.9	0.05
Broad-billed prion	logit-normal	0.9	0.05
Pycroft's petrel	logit-normal	0.9	0.05
Cook's petrel	logit-normal	0.9	0.05
Chatham petrel	logit-normal	0.9	0.05
Mottled petrel	logit-normal	0.9	0.05
White-naped petrel	logit-normal	0.9	0.05
Kermadec petrel	logit-normal	0.9	0.05
Grey-faced petrel	logit-normal	0.9	0.05
Chatham Island taiko	logit-normal	0.9	0.05
White-headed petrel	logit-normal	0.9	0.05
Soft-plumaged petrel	logit-normal	0.9	0.05
Common diving petrel	logit-normal	0.9	0.05
Whenua Hou diving petrel	logit-normal	0.9	0.05
New Zealand white-faced storm petrel	logit-normal	0.9	0.05
White-bellied storm petrel	logit-normal	0.9	0.05
Black-bellied storm petrel	logit-normal	0.9	0.05
Kermadec storm petrel	logit-normal	0.9	0.05
New Zealand storm petrel	logit-normal	0.9	0.05
Yellow-eyed penguin	logit-normal	0.9	0.05
Northern little penguin	logit-normal	0.9	0.05
White-flippered little penguin	logit-normal	0.9	0.05
Southern little penguin	logit-normal	0.9	0.05
Chatham Island little penguin	logit-normal	0.9	0.05
Eastern rockhopper penguin	logit-normal	0.9	0.05

Table 11: Continued

Common name	Distribution	Parameter *a*	Parameter *b*
Fiordland crested penguin	logit-normal	0.9	0.05
Snares crested penguin	logit-normal	0.9	0.05
Erect-crested penguin	logit-normal	0.9	0.05
Australasian gannet	logit-normal	0.9	0.05
Masked booby	logit-normal	0.9	0.05
Pied shag	logit-normal	0.9	0.05
Little black shag	logit-normal	0.9	0.05
New Zealand king shag	logit-normal	0.9	0.05
Otago shag	logit-normal	0.9	0.05
Foveaux shag	logit-normal	0.9	0.05
Chatham Island shag	logit-normal	0.9	0.05
Bounty Island shag	logit-normal	0.9	0.05
Auckland Island shag	logit-normal	0.9	0.05
Campbell Island shag	logit-normal	0.9	0.05
Spotted shag	logit-normal	0.9	0.05
Pitt Island shag	logit-normal	0.9	0.05
Subantarctic skua	logit-normal	0.9	0.05
Southern black-backed gull	logit-normal	0.9	0.05
Caspian tern	logit-normal	0.9	0.05
White tern	logit-normal	0.9	0.05

Table 12: Summary statistics of raw inputs for annual numbers of breeding pairs (N_s^{BP}), proportion of adults breeding (P_s^B) and age at first reproduction (A_s^{curr}). Continued on following pages.

	N_s^{BP}		P_s^B		A_s^{curr}	
Common name	Mean	95% CI	Mean	95% CI	Mean	95% CI
Gibson's albatross	4 310	3 500–5 220	0.599	0.497–0.693	11	10.1–11.9
Antipodean albatross	3 300	2 970–3 670	0.599	0.501–0.692	10	7.16–12.9
Southern royal albatross	8 580	7 020–10 400	0.599	0.499–0.693	9.55	8.55–10.6
Northern royal albatross	4 030	3 300–4 890	0.609	0.51–0.702	9.54	8.56–10.5
Campbell black-browed albatross	20 000	17 100–23 100	0.889	0.752–0.964	9.5	6.18–12.8
New Zealand white-capped albatross	86 000	70 400–104 000	0.677	0.574–0.769	12	9.12–14.8
Salvin's albatross	41 200	28 400–57 500	0.89	0.755–0.963	12	9.18–14.9
Chatham Island albatross	5 290	5 140–5 450	0.888	0.75–0.964	12	9.16–14.8
Grey-headed albatross	5 270	4 420–6 270	0.747	0.64–0.832	10	7.15–12.8
Southern Buller's albatross	14 900	13 700–16 200	0.89	0.755–0.964	12	9.15–14.9
Northern Buller's albatross	20 300	19 300–21 300	0.89	0.757–0.965	12	9.15–14.8
Light-mantled sooty albatross	6 830	6 770–6 900	0.599	0.5–0.695	12	9.16–14.8
Northern giant petrel	2 640	2 160–3 110	0.889	0.753–0.965	7.99	6.1–9.9
Grey petrel	52 700	33 100–71 900	0.796	0.687–0.88	7.01	5.11–8.9
Black petrel	5 280	4 210–6 570	0.609	0.509–0.704	6.6	6.23–6.97
Westland petrel	7 910	4 190–13 500	0.889	0.752–0.963	6.49	4.13–8.87
White-chinned petrel	249 000	209 000–295 000	0.889	0.748–0.964	6.49	4.13–8.87
Flesh-footed shearwater	20 700	16 500–24 900	0.796	0.683–0.88	6.5	4.13–8.88
Wedge-tailed shearwater	49 900	26 300–85 900	0.888	0.749–0.964	3.99	3.05–4.94
Buller's shearwater	78 500	67 700–89 200	0.889	0.753–0.963	6.52	4.13–8.89
Sooty shearwater	5 000 000	2 640 000–8 660 000	0.888	0.751–0.964	6	5.05–6.95
Fluttering shearwater	297 000	109 000–490 000	0.889	0.748–0.964	5	4.05–5.95
Hutton's shearwater	114 000	75 300–166 000	0.889	0.75–0.964	4.99	4.05–5.94
Little shearwater	162 000	117 000–208 000	0.889	0.754–0.963	5	4.05–5.95
Snares Cape petrel	8 440	4 460–14 400	0.889	0.756–0.964	5.5	3.13–7.87
Fairy prion	1 500 000	1 220 000–1 810 000	0.889	0.753–0.964	4.5	4.03–4.98
Antarctic prion	677 000	366 000–985 000	0.889	0.749–0.963	5.5	5.02–5.97
Broad-billed prion	350 000	286 000–423 000	0.889	0.749–0.964	4.5	4.03–4.97
Pycroft's petrel	2 500	2 030–2 970	0.89	0.753–0.965	6.5	6.02–6.98
Cook's petrel	317 000	221 000–413 000	0.89	0.751–0.965	6.5	6.03–6.97
Chatham petrel	250	166–358	0.89	0.753–0.965	6.5	6.02–6.98
Mottled petrel	350 000	302 000–398 000	0.89	0.757–0.963	6.5	6.03–6.98
White-naped petrel	50 000	26 800–84 900	0.888	0.75–0.964	6.5	6.03–6.98
Kermadec petrel	6 000	5 050–6 950	0.889	0.753–0.964	6.5	6.02–6.97
Grey-faced petrel	250 000	202 000–298 000	0.89	0.753–0.964	6.5	6.03–6.97
Chatham Island taiko	41	33.4–49.8	0.89	0.757–0.964	6.5	6.03–6.98
White-headed petrel	199 000	105 000–337 000	0.599	0.502–0.693	5.49	4.07–6.92
Soft-plumaged petrel	5 510	1 230–9 770	0.888	0.75–0.963	6.5	6.03–6.97
Common diving petrel	1 220 000	343 000–2 110 000	0.889	0.755–0.963	2.5	2.03–2.98
Whenua Hou diving petrel	87.4	70.7–104	0.834	0.781–0.878	2.5	2.02–2.97
New Zealand white-faced storm petrel	1 850 000	758 000–2 940 000	0.889	0.751–0.964	4.01	3.05–4.95
White-bellied storm petrel	998	539–1 700	0.89	0.749–0.964	4.51	4.03–4.98
Black-bellied storm petrel	75 100	51 300–98 700	0.89	0.753–0.964	4.5	4.02–4.98
Kermadec storm petrel	69.9	22.3–118	0.89	0.755–0.963	4.01	3.05–4.96
New Zealand storm petrel	511	46.8–974	0.889	0.75–0.963	4.5	4.02–4.98
Yellow-eyed penguin	1 210	989–1 470	0.685	0.584–0.776	3	2.05–3.95
Northern little penguin	7 510	5 130–9 870	0.89	0.756–0.964	2.5	2.02–2.97
White-flippered little penguin	2 200	1 450–3 210	0.889	0.751–0.963	2.5	2.02–2.97

Table 12: Continued

	N_s^{BP}		P_s^B		A_s^{curr}	
Common name	Mean	95% CI	Mean	95% CI	Mean	95% CI
Southern little penguin	7 520	5 130–9 880	0.889	0.752–0.964	2.5	2.02–2.97
Chatham Island little penguin	7 500	5 130–9 860	0.889	0.752–0.964	2.5	2.03–2.98
Eastern rockhopper penguin	48 700	39 500–58 000	0.889	0.756–0.964	4.5	3.07–5.92
Fiordland crested penguin	2 990	1 610–5 130	0.889	0.749–0.964	4.51	3.08–5.92
Snares crested penguin	27 700	24 800–30 500	0.888	0.748–0.963	5.5	5.03–5.98
Erect-crested penguin	81 000	77 200–84 800	0.89	0.755–0.964	5.5	5.03–5.97
Australasian gannet	46 400	24 700–79 500	0.889	0.753–0.963	5	3.1–6.9
Masked booby	240	158–348	0.888	0.746–0.964	3	2.05–3.95
Pied shag	6 400	5 240–7 710	0.998	0.993–1	2.66	2.03–3.29
Little black shag	1 500	807–2 600	0.888	0.747–0.965	2	1.06–2.95
New Zealand king shag	187	152–227	0.889	0.753–0.964	4	3.05–4.95
Otago shag	1 320	1 230–1 400	0.888	0.75–0.964	4	3.05–4.95
Foveaux shag	961	847–1 070	0.889	0.75–0.964	4.01	3.05–4.95
Chatham Island shag	355	291–430	0.889	0.754–0.964	4	3.05–4.95
Bounty Island shag	120	78.9–176	0.889	0.75–0.964	3.99	3.04–4.95
Auckland Island shag	2 540	1 040–4 020	0.889	0.75–0.963	4	3.05–4.95
Campbell Island shag	1 990	1 070–3 380	0.889	0.752–0.964	4	3.06–4.95
Spotted shag	20 000	10 500–29 400	0.889	0.753–0.965	2	1.05–2.95
Pitt Island shag	338	276–410	0.889	0.751–0.964	3.99	3.05–4.95
Subantarctic skua	460	450–469	0.889	0.753–0.964	8.03	7.64–8.42
Southern black-backed gull	1 860 000	759 000–2 950 000	0.889	0.752–0.964	3.99	3.05–4.95
Caspian tern	998	664–1 440	0.889	0.753–0.964	3	2.05–3.95
White tern	80.1	61–99.1	0.889	0.756–0.965	4	3.05–4.95

Table 13: Summary statistics of raw inputs for current and optimal adult survival rate (S_s^{curr} and S_s^{opt} respectively). Also listed is the survivorship from age zero to the age at first breeding (S_s^A). Continued on following pages.

	S_s^{curr}		S_s^{opt}		S_s^A	
Common name	Mean	95% CI	Mean	95% CI	Mean	95% CI
Gibson's albatross	0.918	0.872–0.951	0.961	0.939–0.984	0.188	0.0282–0.396
Antipodean albatross	0.908	0.863–0.943	0.957	0.941–0.969	0.206	0.0308–0.413
Southern royal albatross	0.948	0.931–0.963	0.948	0.931–0.962	0.195	0.0409–0.367
Northern royal albatross	0.939	0.909–0.968	0.938	0.909–0.967	0.179	0.0353–0.364
Campbell black-browed albatross	0.945	0.93–0.957	0.945	0.929–0.957	0.199	0.0314–0.408
New Zealand white-capped albatross	0.899	0.859–0.93	0.959	0.935–0.975	0.161	0.0172–0.365
Salvin's albatross	0.965	0.94–0.982	0.965	0.94–0.982	0.175	0.0194–0.391
Chatham Island albatross	0.965	0.941–0.982	0.966	0.941–0.982	0.174	0.0172–0.39
Grey-headed albatross	0.952	0.932–0.968	0.952	0.932–0.967	0.198	0.0316–0.405
Southern Buller's albatross	0.955	0.931–0.979	0.955	0.931–0.979	0.156	0.017–0.367
Northern Buller's albatross	0.955	0.931–0.979	0.955	0.931–0.979	0.155	0.0168–0.355
Light-mantled sooty albatross	0.97	0.961–0.98	0.97	0.961–0.979	0.185	0.0219–0.403
Northern giant petrel	0.93	0.901–0.958	0.93	0.902–0.958	0.218	0.0524–0.41
Grey petrel	0.935	0.902–0.968	0.935	0.902–0.968	0.266	0.0755–0.477
Black petrel	0.87	0.86–0.88	0.949	0.926–0.966	0.306	0.115–0.482
Westland petrel	0.947	0.919–0.974	0.946	0.919–0.974	0.314	0.0877–0.542
White-chinned petrel	0.935	0.902–0.968	0.935	0.902–0.968	0.292	0.0805–0.516
Flesh-footed shearwater	0.935	0.931–0.94	0.932	0.844–0.978	0.292	0.0723–0.54
Wedge-tailed shearwater	0.923	0.891–0.956	0.924	0.891–0.956	0.416	0.213–0.589
Buller's shearwater	0.915	0.839–0.962	0.915	0.839–0.962	0.258	0.06–0.49
Sooty shearwater	0.92	0.863–0.976	0.919	0.863–0.976	0.283	0.103–0.513
Fluttering shearwater	0.924	0.891–0.956	0.923	0.891–0.956	0.346	0.153–0.525
Hutton's shearwater	0.923	0.891–0.956	0.924	0.891–0.956	0.344	0.153–0.523
Little shearwater	0.924	0.891–0.956	0.924	0.891–0.956	0.346	0.158–0.527
Snares Cape petrel	0.856	0.775–0.935	0.855	0.775–0.935	0.228	0.049–0.479
Fairy prion	0.837	0.77–0.889	0.838	0.771–0.89	0.244	0.114–0.377
Antarctic prion	0.838	0.773–0.89	0.838	0.774–0.89	0.185	0.0734–0.313
Broad-billed prion	0.838	0.773–0.891	0.837	0.772–0.891	0.244	0.116–0.379
Pycroft's petrel	0.933	0.851–0.978	0.933	0.846–0.977	0.284	0.0873–0.49
Cook's petrel	0.933	0.845–0.978	0.933	0.848–0.978	0.283	0.0877–0.498
Chatham petrel	0.934	0.85–0.978	0.933	0.845–0.978	0.283	0.0895–0.497
Mottled petrel	0.933	0.85–0.978	0.933	0.848–0.978	0.284	0.089–0.493
White-naped petrel	0.933	0.849–0.978	0.933	0.845–0.978	0.283	0.0894–0.497
Kermadec petrel	0.932	0.845–0.978	0.933	0.846–0.978	0.283	0.0878–0.493
Grey-faced petrel	0.932	0.847–0.978	0.933	0.846–0.978	0.284	0.0875–0.496
Chatham Island taiko	0.933	0.845–0.978	0.933	0.847–0.978	0.284	0.0876–0.496
White-headed petrel	0.932	0.846–0.978	0.933	0.845–0.978	0.339	0.119–0.56
Soft-plumaged petrel	0.933	0.844–0.979	0.932	0.845–0.978	0.283	0.0902–0.492
Common diving petrel	0.81	0.753–0.867	0.81	0.753–0.867	0.397	0.261–0.534
Whenua Hou diving petrel	0.86	0.822–0.893	0.86	0.822–0.893	0.46	0.325–0.584
New Zealand white-faced storm petrel	0.896	0.825–0.945	0.896	0.823–0.946	0.371	0.18–0.545
White-bellied storm petrel	0.895	0.822–0.944	0.896	0.824–0.945	0.33	0.163–0.498
Black-bellied storm petrel	0.896	0.825–0.946	0.896	0.825–0.945	0.331	0.158–0.498
Kermadec storm petrel	0.896	0.823–0.946	0.895	0.823–0.945	0.368	0.179–0.548
New Zealand storm petrel	0.896	0.823–0.946	0.896	0.824–0.945	0.329	0.154–0.492
Yellow-eyed penguin	0.867	0.799–0.919	0.867	0.799–0.917	0.263	0.146–0.383
Northern little penguin	0.829	0.787–0.866	0.829	0.788–0.865	0.265	0.176–0.352

Table 13: Continued

	S_s^{curr}		S_s^{opt}		S_s^A	
Common name	Mean	95% CI	Mean	95% CI	Mean	95% CI
White-flippered little penguin	0.829	0.788–0.866	0.829	0.787–0.866	0.265	0.175–0.353
Southern little penguin	0.829	0.788–0.866	0.829	0.789–0.866	0.264	0.174–0.352
Chatham Island little penguin	0.829	0.787–0.865	0.829	0.788–0.866	0.264	0.178–0.352
Eastern rockhopper penguin	0.84	0.817–0.86	0.84	0.817–0.86	0.158	0.0636–0.263
Fiordland crested penguin	0.84	0.817–0.861	0.84	0.817–0.861	0.158	0.065–0.263
Snares crested penguin	0.84	0.817–0.86	0.84	0.817–0.861	0.117	0.0501–0.181
Erect-crested penguin	0.84	0.817–0.86	0.84	0.817–0.86	0.117	0.0509–0.181
Australasian gannet	0.933	0.846–0.978	0.932	0.847–0.978	0.372	0.128–0.602
Masked booby	0.848	0.781–0.9	0.848	0.783–0.901	0.391	0.216–0.561
Pied shag	0.878	0.86–0.896	0.878	0.86–0.896	0.466	0.313–0.595
Little black shag	0.878	0.86–0.896	0.878	0.86–0.896	0.55	0.367–0.718
New Zealand king shag	0.878	0.86–0.896	0.878	0.86–0.896	0.34	0.18–0.481
Otago shag	0.878	0.86–0.896	0.878	0.86–0.896	0.34	0.182–0.483
Foveaux shag	0.878	0.86–0.896	0.878	0.86–0.896	0.339	0.178–0.48
Chatham Island shag	0.878	0.86–0.896	0.878	0.86–0.896	0.339	0.175–0.484
Bounty Island shag	0.878	0.86–0.896	0.878	0.86–0.896	0.339	0.178–0.484
Auckland Island shag	0.878	0.86–0.896	0.878	0.86–0.896	0.34	0.178–0.485
Campbell Island shag	0.878	0.86–0.896	0.878	0.86–0.896	0.339	0.178–0.484
Spotted shag	0.878	0.86–0.896	0.878	0.86–0.896	0.55	0.368–0.716
Pitt Island shag	0.878	0.86–0.896	0.878	0.86–0.896	0.34	0.177–0.485
Subantarctic skua	0.94	0.912–0.969	0.94	0.912–0.969	0.23	0.0634–0.422
Southern black-backed gull	0.808	0.744–0.862	0.808	0.742–0.862	0.248	0.114–0.394
Caspian tern	0.876	0.819–0.934	0.877	0.819–0.934	0.431	0.235–0.617
White tern	0.805	0.781–0.829	0.805	0.781–0.829	0.242	0.119–0.368

Table 14: Sources for species values of number of breeding pairs (N_s^{BP}). Richard et al. (2017b) provide references to sources for prior distributions that have not been updated. Subsequent to the current project, numbers for flesh-footed shearwater and black petrel have been further updated by Mischler et al. (2022) and Bell et al. (2022) respectively. Continued on next page.

Common name	N_s^{BP}
Gibson's albatross	Baker & Jensz (2014), Rexer-Huber et al. (2020a)
Antipodean albatross	Miskelly et al. (2008), Richard (2021), DOC website
Southern royal albatross	Agreement on the Conservation of Albatrosses and Petrels (2009), Moore et al. (2012), Baker et al. (2020a)
Northern royal albatross	Frost (2018, 2021)
Campbell black-browed albatross	Frost (2020), Rexer-Huber et al. (2020b)
New Zealand white-capped albatross	Baker et al. (2020b)
Salvin's albatross	Baker & Jensz (2019), Sagar et al. (2014)
Chatham Island albatross	Bell et al. (2017a)
Grey-headed albatross	Frost (2020), Rexer-Huber et al. (2020b)
Southern Buller's albatross	Sagar (2014), Thompson et al. (2016)
Northern Buller's albatross	Bell et al. (2017b, 2018), Frost et al. (2018)
Light-mantled sooty albatross	Richard et al. (2017b)
Northern giant petrel	Richard et al. (2017b)
Grey petrel	Richard et al. (2017b)
Black petrel	Bell et al. (2016), E. Bell (pers. comm.)
Westland petrel	Waugh et al. (2020)
White-chinned petrel	Rexer-Huber (2017), Rexer-Huber et al. (2017, 2020c), Thompson (2019)
Flesh-footed shearwater	Baker et al. (2010), Bell & Boyle (2017), Crowe (2018), Crowe & Bell (2019), Crowe & Burgin (2021), Waugh et al. (2013, 2014), G. Taylor (pers. comm.)
Wedge-tailed shearwater	Richard et al. (2017b)
Buller's shearwater	Friesen et al. (2021)
Sooty shearwater	Richard et al. (2017b)
Fluttering shearwater	Richard et al. (2017b)
Hutton's shearwater	Richard et al. (2017b)
Little shearwater	Richard et al. (2017b)
Snares Cape petrel	Richard et al. (2017b)
Fairy prion	Richard et al. (2017b)
Antarctic prion	Richard et al. (2017b)
Broad-billed prion	Richard et al. (2017b)
Pycroft's petrel	Richard et al. (2017b)
Cook's petrel	Richard et al. (2017b)
Chatham petrel	Richard et al. (2017b)
Mottled petrel	Richard et al. (2017b)
White-naped petrel	Richard et al. (2017b)
Kermadec petrel	Richard et al. (2017b)
Grey-faced petrel	Richard et al. (2017b)
Chatham Island taiko	J. Fischer (pers. comm.)
White-headed petrel	Richard et al. (2017b)
Soft-plumaged petrel	Richard et al. (2017b)
Common diving petrel	Richard et al. (2017b)
Whenua Hou diving petrel	Fischer et al. (2022)
New Zealand white-faced storm petrel	Richard et al. (2017b)
White-bellied storm petrel	Richard et al. (2017b)
Black-bellied storm petrel	Richard et al. (2017b)
Kermadec storm petrel	Richard et al. (2017b)

Table 14: Continued

Common name	N_s^{BP}
New Zealand storm petrel	Richard et al. (2017b)
Yellow-eyed penguin	T. Webster (pers. comm.), Moore et al. (2001), Muller et al. (2020)
Northern little penguin	Richard et al. (2017b)
White-flippered little penguin	Richard et al. (2017b)
Southern little penguin	Richard et al. (2017b)
Chatham Island little penguin	Richard et al. (2017b)
Eastern rockhopper penguin	Richard et al. (2017b)
Fiordland crested penguin	Richard et al. (2017b)
Snares crested penguin	Richard et al. (2017b)
Erect-crested penguin	Richard et al. (2017b)
Australasian gannet	Richard et al. (2017b)
Masked booby	Richard et al. (2017b)
Pied shag	Richard et al. (2017b)
Little black shag	Richard et al. (2017b)
New Zealand king shag	Richard et al. (2017b)
Otago shag	Richard et al. (2017b)
Foveaux shag	Richard et al. (2017b)
Chatham Island shag	Richard et al. (2017b)
Bounty Island shag	Richard et al. (2017b)
Auckland Island shag	Richard et al. (2017b)
Campbell Island shag	Richard et al. (2017b)
Spotted shag	Richard et al. (2017b)
Pitt Island shag	Richard et al. (2017b)
Subantarctic skua	Richard et al. (2017b)
Southern black-backed gull	Richard et al. (2017b)
Caspian tern	Richard et al. (2017b)
White tern	Richard et al. (2017b)

Table 15: Sources for species values of proportions of adults breeding in a given year (P_s^B) and current age at first breeding (A_s^{curr}). Richard et al. (2017b) provide references to sources for prior distributions that have not been updated. Continued on next page.

Common name	P_s^B	A_s^{curr}
Gibson's albatross	Richard et al. (2017b)	Richard et al. (2017b)
Antipodean albatross	Richard et al. (2017b)	Richard (2021)
Southern royal albatross	Richard et al. (2017b)	Richard et al. (2017b)
Northern royal albatross	Richard et al. (2017b)	Richard et al. (2017b)
Campbell black-browed albatross	Richard et al. (2017b)	Richard et al. (2017b)
New Zealand white-capped albatross	Richard et al. (2017b)	Richard et al. (2017b)
Salvin's albatross	Richard et al. (2017b)	Richard et al. (2017b)
Chatham Island albatross	Richard et al. (2017b)	Richard et al. (2017b)
Grey-headed albatross	Richard et al. (2017b)	Richard et al. (2017b)
Southern Buller's albatross	Richard et al. (2017b)	Richard et al. (2017b)
Northern Buller's albatross	Richard et al. (2017b)	Richard et al. (2017b)
Light-mantled sooty albatross	Richard et al. (2017b)	Richard et al. (2017b)
Northern giant petrel	Richard et al. (2017b)	Richard et al. (2017b)
Grey petrel	Richard et al. (2017b)	Richard et al. (2017b)
Black petrel	E. Bell (pers. comm.)	Richard et al. (2017b)
Westland petrel	Richard et al. (2017b)	Richard et al. (2017b)
White-chinned petrel	Richard et al. (2017b)	Richard et al. (2017b)
Flesh-footed shearwater	P. Crowe (pers. comm.)	Richard et al. (2017b)
Wedge-tailed shearwater	Richard et al. (2017b)	Richard et al. (2017b)
Buller's shearwater	Richard et al. (2017b)	Richard et al. (2017b)
Sooty shearwater	Richard et al. (2017b)	Richard et al. (2017b)
Fluttering shearwater	Richard et al. (2017b)	Richard et al. (2017b)
Hutton's shearwater	Richard et al. (2017b)	Richard et al. (2017b)
Little shearwater	Richard et al. (2017b)	Richard et al. (2017b)
Snares Cape petrel	Richard et al. (2017b)	Richard et al. (2017b)
Fairy prion	Richard et al. (2017b)	Richard et al. (2017b)
Antarctic prion	Richard et al. (2017b)	Richard et al. (2017b)
Broad-billed prion	Richard et al. (2017b)	Richard et al. (2017b)
Pycroft's petrel	Richard et al. (2017b)	Richard et al. (2017b)
Cook's petrel	Richard et al. (2017b)	Richard et al. (2017b)
Chatham petrel	Richard et al. (2017b)	Richard et al. (2017b)
Mottled petrel	Richard et al. (2017b)	Richard et al. (2017b)
White-naped petrel	Richard et al. (2017b)	Richard et al. (2017b)
Kermadec petrel	Richard et al. (2017b)	Richard et al. (2017b)
Grey-faced petrel	Richard et al. (2017b)	Richard et al. (2017b)
Chatham Island taiko	Richard et al. (2017b)	Richard et al. (2017b)
White-headed petrel	Richard et al. (2017b)	Richard et al. (2017b)
Soft-plumaged petrel	Richard et al. (2017b)	Richard et al. (2017b)
Common diving petrel	Richard et al. (2017b)	Richard et al. (2017b)
Whenua Hou diving petrel	Fischer et al. (2022)	Richard et al. (2017b)
New Zealand white-faced storm petrel	Richard et al. (2017b)	Richard et al. (2017b)
White-bellied storm petrel	Richard et al. (2017b)	Richard et al. (2017b)
Black-bellied storm petrel	Richard et al. (2017b)	Richard et al. (2017b)
Kermadec storm petrel	Richard et al. (2017b)	Richard et al. (2017b)
New Zealand storm petrel	Richard et al. (2017b)	Richard et al. (2017b)
Yellow-eyed penguin	Richard et al. (2017b)	Richard et al. (2017b)
Northern little penguin	Richard et al. (2017b)	Richard et al. (2017b)
White-flippered little penguin	Richard et al. (2017b)	Richard et al. (2017b)
Southern little penguin	Richard et al. (2017b)	Richard et al. (2017b)

Table 15: Continued

Common name	P_s^B	A_s^{curr}
Chatham Island little penguin	Richard et al. (2017b)	Richard et al. (2017b)
Eastern rockhopper penguin	Richard et al. (2017b)	Richard et al. (2017b)
Fiordland crested penguin	Richard et al. (2017b)	Richard et al. (2017b)
Snares crested penguin	Richard et al. (2017b)	Richard et al. (2017b)
Erect-crested penguin	Richard et al. (2017b)	Richard et al. (2017b)
Australasian gannet	Richard et al. (2017b)	Richard et al. (2017b)
Masked booby	Richard et al. (2017b)	Richard et al. (2017b)
Pied shag	Richard et al. (2017b)	Richard et al. (2017b)
Little black shag	Richard et al. (2017b)	Richard et al. (2017b)
New Zealand king shag	Richard et al. (2017b)	Richard et al. (2017b)
Otago shag	Richard et al. (2017b)	Richard et al. (2017b)
Foveaux shag	Richard et al. (2017b)	Richard et al. (2017b)
Chatham Island shag	Richard et al. (2017b)	Richard et al. (2017b)
Bounty Island shag	Richard et al. (2017b)	Richard et al. (2017b)
Auckland Island shag	Richard et al. (2017b)	Richard et al. (2017b)
Campbell Island shag	Richard et al. (2017b)	Richard et al. (2017b)
Spotted shag	Richard et al. (2017b)	Richard et al. (2017b)
Pitt Island shag	Richard et al. (2017b)	Richard et al. (2017b)
Subantarctic skua	Richard et al. (2017b)	Richard et al. (2017b)
Southern black-backed gull	Richard et al. (2017b)	Richard et al. (2017b)
Caspian tern	Richard et al. (2017b)	Richard et al. (2017b)
White tern	Richard et al. (2017b)	Richard et al. (2017b)

Table 16: Sources for species values of current annual survival probability (S_s^{curr}) and optimal annual survival probability (S_s^{opt}). Richard et al. (2017b) provide references to sources for prior distributions that have not been updated. Continued on next page.

Common name	S_s^{curr}	S_s^{opt}
Gibson's albatross	Richard et al. (2017b)	Richard et al. (2017b)
Antipodean albatross	Richard (2021)	Richard et al. (2017b)
Southern royal albatross	Richard et al. (2017b)	Richard et al. (2017b)
Northern royal albatross	Richard et al. (2017b)	Richard et al. (2017b)
Campbell black-browed albatross	Richard et al. (2017b)	Richard et al. (2017b)
New Zealand white-capped albatross	Rexer-Huber et al. (2020a)	Richard et al. (2017b)
Salvin's albatross	Richard et al. (2017b)	Richard et al. (2017b)
Chatham Island albatross	Richard et al. (2017b)	Richard et al. (2017b)
Grey-headed albatross	Richard et al. (2017b)	Richard et al. (2017b)
Southern Buller's albatross	Richard et al. (2017b)	Richard et al. (2017b)
Northern Buller's albatross	Richard et al. (2017b)	Richard et al. (2017b)
Light-mantled sooty albatross	Richard et al. (2017b)	Richard et al. (2017b)
Northern giant petrel	G. Taylor (pers. comm.)	G. Taylor (pers. comm.)
Grey petrel	Richard et al. (2017b)	Richard et al. (2017b)
Black petrel	Zhang et al. (2020)	Richard et al. (2017b)
Westland petrel	Richard et al. (2017b)	Richard et al. (2017b)
White-chinned petrel	Richard et al. (2017b)	Richard et al. (2017b)
Flesh-footed shearwater	Richard et al. (2017b)	Richard et al. (2017b)
Wedge-tailed shearwater	Richard et al. (2017b)	Richard et al. (2017b)
Buller's shearwater	Richard et al. (2017b)	Richard et al. (2017b)
Sooty shearwater	Richard et al. (2017b)	Richard et al. (2017b)
Fluttering shearwater	Richard et al. (2017b)	Richard et al. (2017b)
Hutton's shearwater	Richard et al. (2017b)	Richard et al. (2017b)
Little shearwater	Richard et al. (2017b)	Richard et al. (2017b)
Snares Cape petrel	Richard et al. (2017b)	Richard et al. (2017b)
Fairy prion	Richard et al. (2017b)	Richard et al. (2017b)
Antarctic prion	Richard et al. (2017b)	Richard et al. (2017b)
Broad-billed prion	Richard et al. (2017b)	Richard et al. (2017b)
Pycroft's petrel	Richard et al. (2017b)	Richard et al. (2017b)
Cook's petrel	Richard et al. (2017b)	Richard et al. (2017b)
Chatham petrel	Richard et al. (2017b)	Richard et al. (2017b)
Mottled petrel	Richard et al. (2017b)	Richard et al. (2017b)
White-naped petrel	Richard et al. (2017b)	Richard et al. (2017b)
Kermadec petrel	Richard et al. (2017b)	Richard et al. (2017b)
Grey-faced petrel	Richard et al. (2017b)	Richard et al. (2017b)
Chatham Island taiko	Richard et al. (2017b)	Richard et al. (2017b)
White-headed petrel	Richard et al. (2017b)	Richard et al. (2017b)
Soft-plumaged petrel	Richard et al. (2017b)	Richard et al. (2017b)
Common diving petrel	Richard et al. (2017b)	Richard et al. (2017b)
Whenua Hou diving petrel	Fischer et al. (2022)	Fischer et al. (2022)
New Zealand white-faced storm petrel	Richard et al. (2017b)	Richard et al. (2017b)
White-bellied storm petrel	Richard et al. (2017b)	Richard et al. (2017b)
Black-bellied storm petrel	Richard et al. (2017b)	Richard et al. (2017b)
Kermadec storm petrel	Richard et al. (2017b)	Richard et al. (2017b)
New Zealand storm petrel	Richard et al. (2017b)	Richard et al. (2017b)
Yellow-eyed penguin	Richard et al. (2017b)	Richard et al. (2017b)
Northern little penguin	Richard et al. (2017b)	Richard et al. (2017b)
White-flippered little penguin	Richard et al. (2017b)	Richard et al. (2017b)
Southern little penguin	Richard et al. (2017b)	Richard et al. (2017b)

Table 16: Continued

Common name	S_s^{curr}	S_s^{opt}
Chatham Island little penguin	Richard et al. (2017b)	Richard et al. (2017b)
Eastern rockhopper penguin	Richard et al. (2017b)	Richard et al. (2017b)
Fiordland crested penguin	Richard et al. (2017b)	Richard et al. (2017b)
Snares crested penguin	Richard et al. (2017b)	Richard et al. (2017b)
Erect-crested penguin	Richard et al. (2017b)	Richard et al. (2017b)
Australasian gannet	Richard et al. (2017b)	Richard et al. (2017b)
Masked booby	Richard et al. (2017b)	Richard et al. (2017b)
Pied shag	Richard et al. (2017b)	Richard et al. (2017b)
Little black shag	Richard et al. (2017b)	Richard et al. (2017b)
New Zealand king shag	Richard et al. (2017b)	Richard et al. (2017b)
Otago shag	Richard et al. (2017b)	Richard et al. (2017b)
Foveaux shag	Richard et al. (2017b)	Richard et al. (2017b)
Chatham Island shag	Richard et al. (2017b)	Richard et al. (2017b)
Bounty Island shag	Richard et al. (2017b)	Richard et al. (2017b)
Auckland Island shag	Richard et al. (2017b)	Richard et al. (2017b)
Campbell Island shag	Richard et al. (2017b)	Richard et al. (2017b)
Spotted shag	Richard et al. (2017b)	Richard et al. (2017b)
Pitt Island shag	Richard et al. (2017b)	Richard et al. (2017b)
Subantarctic skua	Richard et al. (2017b)	Richard et al. (2017b)
Southern black-backed gull	Richard et al. (2017b)	Richard et al. (2017b)
Caspian tern	Richard et al. (2017b)	Richard et al. (2017b)
White tern	Richard et al. (2017b)	Richard et al. (2017b)

4. SUMMARIES BY SPECIES

4.1 Gibson's albatross (*Diomedea antipodensis gibsoni*)

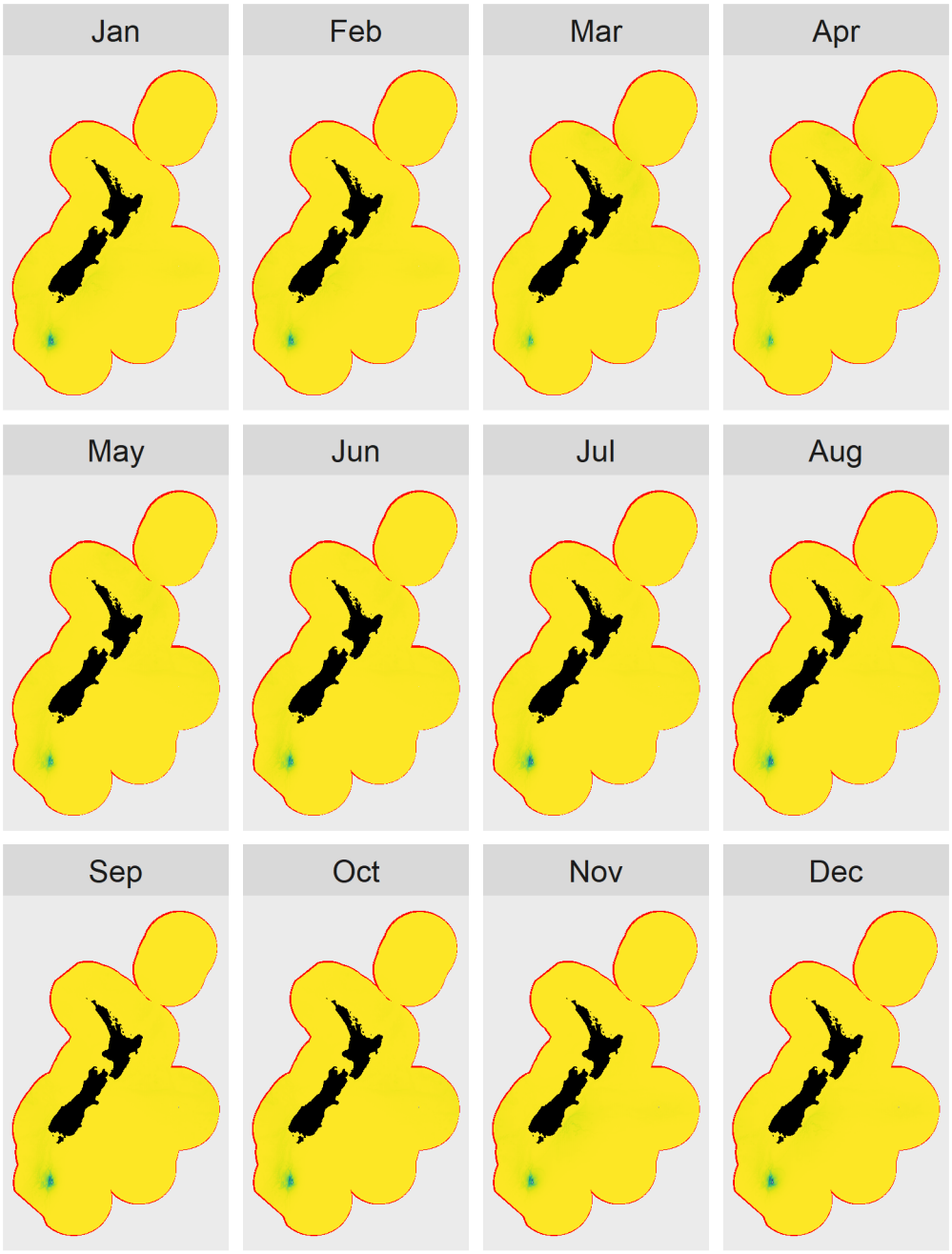

Figure 1: Relative density maps of adult Gibson's albatross by month (proportion of individuals per square kilometre). Breeding takes place during: Jan,Feb,Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 17: Input covariate probabilities for Gibson's albatross.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.67	0.50	Breeding
Feb	0.55	0.50	Breeding
Mar	0.59	0.50	Breeding
Apr	0.46	0.50	Breeding
May	0.34	0.00	Breeding
Jun	0.50	0.00	Breeding
Jul	0.39	0.00	Breeding
Aug	0.20	0.00	Breeding
Sep	0.19	0.00	Breeding
Oct	0.23	0.00	Breeding
Nov	0.32	0.00	Breeding
Dec	0.67	1.00	Breeding

Table 18: Prior distributions of demographic parameters for Gibson's albatross.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	4 313	0.100
Proportion of adults breeding	logit-normal	0.6	0.05
Age at first reproduction	uniform	10	12
Current adult survival rate	logit-normal	0.92	0.02
Optimal adult survival rate	uniform	0.938	0.985
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 19: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Gibson's albatross. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	4 310	3 500–5 220	Pairs
Proportion of adults breeding	0.599	0.497–0.693	Proportion
Age at first reproduction	11	10.1–11.9	Years
Current adult survival rate	0.918	0.872–0.951	Proportion
Optimal adult survival rate	0.961	0.939–0.984	Proportion
Juvenile survival rate	0.188	0.0282–0.396	Proportion
Population size (adults)	14 500	11 100–18 700	Individuals

4.2 Antipodean albatross (*Diomedea antipodensis antipodensis*)

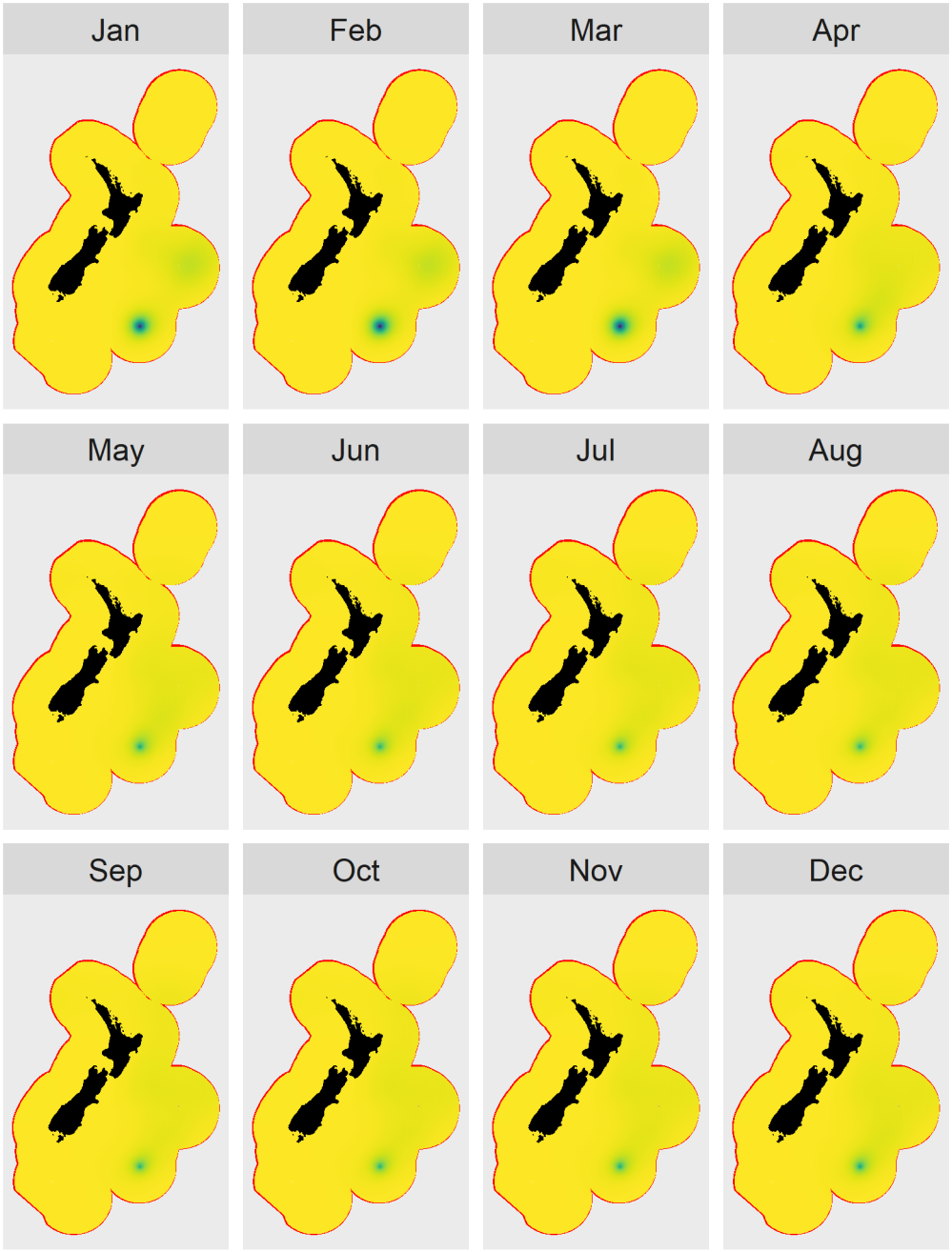

Figure 2: Relative density maps of adult Antipodean albatross by month (proportion of individuals per square kilometre). Breeding takes place during: Jan,Feb,Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 20: Input covariate probabilities for Antipodean albatross.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.61	0.50	Breeding
Feb	0.60	0.50	Breeding
Mar	0.52	0.50	Breeding
Apr	0.44	0.00	Breeding
May	0.31	0.00	Breeding
Jun	0.32	0.00	Breeding
Jul	0.42	0.00	Breeding
Aug	0.43	0.00	Breeding
Sep	0.26	0.00	Breeding
Oct	0.20	0.00	Breeding
Nov	0.20	0.00	Breeding
Dec	0.28	0.50	Breeding

Table 21: Prior distributions of demographic parameters for Antipodean albatross.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	3 303	0.054
Proportion of adults breeding	logit-normal	0.6	0.05
Age at first reproduction	uniform	7	13
Current adult survival rate	logit-normal	0.91	0.02
Optimal adult survival rate	logit-normal	0.957	0.007
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 22: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Antipodean albatross. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	3 300	2 970–3 670	Pairs
Proportion of adults breeding	0.599	0.501–0.692	Proportion
Age at first reproduction	10	7.16–12.9	Years
Current adult survival rate	0.908	0.863–0.943	Proportion
Optimal adult survival rate	0.957	0.941–0.969	Proportion
Juvenile survival rate	0.206	0.0308–0.413	Proportion
Population size (adults)	11 100	9 160–13 500	Individuals

4.3 Southern royal albatross (*Diomedea epomophora*)

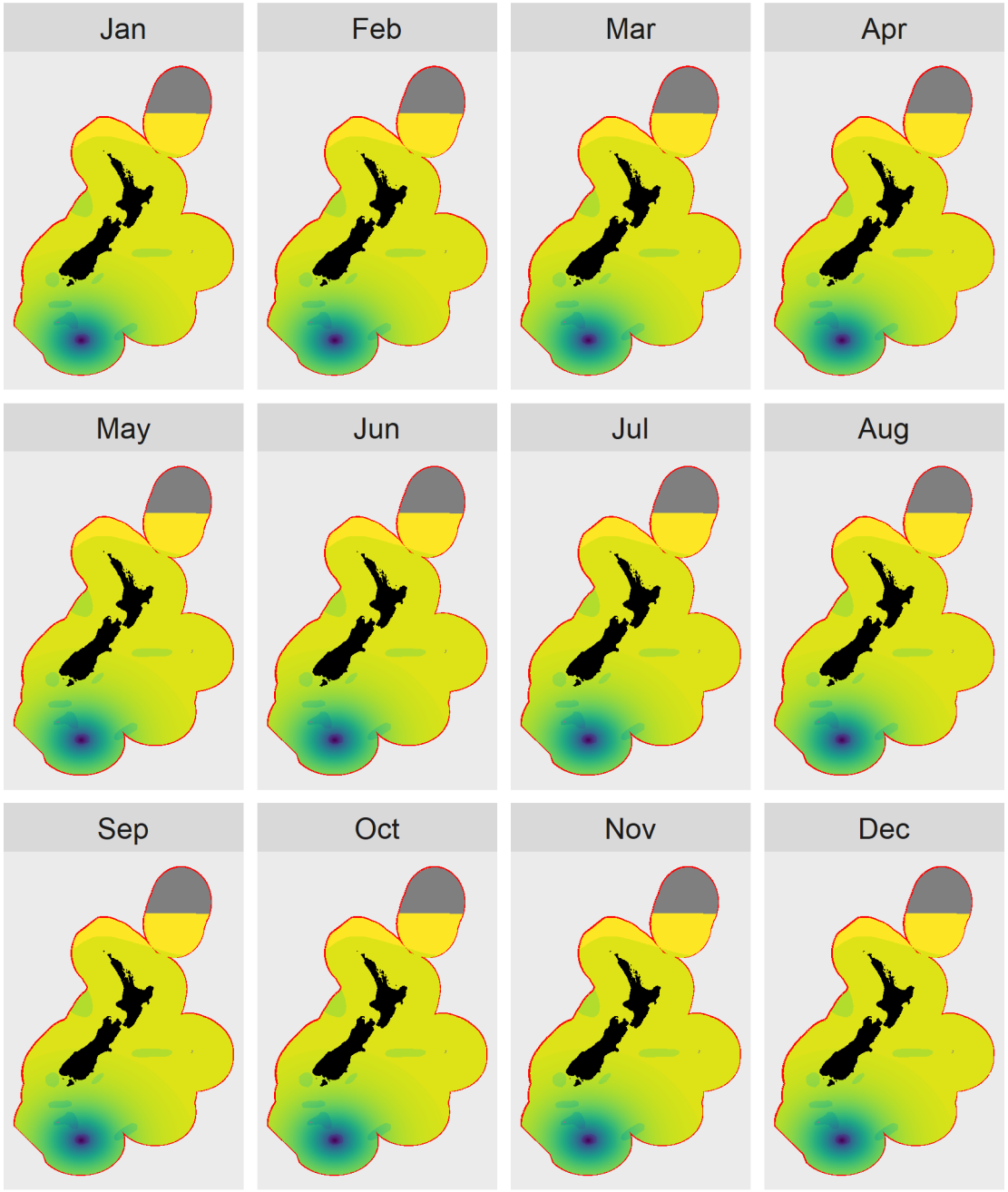

Figure 3: Relative density maps of adult Southern royal albatross by month (proportion of individuals per square kilometre). Breeding takes place during: Jan,Feb,Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 23: Input covariate probabilities for Southern royal albatross.

Month	Probability in EEZ	Probability on nest	Season
Jan	1.00	0.50	Breeding
Feb	1.00	0.50	Breeding
Mar	1.00	0.00	Breeding
Apr	1.00	0.00	Breeding
May	1.00	0.00	Breeding
Jun	1.00	0.00	Breeding
Jul	1.00	0.00	Breeding
Aug	1.00	0.00	Breeding
Sep	1.00	0.00	Breeding
Oct	1.00	0.00	Breeding
Nov	1.00	0.50	Breeding
Dec	1.00	0.50	Breeding

Table 24: Prior distributions of demographic parameters for Southern royal albatross.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	8 564	0.100
Proportion of adults breeding	logit-normal	0.6	0.05
Age at first reproduction	uniform	8.5	10.6
Current adult survival rate	logit-normal	0.949	0.008
Optimal adult survival rate	logit-normal	0.949	0.008
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 25: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Southern royal albatross. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	8 580	7 020–10 400	Pairs
Proportion of adults breeding	0.599	0.499–0.693	Proportion
Age at first reproduction	9.55	8.55–10.6	Years
Current adult survival rate	0.948	0.931–0.963	Proportion
Optimal adult survival rate	0.948	0.931–0.962	Proportion
Juvenile survival rate	0.195	0.0409–0.367	Proportion
Population size (adults)	28 800	22 300–37 200	Individuals

4.4 Northern royal albatross (*Diomedea sanfordi*)

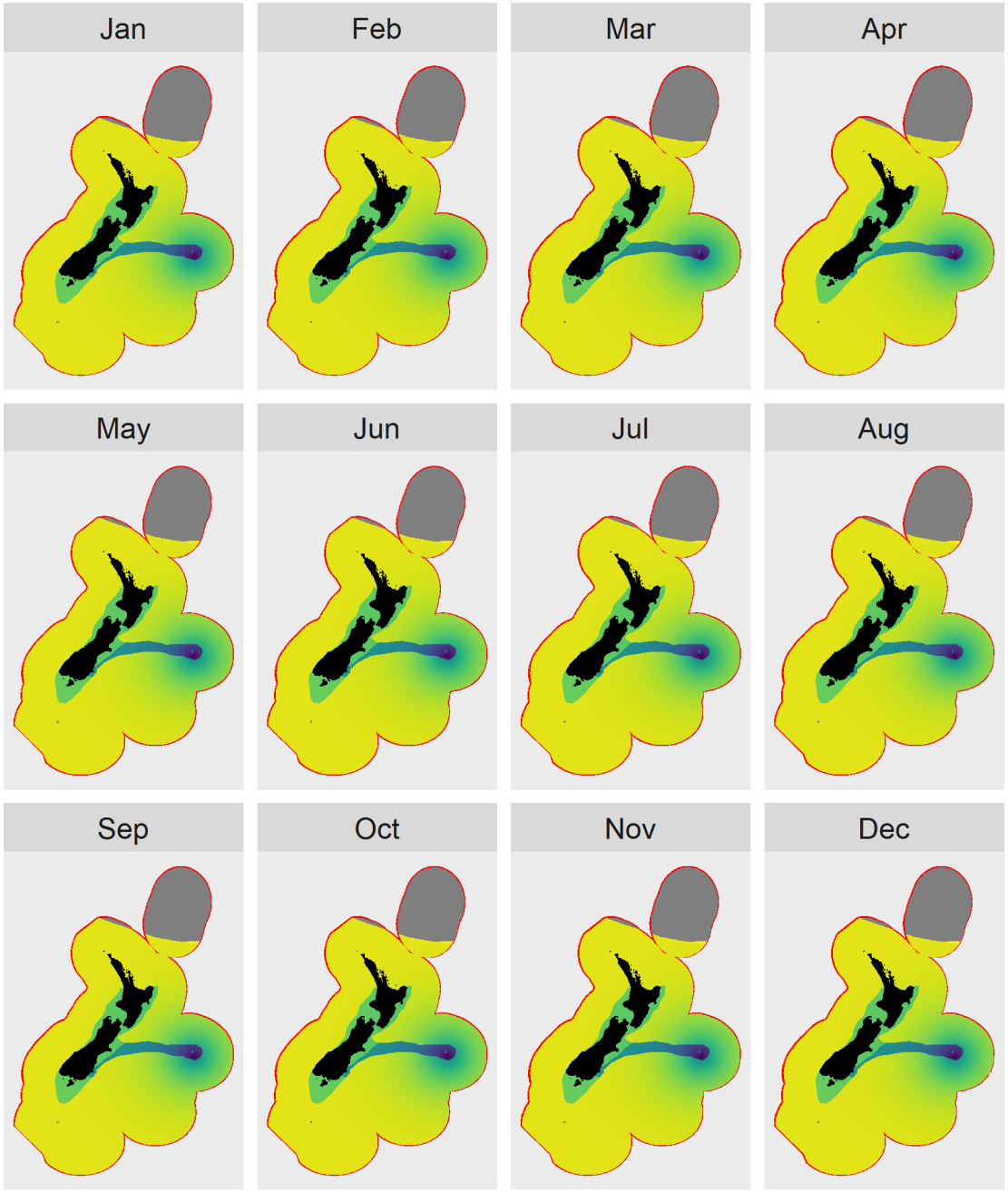

Figure 4: Relative density maps of adult Northern royal albatross by month (proportion of individuals per square kilometre). Breeding takes place during: Jan,Feb,Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 26: Input covariate probabilities for Northern royal albatross.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.43	0.50	Breeding
Feb	0.43	0.50	Breeding
Mar	0.43	0.50	Breeding
Apr	0.21	0.00	Breeding
May	0.21	0.00	Breeding
Jun	0.21	0.00	Breeding
Jul	0.18	0.00	Breeding
Aug	0.18	0.00	Breeding
Sep	0.18	0.00	Breeding
Oct	0.57	0.25	Breeding
Nov	0.57	0.50	Breeding
Dec	0.57	0.50	Breeding

Table 27: Prior distributions of demographic parameters for Northern royal albatross.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	4 026	0.100
Proportion of adults breeding	logit-normal	0.61	0.05
Age at first reproduction	uniform	8.5	10.6
Current adult survival rate	uniform	0.908	0.969
Optimal adult survival rate	uniform	0.908	0.969
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 28: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Northern royal albatross. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	4 030	3 300–4 890	Pairs
Proportion of adults breeding	0.609	0.51–0.702	Proportion
Age at first reproduction	9.54	8.56–10.5	Years
Current adult survival rate	0.939	0.909–0.968	Proportion
Optimal adult survival rate	0.938	0.909–0.967	Proportion
Juvenile survival rate	0.179	0.0353–0.364	Proportion
Population size (adults)	13 300	10 300–17 200	Individuals

4.5 Campbell black-browed albatross (*Thalassarche impavida*)

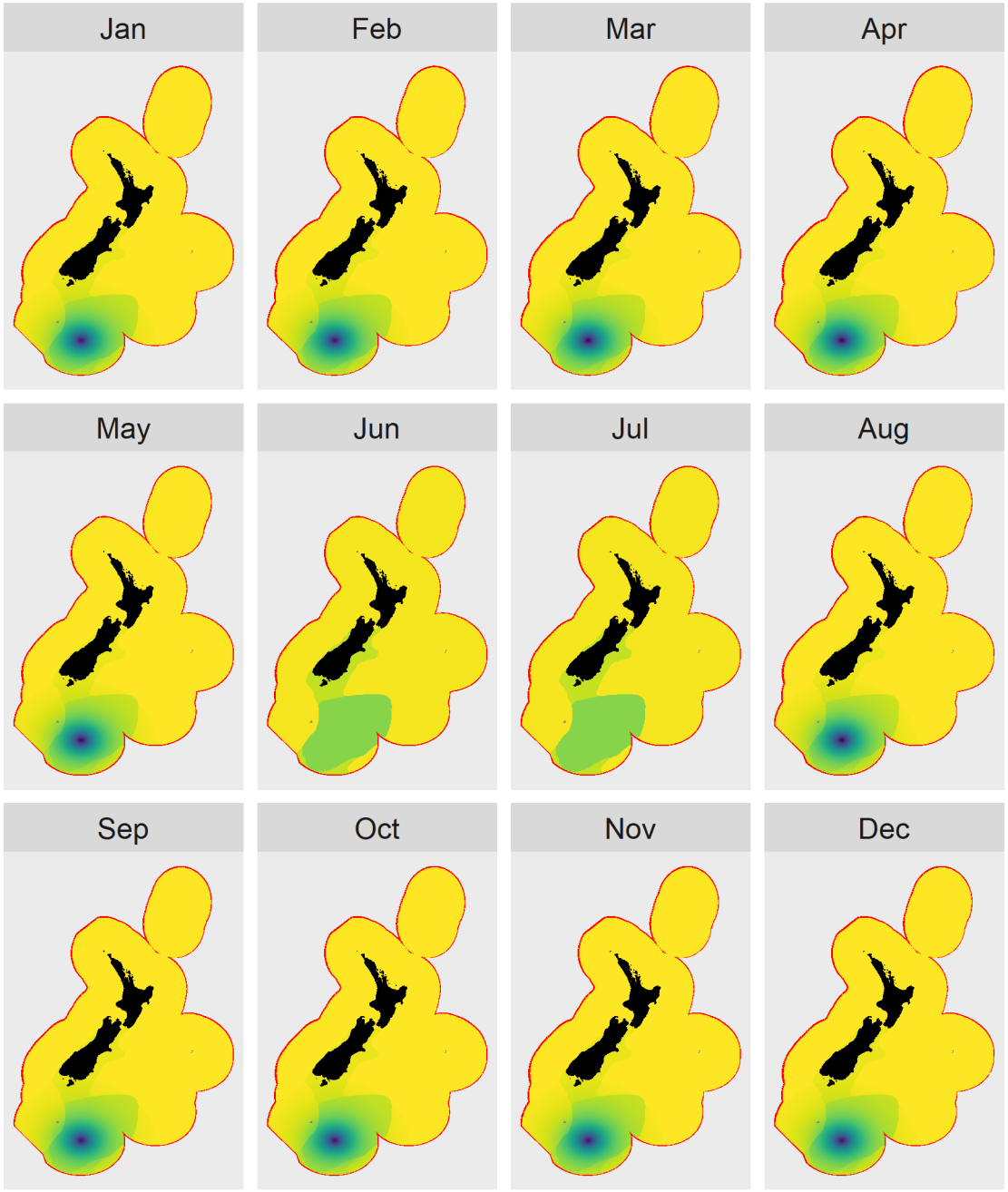

Figure 5: Relative density maps of adult Campbell black-browed albatross by month (proportion of individuals per square kilometre). Breeding takes place during: Aug,Sep,Oct,Nov,Dec,Jan,Feb,Mar,Apr,May. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 29: Input covariate probabilities for Campbell black-browed albatross.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.95	0.50	Breeding
Feb	0.95	0.50	Breeding
Mar	0.95	0.00	Breeding
Apr	0.95	0.00	Breeding
May	0.95	0.00	Breeding
Jun	0.50	0.00	Non-breeding
Jul	0.50	0.00	Non-breeding
Aug	0.95	0.00	Breeding
Sep	0.95	0.50	Breeding
Oct	0.95	0.50	Breeding
Nov	0.95	0.50	Breeding
Dec	0.95	0.50	Breeding

Table 30: Prior distributions of demographic parameters for Campbell black-browed albatross.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	19 950	0.076
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	6	13
Current adult survival rate	logit-normal	0.945	0.007
Optimal adult survival rate	logit-normal	0.945	0.007
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 31: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Campbell black-browed albatross. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	20 000	17 100–23 100	Pairs
Proportion of adults breeding	0.889	0.752–0.964	Proportion
Age at first reproduction	9.5	6.18–12.8	Years
Current adult survival rate	0.945	0.93–0.957	Proportion
Optimal adult survival rate	0.945	0.929–0.957	Proportion
Juvenile survival rate	0.199	0.0314–0.408	Proportion
Population size (adults)	45 100	37 400–55 800	Individuals

4.6 New Zealand white-capped albatross (*Thalassarche cauta steadi*)

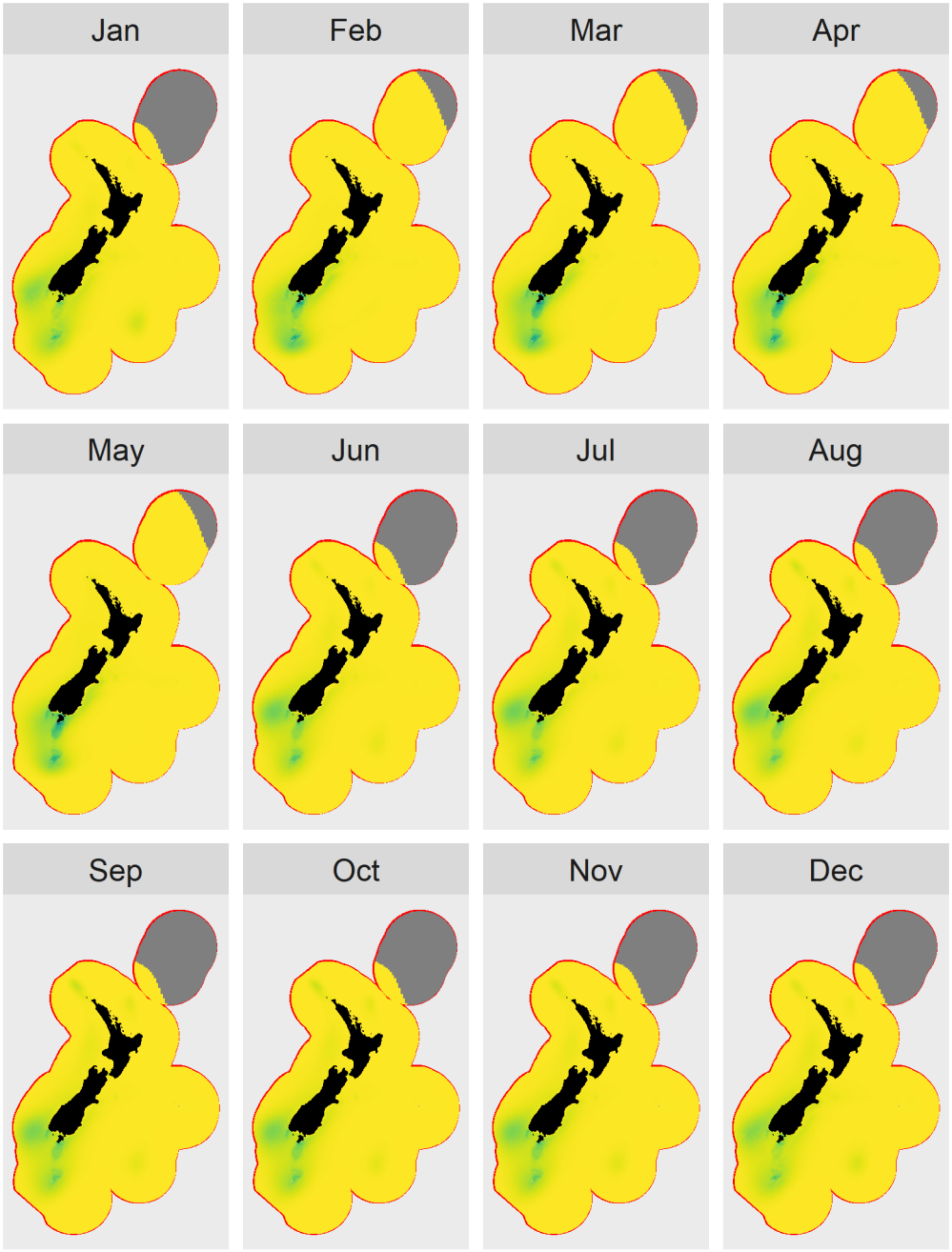

Figure 6: Relative density maps of adult New Zealand white-capped albatross by month (proportion of individuals per square kilometre). Breeding takes place during: Nov,Dec,Jan,Feb,Mar,Apr,May,Jun,Jul,Aug. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 32: Input covariate probabilities for New Zealand white-capped albatross.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.54	0.50	Breeding
Feb	0.77	0.50	Breeding
Mar	0.50	0.00	Breeding
Apr	0.51	0.00	Breeding
May	0.53	0.00	Breeding
Jun	0.53	0.00	Breeding
Jul	0.42	0.00	Breeding
Aug	0.44	0.00	Breeding
Sep	0.37	0.00	Non-breeding
Oct	0.53	0.00	Non-breeding
Nov	0.62	0.50	Breeding
Dec	0.56	0.50	Breeding

Table 33: Prior distributions of demographic parameters for New Zealand white-capped albatross.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	85 944	0.100
Proportion of adults breeding	logit-normal	0.68	0.05
Age at first reproduction	uniform	9	15
Current adult survival rate	logit-normal	0.9	0.018
Optimal adult survival rate	logit-normal	0.96	0.01
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 34: Summary statistics for prior distributions of demographic parameters, and derived quantities, for New Zealand white-capped albatross. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	86 000	70 400–104 000	Pairs
Proportion of adults breeding	0.677	0.574–0.769	Proportion
Age at first reproduction	12	9.12–14.8	Years
Current adult survival rate	0.899	0.859–0.93	Proportion
Optimal adult survival rate	0.959	0.935–0.975	Proportion
Juvenile survival rate	0.161	0.0172–0.365	Proportion
Population size (adults)	255 000	200 000–327 000	Individuals

4.7 Salvin's albatross (*Thalassarche salvini*)

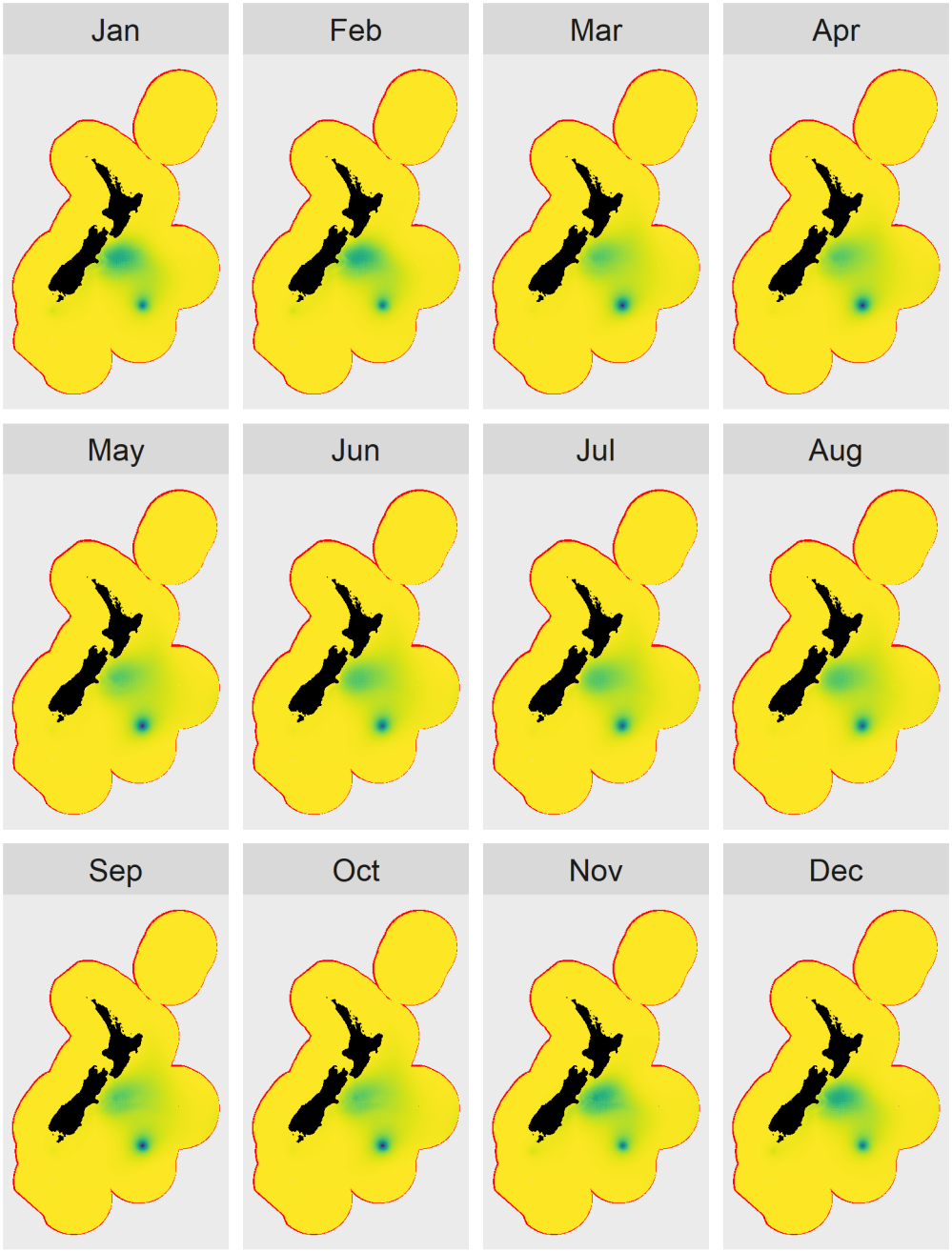

Figure 7: Relative density maps of adult Salvin's albatross by month (proportion of individuals per square kilometre). Breeding takes place during: Sep,Oct,Nov,Dec,Jan,Feb,Mar,Apr. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 35: Input covariate probabilities for Salvin's albatross.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.51	0.00	Breeding
Feb	0.23	0.00	Breeding
Mar	0.09	0.00	Breeding
Apr	0.00	0.00	Breeding
May	0.03	0.00	Non-breeding
Jun	0.18	0.00	Non-breeding
Jul	0.62	0.00	Non-breeding
Aug	0.87	0.25	Non-breeding
Sep	0.84	0.50	Breeding
Oct	0.86	0.50	Breeding
Nov	0.85	0.50	Breeding
Dec	0.84	0.50	Breeding

Table 36: Prior distributions of demographic parameters for Salvin's albatross.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	41 208	0.180
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	9	15
Current adult survival rate	logit-normal	0.967	0.01
Optimal adult survival rate	logit-normal	0.967	0.01
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 37: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Salvin's albatross. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	41 200	28 400–57 500	Pairs
Proportion of adults breeding	0.89	0.755–0.963	Proportion
Age at first reproduction	12	9.18–14.9	Years
Current adult survival rate	0.965	0.94–0.982	Proportion
Optimal adult survival rate	0.965	0.94–0.982	Proportion
Juvenile survival rate	0.175	0.0194–0.391	Proportion
Population size (adults)	92 900	63 000–133 000	Individuals

4.8 Chatham Island albatross (*Thalassarche eremita*)

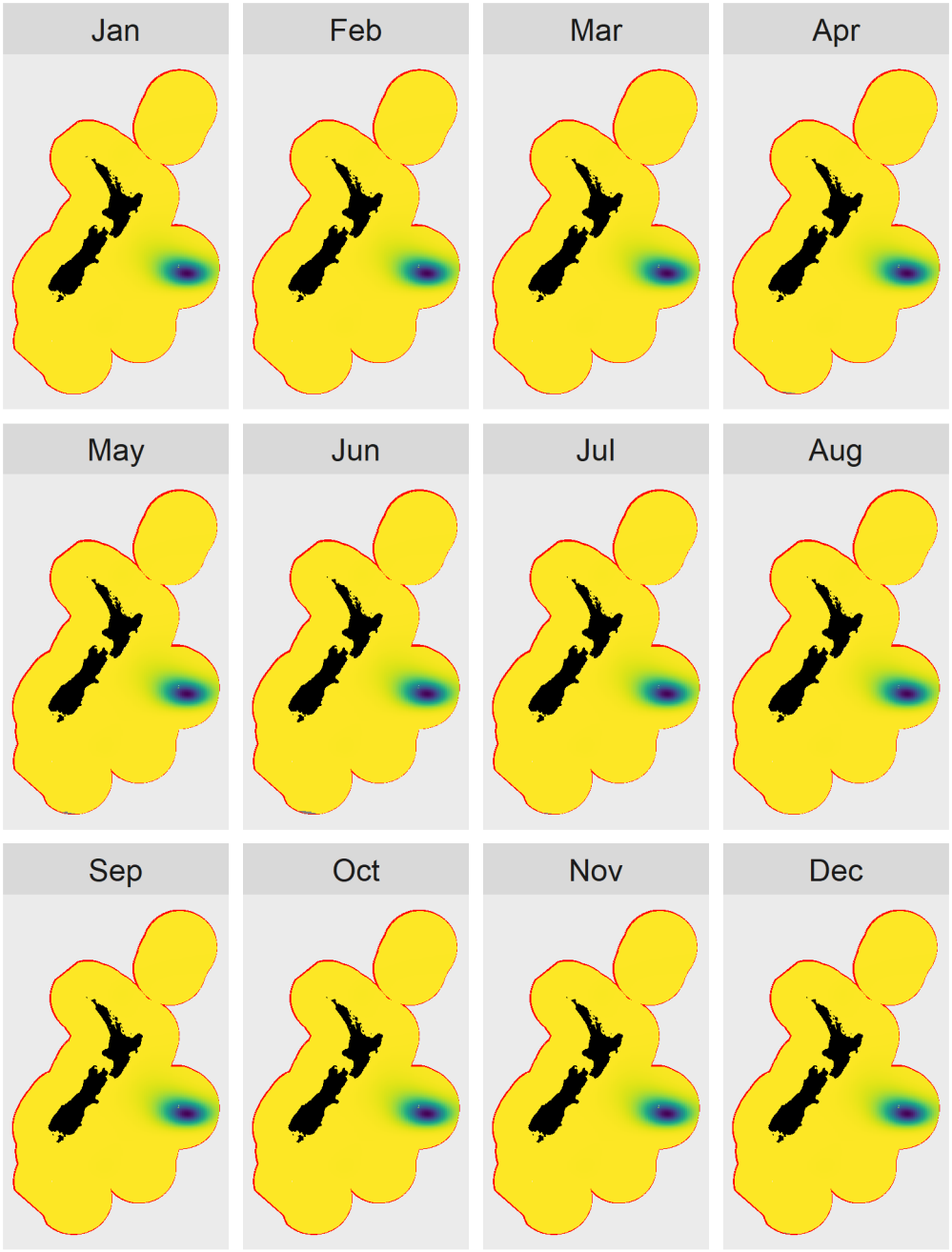

Figure 8: Relative density maps of adult Chatham Island albatross by month (proportion of individuals per square kilometre). Breeding takes place during: Aug,Sep,Oct,Nov,Dec,Jan,Feb,Mar,Apr,May. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 38: Input covariate probabilities for Chatham Island albatross.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.72	0.00	Breeding
Feb	0.29	0.00	Breeding
Mar	0.07	0.00	Breeding
Apr	0.00	0.00	Breeding
May	0.00	0.00	Breeding
Jun	0.00	0.00	Non-breeding
Jul	0.02	0.00	Non-breeding
Aug	0.02	0.50	Breeding
Sep	0.94	0.50	Breeding
Oct	0.94	0.50	Breeding
Nov	0.94	0.50	Breeding
Dec	0.94	0.50	Breeding

Table 39: Prior distributions of demographic parameters for Chatham Island albatross.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	5 294	0.015
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	9	15
Current adult survival rate	logit-normal	0.967	0.01
Optimal adult survival rate	logit-normal	0.967	0.01
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 40: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Chatham Island albatross. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	5 290	5 140–5 450	Pairs
Proportion of adults breeding	0.888	0.75–0.964	Proportion
Age at first reproduction	12	9.16–14.8	Years
Current adult survival rate	0.965	0.941–0.982	Proportion
Optimal adult survival rate	0.966	0.941–0.982	Proportion
Juvenile survival rate	0.174	0.0172–0.39	Proportion
Population size (adults)	12 000	10 900–14 200	Individuals

4.9 Grey-headed albatross (*Thalassarche chrysostoma*)

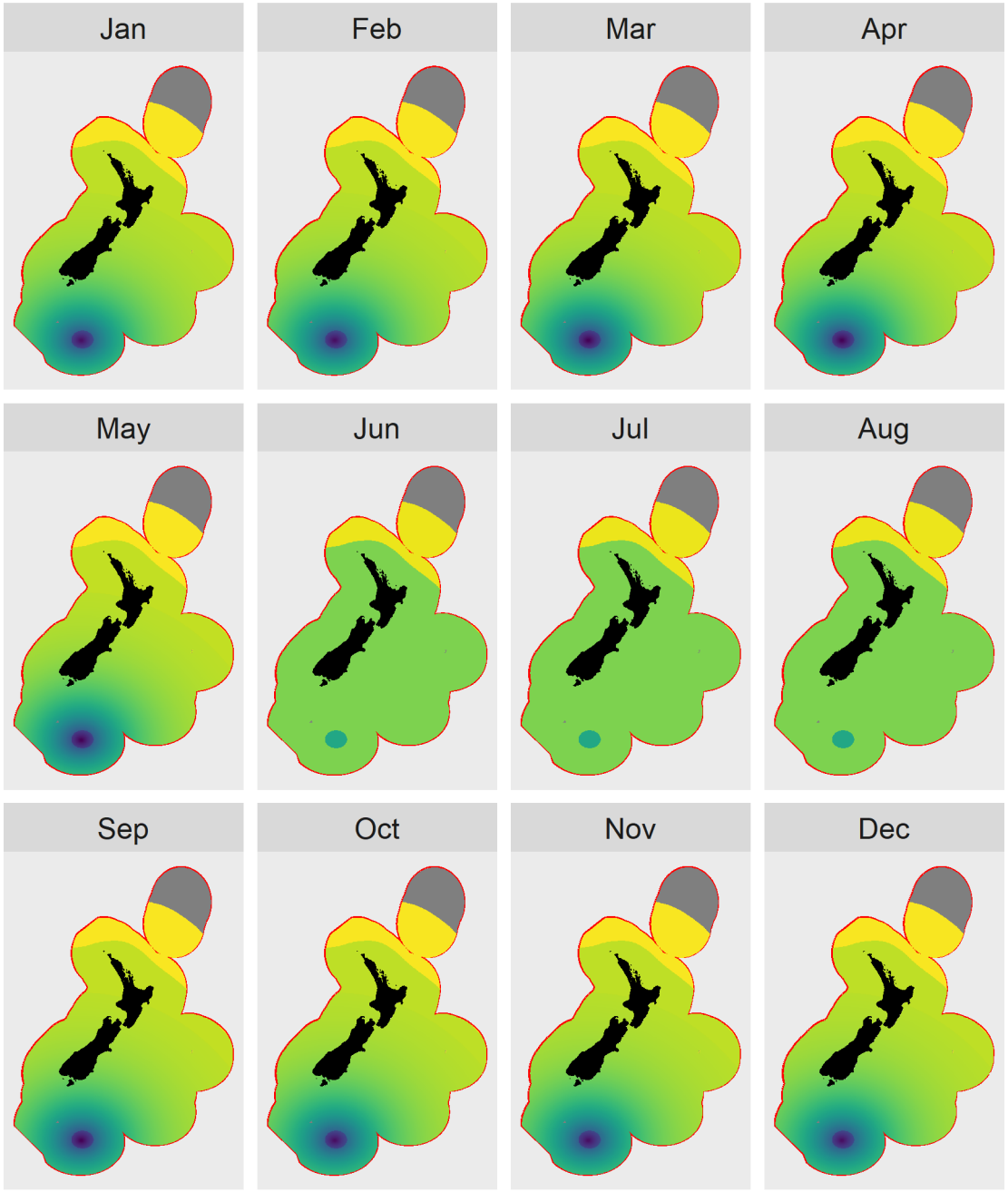

Figure 9: Relative density maps of adult Grey-headed albatross by month (proportion of individuals per square kilometre). Breeding takes place during: Sep,Oct,Nov,Dec,Jan,Feb,Mar,Apr,May. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 41: Input covariate probabilities for Grey-headed albatross.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.80	0.50	Breeding
Feb	0.80	0.50	Breeding
Mar	0.80	0.00	Breeding
Apr	0.80	0.00	Breeding
May	0.80	0.00	Breeding
Jun	0.20	0.00	Non-breeding
Jul	0.20	0.00	Non-breeding
Aug	0.20	0.00	Non-breeding
Sep	0.80	0.00	Breeding
Oct	0.80	0.50	Breeding
Nov	0.80	0.50	Breeding
Dec	0.80	0.50	Breeding

Table 42: Prior distributions of demographic parameters for Grey-headed albatross.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	5 270	0.089
Proportion of adults breeding	logit-normal	0.75	0.05
Age at first reproduction	uniform	7	13
Current adult survival rate	logit-normal	0.953	0.009
Optimal adult survival rate	logit-normal	0.953	0.009
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 43: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Grey-headed albatross. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	5 270	4 420–6 270	Pairs
Proportion of adults breeding	0.747	0.64–0.832	Proportion
Age at first reproduction	10	7.15–12.8	Years
Current adult survival rate	0.952	0.932–0.968	Proportion
Optimal adult survival rate	0.952	0.932–0.967	Proportion
Juvenile survival rate	0.198	0.0316–0.405	Proportion
Population size (adults)	14 200	11 400–17 800	Individuals

4.10 Southern Buller's albatross (*Thalassarche bulleri bulleri*)

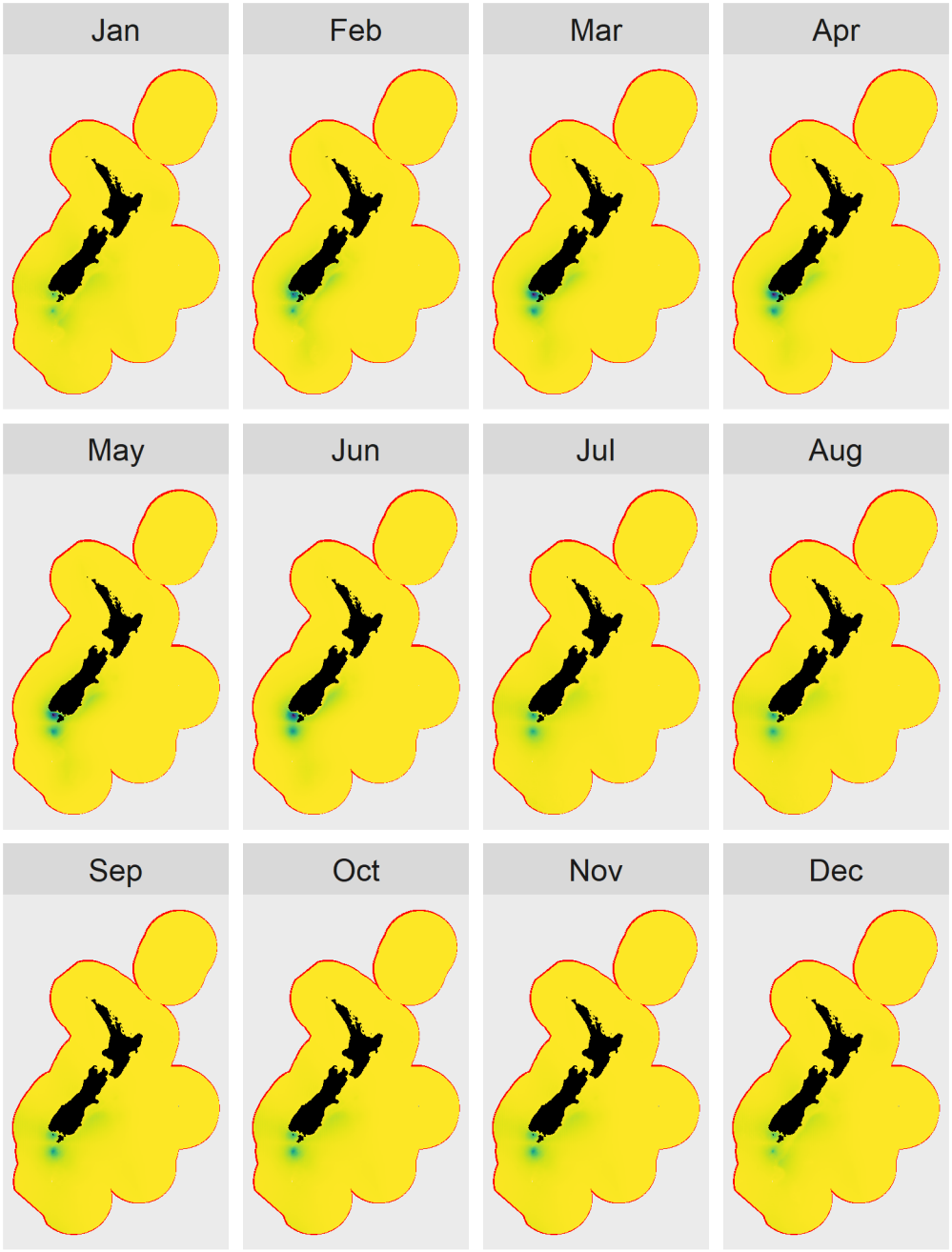

Figure 10: Relative density maps of adult Southern Buller's albatross by month (proportion of individuals per square kilometre). Breeding takes place during: Dec,Jan,Feb,Mar,Apr,May,Jun,Jul,Aug. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 44: Input covariate probabilities for Southern Buller's albatross.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.36	0.50	Breeding
Feb	0.51	0.50	Breeding
Mar	0.65	0.50	Breeding
Apr	0.86	0.50	Breeding
May	0.85	0.00	Breeding
Jun	0.75	0.00	Breeding
Jul	0.71	0.00	Breeding
Aug	0.51	0.00	Breeding
Sep	0.18	0.00	Non-breeding
Oct	0.00	0.00	Non-breeding
Nov	0.00	0.00	Non-breeding
Dec	0.08	0.00	Breeding

Table 45: Prior distributions of demographic parameters for Southern Buller's albatross.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	14 903	0.043
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	9	15
Current adult survival rate	uniform	0.93	0.98
Optimal adult survival rate	uniform	0.93	0.98
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 46: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Southern Buller's albatross. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	14 900	13 700–16 200	Pairs
Proportion of adults breeding	0.89	0.755–0.964	Proportion
Age at first reproduction	12	9.15–14.9	Years
Current adult survival rate	0.955	0.931–0.979	Proportion
Optimal adult survival rate	0.955	0.931–0.979	Proportion
Juvenile survival rate	0.156	0.017–0.367	Proportion
Population size (adults)	33 600	29 500–40 100	Individuals

4.11 Northern Buller's albatross (*Thalassarche bulleri platei*)

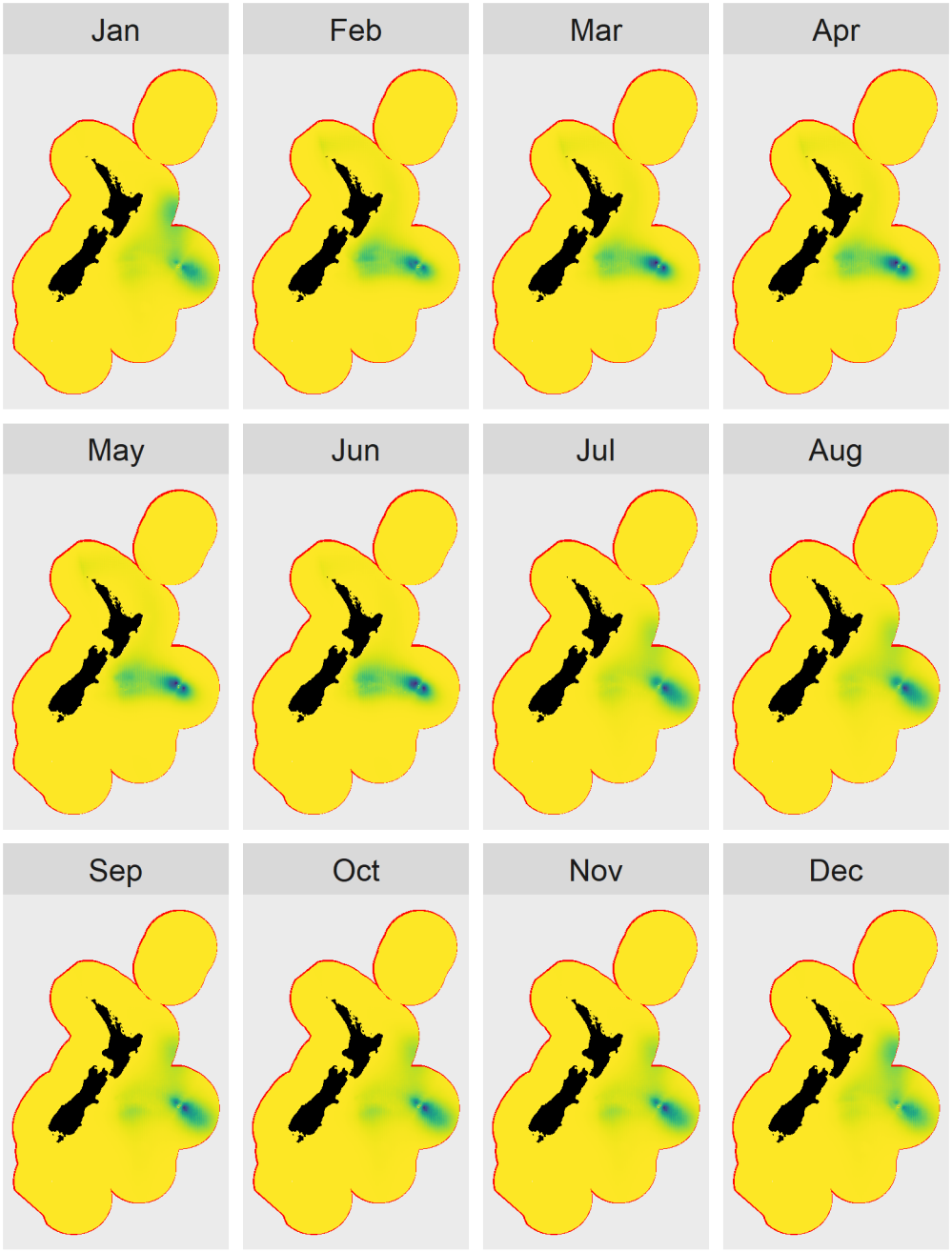

Figure 11: Relative density maps of adult Northern Buller's albatross by month (proportion of individuals per square kilometre). Breeding takes place during: Oct,Nov,Dec,Jan,Feb,Mar,Apr,May,Jun. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 47: Input covariate probabilities for Northern Buller's albatross.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.90	0.50	Breeding
Feb	0.90	0.00	Breeding
Mar	0.90	0.00	Breeding
Apr	0.90	0.00	Breeding
May	0.90	0.00	Breeding
Jun	0.90	0.00	Breeding
Jul	0.02	0.00	Non-breeding
Aug	0.02	0.00	Non-breeding
Sep	0.02	0.00	Non-breeding
Oct	0.90	0.50	Breeding
Nov	0.90	0.50	Breeding
Dec	0.90	0.50	Breeding

Table 48: Prior distributions of demographic parameters for Northern Buller's albatross.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	20 305	0.025
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	9	15
Current adult survival rate	uniform	0.93	0.98
Optimal adult survival rate	uniform	0.93	0.98
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 49: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Northern Buller's albatross. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	20 300	19 300–21 300	Pairs
Proportion of adults breeding	0.89	0.757–0.965	Proportion
Age at first reproduction	12	9.15–14.8	Years
Current adult survival rate	0.955	0.931–0.979	Proportion
Optimal adult survival rate	0.955	0.931–0.979	Proportion
Juvenile survival rate	0.155	0.0168–0.355	Proportion
Population size (adults)	45 800	41 300–54 000	Individuals

4.12 Light-mantled sooty albatross (*Phoebetria palpebrata*)

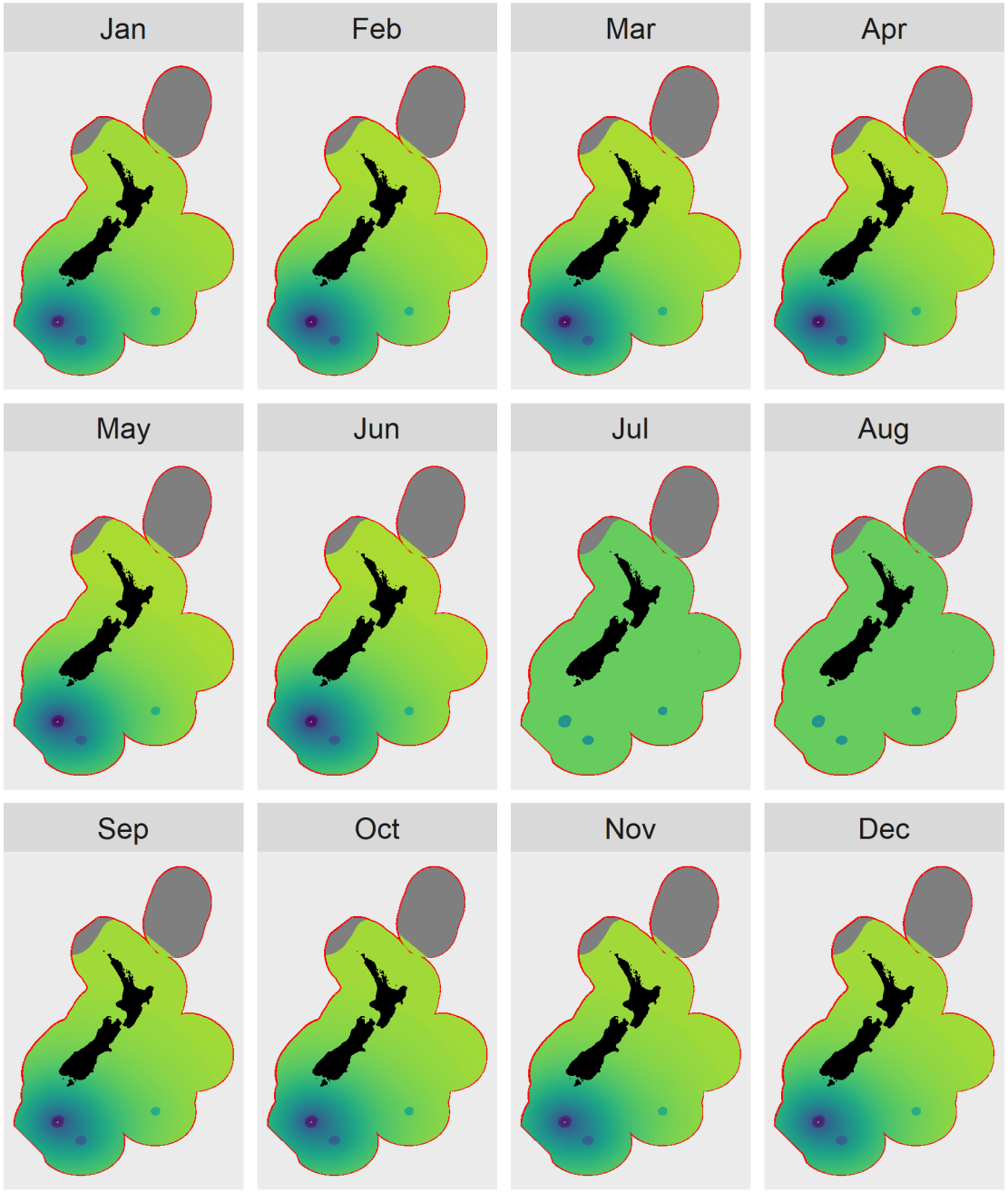

Figure 12: Relative density maps of adult Light-mantled sooty albatross by month (proportion of individuals per square kilometre). Breeding takes place during: Sep,Oct,Nov,Dec,Jan,Feb,Mar,Apr,May,Jun. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 50: Input covariate probabilities for Light-mantled sooty albatross.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.68	0.50	Breeding
Feb	0.68	0.05	Breeding
Mar	0.68	0.05	Breeding
Apr	0.68	0.05	Breeding
May	0.68	0.05	Breeding
Jun	0.68	0.00	Breeding
Jul	0.20	0.00	Non-breeding
Aug	0.20	0.00	Non-breeding
Sep	0.68	0.50	Breeding
Oct	0.68	0.50	Breeding
Nov	0.68	0.50	Breeding
Dec	0.68	0.50	Breeding

Table 51: Prior distributions of demographic parameters for Light-mantled sooty albatross.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	6 770	6 900
Proportion of adults breeding	logit-normal	0.6	0.05
Age at first reproduction	uniform	9	15
Current adult survival rate	uniform	0.96	0.98
Optimal adult survival rate	uniform	0.96	0.98
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 52: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Light-mantled sooty albatross. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	6 830	6 770–6 900	Pairs
Proportion of adults breeding	0.599	0.5–0.695	Proportion
Age at first reproduction	12	9.16–14.8	Years
Current adult survival rate	0.97	0.961–0.98	Proportion
Optimal adult survival rate	0.97	0.961–0.979	Proportion
Juvenile survival rate	0.185	0.0219–0.403	Proportion
Population size (adults)	23 000	19 700–27 400	Individuals

4.13 Northern giant petrel (*Macronectes halli*)

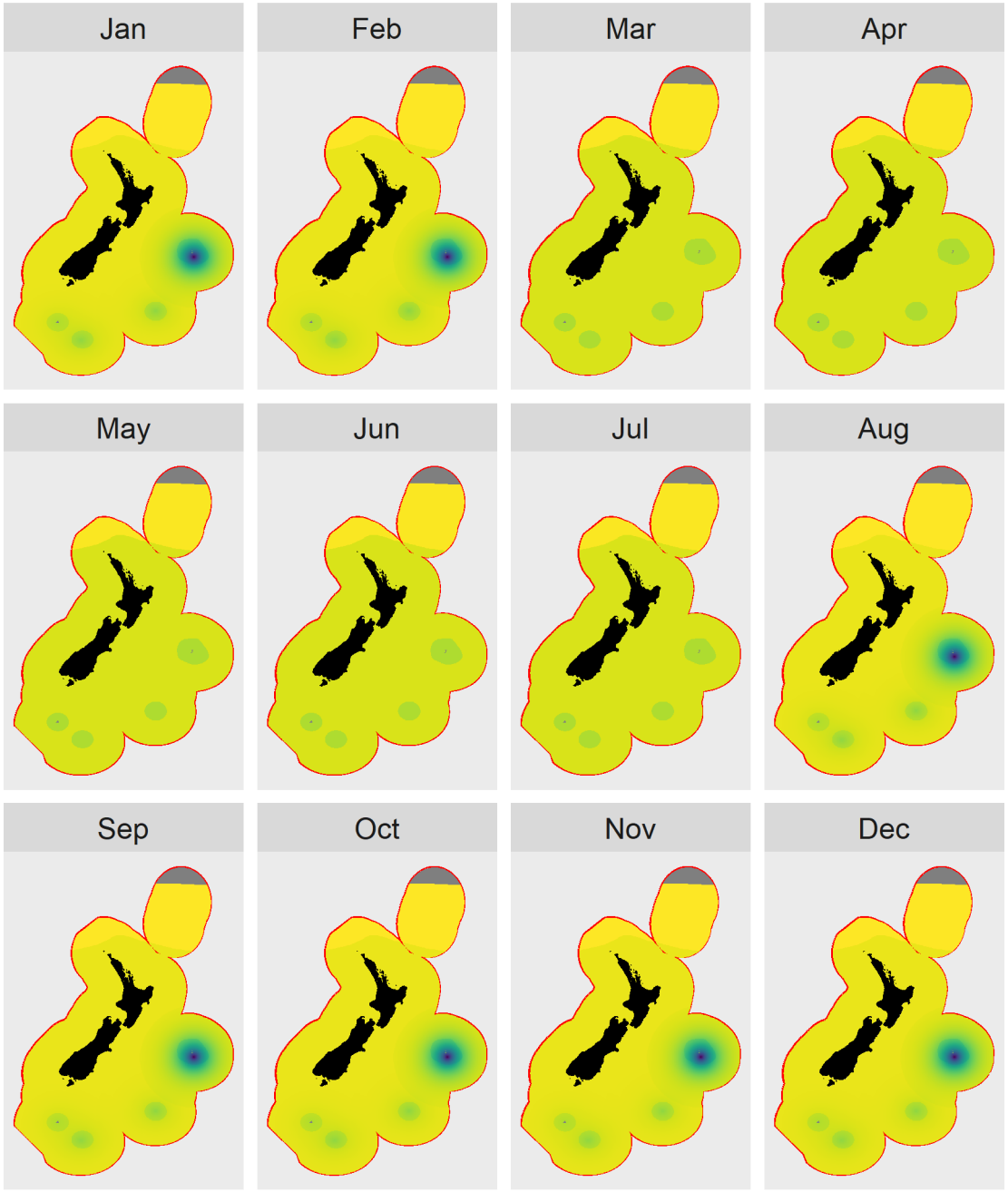

Figure 13: Relative density maps of adult Northern giant petrel by month (proportion of individuals per square kilometre). Breeding takes place during: Aug,Sep,Oct,Nov,Dec,Jan,Feb. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 53: Input covariate probabilities for Northern giant petrel.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.97	0.50	Breeding
Feb	0.97	0.50	Breeding
Mar	0.75	0.00	Non-breeding
Apr	0.75	0.00	Non-breeding
May	0.75	0.00	Non-breeding
Jun	0.75	0.00	Non-breeding
Jul	0.75	0.00	Non-breeding
Aug	0.97	0.50	Breeding
Sep	0.97	0.50	Breeding
Oct	0.97	0.50	Breeding
Nov	0.97	0.50	Breeding
Dec	0.97	0.50	Breeding

Table 54: Prior distributions of demographic parameters for Northern giant petrel.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	2 140	3 140
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	6	10
Current adult survival rate	uniform	0.9	0.96
Optimal adult survival rate	uniform	0.9	0.96
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 55: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Northern giant petrel. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	2 640	2 160–3 110	Pairs
Proportion of adults breeding	0.889	0.753–0.965	Proportion
Age at first reproduction	7.99	6.1–9.9	Years
Current adult survival rate	0.93	0.901–0.958	Proportion
Optimal adult survival rate	0.93	0.902–0.958	Proportion
Juvenile survival rate	0.218	0.0524–0.41	Proportion
Population size (adults)	5 960	4 700–7 500	Individuals

4.14 Grey petrel (*Procellaria cinerea*)

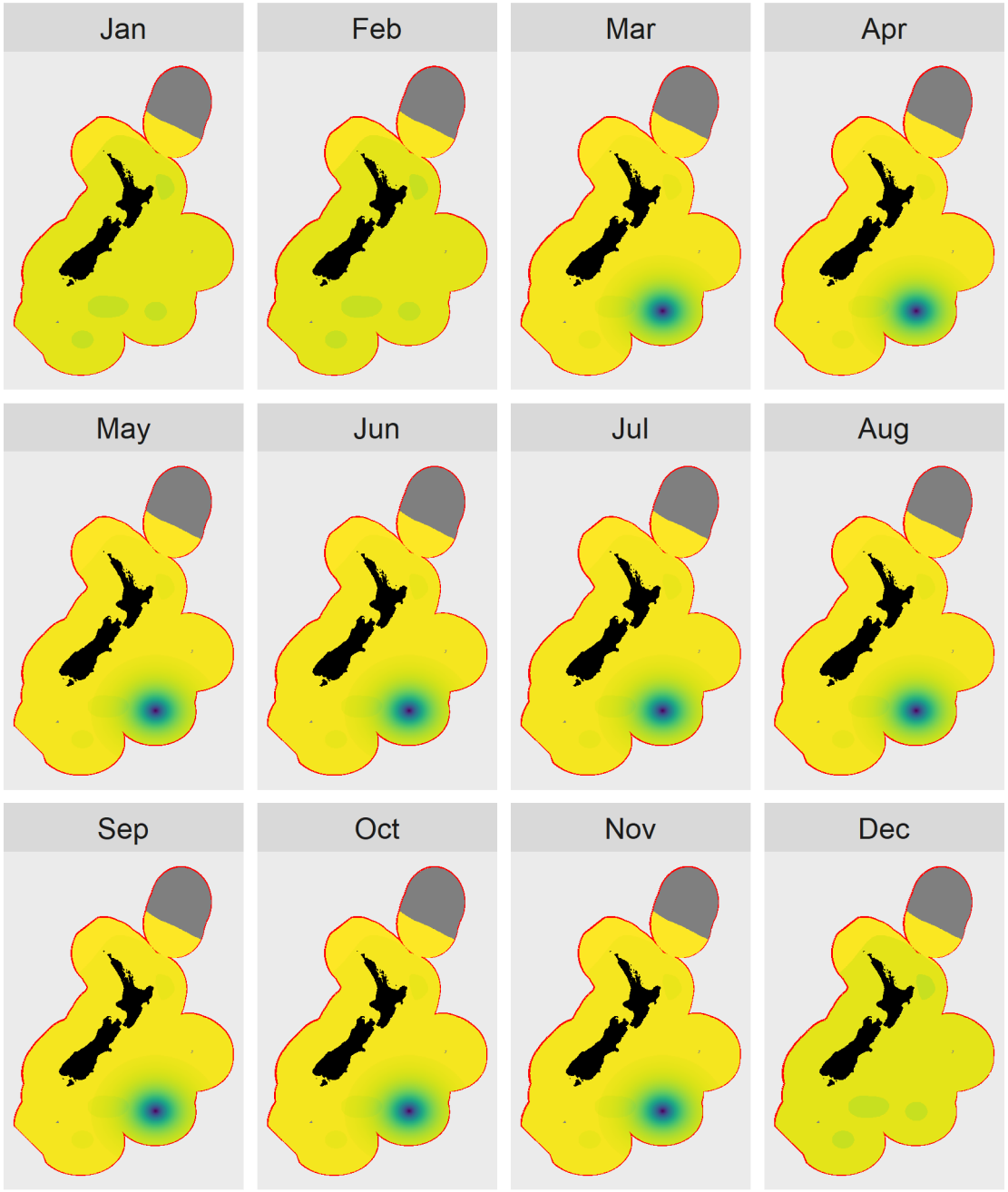

Figure 14: Relative density maps of adult Grey petrel by month (proportion of individuals per square kilometre). Breeding takes place during: Feb,Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 56: Input covariate probabilities for Grey petrel.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.21	0.00	Non-breeding
Feb	0.21	1.00	Breeding
Mar	0.21	0.50	Breeding
Apr	0.32	0.50	Breeding
May	0.32	0.50	Breeding
Jun	0.32	0.50	Breeding
Jul	0.19	0.00	Breeding
Aug	0.19	0.00	Breeding
Sep	0.19	0.00	Breeding
Oct	0.02	0.00	Breeding
Nov	0.02	0.00	Breeding
Dec	0.02	0.00	Non-breeding

Table 57: Prior distributions of demographic parameters for Grey petrel.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	32 000	73 000
Proportion of adults breeding	logit-normal	0.8	0.05
Age at first reproduction	uniform	5	9
Current adult survival rate	uniform	0.9	0.97
Optimal adult survival rate	uniform	0.9	0.97
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 58: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Grey petrel. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	52 700	33 100–71 900	Pairs
Proportion of adults breeding	0.796	0.687–0.88	Proportion
Age at first reproduction	7.01	5.11–8.9	Years
Current adult survival rate	0.935	0.902–0.968	Proportion
Optimal adult survival rate	0.935	0.902–0.968	Proportion
Juvenile survival rate	0.266	0.0755–0.477	Proportion
Population size (adults)	133 000	81 800–190 000	Individuals

4.15 Black petrel (*Procellaria parkinsoni*)

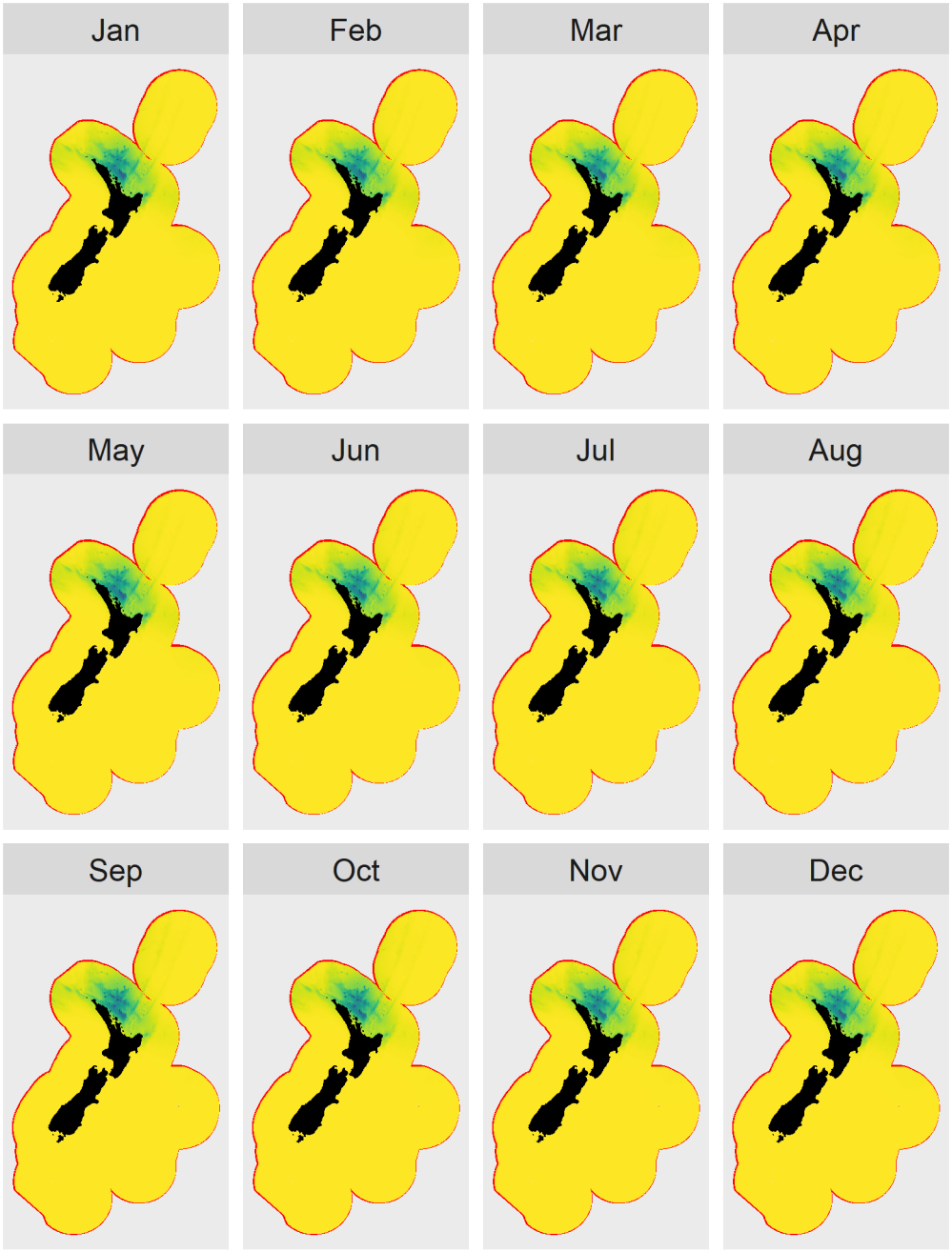

Figure 15: Relative density maps of adult Black petrel by month (proportion of individuals per square kilometre). Breeding takes place during: Oct,Nov,Dec,Jan,Feb,Mar,Apr,May. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 59: Input covariate probabilities for Black petrel.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.38	0.50	Breeding
Feb	0.58	0.50	Breeding
Mar	0.45	0.00	Breeding
Apr	0.47	0.00	Breeding
May	0.25	0.00	Breeding
Jun	0.00	0.00	Non-breeding
Jul	0.00	0.00	Non-breeding
Aug	0.00	0.00	Non-breeding
Sep	0.00	0.00	Non-breeding
Oct	0.02	0.00	Breeding
Nov	0.19	0.25	Breeding
Dec	0.27	0.50	Breeding

Table 60: Prior distributions of demographic parameters for Black petrel.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	5 286	0.114
Proportion of adults breeding	logit-normal	0.61	0.05
Age at first reproduction	uniform	6.21	6.99
Current adult survival rate	logit-normal	0.87	0.005
Optimal adult survival rate	logit-normal	0.95	0.01
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 61: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Black petrel. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	5 280	4 210–6 570	Pairs
Proportion of adults breeding	0.609	0.509–0.704	Proportion
Age at first reproduction	6.6	6.23–6.97	Years
Current adult survival rate	0.87	0.86–0.88	Proportion
Optimal adult survival rate	0.949	0.926–0.966	Proportion
Juvenile survival rate	0.306	0.115–0.482	Proportion
Population size (adults)	17 500	13 200–22 900	Individuals

4.16 Westland petrel (*Procellaria westlandica*)

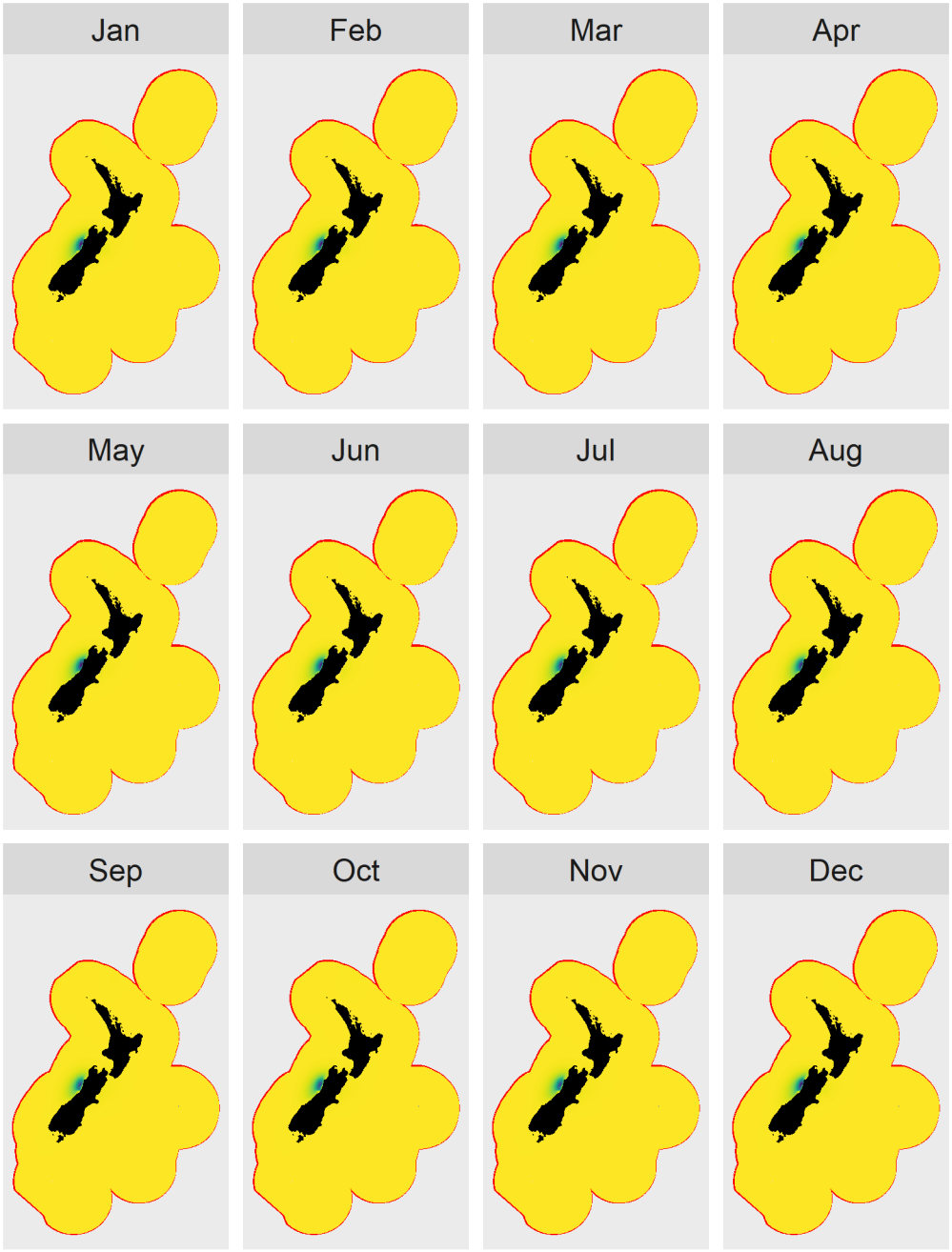

Figure 16: Relative density maps of adult Westland petrel by month (proportion of individuals per square kilometre). Breeding takes place during: Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 62: Input covariate probabilities for Westland petrel.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.00	0.00	Non-breeding
Feb	0.00	0.00	Non-breeding
Mar	0.01	0.00	Breeding
Apr	0.35	0.00	Breeding
May	0.69	0.25	Breeding
Jun	0.85	0.50	Breeding
Jul	0.78	0.50	Breeding
Aug	0.63	0.00	Breeding
Sep	0.41	0.00	Breeding
Oct	0.54	0.00	Breeding
Nov	0.41	0.00	Breeding
Dec	0.03	0.00	Breeding

Table 63: Prior distributions of demographic parameters for Westland petrel.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	7 965	0.300
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	4	9
Current adult survival rate	uniform	0.918	0.975
Optimal adult survival rate	uniform	0.918	0.975
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 64: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Westland petrel. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	7 910	4 190–13 500	Pairs
Proportion of adults breeding	0.889	0.752–0.963	Proportion
Age at first reproduction	6.49	4.13–8.87	Years
Current adult survival rate	0.947	0.919–0.974	Proportion
Optimal adult survival rate	0.946	0.919–0.974	Proportion
Juvenile survival rate	0.314	0.0877–0.542	Proportion
Population size (adults)	17 900	9 380–31 100	Individuals

4.17 White-chinned petrel (*Procellaria aequinoctialis*)

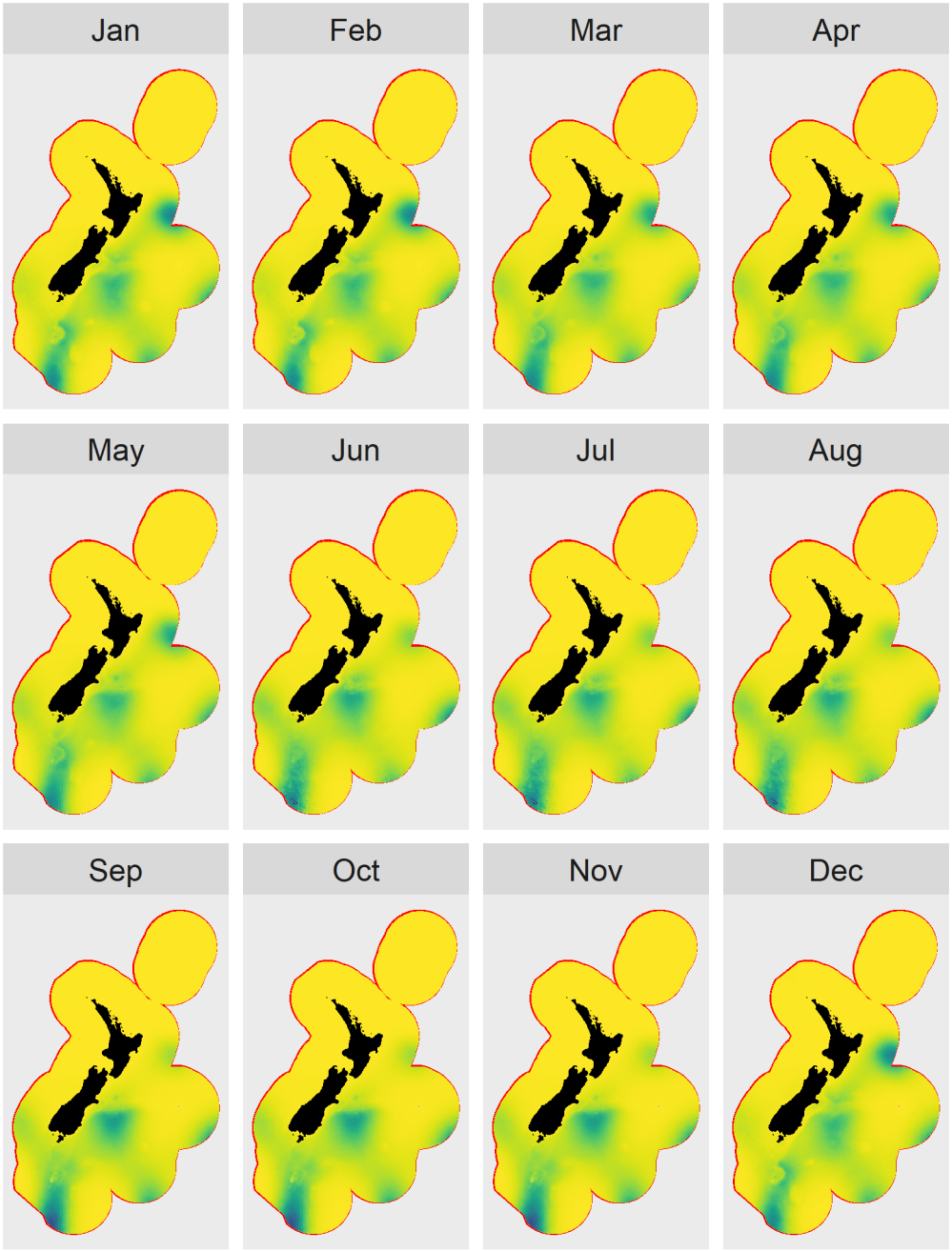

Figure 17: Relative density maps of adult White-chinned petrel by month (proportion of individuals per square kilometre). Breeding takes place during: Nov,Dec,Jan,Feb,Mar,Apr,May. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 65: Input covariate probabilities for White-chinned petrel.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.68	0.50	Breeding
Feb	0.40	0.50	Breeding
Mar	0.14	0.00	Breeding
Apr	0.07	0.00	Breeding
May	0.09	0.00	Breeding
Jun	0.00	0.00	Non-breeding
Jul	0.00	0.00	Non-breeding
Aug	0.00	0.00	Non-breeding
Sep	0.00	0.50	Non-breeding
Oct	0.37	0.50	Non-breeding
Nov	0.65	0.50	Breeding
Dec	0.85	0.50	Breeding

Table 66: Prior distributions of demographic parameters for White-chinned petrel.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	249 309	0.089
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	4	9
Current adult survival rate	uniform	0.9	0.97
Optimal adult survival rate	uniform	0.9	0.97
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 67: Summary statistics for prior distributions of demographic parameters, and derived quantities, for White-chinned petrel. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	249 000	209 000–295 000	Pairs
Proportion of adults breeding	0.889	0.748–0.964	Proportion
Age at first reproduction	6.49	4.13–8.87	Years
Current adult survival rate	0.935	0.902–0.968	Proportion
Optimal adult survival rate	0.935	0.902–0.968	Proportion
Juvenile survival rate	0.292	0.0805–0.516	Proportion
Population size (adults)	563 000	457 000–706 000	Individuals

4.18 Flesh-footed shearwater (*Puffinus carneipes*)

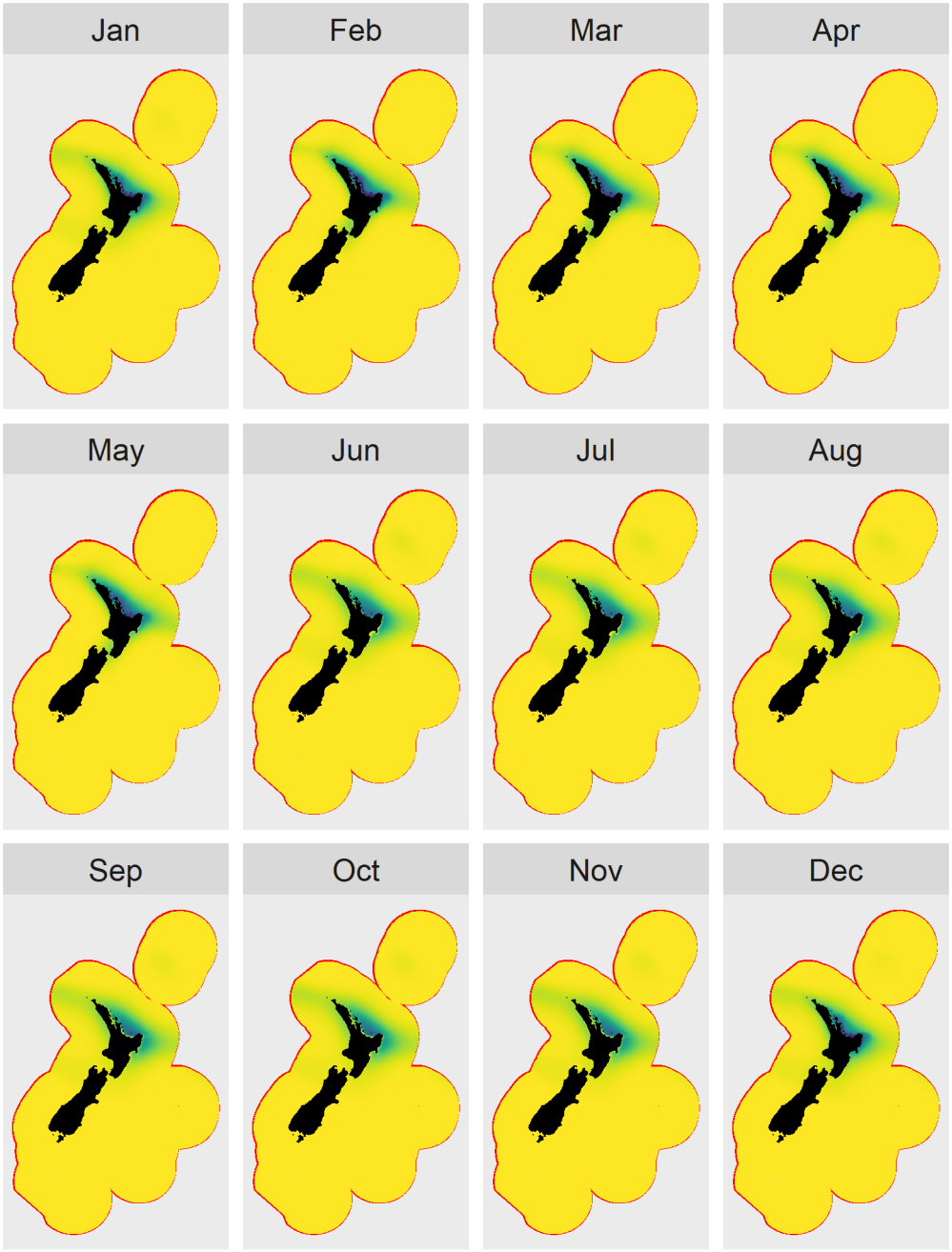

Figure 18: Relative density maps of adult Flesh-footed shearwater by month (proportion of individuals per square kilometre). Breeding takes place during: Sep,Oct,Nov,Dec,Jan,Feb,Mar,Apr,May. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 68: Input covariate probabilities for Flesh-footed shearwater.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.75	0.50	Breeding
Feb	0.80	0.15	Breeding
Mar	0.54	0.00	Breeding
Apr	0.26	0.00	Breeding
May	0.01	0.00	Breeding
Jun	0.00	0.00	Non-breeding
Jul	0.00	0.00	Non-breeding
Aug	0.00	0.00	Non-breeding
Sep	0.00	0.00	Breeding
Oct	0.22	0.20	Breeding
Nov	0.81	0.20	Breeding
Dec	0.89	0.50	Breeding

Table 69: Prior distributions of demographic parameters for Flesh-footed shearwater.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	normal	20 674	2 160
Proportion of adults breeding	logit-normal	0.8	0.05
Age at first reproduction	uniform	4	9
Current adult survival rate	uniform	0.931	0.94
Optimal adult survival rate	logit-normal	0.94	0.03
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 70: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Flesh-footed shearwater. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	20 700	16 500–24 900	Pairs
Proportion of adults breeding	0.796	0.683–0.88	Proportion
Age at first reproduction	6.5	4.13–8.88	Years
Current adult survival rate	0.935	0.931–0.94	Proportion
Optimal adult survival rate	0.932	0.844–0.978	Proportion
Juvenile survival rate	0.292	0.0723–0.54	Proportion
Population size (adults)	52 100	40 400–65 600	Individuals

4.19 Wedge-tailed shearwater (*Puffinus pacificus*)

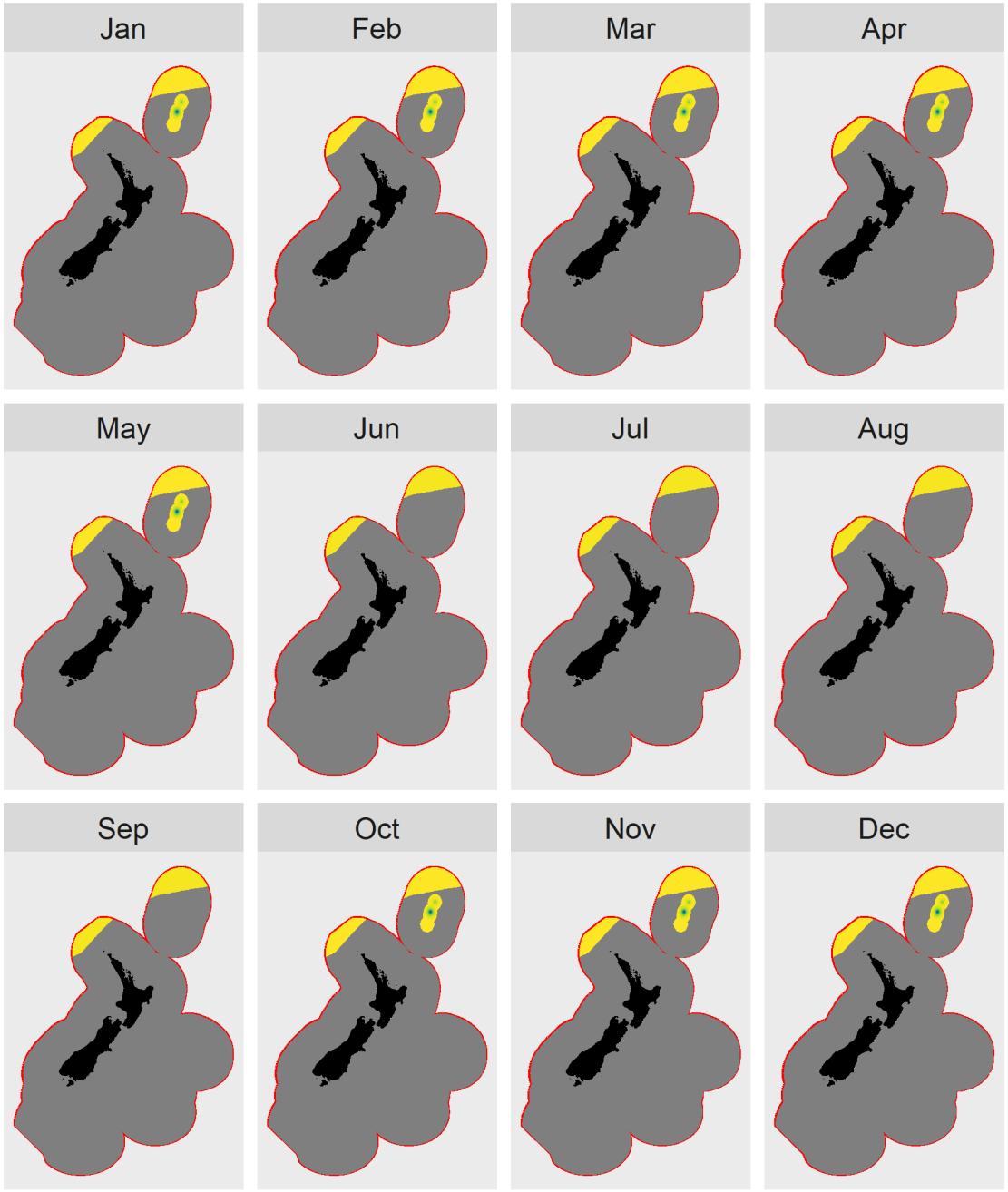

Figure 19: Relative density maps of adult Wedge-tailed shearwater by month (proportion of individuals per square kilometre). Breeding takes place during: Oct,Nov,Dec,Jan,Feb,Mar,Apr,May. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 71: Input covariate probabilities for Wedge-tailed shearwater.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.90	0.50	Breeding
Feb	0.90	0.50	Breeding
Mar	0.90	0.50	Breeding
Apr	0.90	0.50	Breeding
May	0.90	0.50	Breeding
Jun	0.00	0.00	Non-breeding
Jul	0.00	0.00	Non-breeding
Aug	0.00	0.00	Non-breeding
Sep	0.00	0.00	Non-breeding
Oct	0.90	0.50	Breeding
Nov	0.90	0.50	Breeding
Dec	0.90	0.50	Breeding

Table 72: Prior distributions of demographic parameters for Wedge-tailed shearwater.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	50 000	0.300
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	3	5
Current adult survival rate	uniform	0.889	0.958
Optimal adult survival rate	uniform	0.889	0.958
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 73: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Wedge-tailed shearwater. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	49 900	26 300–85 900	Pairs
Proportion of adults breeding	0.888	0.749–0.964	Proportion
Age at first reproduction	3.99	3.05–4.94	Years
Current adult survival rate	0.923	0.891–0.956	Proportion
Optimal adult survival rate	0.924	0.891–0.956	Proportion
Juvenile survival rate	0.416	0.213–0.589	Proportion
Population size (adults)	113 000	58 900–198 000	Individuals

4.20 Buller's shearwater (*Puffinus bulleri*)

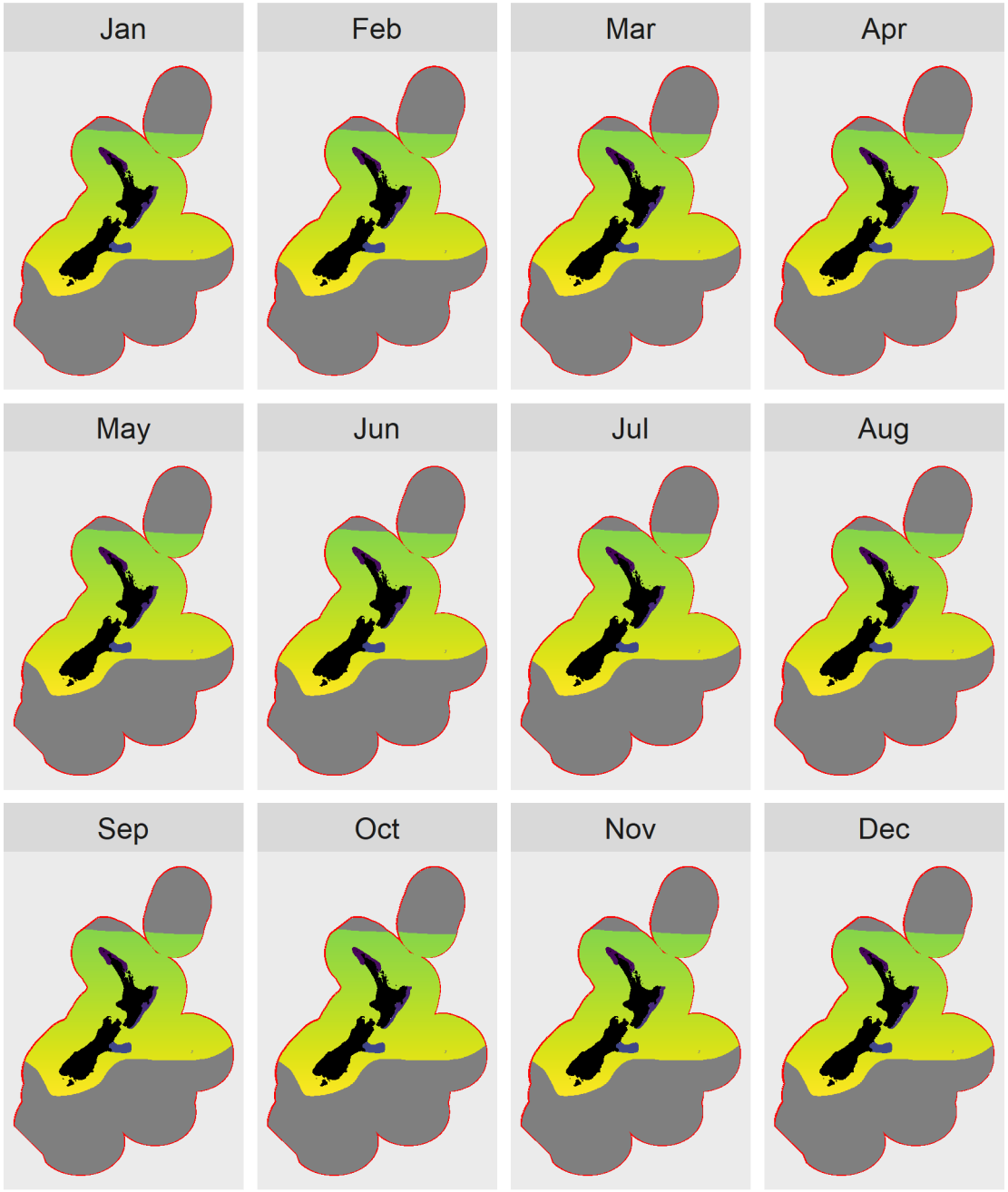

Figure 20: Relative density maps of adult Buller's shearwater by month (proportion of individuals per square kilometre). Breeding takes place during: Sep,Oct,Nov,Dec,Jan,Feb,Mar,Apr,May. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 74: Input covariate probabilities for Buller's shearwater.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.90	0.50	Breeding
Feb	0.90	0.00	Breeding
Mar	0.90	0.00	Breeding
Apr	0.90	0.00	Breeding
May	0.90	0.00	Breeding
Jun	0.00	0.00	Non-breeding
Jul	0.00	0.00	Non-breeding
Aug	0.00	0.00	Non-breeding
Sep	0.90	0.00	Breeding
Oct	0.90	0.50	Breeding
Nov	0.90	0.50	Breeding
Dec	0.90	0.50	Breeding

Table 75: Prior distributions of demographic parameters for Buller's shearwater.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	normal	78 645	5 610
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	4	9
Current adult survival rate	logit-normal	0.92	0.03
Optimal adult survival rate	logit-normal	0.92	0.03
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 76: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Buller's shearwater. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	78 500	67 700–89 200	Pairs
Proportion of adults breeding	0.889	0.753–0.963	Proportion
Age at first reproduction	6.52	4.13–8.89	Years
Current adult survival rate	0.915	0.839–0.962	Proportion
Optimal adult survival rate	0.915	0.839–0.962	Proportion
Juvenile survival rate	0.258	0.06–0.49	Proportion
Population size (adults)	177 000	148 000–216 000	Individuals

4.21 Sooty shearwater (*Puffinus griseus*)

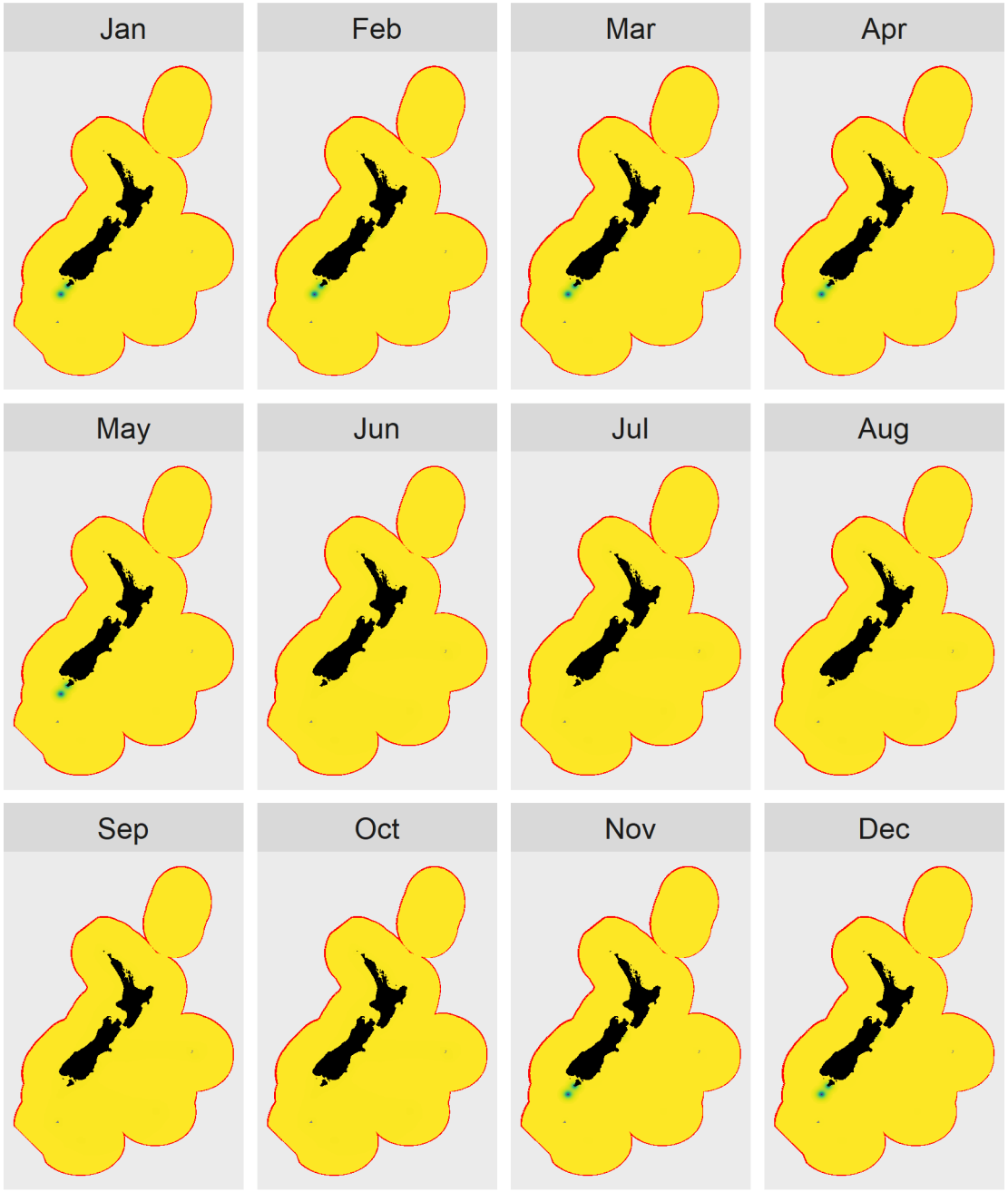

Figure 21: Relative density maps of adult Sooty shearwater by month (proportion of individuals per square kilometre). Breeding takes place during: Nov,Dec,Jan,Feb,Mar,Apr,May. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 77: Input covariate probabilities for Sooty shearwater.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.50	0.50	Breeding
Feb	0.50	0.50	Breeding
Mar	0.50	0.00	Breeding
Apr	0.50	0.00	Breeding
May	0.10	0.00	Breeding
Jun	0.00	0.00	Non-breeding
Jul	0.00	0.00	Non-breeding
Aug	0.00	0.00	Non-breeding
Sep	0.10	0.00	Non-breeding
Oct	0.50	0.00	Non-breeding
Nov	0.50	0.50	Breeding
Dec	0.50	0.50	Breeding

Table 78: Prior distributions of demographic parameters for Sooty shearwater.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	5 000 000	0.300
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	5	7
Current adult survival rate	uniform	0.86	0.979
Optimal adult survival rate	uniform	0.86	0.979
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 79: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Sooty shearwater. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	5 000 000	2 640 000–8 660 000	Pairs
Proportion of adults breeding	0.888	0.751–0.964	Proportion
Age at first reproduction	6	5.05–6.95	Years
Current adult survival rate	0.92	0.863–0.976	Proportion
Optimal adult survival rate	0.919	0.863–0.976	Proportion
Juvenile survival rate	0.283	0.103–0.513	Proportion
Population size (adults)	11 300 000	5 900 000–19 800 000	Individuals

4.22 Fluttering shearwater (*Puffinus gavia*)

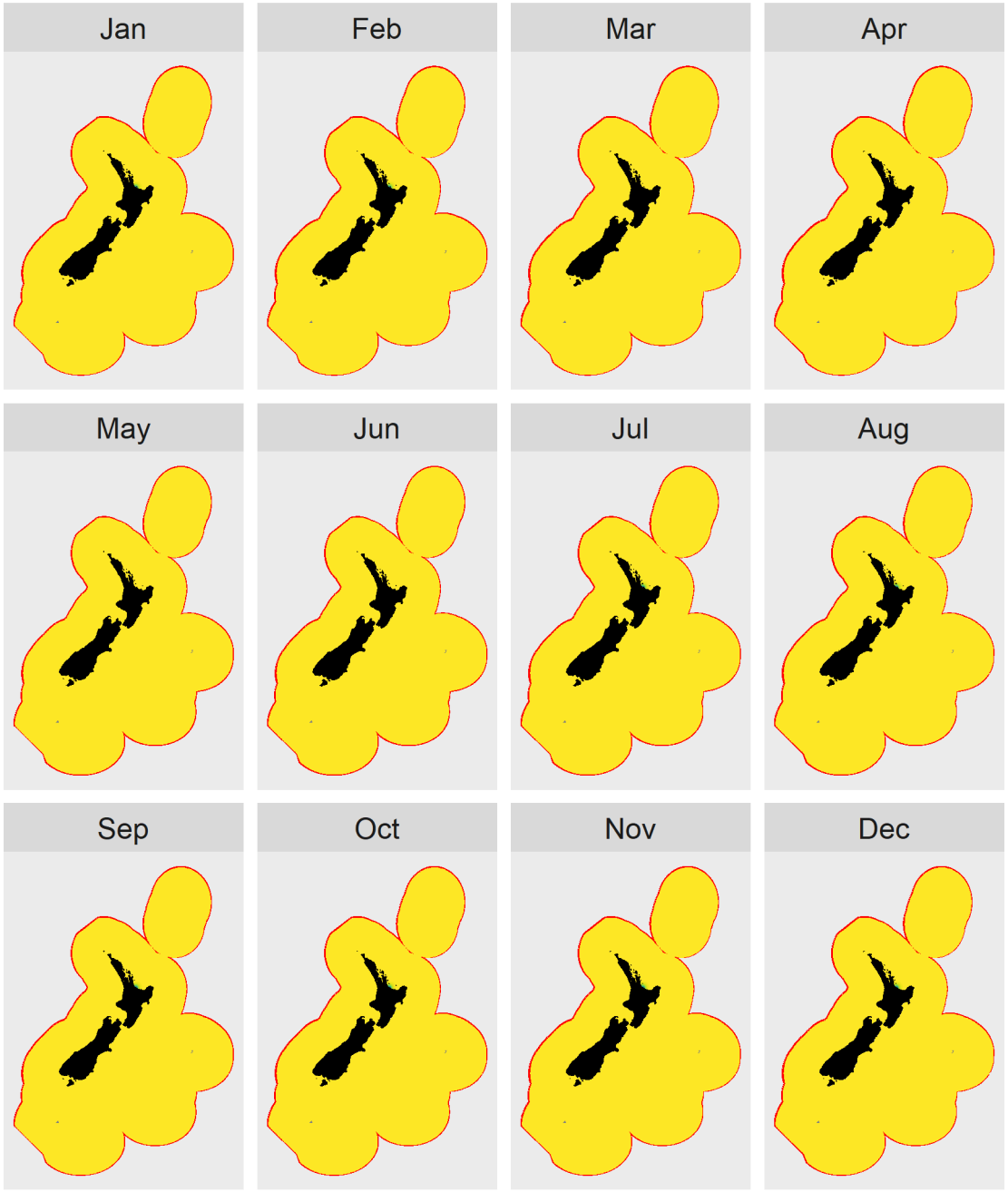

Figure 22: Relative density maps of adult Fluttering shearwater by month (proportion of individuals per square kilometre). Breeding takes place during: Jul,Aug,Sep,Oct,Nov,Dec,Jan,Feb. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 80: Input covariate probabilities for Fluttering shearwater.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.98	0.50	Breeding
Feb	0.98	0.50	Breeding
Mar	0.80	0.00	Non-breeding
Apr	0.80	0.00	Non-breeding
May	0.80	0.00	Non-breeding
Jun	0.80	0.00	Non-breeding
Jul	0.98	0.50	Breeding
Aug	0.98	0.50	Breeding
Sep	0.98	0.50	Breeding
Oct	0.98	0.50	Breeding
Nov	0.98	0.50	Breeding
Dec	0.98	0.50	Breeding

Table 81: Prior distributions of demographic parameters for Fluttering shearwater.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	100 000	500 000
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	4	6
Current adult survival rate	uniform	0.889	0.958
Optimal adult survival rate	uniform	0.889	0.958
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 82: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Fluttering shearwater. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	297 000	109 000–490 000	Pairs
Proportion of adults breeding	0.889	0.748–0.964	Proportion
Age at first reproduction	5	4.05–5.95	Years
Current adult survival rate	0.924	0.891–0.956	Proportion
Optimal adult survival rate	0.923	0.891–0.956	Proportion
Juvenile survival rate	0.346	0.153–0.525	Proportion
Population size (adults)	670 000	242 000–1 130 000	Individuals

4.23 Hutton's shearwater (*Puffinus huttoni*)

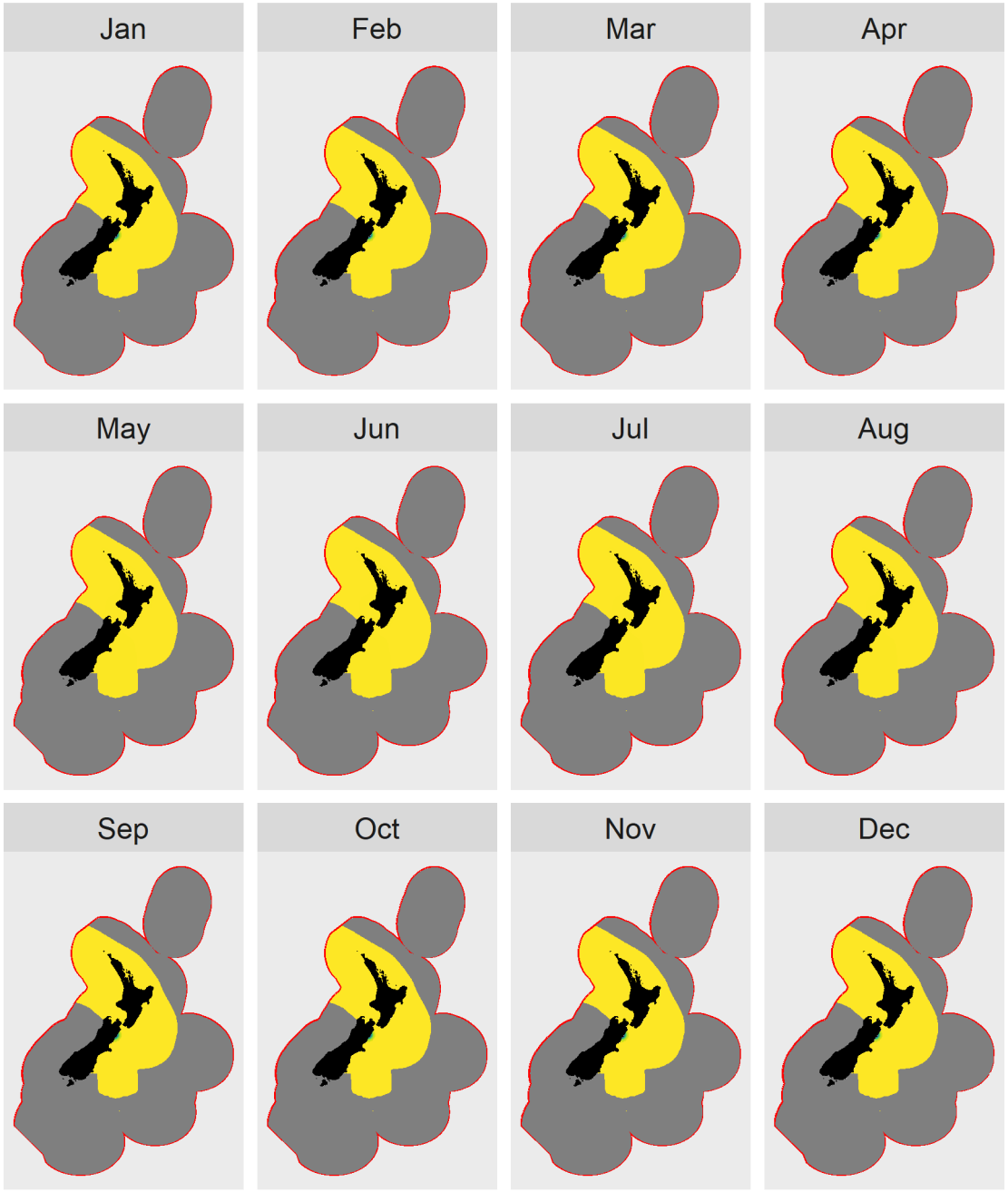

Figure 23: Relative density maps of adult Hutton's shearwater by month (proportion of individuals per square kilometre). Breeding takes place during: Sep,Oct,Nov,Dec,Jan,Feb,Mar,Apr. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 83: Input covariate probabilities for Hutton's shearwater.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.90	0.50	Breeding
Feb	0.90	0.50	Breeding
Mar	0.90	0.50	Breeding
Apr	0.90	0.50	Breeding
May	0.02	0.00	Non-breeding
Jun	0.02	0.00	Non-breeding
Jul	0.02	0.00	Non-breeding
Aug	0.02	0.00	Non-breeding
Sep	0.90	0.50	Breeding
Oct	0.90	0.50	Breeding
Nov	0.90	0.50	Breeding
Dec	0.90	0.50	Breeding

Table 84: Prior distributions of demographic parameters for Hutton's shearwater.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	114 000	0.200
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	4	6
Current adult survival rate	uniform	0.889	0.958
Optimal adult survival rate	uniform	0.889	0.958
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 85: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Hutton's shearwater. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	114 000	75 300–166 000	Pairs
Proportion of adults breeding	0.889	0.75–0.964	Proportion
Age at first reproduction	4.99	4.05–5.94	Years
Current adult survival rate	0.923	0.891–0.956	Proportion
Optimal adult survival rate	0.924	0.891–0.956	Proportion
Juvenile survival rate	0.344	0.153–0.523	Proportion
Population size (adults)	258 000	166 000–384 000	Individuals

4.24 Little shearwater (*Puffinus assimilis*)

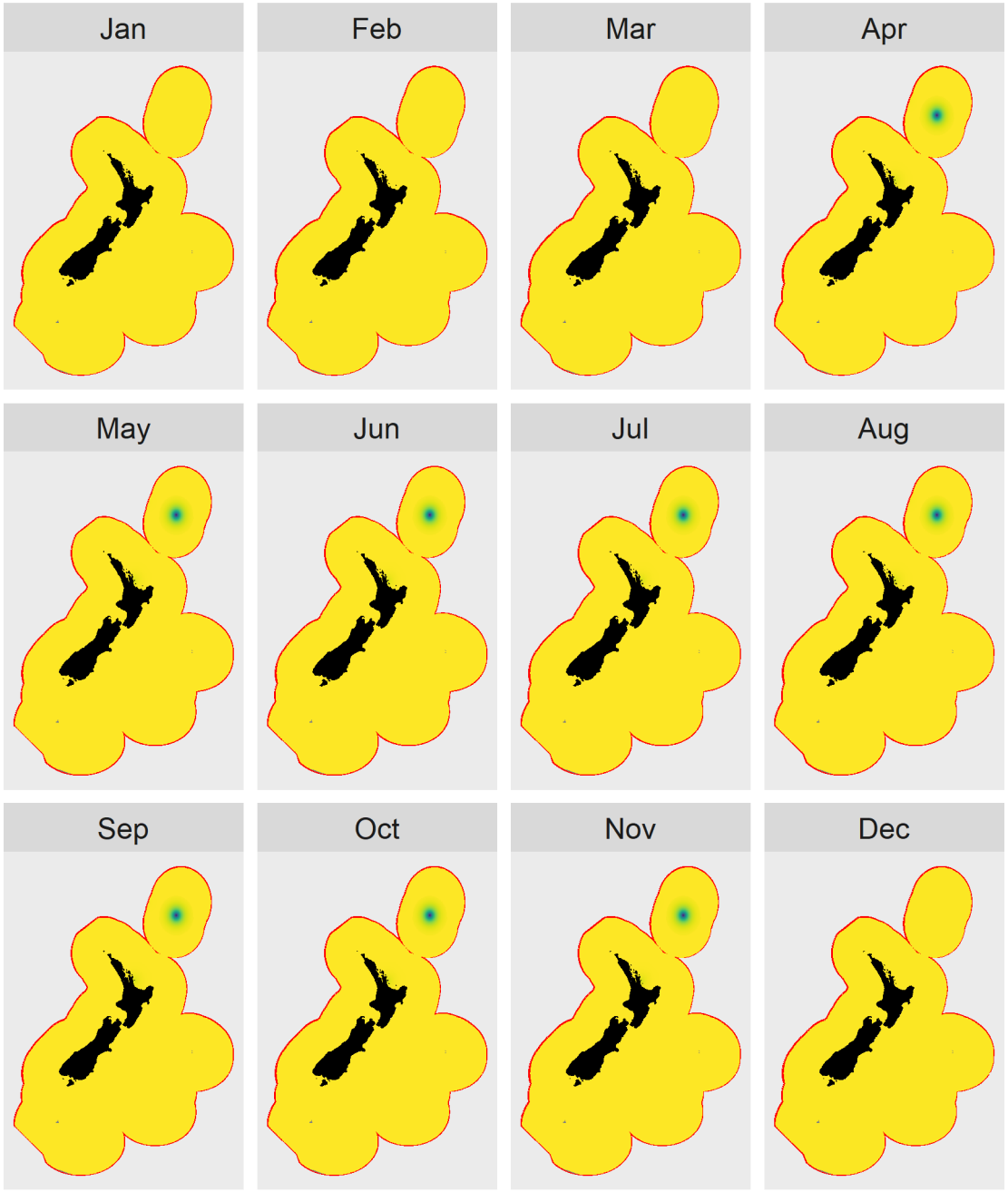

Figure 24: Relative density maps of adult Little shearwater by month (proportion of individuals per square kilometre). Breeding takes place during: Apr,May,Jun,Jul,Aug,Sep,Oct,Nov. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 86: Input covariate probabilities for Little shearwater.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.05	0.00	Non-breeding
Feb	0.05	0.00	Non-breeding
Mar	0.05	0.00	Non-breeding
Apr	0.90	0.50	Breeding
May	0.90	0.50	Breeding
Jun	0.90	0.50	Breeding
Jul	0.90	0.50	Breeding
Aug	0.90	0.50	Breeding
Sep	0.90	0.50	Breeding
Oct	0.90	0.50	Breeding
Nov	0.90	0.50	Breeding
Dec	0.05	0.00	Non-breeding

Table 87: Prior distributions of demographic parameters for Little shearwater.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	115 000	210 000
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	4	6
Current adult survival rate	uniform	0.889	0.958
Optimal adult survival rate	uniform	0.889	0.958
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 88: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Little shearwater. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	162 000	117 000–208 000	Pairs
Proportion of adults breeding	0.889	0.754–0.963	Proportion
Age at first reproduction	5	4.05–5.95	Years
Current adult survival rate	0.924	0.891–0.956	Proportion
Optimal adult survival rate	0.924	0.891–0.956	Proportion
Juvenile survival rate	0.346	0.158–0.527	Proportion
Population size (adults)	367 000	258 000–494 000	Individuals

4.25 Snares Cape petrel (*Daption capense australe*)

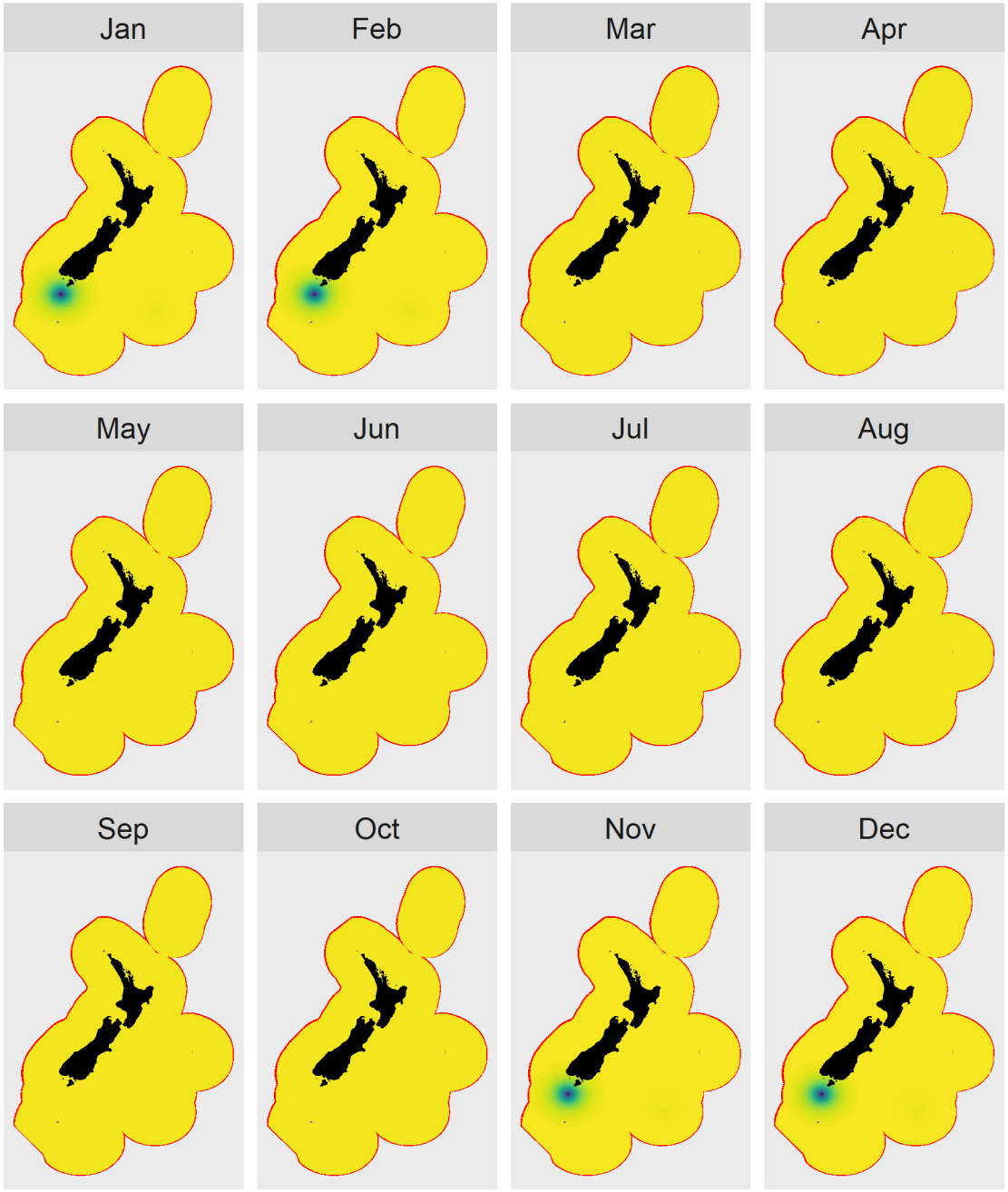

Figure 25: Relative density maps of adult Snares Cape petrel by month (proportion of individuals per square kilometre). Breeding takes place during: Nov,Dec,Jan,Feb. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 89: Input covariate probabilities for Snares Cape petrel.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.99	0.50	Breeding
Feb	0.99	0.50	Breeding
Mar	0.90	0.00	Non-breeding
Apr	0.90	0.00	Non-breeding
May	0.90	0.00	Non-breeding
Jun	0.90	0.00	Non-breeding
Jul	0.90	0.00	Non-breeding
Aug	0.90	0.00	Non-breeding
Sep	0.90	0.00	Non-breeding
Oct	0.90	0.00	Non-breeding
Nov	0.99	0.50	Breeding
Dec	0.99	0.50	Breeding

Table 90: Prior distributions of demographic parameters for Snares Cape petrel.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	8 420	0.300
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	3	8
Current adult survival rate	uniform	0.771	0.939
Optimal adult survival rate	uniform	0.771	0.939
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 91: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Snares Cape petrel. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	8 440	4 460–14 400	Pairs
Proportion of adults breeding	0.889	0.756–0.964	Proportion
Age at first reproduction	5.5	3.13–7.87	Years
Current adult survival rate	0.856	0.775–0.935	Proportion
Optimal adult survival rate	0.855	0.775–0.935	Proportion
Juvenile survival rate	0.228	0.049–0.479	Proportion
Population size (adults)	19 100	9 890–33 100	Individuals

4.26 Fairy prion (*Pachyptila turtur*)

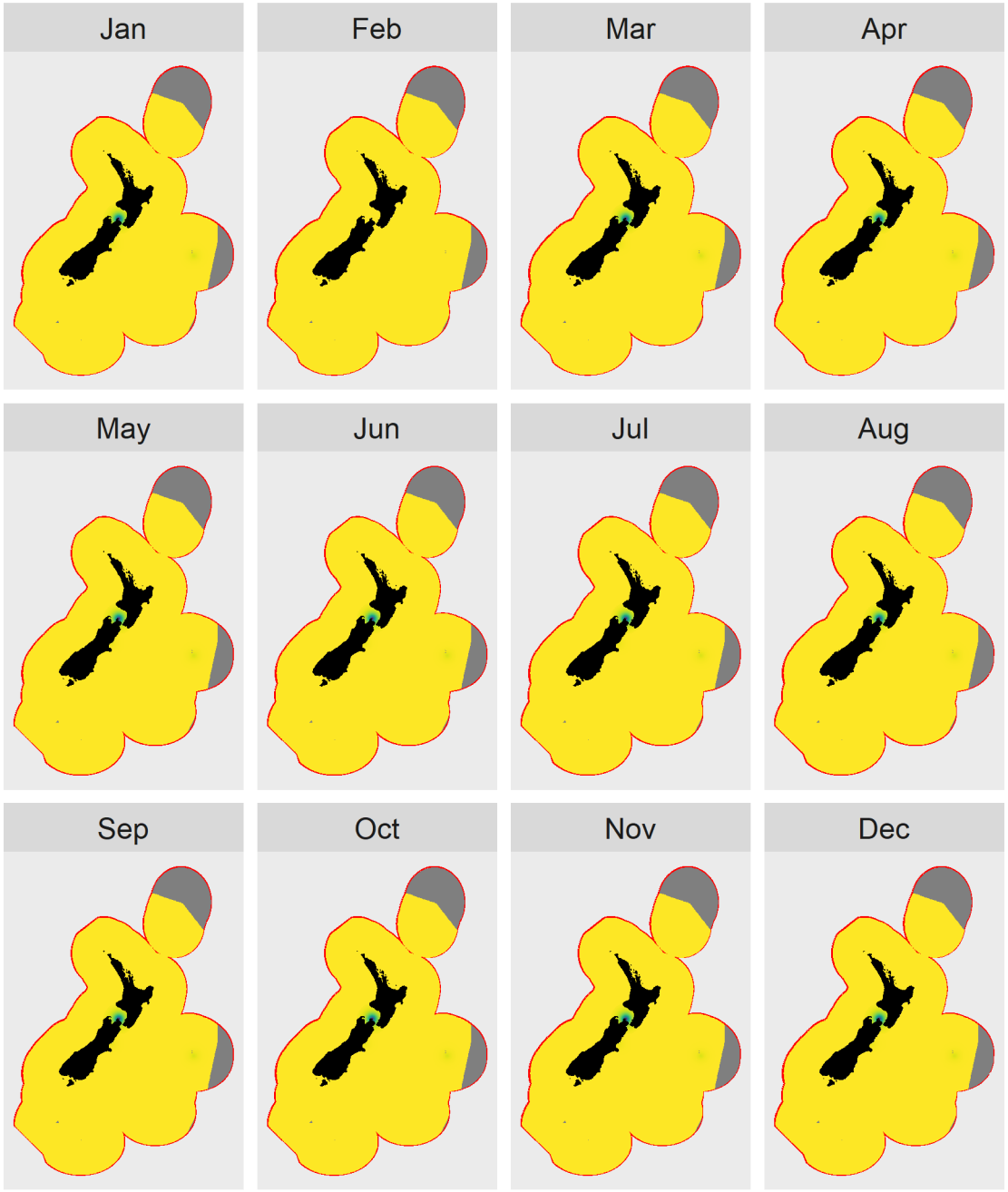

Figure 26: Relative density maps of adult Fairy prion by month (proportion of individuals per square kilometre). Breeding takes place during: Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec,Jan. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 92: Input covariate probabilities for Fairy prion.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.92	0.50	Breeding
Feb	0.15	0.00	Non-breeding
Mar	0.92	0.50	Breeding
Apr	0.92	0.50	Breeding
May	0.92	0.50	Breeding
Jun	0.92	0.50	Breeding
Jul	0.92	0.50	Breeding
Aug	0.92	0.50	Breeding
Sep	0.92	0.50	Breeding
Oct	0.92	0.50	Breeding
Nov	0.92	0.50	Breeding
Dec	0.92	0.50	Breeding

Table 93: Prior distributions of demographic parameters for Fairy prion.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	1 500 000	0.100
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	4	5
Current adult survival rate	logit-normal	0.84	0.03
Optimal adult survival rate	logit-normal	0.84	0.03
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 94: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Fairy prion. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	1 500 000	1 220 000–1 810 000	Pairs
Proportion of adults breeding	0.889	0.753–0.964	Proportion
Age at first reproduction	4.5	4.03–4.98	Years
Current adult survival rate	0.837	0.77–0.889	Proportion
Optimal adult survival rate	0.838	0.771–0.89	Proportion
Juvenile survival rate	0.244	0.114–0.377	Proportion
Population size (adults)	3 380 000	2 690 000–4 300 000	Individuals

4.27 Antarctic prion (*Pachyptila desolata*)

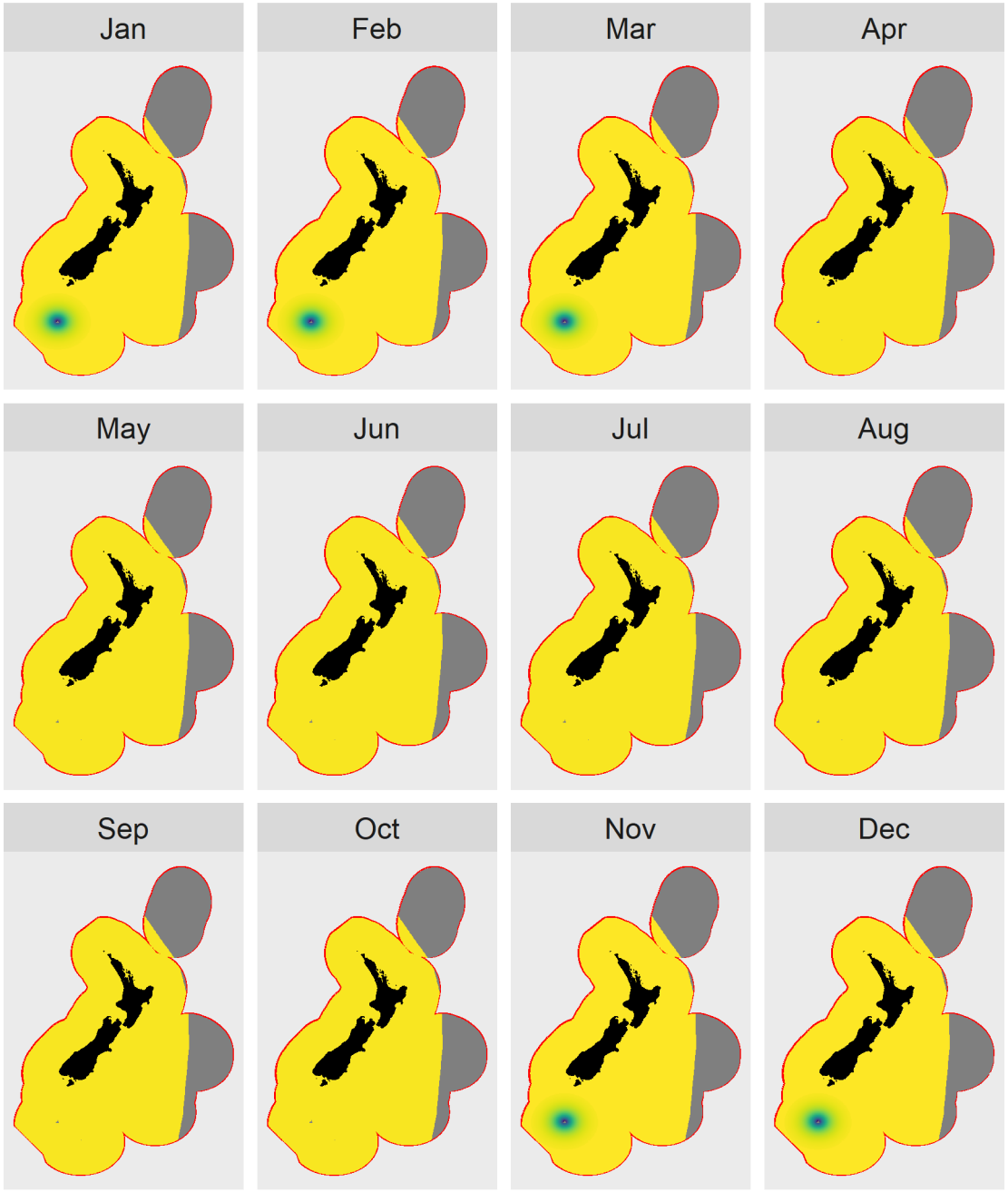

Figure 27: Relative density maps of adult Antarctic prion by month (proportion of individuals per square kilometre). Breeding takes place during: Nov,Dec,Jan,Feb,Mar. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 95: Input covariate probabilities for Antarctic prion.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.92	0.50	Breeding
Feb	0.92	0.50	Breeding
Mar	0.92	0.50	Breeding
Apr	0.15	0.00	Non-breeding
May	0.15	0.00	Non-breeding
Jun	0.15	0.00	Non-breeding
Jul	0.15	0.00	Non-breeding
Aug	0.15	0.00	Non-breeding
Sep	0.15	0.00	Non-breeding
Oct	0.15	0.00	Non-breeding
Nov	0.92	0.50	Breeding
Dec	0.92	0.50	Breeding

Table 96: Prior distributions of demographic parameters for Antarctic prion.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	350 000	1 000 000
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	5	6
Current adult survival rate	logit-normal	0.84	0.03
Optimal adult survival rate	logit-normal	0.84	0.03
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 97: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Antarctic prion. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	677 000	366 000–985 000	Pairs
Proportion of adults breeding	0.889	0.749–0.963	Proportion
Age at first reproduction	5.5	5.02–5.97	Years
Current adult survival rate	0.838	0.773–0.89	Proportion
Optimal adult survival rate	0.838	0.774–0.89	Proportion
Juvenile survival rate	0.185	0.0734–0.313	Proportion
Population size (adults)	1 530 000	811 000–2 310 000	Individuals

4.28 Broad-billed prion (*Pachyptila vittata*)

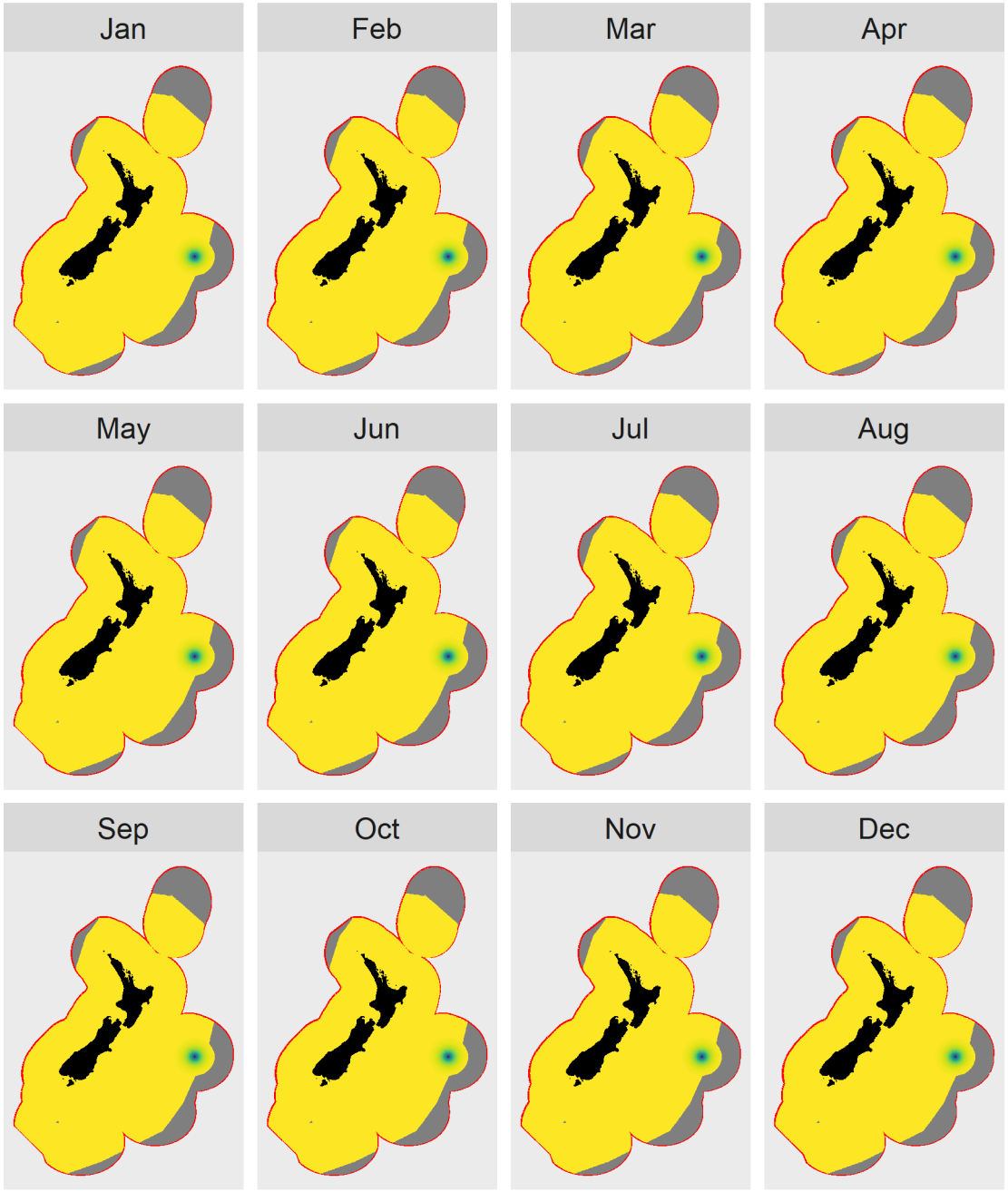

Figure 28: Relative density maps of adult Broad-billed prion by month (proportion of individuals per square kilometre). Breeding takes place during: Jan,Feb,Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 98: Input covariate probabilities for Broad-billed prion.

Month	Probability in EEZ	Probability on nest	Season
Jan	1.00	0.50	Breeding
Feb	1.00	0.50	Breeding
Mar	1.00	0.50	Breeding
Apr	1.00	0.50	Breeding
May	1.00	0.50	Breeding
Jun	1.00	0.50	Breeding
Jul	1.00	0.50	Breeding
Aug	1.00	0.50	Breeding
Sep	1.00	0.50	Breeding
Oct	1.00	0.50	Breeding
Nov	1.00	0.50	Breeding
Dec	1.00	0.50	Breeding

Table 99: Prior distributions of demographic parameters for Broad-billed prion.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	350 000	0.100
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	4	5
Current adult survival rate	logit-normal	0.84	0.03
Optimal adult survival rate	logit-normal	0.84	0.03
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 100: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Broad-billed prion. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	350 000	286 000–423 000	Pairs
Proportion of adults breeding	0.889	0.749–0.964	Proportion
Age at first reproduction	4.5	4.03–4.97	Years
Current adult survival rate	0.838	0.773–0.891	Proportion
Optimal adult survival rate	0.837	0.772–0.891	Proportion
Juvenile survival rate	0.244	0.116–0.379	Proportion
Population size (adults)	792 000	630 000–1 010 000	Individuals

4.29 Pycroft's petrel (*Pterodroma pycrofti*)

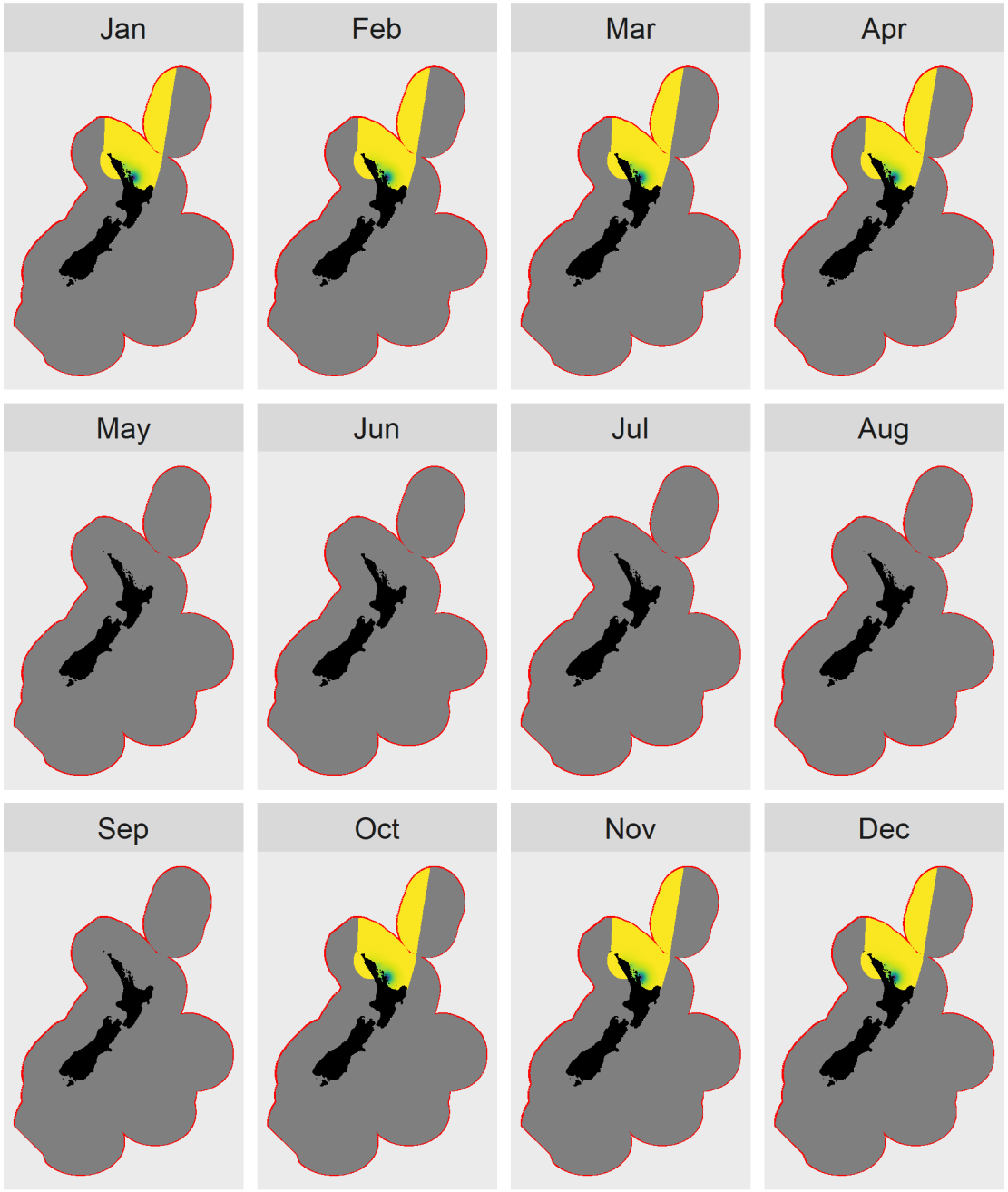

Figure 29: Relative density maps of adult Pycroft's petrel by month (proportion of individuals per square kilometre). Breeding takes place during: Oct,Nov,Dec,Jan,Feb,Mar,Apr. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 101: Input covariate probabilities for Pycroft's petrel.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.90	0.50	Breeding
Feb	0.90	0.50	Breeding
Mar	0.90	0.50	Breeding
Apr	0.90	0.50	Breeding
May	0.00	0.00	Non-breeding
Jun	0.00	0.00	Non-breeding
Jul	0.00	0.00	Non-breeding
Aug	0.00	0.00	Non-breeding
Sep	0.00	0.00	Non-breeding
Oct	0.90	0.50	Breeding
Nov	0.90	0.50	Breeding
Dec	0.90	0.50	Breeding

Table 102: Prior distributions of demographic parameters for Pycroft's petrel.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	2 000	3 000
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	6	7
Current adult survival rate	logit-normal	0.94	0.03
Optimal adult survival rate	logit-normal	0.94	0.03
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 103: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Pycroft's petrel. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	2 500	2 030–2 970	Pairs
Proportion of adults breeding	0.89	0.753–0.965	Proportion
Age at first reproduction	6.5	6.02–6.98	Years
Current adult survival rate	0.933	0.851–0.978	Proportion
Optimal adult survival rate	0.933	0.846–0.977	Proportion
Juvenile survival rate	0.284	0.0873–0.49	Proportion
Population size (adults)	5 640	4 410–7 190	Individuals

4.30 Cook's petrel (*Pterodroma cookii*)

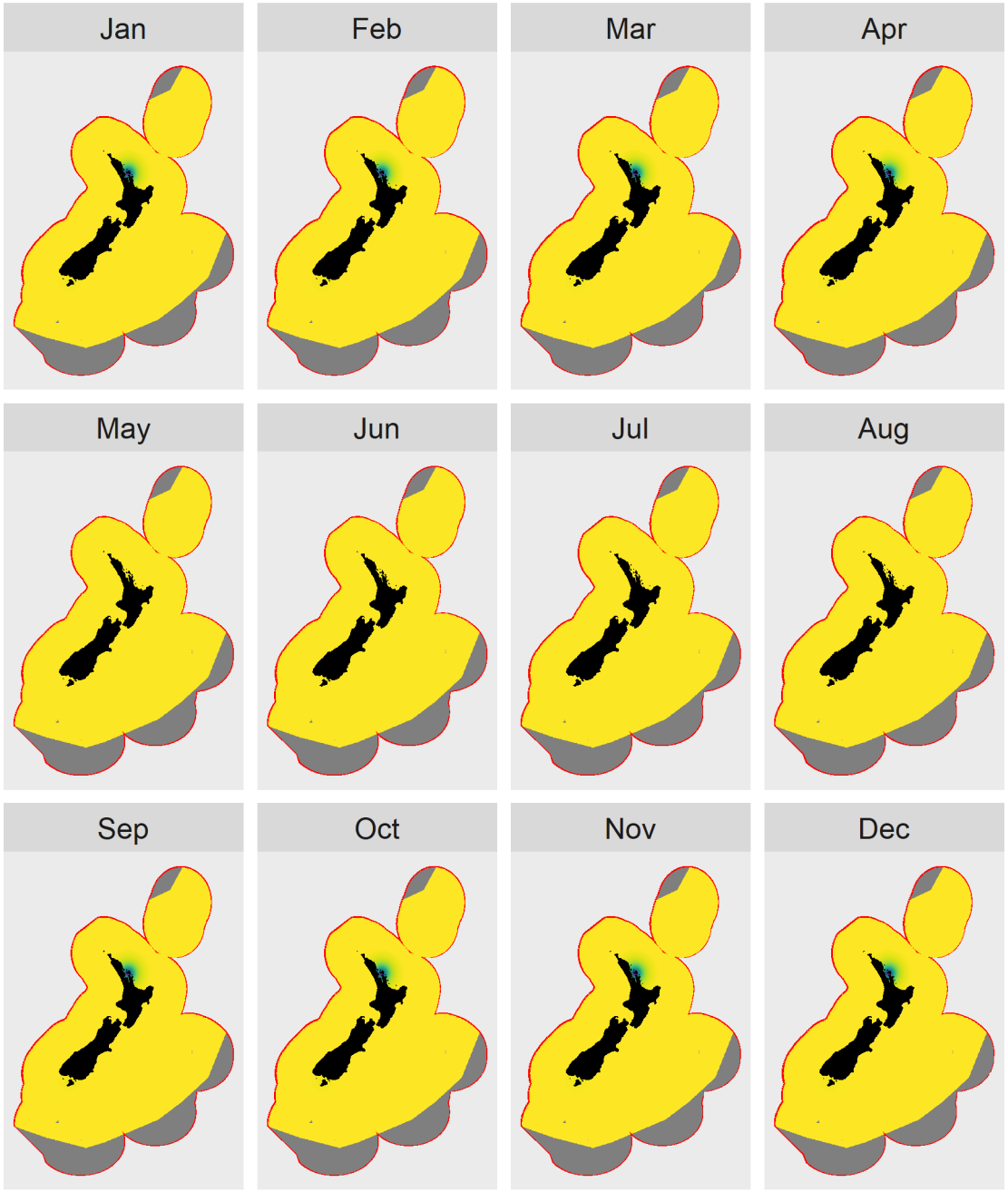

Figure 30: Relative density maps of adult Cook's petrel by month (proportion of individuals per square kilometre). Breeding takes place during: Sep,Oct,Nov,Dec,Jan,Feb,Mar,Apr. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 104: Input covariate probabilities for Cook's petrel.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.90	0.50	Breeding
Feb	0.90	0.50	Breeding
Mar	0.90	0.50	Breeding
Apr	0.90	0.50	Breeding
May	0.00	0.00	Non-breeding
Jun	0.00	0.00	Non-breeding
Jul	0.00	0.00	Non-breeding
Aug	0.00	0.00	Non-breeding
Sep	0.90	0.50	Breeding
Oct	0.90	0.50	Breeding
Nov	0.90	0.50	Breeding
Dec	0.90	0.50	Breeding

Table 105: Prior distributions of demographic parameters for Cook's petrel.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	216 000	419 000
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	6	7
Current adult survival rate	logit-normal	0.94	0.03
Optimal adult survival rate	logit-normal	0.94	0.03
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 106: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Cook's petrel. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	317 000	221 000–413 000	Pairs
Proportion of adults breeding	0.89	0.751–0.965	Proportion
Age at first reproduction	6.5	6.03–6.97	Years
Current adult survival rate	0.933	0.845–0.978	Proportion
Optimal adult survival rate	0.933	0.848–0.978	Proportion
Juvenile survival rate	0.283	0.0877–0.498	Proportion
Population size (adults)	717 000	487 000–980 000	Individuals

4.31 Chatham petrel (*Pterodroma axillaris*)

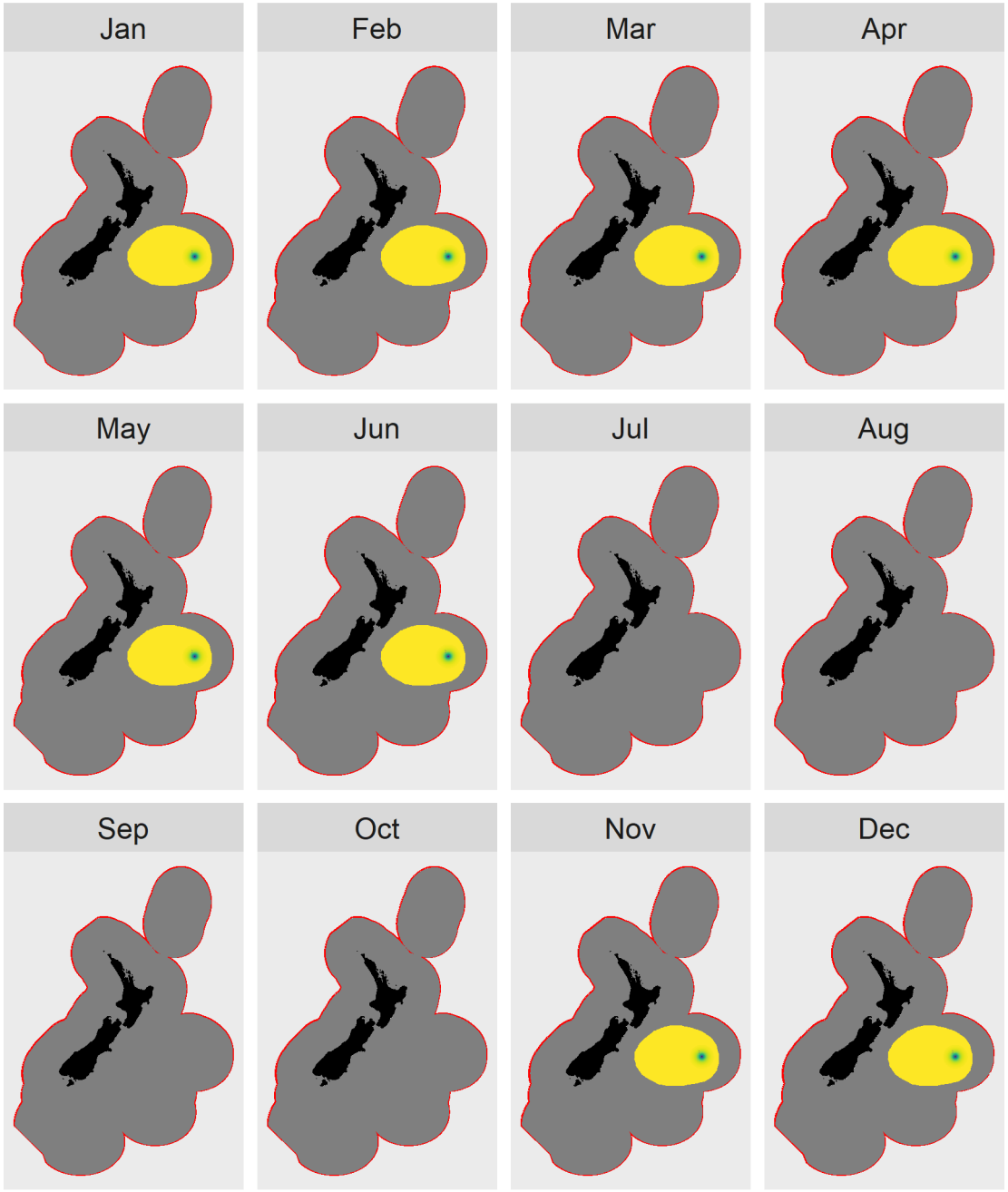

Figure 31: Relative density maps of adult Chatham petrel by month (proportion of individuals per square kilometre). Breeding takes place during: Nov,Dec,Jan,Feb,Mar,Apr,May,Jun. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 107: Input covariate probabilities for Chatham petrel.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.50	0.50	Breeding
Feb	0.50	0.50	Breeding
Mar	0.90	0.50	Breeding
Apr	0.90	0.50	Breeding
May	0.90	0.50	Breeding
Jun	0.00	0.50	Breeding
Jul	0.00	0.00	Non-breeding
Aug	0.00	0.00	Non-breeding
Sep	0.00	0.00	Non-breeding
Oct	0.00	0.00	Non-breeding
Nov	0.50	0.50	Breeding
Dec	0.50	0.50	Breeding

Table 108: Prior distributions of demographic parameters for Chatham petrel.

Parameter	Distribution	Parameter a	Parameter b
Annual breeding pairs	log-normal	250	0.200
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	6	7
Current adult survival rate	logit-normal	0.94	0.03
Optimal adult survival rate	logit-normal	0.94	0.03
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 109: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Chatham petrel. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	250	166–358	Pairs
Proportion of adults breeding	0.89	0.753–0.965	Proportion
Age at first reproduction	6.5	6.02–6.98	Years
Current adult survival rate	0.934	0.85–0.978	Proportion
Optimal adult survival rate	0.933	0.845–0.978	Proportion
Juvenile survival rate	0.283	0.0895–0.497	Proportion
Population size (adults)	564	370–826	Individuals

4.32 Mottled petrel (*Pterodroma inexpectata*)

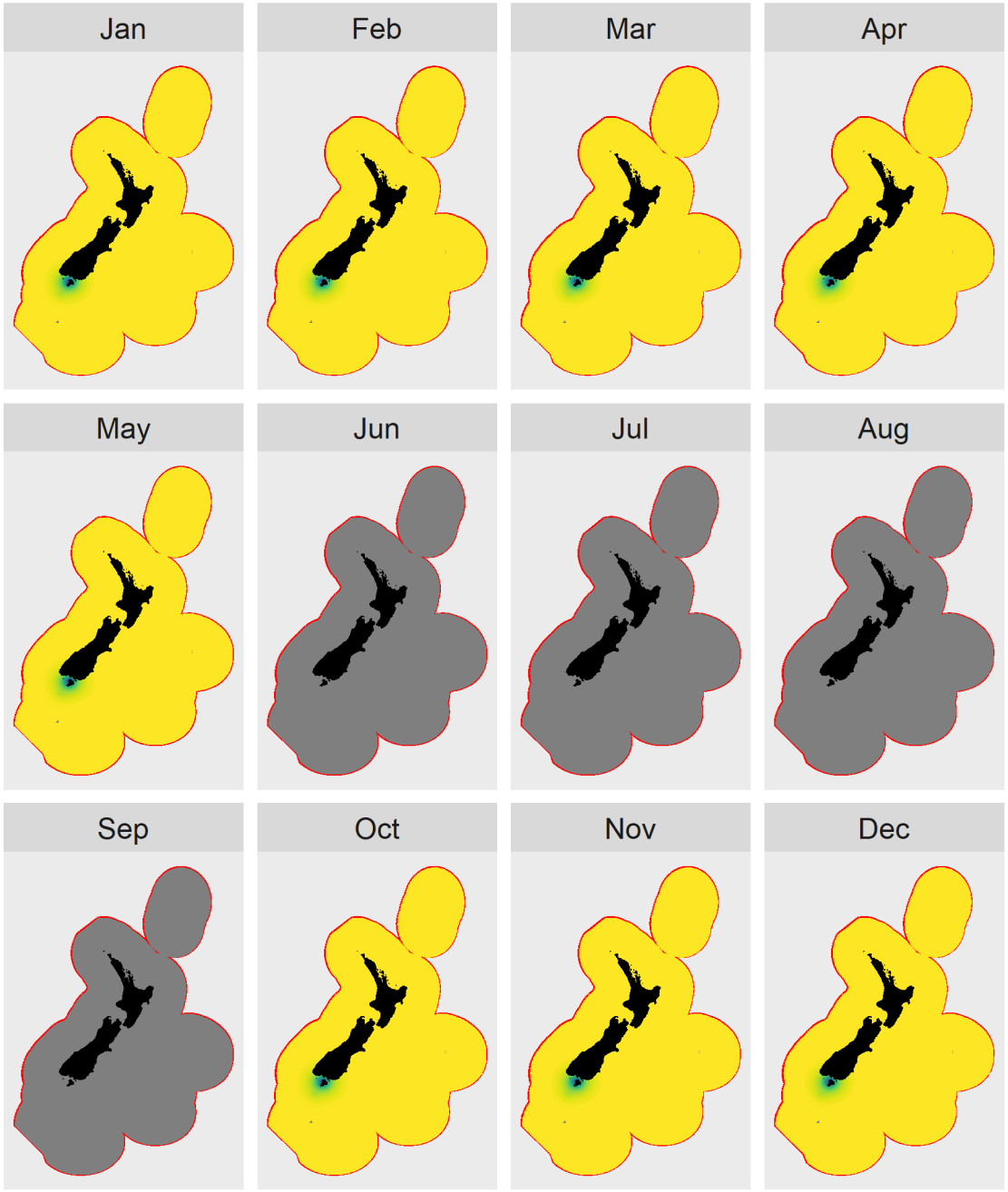

Figure 32: Relative density maps of adult Mottled petrel by month (proportion of individuals per square kilometre). Breeding takes place during: Oct,Nov,Dec,Jan,Feb,Mar,Apr,May. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 110: Input covariate probabilities for Mottled petrel.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.90	0.50	Breeding
Feb	0.90	0.50	Breeding
Mar	0.90	0.50	Breeding
Apr	0.90	0.50	Breeding
May	0.90	0.50	Breeding
Jun	0.00	0.00	Non-breeding
Jul	0.00	0.00	Non-breeding
Aug	0.00	0.00	Non-breeding
Sep	0.00	0.00	Non-breeding
Oct	0.90	0.50	Breeding
Nov	0.90	0.50	Breeding
Dec	0.90	0.50	Breeding

Table 111: Prior distributions of demographic parameters for Mottled petrel.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	300 000	400 000
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	6	7
Current adult survival rate	logit-normal	0.94	0.03
Optimal adult survival rate	logit-normal	0.94	0.03
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 112: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Mottled petrel. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	350 000	302 000–398 000	Pairs
Proportion of adults breeding	0.89	0.757–0.963	Proportion
Age at first reproduction	6.5	6.03–6.98	Years
Current adult survival rate	0.933	0.85–0.978	Proportion
Optimal adult survival rate	0.933	0.848–0.978	Proportion
Juvenile survival rate	0.284	0.089–0.493	Proportion
Population size (adults)	789 000	653 000–964 000	Individuals

4.33 White-naped petrel (*Pterodroma cervicalis*)

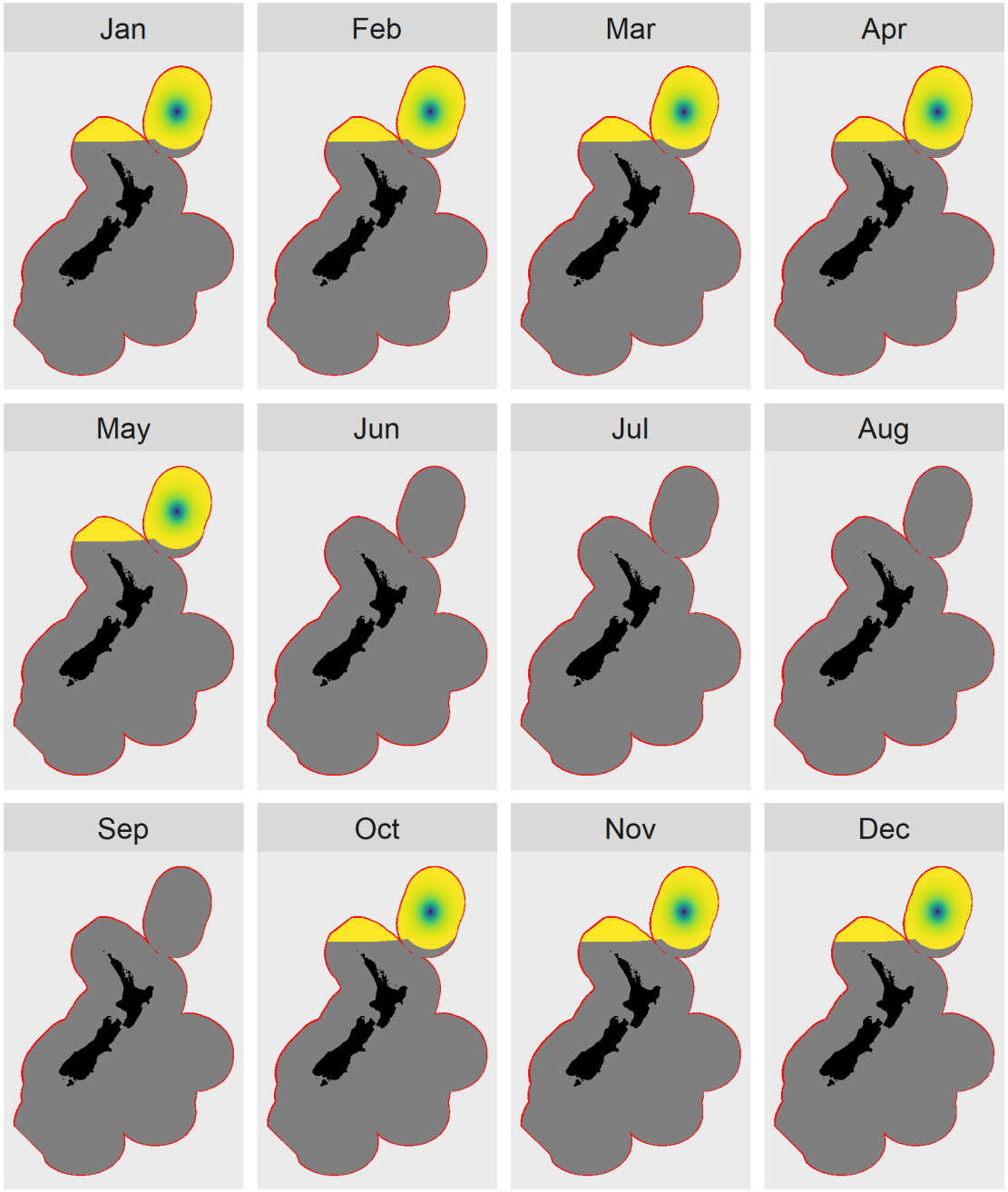

Figure 33: Relative density maps of adult White-naped petrel by month (proportion of individuals per square kilometre). Breeding takes place during: Oct,Nov,Dec,Jan,Feb,Mar,Apr,May. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 113: Input covariate probabilities for White-naped petrel.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.90	0.50	Breeding
Feb	0.90	0.50	Breeding
Mar	0.90	0.50	Breeding
Apr	0.90	0.50	Breeding
May	0.90	0.50	Breeding
Jun	0.00	0.00	Non-breeding
Jul	0.00	0.00	Non-breeding
Aug	0.00	0.00	Non-breeding
Sep	0.00	0.00	Non-breeding
Oct	0.90	0.50	Breeding
Nov	0.90	0.50	Breeding
Dec	0.90	0.50	Breeding

Table 114: Prior distributions of demographic parameters for White-naped petrel.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	50 000	0.300
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	6	7
Current adult survival rate	logit-normal	0.94	0.03
Optimal adult survival rate	logit-normal	0.94	0.03
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 115: Summary statistics for prior distributions of demographic parameters, and derived quantities, for White-naped petrel. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	50 000	26 800–84 900	Pairs
Proportion of adults breeding	0.888	0.75–0.964	Proportion
Age at first reproduction	6.5	6.03–6.98	Years
Current adult survival rate	0.933	0.849–0.978	Proportion
Optimal adult survival rate	0.933	0.845–0.978	Proportion
Juvenile survival rate	0.283	0.0894–0.497	Proportion
Population size (adults)	113 000	60 000–196 000	Individuals

4.34 Kermadec petrel (*Pterodroma neglecta*)

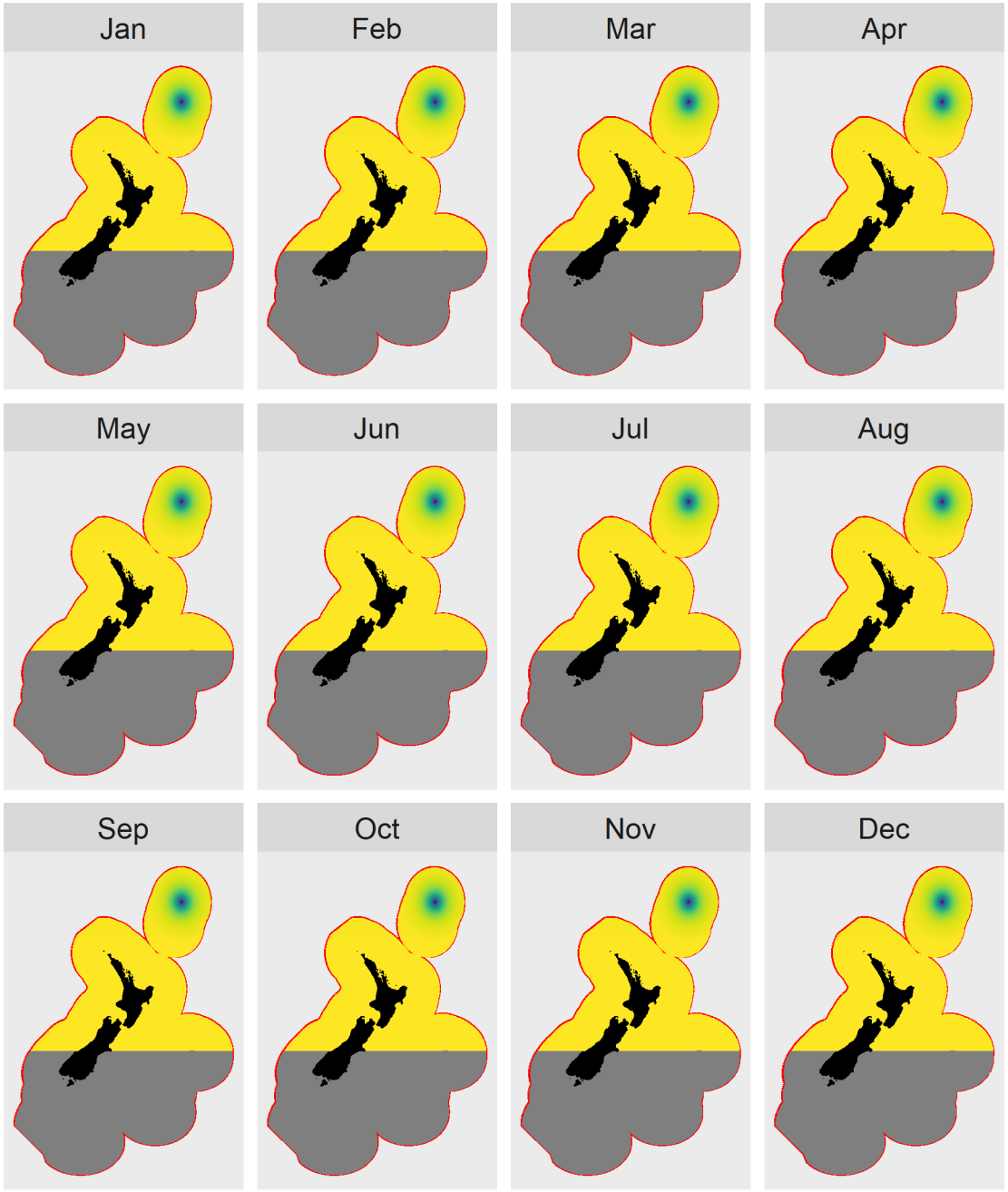

Figure 34: Relative density maps of adult Kermadec petrel by month (proportion of individuals per square kilometre). Breeding takes place during: Jan,Feb,Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 116: Input covariate probabilities for Kermadec petrel.

Month	Probability in EEZ	Probability on nest	Season
Jan	1.00	0.50	Breeding
Feb	1.00	0.50	Breeding
Mar	1.00	0.50	Breeding
Apr	1.00	0.50	Breeding
May	1.00	0.50	Breeding
Jun	1.00	0.50	Breeding
Jul	1.00	0.50	Breeding
Aug	1.00	0.50	Breeding
Sep	1.00	0.50	Breeding
Oct	1.00	0.50	Breeding
Nov	1.00	0.50	Breeding
Dec	1.00	0.50	Breeding

Table 117: Prior distributions of demographic parameters for Kermadec petrel.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	5 000	7 000
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	6	7
Current adult survival rate	logit-normal	0.94	0.03
Optimal adult survival rate	logit-normal	0.94	0.03
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 118: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Kermadec petrel. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	6 000	5 050–6 950	Pairs
Proportion of adults breeding	0.889	0.753–0.964	Proportion
Age at first reproduction	6.5	6.02–6.97	Years
Current adult survival rate	0.932	0.845–0.978	Proportion
Optimal adult survival rate	0.933	0.846–0.978	Proportion
Juvenile survival rate	0.283	0.0878–0.493	Proportion
Population size (adults)	13 600	10 900–17 000	Individuals

4.35 Grey-faced petrel (*Pterodroma macroptera gouldi*)

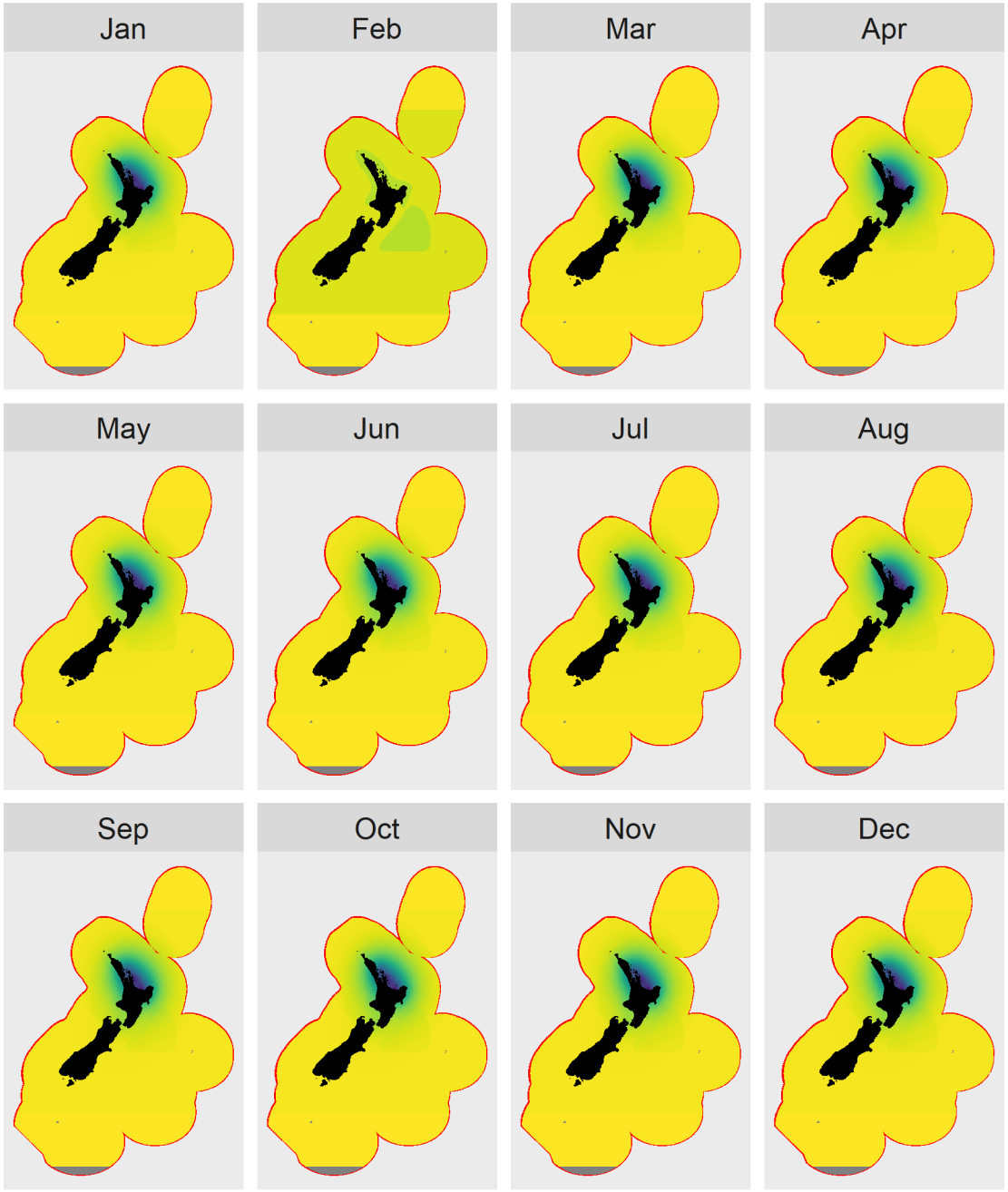

Figure 35: Relative density maps of adult Grey-faced petrel by month (proportion of individuals per square kilometre). Breeding takes place during: Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec,Jan. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 119: Input covariate probabilities for Grey-faced petrel.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.91	0.50	Breeding
Feb	0.10	0.00	Non-breeding
Mar	0.91	0.50	Breeding
Apr	0.91	0.50	Breeding
May	0.91	0.50	Breeding
Jun	0.91	0.50	Breeding
Jul	0.91	0.50	Breeding
Aug	0.91	0.50	Breeding
Sep	0.91	0.50	Breeding
Oct	0.91	0.50	Breeding
Nov	0.91	0.50	Breeding
Dec	0.91	0.50	Breeding

Table 120: Prior distributions of demographic parameters for Grey-faced petrel.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	200 000	300 000
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	6	7
Current adult survival rate	logit-normal	0.94	0.03
Optimal adult survival rate	logit-normal	0.94	0.03
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 121: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Grey-faced petrel. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	250 000	202 000–298 000	Pairs
Proportion of adults breeding	0.89	0.753–0.964	Proportion
Age at first reproduction	6.5	6.03–6.97	Years
Current adult survival rate	0.932	0.847–0.978	Proportion
Optimal adult survival rate	0.933	0.846–0.978	Proportion
Juvenile survival rate	0.284	0.0875–0.496	Proportion
Population size (adults)	564 000	441 000–716 000	Individuals

4.36 Chatham Island taiko (*Pterodroma magentae*)

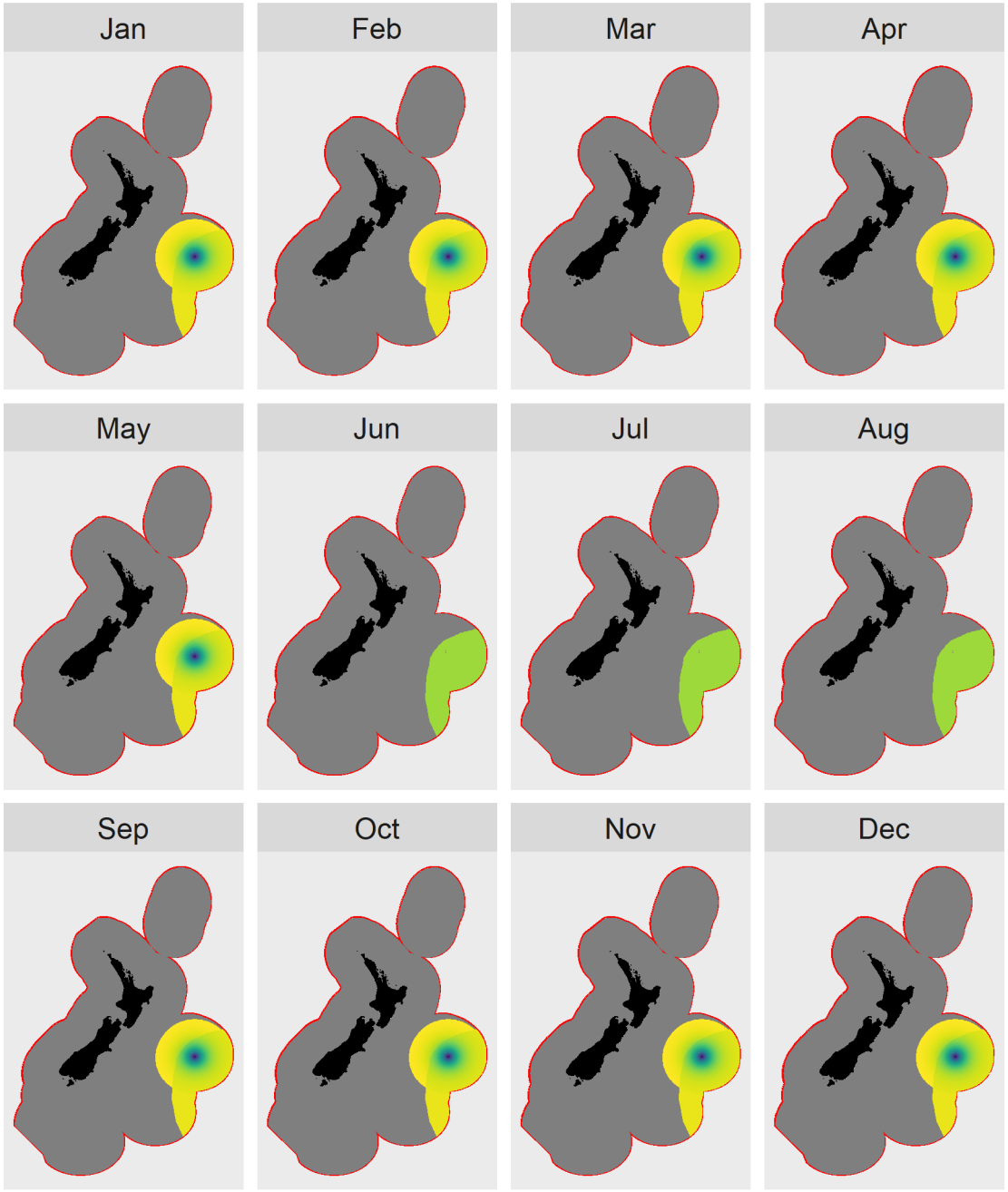

Figure 36: Relative density maps of adult Chatham Island taiko by month (proportion of individuals per square kilometre). Breeding takes place during: Sep,Oct,Nov,Dec,Jan,Feb,Mar,Apr,May. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 122: Input covariate probabilities for Chatham Island taiko.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.92	0.50	Breeding
Feb	0.92	0.50	Breeding
Mar	0.92	0.50	Breeding
Apr	0.92	0.50	Breeding
May	0.92	0.50	Breeding
Jun	0.20	0.00	Non-breeding
Jul	0.20	0.00	Non-breeding
Aug	0.20	0.00	Non-breeding
Sep	0.92	0.50	Breeding
Oct	0.92	0.50	Breeding
Nov	0.92	0.50	Breeding
Dec	0.92	0.50	Breeding

Table 123: Prior distributions of demographic parameters for Chatham Island taiko.

Parameter	Distribution	Parameter a	Parameter b
Annual breeding pairs	log-normal	41	0.100
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	6	7
Current adult survival rate	logit-normal	0.94	0.03
Optimal adult survival rate	logit-normal	0.94	0.03
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 124: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Chatham Island taiko. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	41	33.4–49.8	Pairs
Proportion of adults breeding	0.89	0.757–0.964	Proportion
Age at first reproduction	6.5	6.03–6.98	Years
Current adult survival rate	0.933	0.845–0.978	Proportion
Optimal adult survival rate	0.933	0.847–0.978	Proportion
Juvenile survival rate	0.284	0.0876–0.496	Proportion
Population size (adults)	92.4	73.2–117	Individuals

4.37 White-headed petrel (*Pterodroma lessonii*)

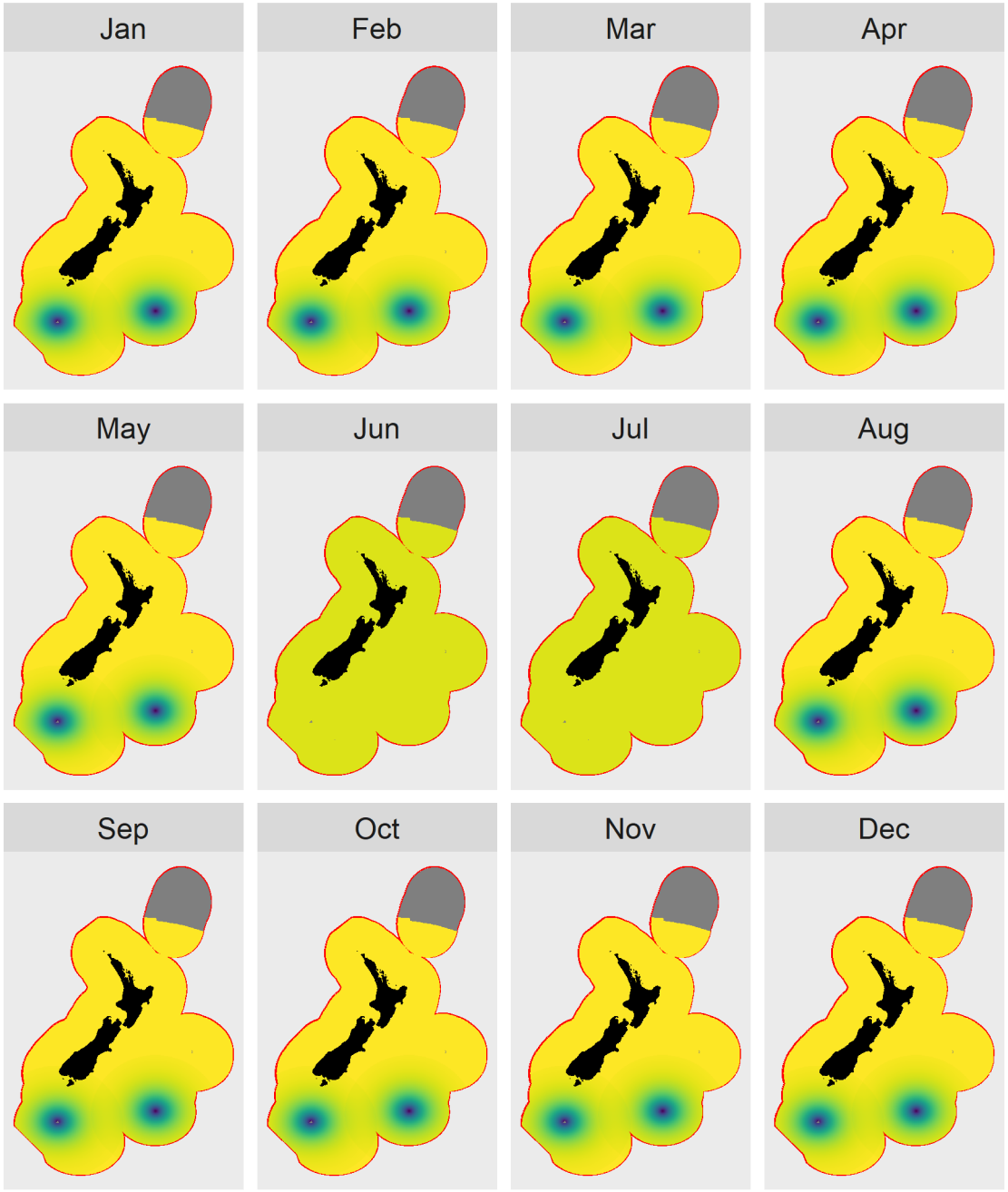

Figure 37: Relative density maps of adult White-headed petrel by month (proportion of individuals per square kilometre). Breeding takes place during: Aug,Sep,Oct,Nov,Dec,Jan,Feb,Mar,Apr,May. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 125: Input covariate probabilities for White-headed petrel.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.64	0.50	Breeding
Feb	0.64	0.50	Breeding
Mar	0.64	0.50	Breeding
Apr	0.64	0.50	Breeding
May	0.64	0.50	Breeding
Jun	0.10	0.00	Non-breeding
Jul	0.10	0.00	Non-breeding
Aug	0.64	0.50	Breeding
Sep	0.64	0.50	Breeding
Oct	0.64	0.50	Breeding
Nov	0.64	0.50	Breeding
Dec	0.64	0.50	Breeding

Table 126: Prior distributions of demographic parameters for White-headed petrel.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	200 000	0.300
Proportion of adults breeding	logit-normal	0.6	0.05
Age at first reproduction	uniform	4	7
Current adult survival rate	logit-normal	0.94	0.03
Optimal adult survival rate	logit-normal	0.94	0.03
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 127: Summary statistics for prior distributions of demographic parameters, and derived quantities, for White-headed petrel. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	199 000	105 000–337 000	Pairs
Proportion of adults breeding	0.599	0.502–0.693	Proportion
Age at first reproduction	5.49	4.07–6.92	Years
Current adult survival rate	0.932	0.846–0.978	Proportion
Optimal adult survival rate	0.933	0.845–0.978	Proportion
Juvenile survival rate	0.339	0.119–0.56	Proportion
Population size (adults)	670 000	345 000–1 170 000	Individuals

4.38 Soft-plumaged petrel (*Pterodroma mollis*)

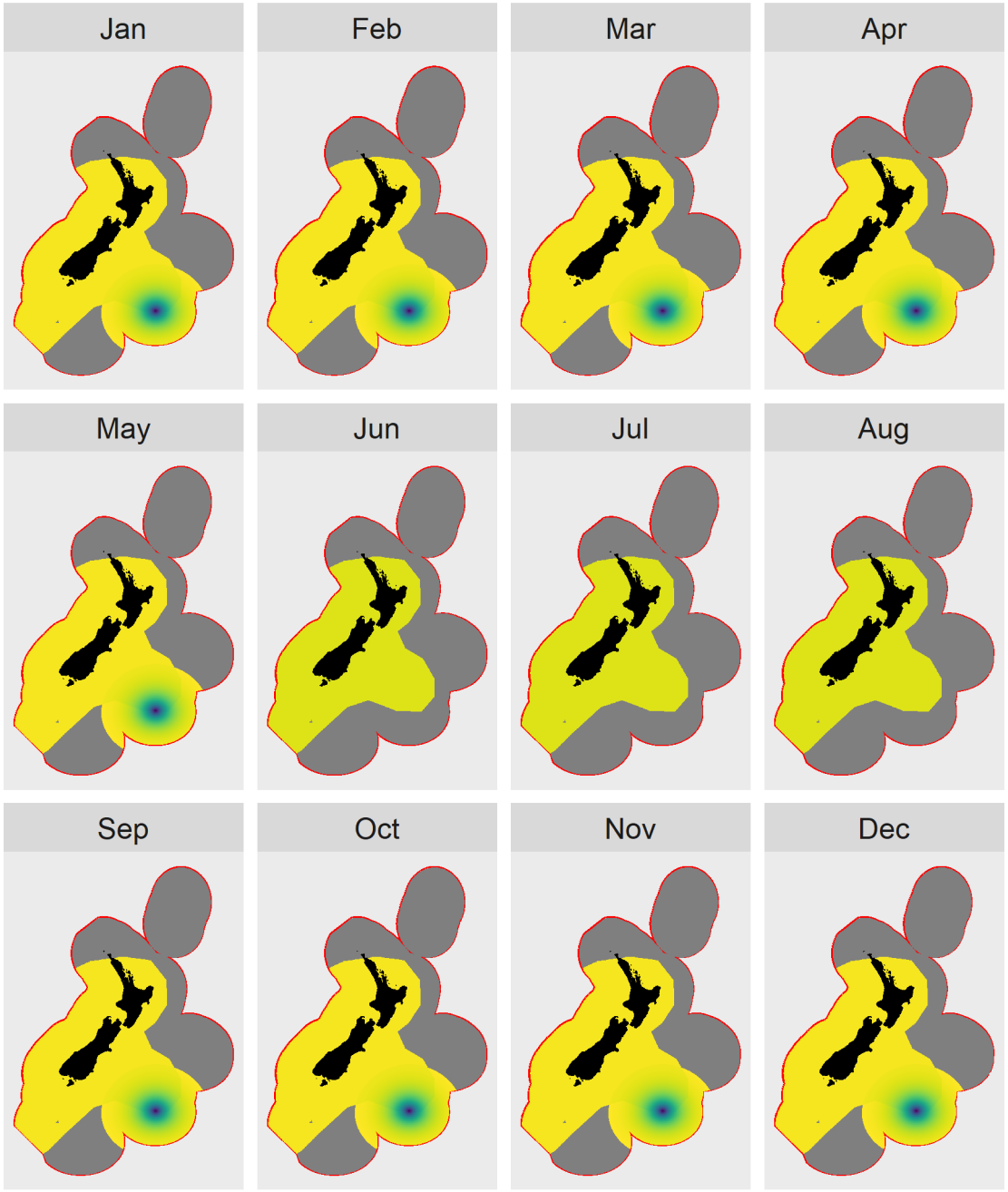

Figure 38: Relative density maps of adult Soft-plumaged petrel by month (proportion of individuals per square kilometre). Breeding takes place during: Sep,Oct,Nov,Dec,Jan,Feb,Mar,Apr,May. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 128: Input covariate probabilities for Soft-plumaged petrel.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.90	0.50	Breeding
Feb	0.90	0.50	Breeding
Mar	0.90	0.50	Breeding
Apr	0.90	0.50	Breeding
May	0.90	0.50	Breeding
Jun	0.00	0.00	Non-breeding
Jul	0.00	0.00	Non-breeding
Aug	0.00	0.00	Non-breeding
Sep	0.90	0.50	Breeding
Oct	0.90	0.50	Breeding
Nov	0.90	0.50	Breeding
Dec	0.90	0.50	Breeding

Table 129: Prior distributions of demographic parameters for Soft-plumaged petrel.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	1 000	9 999
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	6	7
Current adult survival rate	logit-normal	0.94	0.03
Optimal adult survival rate	logit-normal	0.94	0.03
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 130: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Soft-plumaged petrel. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	5 510	1 230–9 770	Pairs
Proportion of adults breeding	0.888	0.75–0.963	Proportion
Age at first reproduction	6.5	6.03–6.97	Years
Current adult survival rate	0.933	0.844–0.979	Proportion
Optimal adult survival rate	0.932	0.845–0.978	Proportion
Juvenile survival rate	0.283	0.0902–0.492	Proportion
Population size (adults)	12 500	2 760–22 500	Individuals

4.39 Common diving petrel (*Pelecanoides urinatrix*)

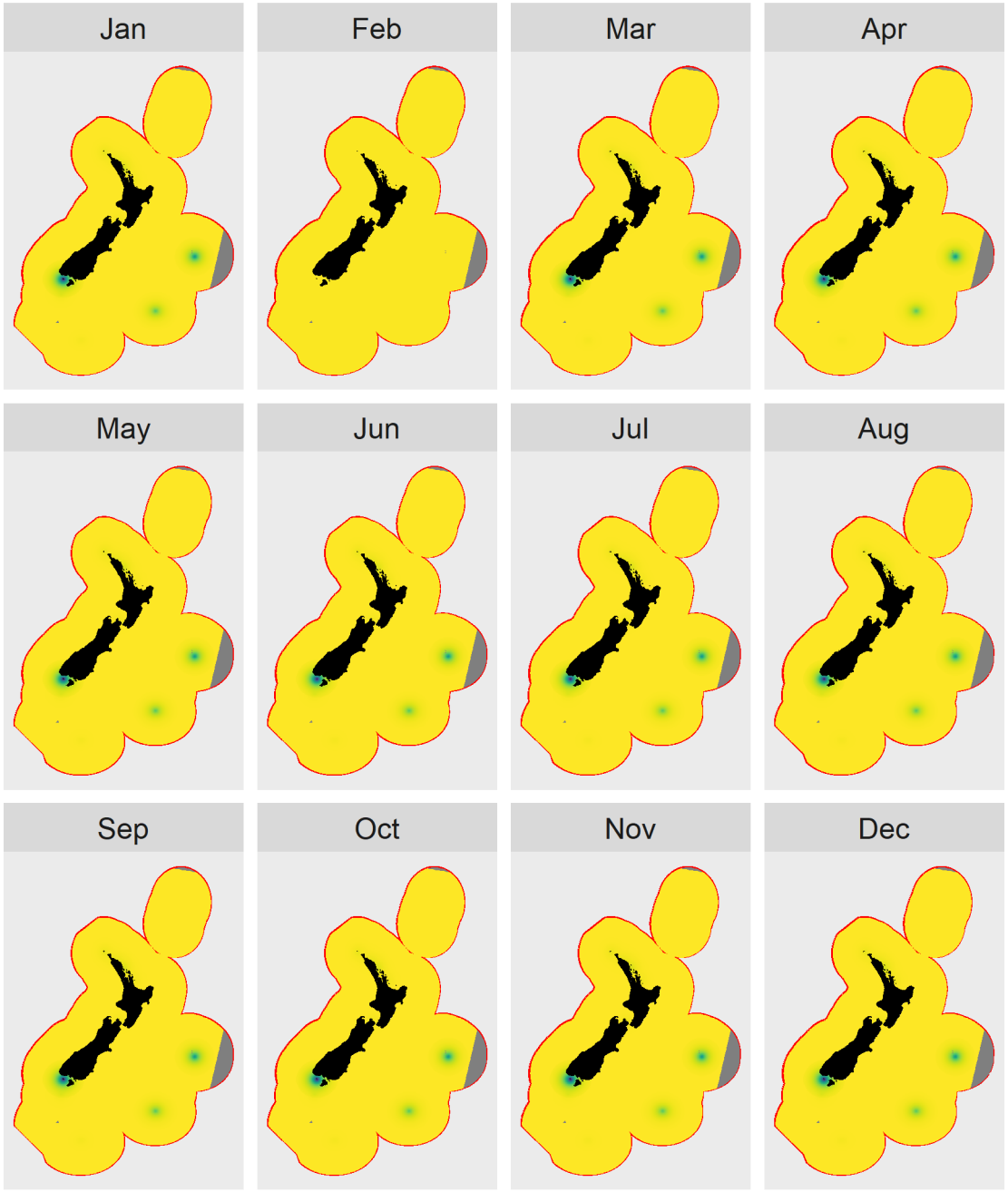

Figure 39: Relative density maps of adult Common diving petrel by month (proportion of individuals per square kilometre). Breeding takes place during: Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec,Jan. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 131: Input covariate probabilities for Common diving petrel.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.92	0.50	Breeding
Feb	0.20	0.00	Non-breeding
Mar	0.92	0.50	Breeding
Apr	0.92	0.50	Breeding
May	0.92	0.50	Breeding
Jun	0.92	0.50	Breeding
Jul	0.92	0.50	Breeding
Aug	0.92	0.50	Breeding
Sep	0.92	0.50	Breeding
Oct	0.92	0.50	Breeding
Nov	0.92	0.50	Breeding
Dec	0.92	0.50	Breeding

Table 132: Prior distributions of demographic parameters for Common diving petrel.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	300 000	2 150 000
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	2	3
Current adult survival rate	uniform	0.75	0.87
Optimal adult survival rate	uniform	0.75	0.87
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 133: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Common diving petrel. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	1 220 000	343 000–2 110 000	Pairs
Proportion of adults breeding	0.889	0.755–0.963	Proportion
Age at first reproduction	2.5	2.03–2.98	Years
Current adult survival rate	0.81	0.753–0.867	Proportion
Optimal adult survival rate	0.81	0.753–0.867	Proportion
Juvenile survival rate	0.397	0.261–0.534	Proportion
Population size (adults)	2 770 000	772 000–4 880 000	Individuals

4.40 Whenua Hou diving petrel (*Pelecanoides whenuahouensis*)

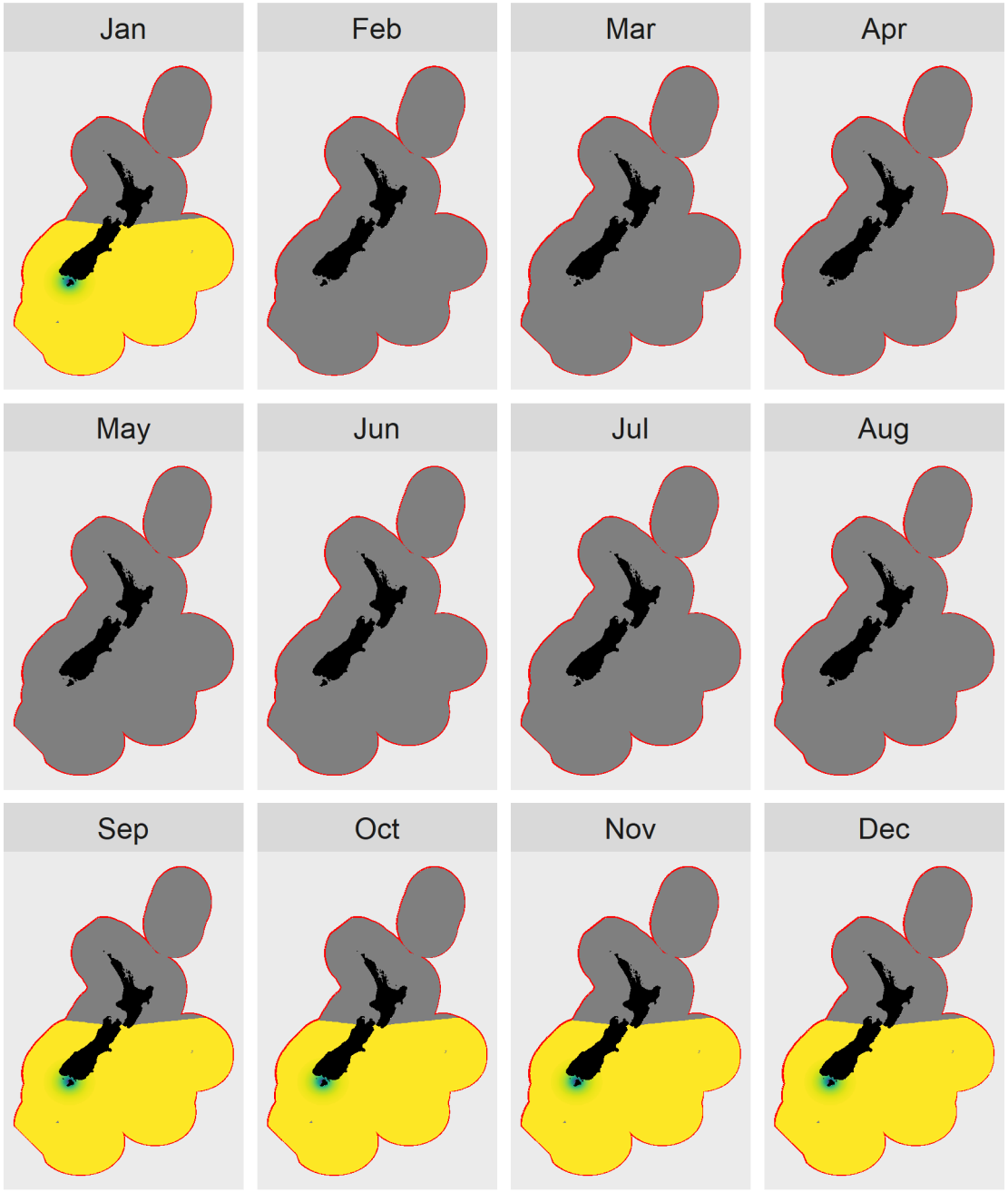

Figure 40: Relative density maps of adult Whenua Hou diving petrel by month (proportion of individuals per square kilometre). Breeding takes place during: Sep,Oct,Nov,Dec,Jan. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 134: Input covariate probabilities for Whenua Hou diving petrel.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.83	0.50	Breeding
Feb	0.00	0.00	Non-breeding
Mar	0.00	0.00	Non-breeding
Apr	0.00	0.00	Non-breeding
May	0.00	0.00	Non-breeding
Jun	0.00	0.00	Non-breeding
Jul	0.00	0.00	Non-breeding
Aug	0.00	0.00	Non-breeding
Sep	0.83	0.50	Breeding
Oct	0.83	0.50	Breeding
Nov	0.83	0.50	Breeding
Dec	0.83	0.50	Breeding

Table 135: Prior distributions of demographic parameters for Whenua Hou diving petrel.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	normal	87.300	8.520
Proportion of adults breeding	logit-normal	0.835	0.025
Age at first reproduction	uniform	2	3
Current adult survival rate	logit-normal	0.861	0.018
Optimal adult survival rate	logit-normal	0.861	0.018
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 136: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Whenua Hou diving petrel. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	87.4	70.7–104	Pairs
Proportion of adults breeding	0.834	0.781–0.878	Proportion
Age at first reproduction	2.5	2.02–2.97	Years
Current adult survival rate	0.86	0.822–0.893	Proportion
Optimal adult survival rate	0.86	0.822–0.893	Proportion
Juvenile survival rate	0.46	0.325–0.584	Proportion
Population size (adults)	210	168–253	Individuals

4.41 New Zealand white-faced storm petrel (*Pelagodroma marina maoriana*)

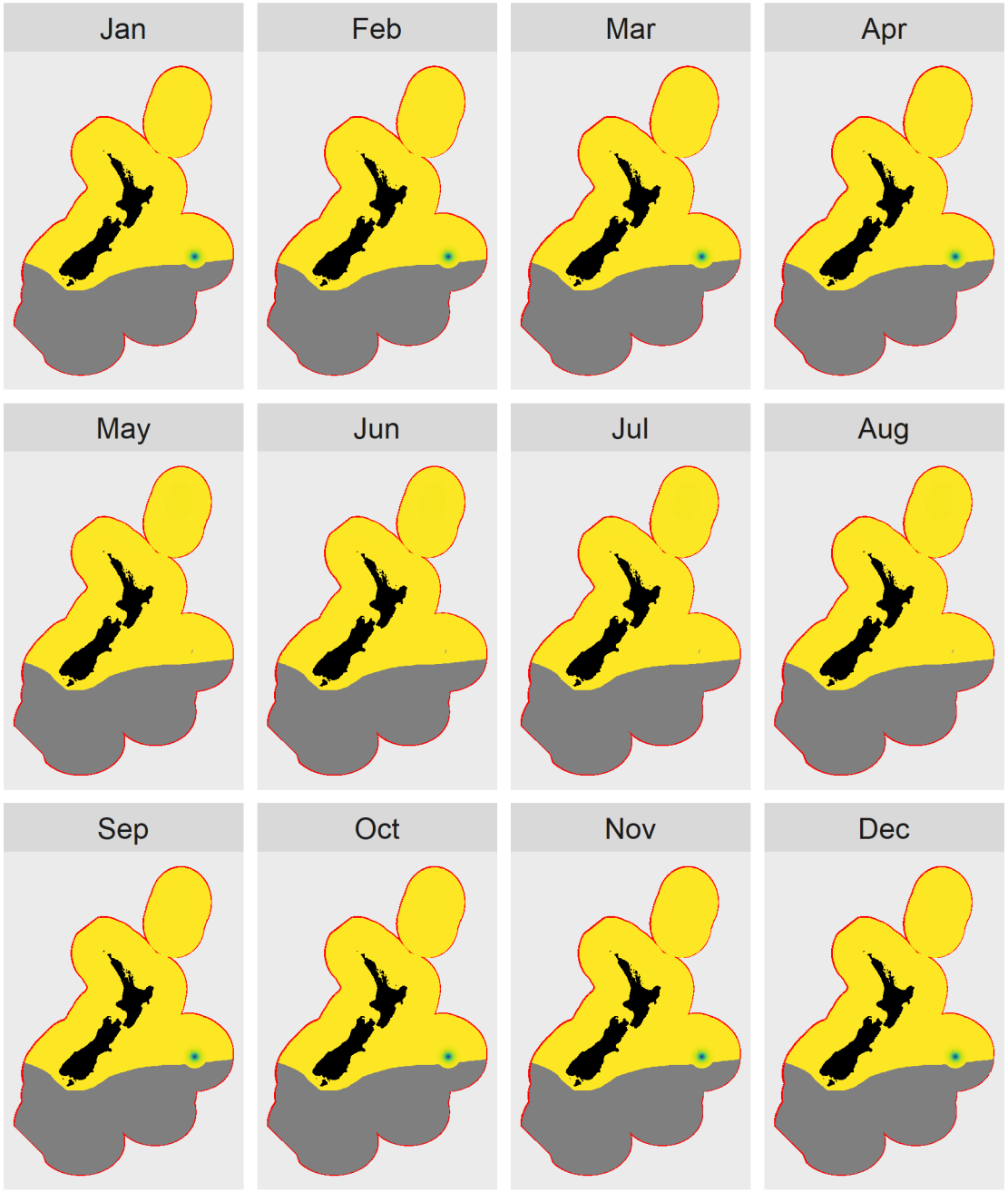

Figure 41: Relative density maps of adult New Zealand white-faced storm petrel by month (proportion of individuals per square kilometre). Breeding takes place during: Sep,Oct,Nov,Dec,Jan,Feb,Mar,Apr. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 137: Input covariate probabilities for New Zealand white-faced storm petrel.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.90	0.50	Breeding
Feb	0.90	0.50	Breeding
Mar	0.90	0.50	Breeding
Apr	0.90	0.50	Breeding
May	0.00	0.00	Non-breeding
Jun	0.00	0.00	Non-breeding
Jul	0.00	0.00	Non-breeding
Aug	0.00	0.00	Non-breeding
Sep	0.90	0.50	Breeding
Oct	0.90	0.50	Breeding
Nov	0.90	0.50	Breeding
Dec	0.90	0.50	Breeding

Table 138: Prior distributions of demographic parameters for New Zealand white-faced storm petrel.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	700 000	3 000 000
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	3	5
Current adult survival rate	logit-normal	0.9	0.03
Optimal adult survival rate	logit-normal	0.9	0.03
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 139: Summary statistics for prior distributions of demographic parameters, and derived quantities, for New Zealand white-faced storm petrel. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	1 850 000	758 000–2 940 000	Pairs
Proportion of adults breeding	0.889	0.751–0.964	Proportion
Age at first reproduction	4.01	3.05–4.95	Years
Current adult survival rate	0.896	0.825–0.945	Proportion
Optimal adult survival rate	0.896	0.823–0.946	Proportion
Juvenile survival rate	0.371	0.18–0.545	Proportion
Population size (adults)	4 170 000	1 700 000–6 860 000	Individuals

4.42 White-bellied storm petrel (*Fregetta grallaria grallaria*)

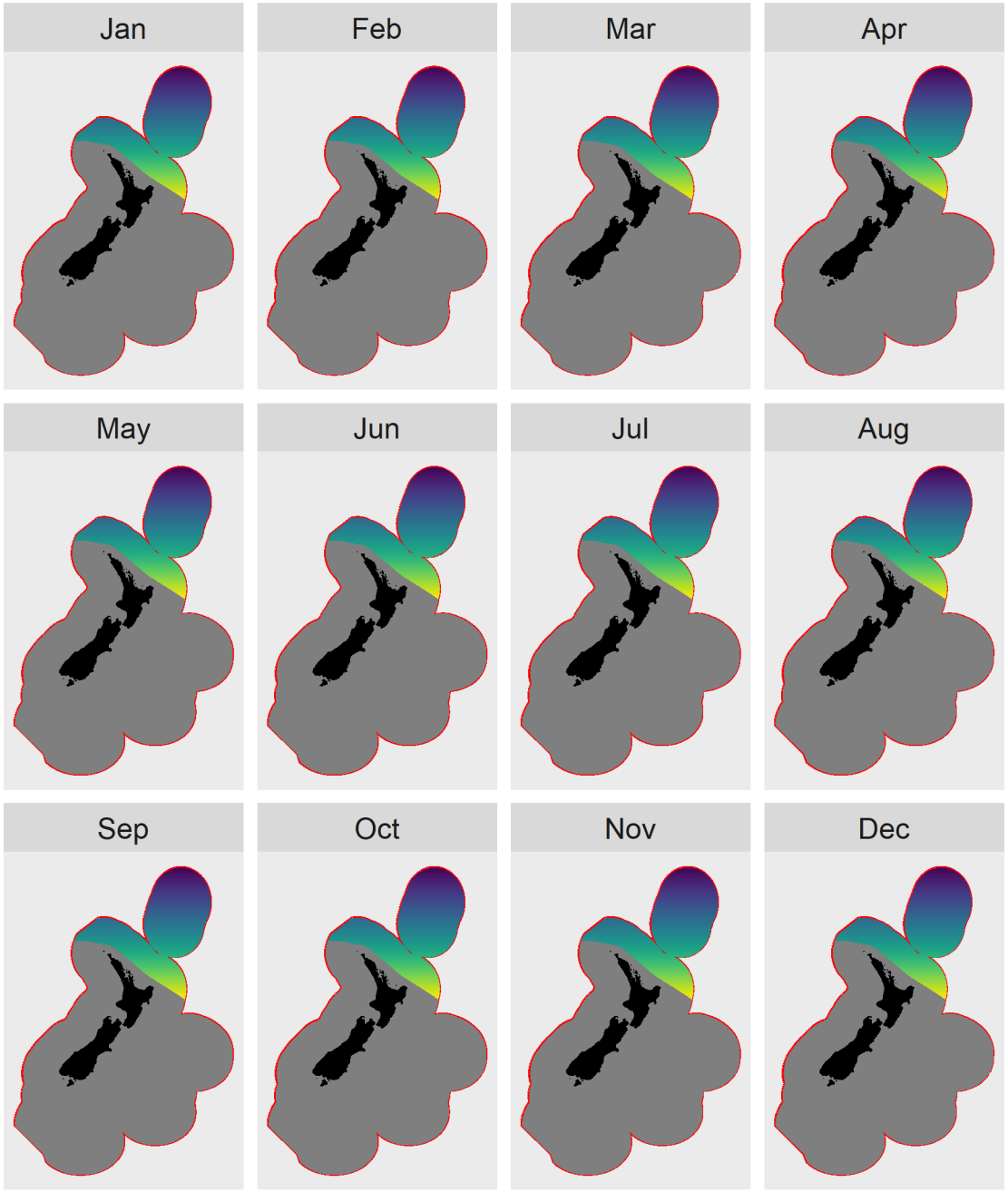

Figure 42: Relative density maps of adult White-bellied storm petrel by month (proportion of individuals per square kilometre). Breeding takes place during: Apr,May,Jun,Jul,Aug. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 140: Input covariate probabilities for White-bellied storm petrel.

Month	Probability in EEZ	Probability on nest	Season
Jan	1.00	0.00	Non-breeding
Feb	1.00	0.00	Non-breeding
Mar	1.00	0.00	Non-breeding
Apr	1.00	0.50	Breeding
May	1.00	0.50	Breeding
Jun	1.00	0.50	Breeding
Jul	1.00	0.50	Breeding
Aug	1.00	0.50	Breeding
Sep	1.00	0.00	Non-breeding
Oct	1.00	0.00	Non-breeding
Nov	1.00	0.00	Non-breeding
Dec	1.00	0.00	Non-breeding

Table 141: Prior distributions of demographic parameters for White-bellied storm petrel.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	1 000	0.300
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	4	5
Current adult survival rate	logit-normal	0.9	0.03
Optimal adult survival rate	logit-normal	0.9	0.03
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 142: Summary statistics for prior distributions of demographic parameters, and derived quantities, for White-bellied storm petrel. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	998	539–1 700	Pairs
Proportion of adults breeding	0.89	0.749–0.964	Proportion
Age at first reproduction	4.51	4.03–4.98	Years
Current adult survival rate	0.895	0.822–0.944	Proportion
Optimal adult survival rate	0.896	0.824–0.945	Proportion
Juvenile survival rate	0.33	0.163–0.498	Proportion
Population size (adults)	2 250	1 190–3 870	Individuals

4.43 Black-bellied storm petrel (*Fregetta tropica*)

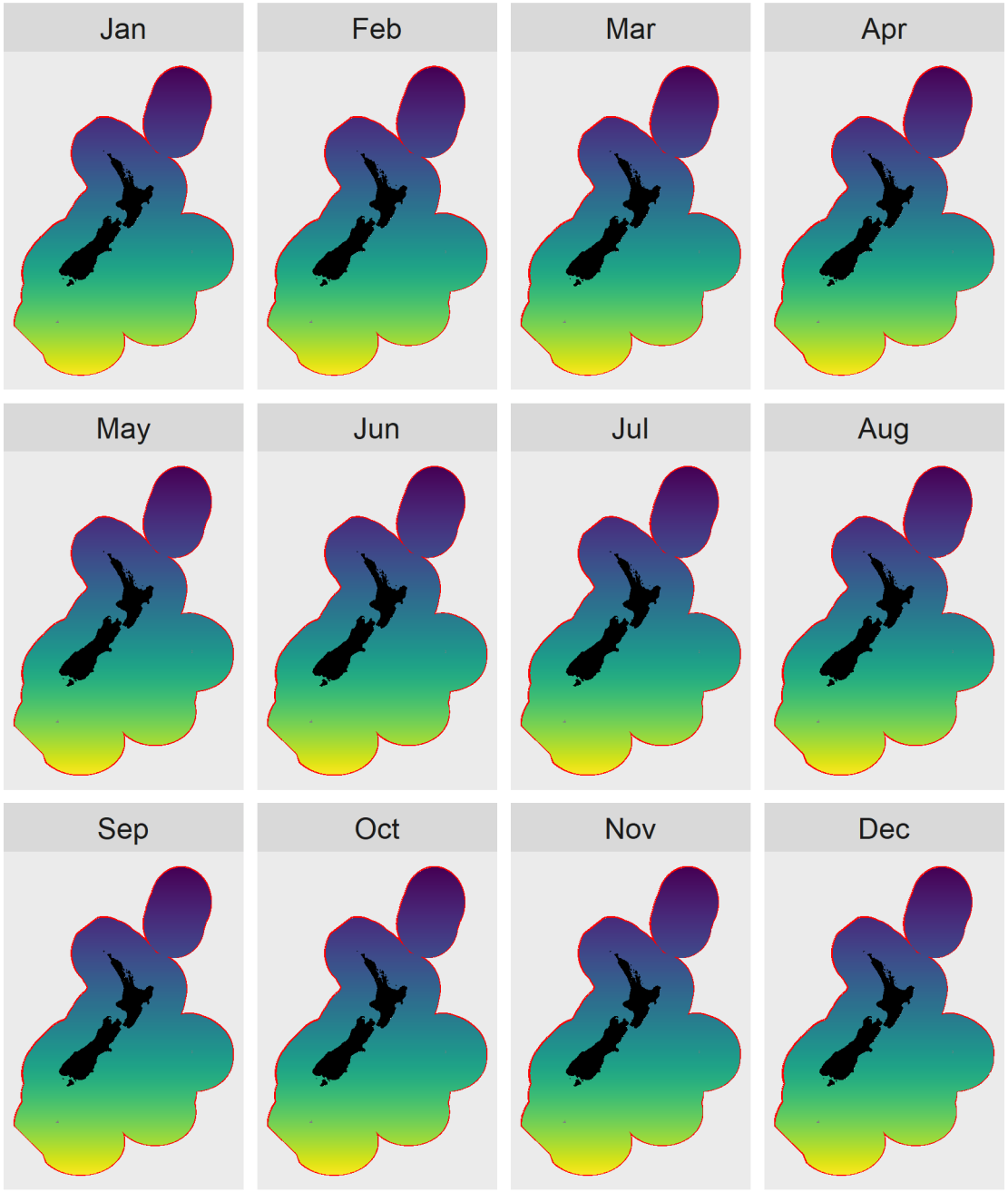

Figure 43: Relative density maps of adult Black-bellied storm petrel by month (proportion of individuals per square kilometre). Breeding takes place during: Oct,Nov,Dec,Jan,Feb,Mar,Apr,May. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 143: Input covariate probabilities for Black-bellied storm petrel.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.95	0.50	Breeding
Feb	0.95	0.50	Breeding
Mar	0.95	0.50	Breeding
Apr	0.95	0.50	Breeding
May	0.95	0.50	Breeding
Jun	0.50	0.00	Non-breeding
Jul	0.50	0.00	Non-breeding
Aug	0.50	0.00	Non-breeding
Sep	0.50	0.00	Non-breeding
Oct	0.95	0.50	Breeding
Nov	0.95	0.50	Breeding
Dec	0.95	0.50	Breeding

Table 144: Prior distributions of demographic parameters for Black-bellied storm petrel.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	50 000	100 000
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	4	5
Current adult survival rate	logit-normal	0.9	0.03
Optimal adult survival rate	logit-normal	0.9	0.03
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 145: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Black-bellied storm petrel. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	75 100	51 300–98 700	Pairs
Proportion of adults breeding	0.89	0.753–0.964	Proportion
Age at first reproduction	4.5	4.02–4.98	Years
Current adult survival rate	0.896	0.825–0.946	Proportion
Optimal adult survival rate	0.896	0.825–0.945	Proportion
Juvenile survival rate	0.331	0.158–0.498	Proportion
Population size (adults)	169 000	113 000–234 000	Individuals

4.44 Kermadec storm petrel (*Pelagodroma albiclunis*)

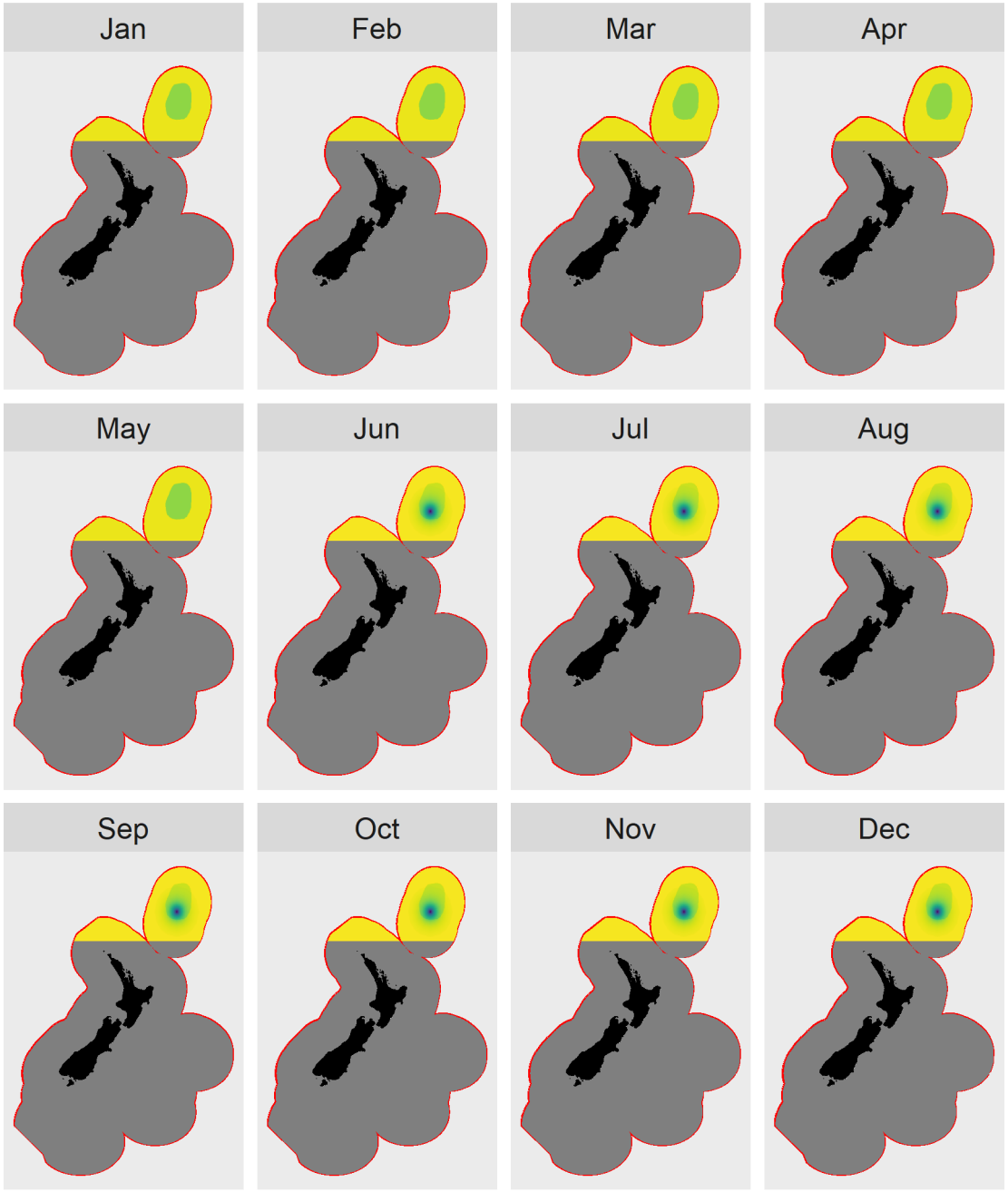

Figure 44: Relative density maps of adult Kermadec storm petrel by month (proportion of individuals per square kilometre). Breeding takes place during: Jun,Jul,Aug,Sep,Oct,Nov,Dec. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 146: Input covariate probabilities for Kermadec storm petrel.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.50	0.00	Non-breeding
Feb	0.50	0.00	Non-breeding
Mar	0.50	0.00	Non-breeding
Apr	0.50	0.00	Non-breeding
May	0.50	0.00	Non-breeding
Jun	0.95	0.50	Breeding
Jul	0.95	0.50	Breeding
Aug	0.95	0.50	Breeding
Sep	0.95	0.50	Breeding
Oct	0.95	0.50	Breeding
Nov	0.95	0.50	Breeding
Dec	0.95	0.50	Breeding

Table 147: Prior distributions of demographic parameters for Kermadec storm petrel.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	20	120
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	3	5
Current adult survival rate	logit-normal	0.9	0.03
Optimal adult survival rate	logit-normal	0.9	0.03
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 148: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Kermadec storm petrel. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	69.9	22.3–118	Pairs
Proportion of adults breeding	0.89	0.755–0.963	Proportion
Age at first reproduction	4.01	3.05–4.96	Years
Current adult survival rate	0.896	0.823–0.946	Proportion
Optimal adult survival rate	0.895	0.823–0.945	Proportion
Juvenile survival rate	0.368	0.179–0.548	Proportion
Population size (adults)	158	50.4–272	Individuals

4.45 New Zealand storm petrel (*Pealeornis maoriana*)

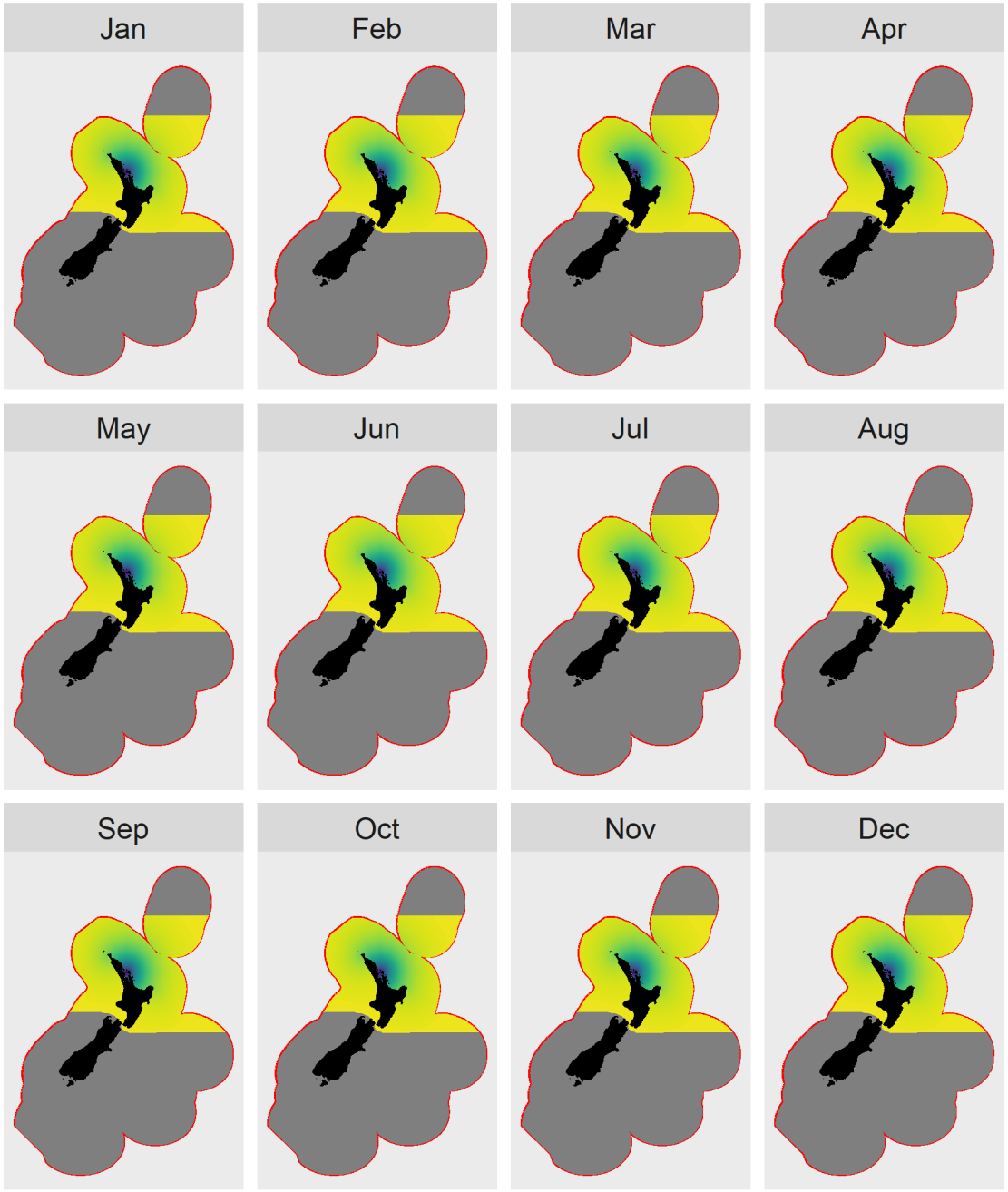

Figure 45: Relative density maps of adult New Zealand storm petrel by month (proportion of individuals per square kilometre). Breeding takes place during: Jan,Feb,Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 149: Input covariate probabilities for New Zealand storm petrel.

Month	Probability in EEZ	Probability on nest	Season
Jan	1.00	0.50	Breeding
Feb	1.00	0.50	Breeding
Mar	1.00	0.50	Breeding
Apr	1.00	0.50	Breeding
May	1.00	0.50	Breeding
Jun	1.00	0.50	Breeding
Jul	1.00	0.50	Breeding
Aug	1.00	0.50	Breeding
Sep	1.00	0.50	Breeding
Oct	1.00	0.50	Breeding
Nov	1.00	0.50	Breeding
Dec	1.00	0.50	Breeding

Table 150: Prior distributions of demographic parameters for New Zealand storm petrel.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	20	1 000
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	4	5
Current adult survival rate	logit-normal	0.9	0.03
Optimal adult survival rate	logit-normal	0.9	0.03
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 151: Summary statistics for prior distributions of demographic parameters, and derived quantities, for New Zealand storm petrel. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	511	46.8–974	Pairs
Proportion of adults breeding	0.889	0.75–0.963	Proportion
Age at first reproduction	4.5	4.02–4.98	Years
Current adult survival rate	0.896	0.823–0.946	Proportion
Optimal adult survival rate	0.896	0.824–0.945	Proportion
Juvenile survival rate	0.329	0.154–0.492	Proportion
Population size (adults)	1 150	103–2 250	Individuals

4.46 Yellow-eyed penguin (*Megadyptes antipodes*)

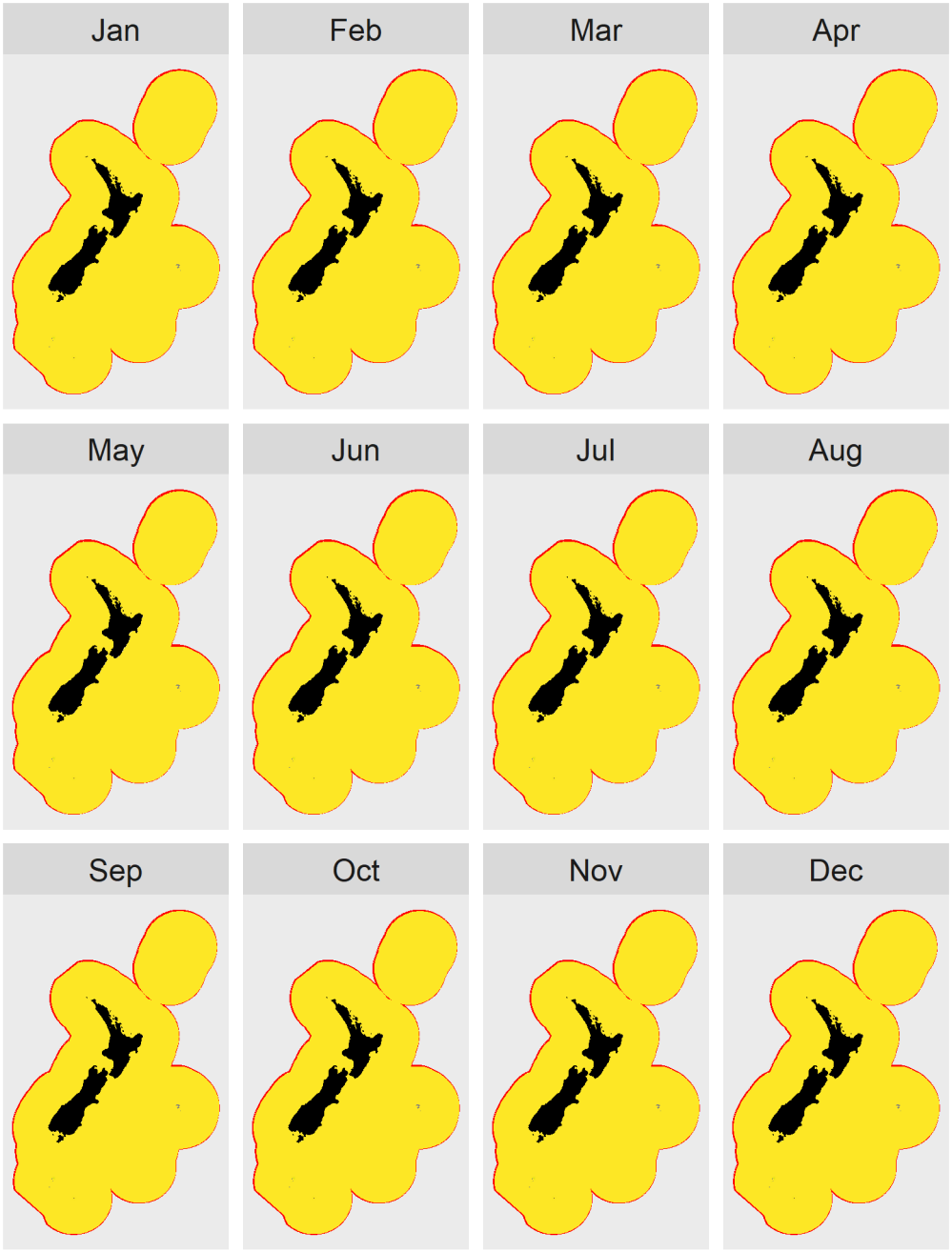

Figure 46: Relative density maps of adult Yellow-eyed penguin by month (proportion of individuals per square kilometre). Breeding takes place during: Sep,Oct,Nov,Dec,Jan,Feb. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 152: Input covariate probabilities for Yellow-eyed penguin.

Month	Probability in EEZ	Probability on nest	Season
Jan	1.00	0.00	Breeding
Feb	1.00	0.00	Breeding
Mar	0.60	0.00	Non-breeding
Apr	0.60	0.00	Non-breeding
May	1.00	0.00	Non-breeding
Jun	1.00	0.00	Non-breeding
Jul	1.00	0.00	Non-breeding
Aug	1.00	0.00	Non-breeding
Sep	1.00	0.25	Breeding
Oct	1.00	0.50	Breeding
Nov	1.00	0.50	Breeding
Dec	1.00	0.25	Breeding

Table 153: Prior distributions of demographic parameters for Yellow-eyed penguin.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	1 210	0.100
Proportion of adults breeding	logit-normal	0.688	0.05
Age at first reproduction	uniform	2	4
Current adult survival rate	logit-normal	0.87	0.03
Optimal adult survival rate	logit-normal	0.87	0.03
Egg survival rate multiplier	logit-normal	0.5	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 154: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Yellow-eyed penguin. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	1 210	989–1 470	Pairs
Proportion of adults breeding	0.685	0.584–0.776	Proportion
Age at first reproduction	3	2.05–3.95	Years
Current adult survival rate	0.867	0.799–0.919	Proportion
Optimal adult survival rate	0.867	0.799–0.917	Proportion
Juvenile survival rate	0.263	0.146–0.383	Proportion
Population size (adults)	3 560	2 780–4 520	Individuals

4.47 Northern little penguin (*Eudyptula minor f. iredalei*)

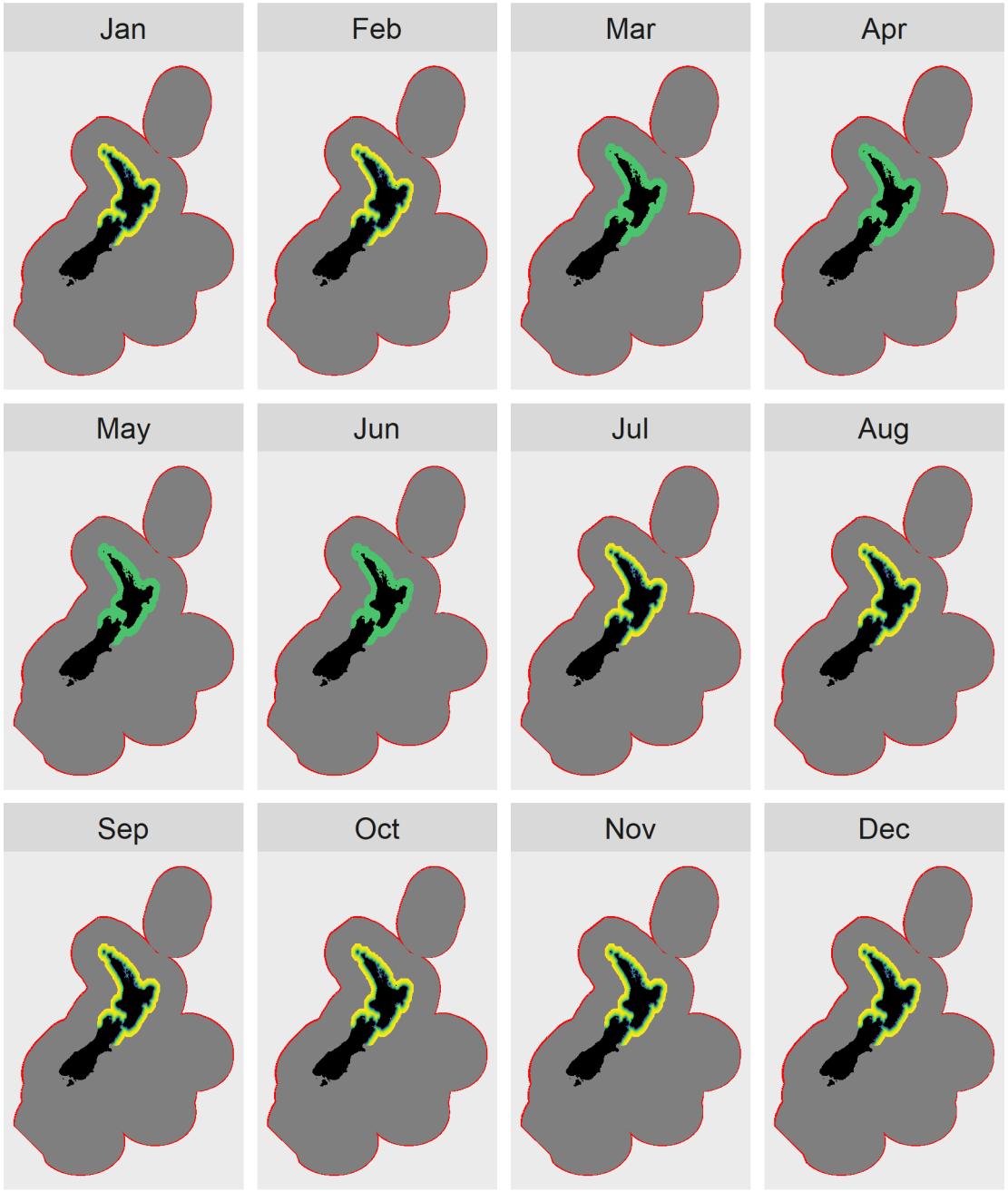

Figure 47: Relative density maps of adult Northern little penguin by month (proportion of individuals per square kilometre). Breeding takes place during: Jul,Aug,Sep,Oct,Nov,Dec,Jan,Feb. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 155: Input covariate probabilities for Northern little penguin.

Month	Probability in EEZ	Probability on nest	Season
Jan	1.00	0.50	Breeding
Feb	1.00	0.50	Breeding
Mar	1.00	0.00	Non-breeding
Apr	1.00	0.00	Non-breeding
May	1.00	0.00	Non-breeding
Jun	1.00	0.00	Non-breeding
Jul	1.00	0.50	Breeding
Aug	1.00	0.50	Breeding
Sep	1.00	0.50	Breeding
Oct	1.00	0.50	Breeding
Nov	1.00	0.50	Breeding
Dec	1.00	0.50	Breeding

Table 156: Prior distributions of demographic parameters for Northern little penguin.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	5 000	10 000
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	2	3
Current adult survival rate	logit-normal	0.83	0.02
Optimal adult survival rate	logit-normal	0.83	0.02
Egg survival rate multiplier	logit-normal	0.5	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 157: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Northern little penguin. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	7 510	5 130–9 870	Pairs
Proportion of adults breeding	0.89	0.756–0.964	Proportion
Age at first reproduction	2.5	2.02–2.97	Years
Current adult survival rate	0.829	0.787–0.866	Proportion
Optimal adult survival rate	0.829	0.788–0.865	Proportion
Juvenile survival rate	0.265	0.176–0.352	Proportion
Population size (adults)	17 000	11 300–23 400	Individuals

4.48 White-flippered little penguin (*Eudyptula minor f. albosignata*)

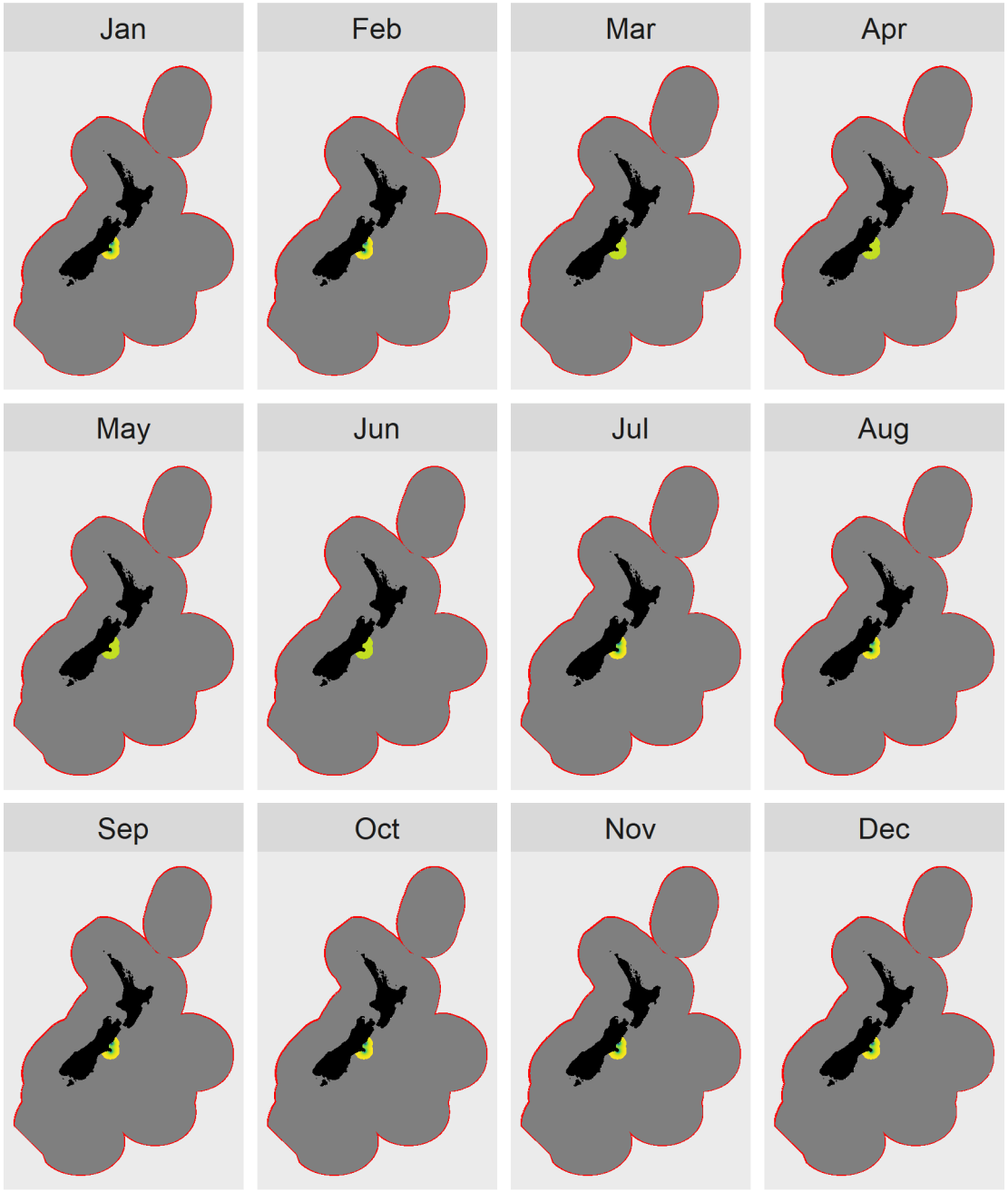

Figure 48: Relative density maps of adult White-flippered little penguin by month (proportion of individuals per square kilometre). Breeding takes place during: Jul,Aug,Sep,Oct,Nov,Dec,Jan,Feb. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 158: Input covariate probabilities for White-flippered little penguin.

Month	Probability in EEZ	Probability on nest	Season
Jan	1.00	0.50	Breeding
Feb	1.00	0.50	Breeding
Mar	1.00	0.00	Non-breeding
Apr	1.00	0.00	Non-breeding
May	1.00	0.00	Non-breeding
Jun	1.00	0.00	Non-breeding
Jul	1.00	0.50	Breeding
Aug	1.00	0.50	Breeding
Sep	1.00	0.50	Breeding
Oct	1.00	0.50	Breeding
Nov	1.00	0.50	Breeding
Dec	1.00	0.50	Breeding

Table 159: Prior distributions of demographic parameters for White-flippered little penguin.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	2 200	0.200
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	2	3
Current adult survival rate	logit-normal	0.83	0.02
Optimal adult survival rate	logit-normal	0.83	0.02
Egg survival rate multiplier	logit-normal	0.5	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 160: Summary statistics for prior distributions of demographic parameters, and derived quantities, for White-flippered little penguin. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	2 200	1 450–3 210	Pairs
Proportion of adults breeding	0.889	0.751–0.963	Proportion
Age at first reproduction	2.5	2.02–2.97	Years
Current adult survival rate	0.829	0.788–0.866	Proportion
Optimal adult survival rate	0.829	0.787–0.866	Proportion
Juvenile survival rate	0.265	0.175–0.353	Proportion
Population size (adults)	4 970	3 230–7 370	Individuals

4.49 Southern little penguin (*Eudyptula minor f. minor*)

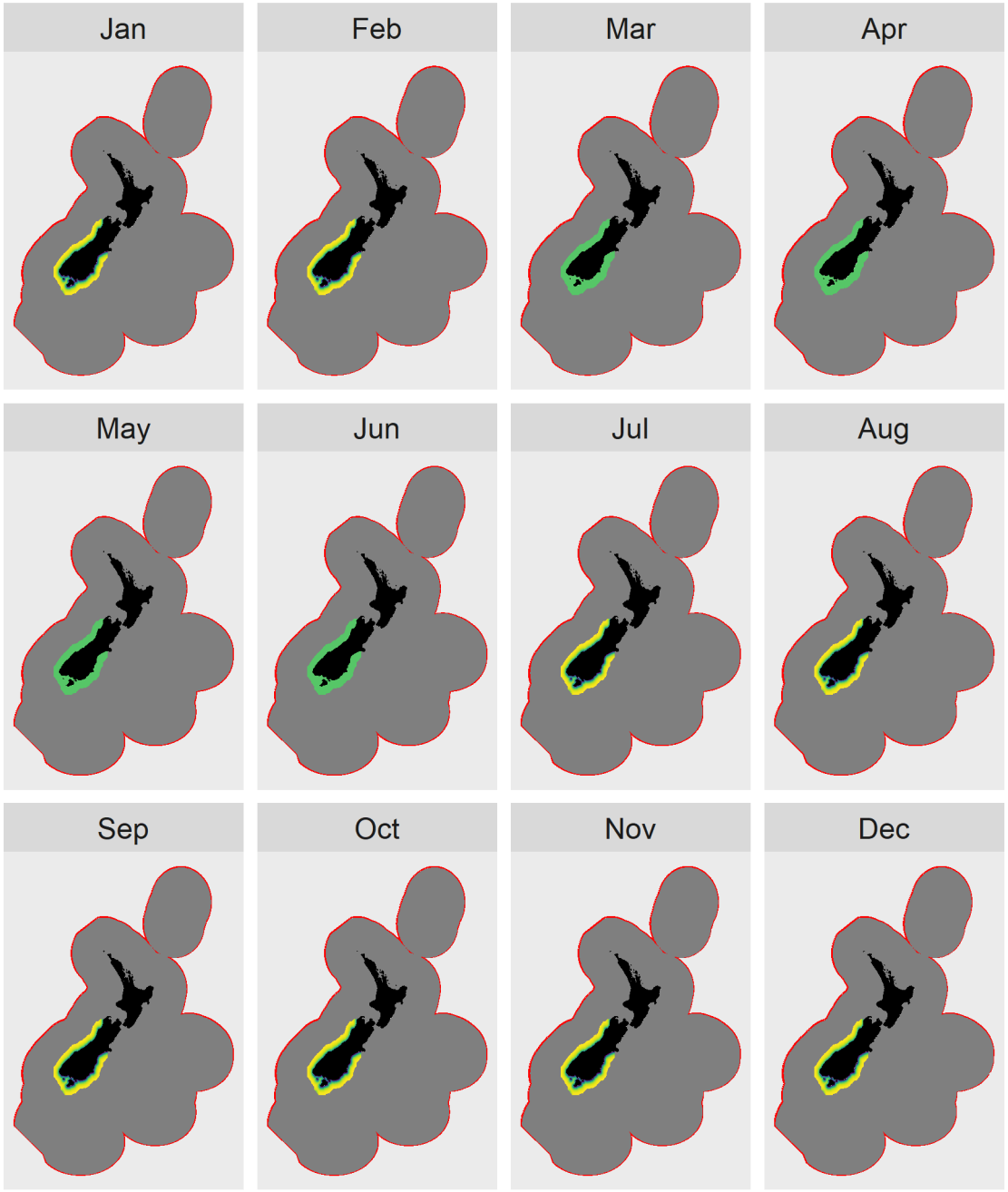

Figure 49: Relative density maps of adult Southern little penguin by month (proportion of individuals per square kilometre). Breeding takes place during: Jul,Aug,Sep,Oct,Nov,Dec,Jan,Feb. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 161: Input covariate probabilities for Southern little penguin.

Month	Probability in EEZ	Probability on nest	Season
Jan	1.00	0.50	Breeding
Feb	1.00	0.50	Breeding
Mar	1.00	0.00	Non-breeding
Apr	1.00	0.00	Non-breeding
May	1.00	0.00	Non-breeding
Jun	1.00	0.00	Non-breeding
Jul	1.00	0.50	Breeding
Aug	1.00	0.50	Breeding
Sep	1.00	0.50	Breeding
Oct	1.00	0.50	Breeding
Nov	1.00	0.50	Breeding
Dec	1.00	0.50	Breeding

Table 162: Prior distributions of demographic parameters for Southern little penguin.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	5 000	10 000
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	2	3
Current adult survival rate	logit-normal	0.83	0.02
Optimal adult survival rate	logit-normal	0.83	0.02
Egg survival rate multiplier	logit-normal	0.5	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 163: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Southern little penguin. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	7 520	5 130–9 880	Pairs
Proportion of adults breeding	0.889	0.752–0.964	Proportion
Age at first reproduction	2.5	2.02–2.97	Years
Current adult survival rate	0.829	0.788–0.866	Proportion
Optimal adult survival rate	0.829	0.789–0.866	Proportion
Juvenile survival rate	0.264	0.174–0.352	Proportion
Population size (adults)	17 000	11 200–23 500	Individuals

4.50 Chatham Island little penguin (*Eudyptula minor f. chathamensis*)

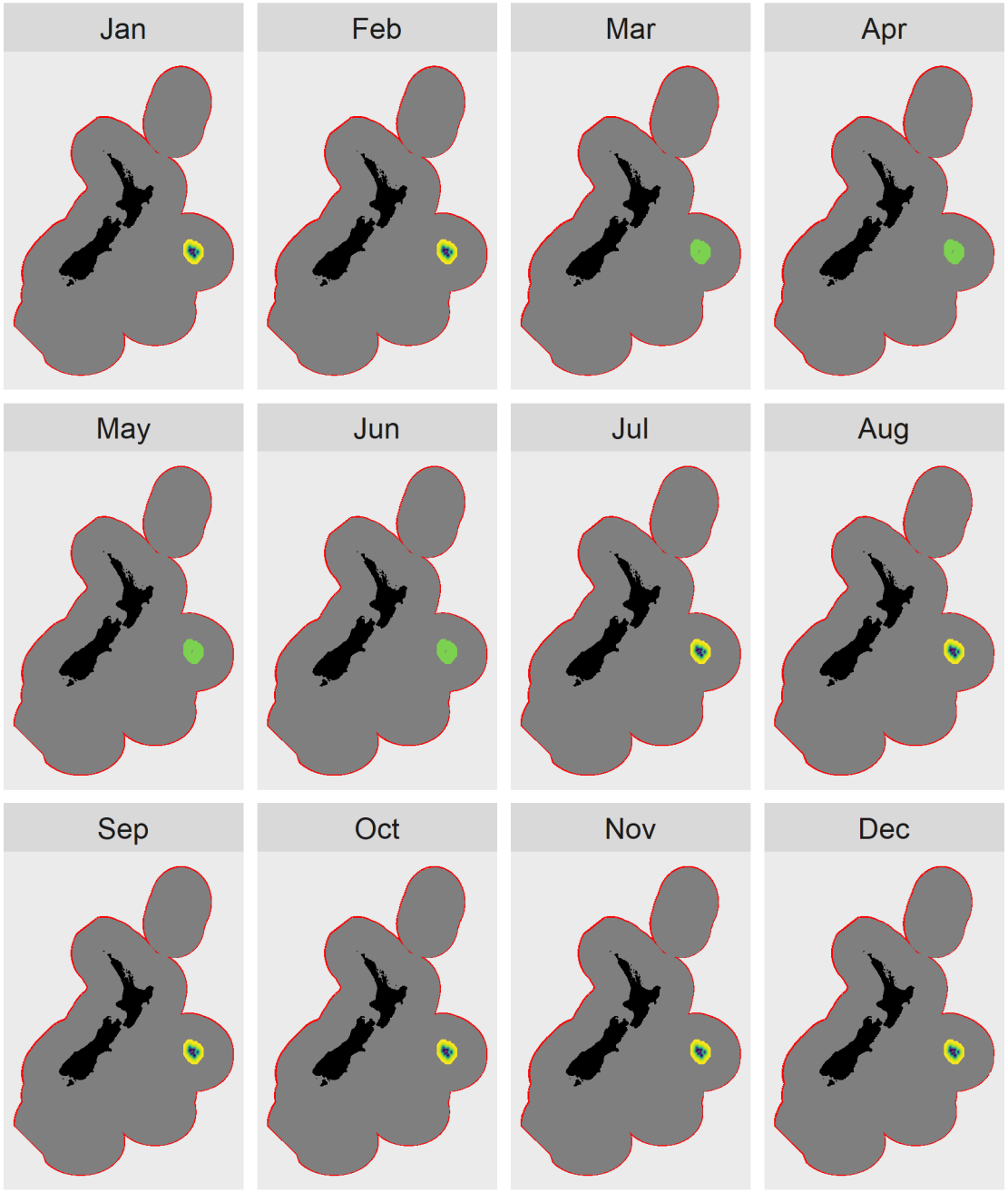

Figure 50: Relative density maps of adult Chatham Island little penguin by month (proportion of individuals per square kilometre). Breeding takes place during: Jul,Aug,Sep,Oct,Nov,Dec,Jan,Feb. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 164: Input covariate probabilities for Chatham Island little penguin.

Month	Probability in EEZ	Probability on nest	Season
Jan	1.00	0.50	Breeding
Feb	1.00	0.50	Breeding
Mar	1.00	0.00	Non-breeding
Apr	1.00	0.00	Non-breeding
May	1.00	0.00	Non-breeding
Jun	1.00	0.00	Non-breeding
Jul	1.00	0.50	Breeding
Aug	1.00	0.50	Breeding
Sep	1.00	0.50	Breeding
Oct	1.00	0.50	Breeding
Nov	1.00	0.50	Breeding
Dec	1.00	0.50	Breeding

Table 165: Prior distributions of demographic parameters for Chatham Island little penguin.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	5 000	10 000
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	2	3
Current adult survival rate	logit-normal	0.83	0.02
Optimal adult survival rate	logit-normal	0.83	0.02
Egg survival rate multiplier	logit-normal	0.5	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 166: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Chatham Island little penguin. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	7 500	5 130–9 860	Pairs
Proportion of adults breeding	0.889	0.752–0.964	Proportion
Age at first reproduction	2.5	2.03–2.98	Years
Current adult survival rate	0.829	0.787–0.865	Proportion
Optimal adult survival rate	0.829	0.788–0.866	Proportion
Juvenile survival rate	0.264	0.178–0.352	Proportion
Population size (adults)	17 000	11 300–23 500	Individuals

4.51 Eastern rockhopper penguin (*Eudyptes chrysocome filholi*)

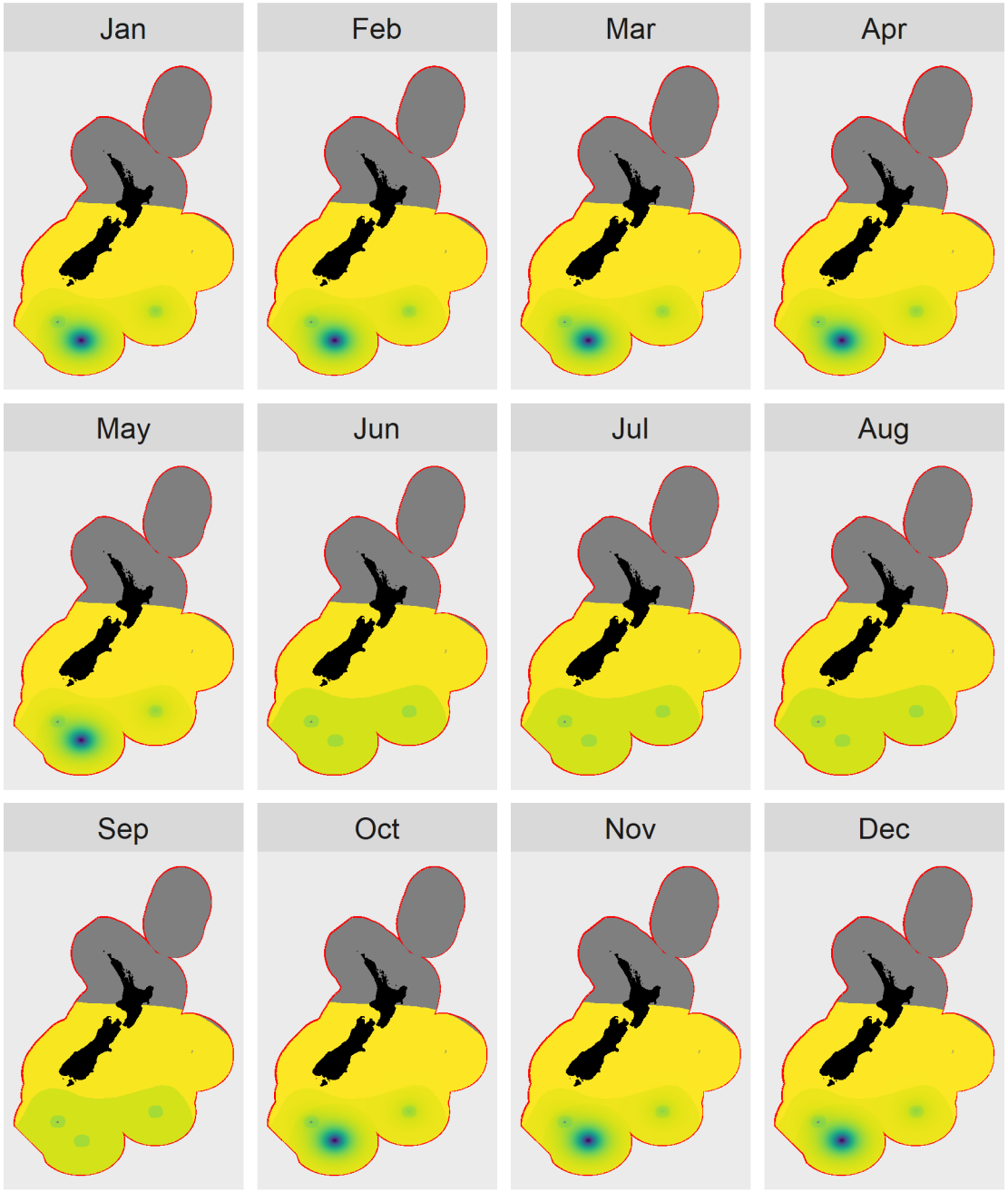

Figure 51: Relative density maps of adult Eastern rockhopper penguin by month (proportion of individuals per square kilometre). Breeding takes place during: Oct,Nov,Dec,Jan,Feb,Mar,Apr,May. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 167: Input covariate probabilities for Eastern rockhopper penguin.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.90	0.50	Breeding
Feb	0.90	0.50	Breeding
Mar	0.90	0.50	Breeding
Apr	0.90	0.50	Breeding
May	0.90	0.50	Breeding
Jun	0.05	0.00	Non-breeding
Jul	0.05	0.00	Non-breeding
Aug	0.05	0.00	Non-breeding
Sep	0.05	0.00	Non-breeding
Oct	0.90	0.50	Breeding
Nov	0.90	0.50	Breeding
Dec	0.90	0.50	Breeding

Table 168: Prior distributions of demographic parameters for Eastern rockhopper penguin.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	38 961	58 500
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	3	6
Current adult survival rate	logit-normal	0.84	0.011
Optimal adult survival rate	logit-normal	0.84	0.011
Egg survival rate multiplier	logit-normal	0.5	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 169: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Eastern rockhopper penguin. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	48 700	39 500–58 000	Pairs
Proportion of adults breeding	0.889	0.756–0.964	Proportion
Age at first reproduction	4.5	3.07–5.92	Years
Current adult survival rate	0.84	0.817–0.86	Proportion
Optimal adult survival rate	0.84	0.817–0.86	Proportion
Juvenile survival rate	0.158	0.0636–0.263	Proportion
Population size (adults)	110 000	86 100–140 000	Individuals

4.52 Fiordland crested penguin (*Eudyptes pachyrhynchus*)

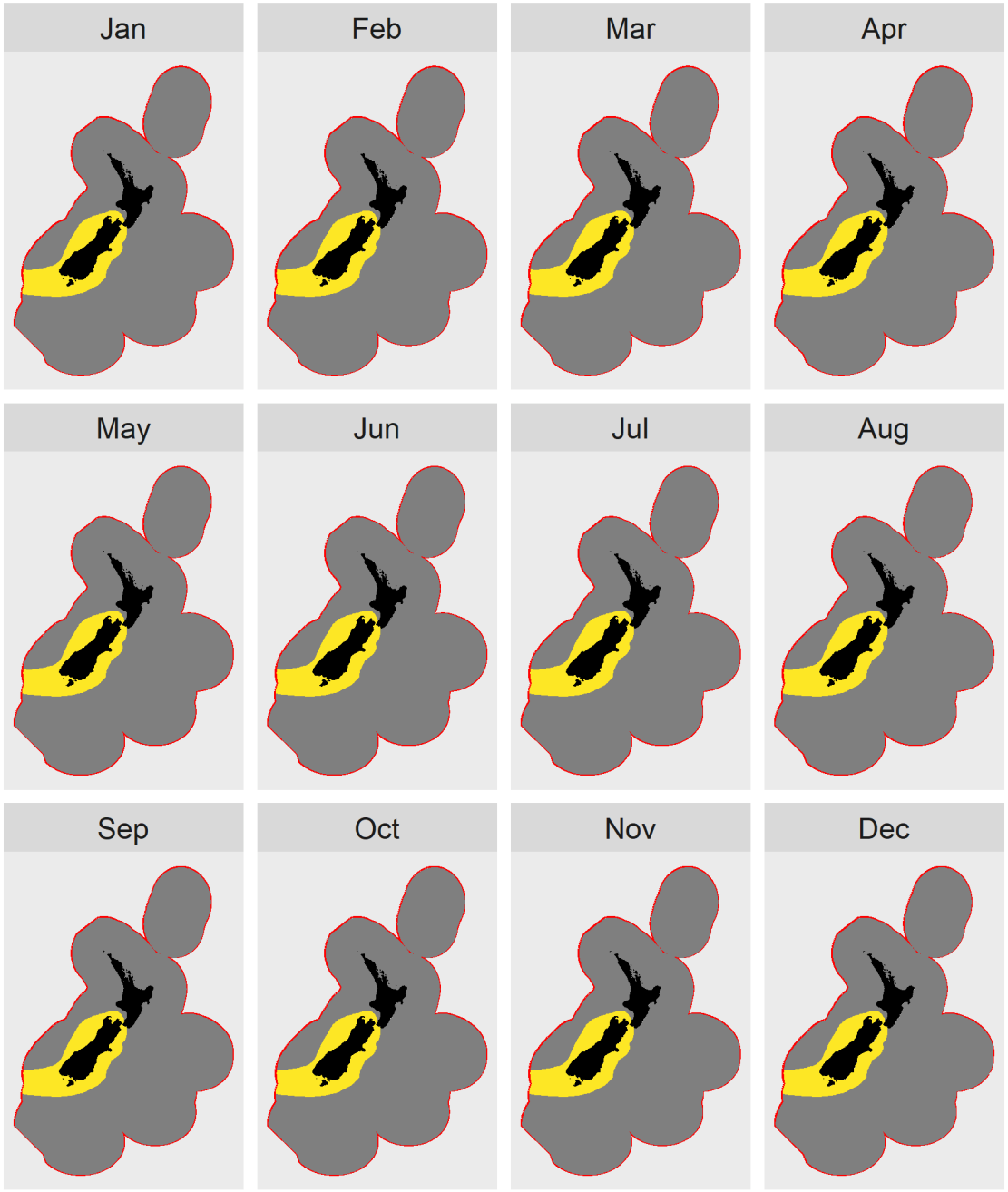

Figure 52: Relative density maps of adult Fiordland crested penguin by month (proportion of individuals per square kilometre). Breeding takes place during: Jul,Aug,Sep,Oct,Nov,Dec,Jan,Feb,Mar. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 170: Input covariate probabilities for Fiordland crested penguin.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.95	0.50	Breeding
Feb	0.95	0.50	Breeding
Mar	0.95	0.50	Breeding
Apr	0.50	0.00	Non-breeding
May	0.50	0.00	Non-breeding
Jun	0.50	0.00	Non-breeding
Jul	0.95	0.50	Breeding
Aug	0.95	0.50	Breeding
Sep	0.95	0.50	Breeding
Oct	0.95	0.50	Breeding
Nov	0.95	0.50	Breeding
Dec	0.95	0.50	Breeding

Table 171: Prior distributions of demographic parameters for Fiordland crested penguin.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	3 000	0.300
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	3	6
Current adult survival rate	logit-normal	0.84	0.011
Optimal adult survival rate	logit-normal	0.84	0.011
Egg survival rate multiplier	logit-normal	0.5	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 172: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Fiordland crested penguin. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	2 990	1 610–5 130	Pairs
Proportion of adults breeding	0.889	0.749–0.964	Proportion
Age at first reproduction	4.51	3.08–5.92	Years
Current adult survival rate	0.84	0.817–0.861	Proportion
Optimal adult survival rate	0.84	0.817–0.861	Proportion
Juvenile survival rate	0.158	0.065–0.263	Proportion
Population size (adults)	6 760	3 580–11 800	Individuals

4.53 Snares crested penguin (*Eudyptes robustus*)

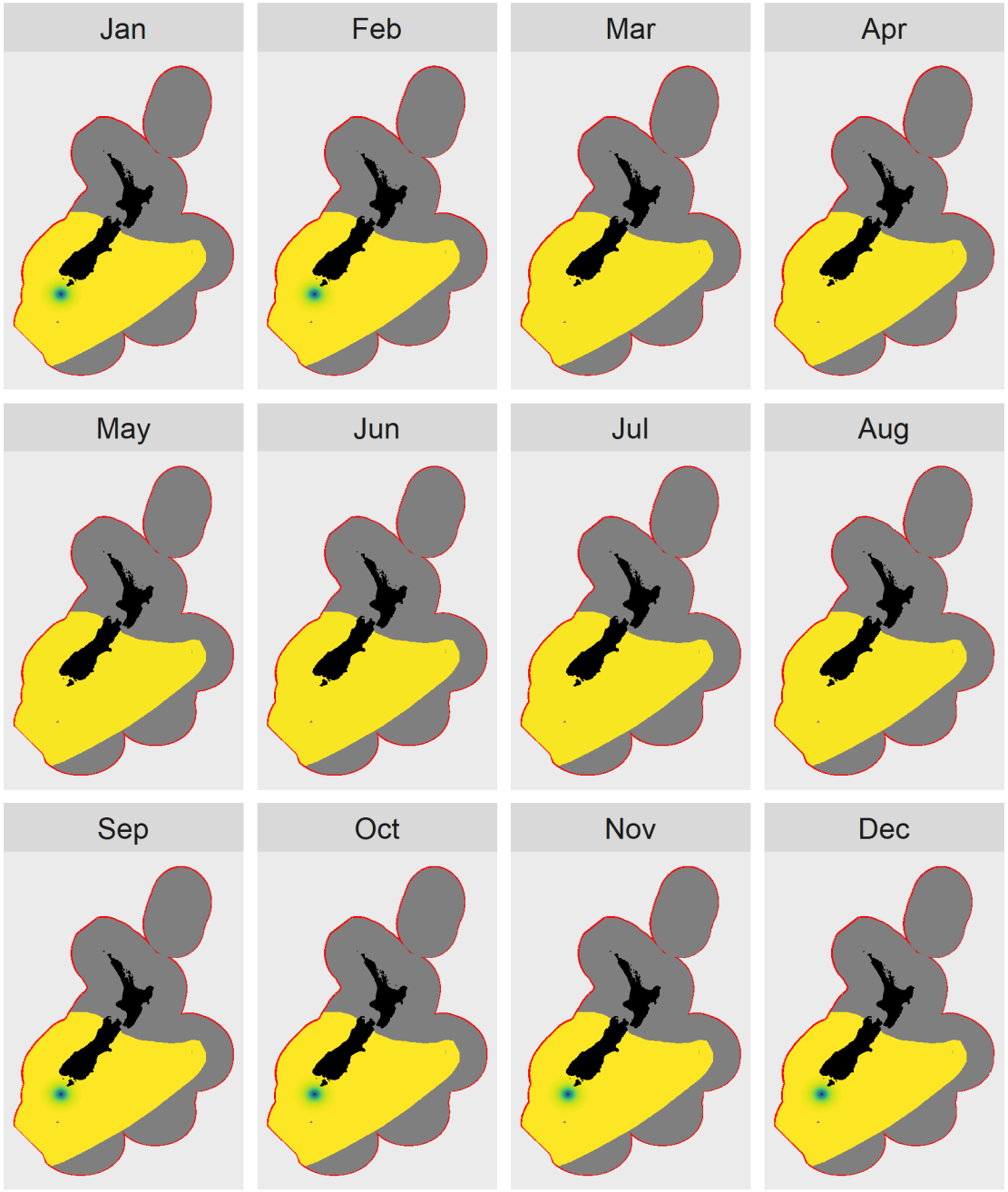

Figure 53: Relative density maps of adult Snares crested penguin by month (proportion of individuals per square kilometre). Breeding takes place during: Sep,Oct,Nov,Dec,Jan,Feb. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 173: Input covariate probabilities for Snares crested penguin.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.90	0.50	Breeding
Feb	0.90	0.50	Breeding
Mar	0.05	0.00	Non-breeding
Apr	0.05	0.00	Non-breeding
May	0.05	0.00	Non-breeding
Jun	0.05	0.00	Non-breeding
Jul	0.05	0.00	Non-breeding
Aug	0.05	0.00	Non-breeding
Sep	0.90	0.50	Breeding
Oct	0.90	0.50	Breeding
Nov	0.90	0.50	Breeding
Dec	0.90	0.50	Breeding

Table 174: Prior distributions of demographic parameters for Snares crested penguin.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	24 666	30 672
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	5	6
Current adult survival rate	logit-normal	0.84	0.011
Optimal adult survival rate	logit-normal	0.84	0.011
Egg survival rate multiplier	logit-normal	0.5	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 175: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Snares crested penguin. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	27 700	24 800–30 500	Pairs
Proportion of adults breeding	0.888	0.748–0.963	Proportion
Age at first reproduction	5.5	5.03–5.98	Years
Current adult survival rate	0.84	0.817–0.86	Proportion
Optimal adult survival rate	0.84	0.817–0.861	Proportion
Juvenile survival rate	0.117	0.0501–0.181	Proportion
Population size (adults)	62 500	53 300–75 900	Individuals

4.54 Erect-crested penguin (*Eudyptes sclateri*)

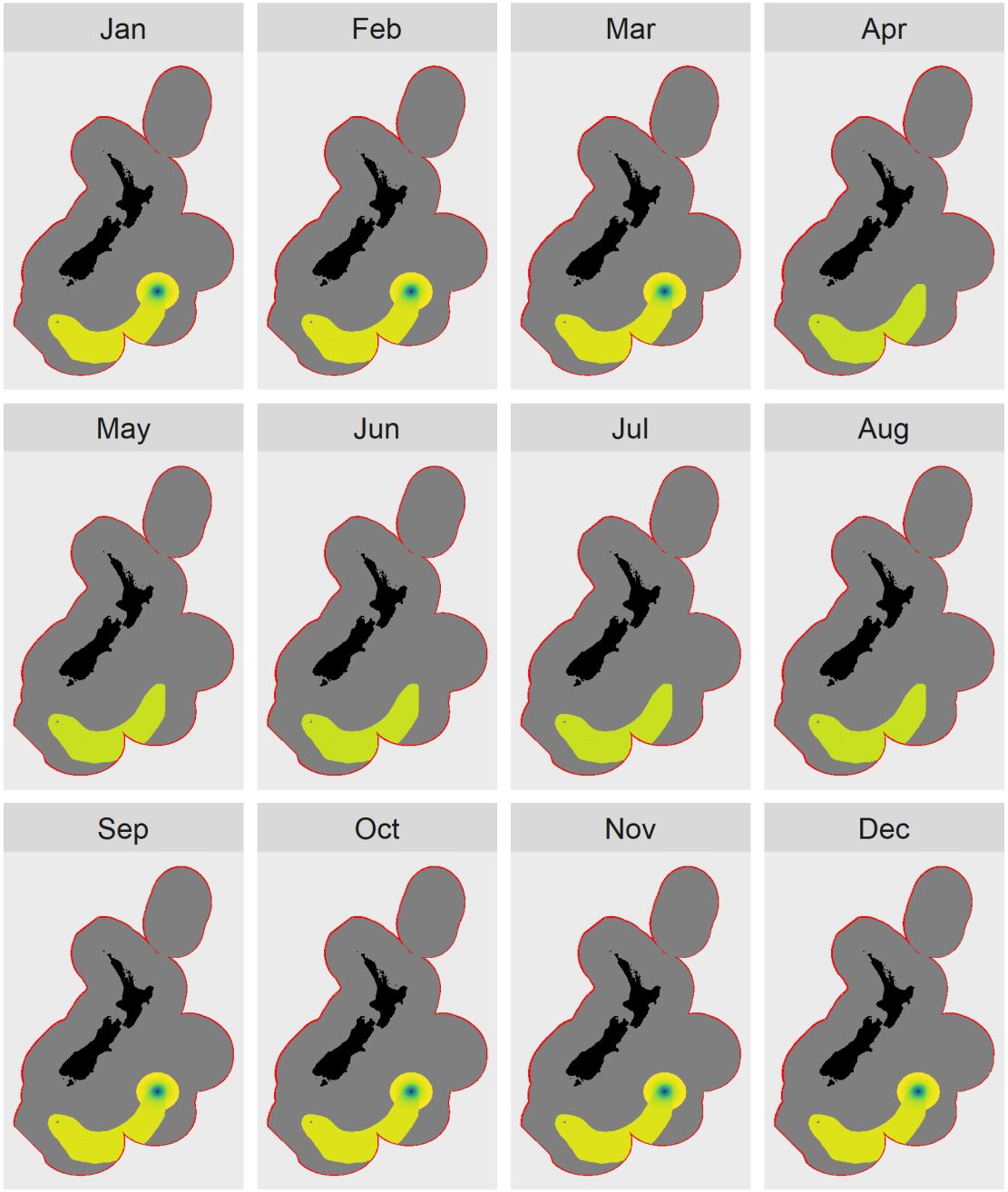

Figure 54: Relative density maps of adult Erect-crested penguin by month (proportion of individuals per square kilometre). Breeding takes place during: Sep,Oct,Nov,Dec,Jan,Feb,Mar. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 176: Input covariate probabilities for Erect-crested penguin.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.95	0.50	Breeding
Feb	0.95	0.50	Breeding
Mar	0.95	0.50	Breeding
Apr	0.50	0.00	Non-breeding
May	0.50	0.00	Non-breeding
Jun	0.50	0.00	Non-breeding
Jul	0.50	0.00	Non-breeding
Aug	0.50	0.00	Non-breeding
Sep	0.95	0.50	Breeding
Oct	0.95	0.50	Breeding
Nov	0.95	0.50	Breeding
Dec	0.95	0.50	Breeding

Table 177: Prior distributions of demographic parameters for Erect-crested penguin.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	77 000	85 000
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	5	6
Current adult survival rate	logit-normal	0.84	0.011
Optimal adult survival rate	logit-normal	0.84	0.011
Egg survival rate multiplier	logit-normal	0.5	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 178: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Erect-crested penguin. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	81 000	77 200–84 800	Pairs
Proportion of adults breeding	0.89	0.755–0.964	Proportion
Age at first reproduction	5.5	5.03–5.97	Years
Current adult survival rate	0.84	0.817–0.86	Proportion
Optimal adult survival rate	0.84	0.817–0.86	Proportion
Juvenile survival rate	0.117	0.0509–0.181	Proportion
Population size (adults)	183 000	164 000–216 000	Individuals

4.55 Australasian gannet (*Morus serrator*)

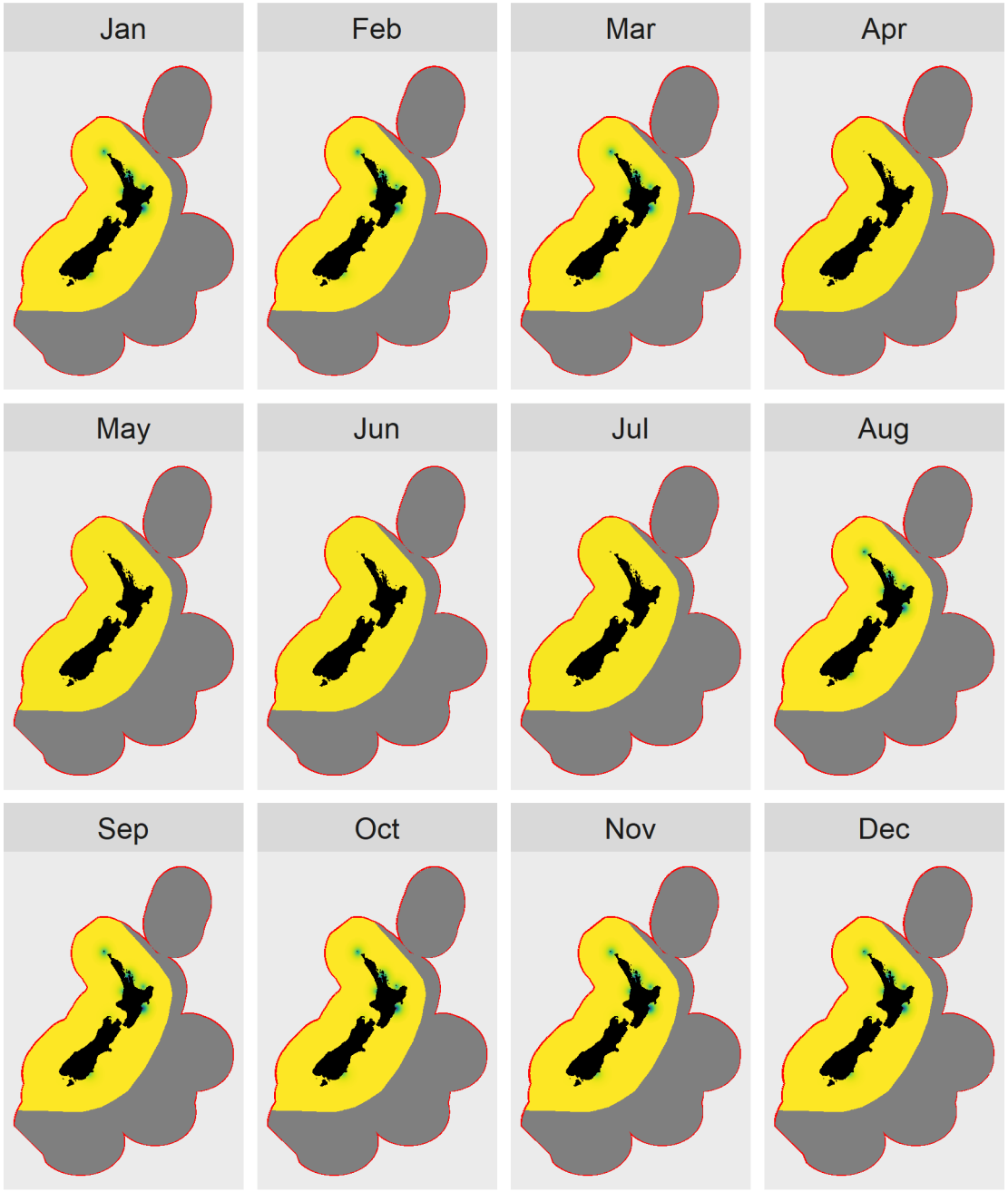

Figure 55: Relative density maps of adult Australasian gannet by month (proportion of individuals per square kilometre). Breeding takes place during: Aug,Sep,Oct,Nov,Dec,Jan,Feb,Mar. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 179: Input covariate probabilities for Australasian gannet.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.92	0.50	Breeding
Feb	0.92	0.50	Breeding
Mar	0.92	0.50	Breeding
Apr	0.20	0.00	Non-breeding
May	0.20	0.00	Non-breeding
Jun	0.20	0.00	Non-breeding
Jul	0.20	0.00	Non-breeding
Aug	0.92	0.50	Breeding
Sep	0.92	0.50	Breeding
Oct	0.92	0.50	Breeding
Nov	0.92	0.50	Breeding
Dec	0.92	0.50	Breeding

Table 180: Prior distributions of demographic parameters for Australasian gannet.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	46 004	0.300
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	3	7
Current adult survival rate	logit-normal	0.94	0.03
Optimal adult survival rate	logit-normal	0.94	0.03
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 181: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Australasian gannet. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	46 400	24 700–79 500	Pairs
Proportion of adults breeding	0.889	0.753–0.963	Proportion
Age at first reproduction	5	3.1–6.9	Years
Current adult survival rate	0.933	0.846–0.978	Proportion
Optimal adult survival rate	0.932	0.847–0.978	Proportion
Juvenile survival rate	0.372	0.128–0.602	Proportion
Population size (adults)	105 000	54 500–183 000	Individuals

4.56 Masked booby (*Sula dactylatra*)

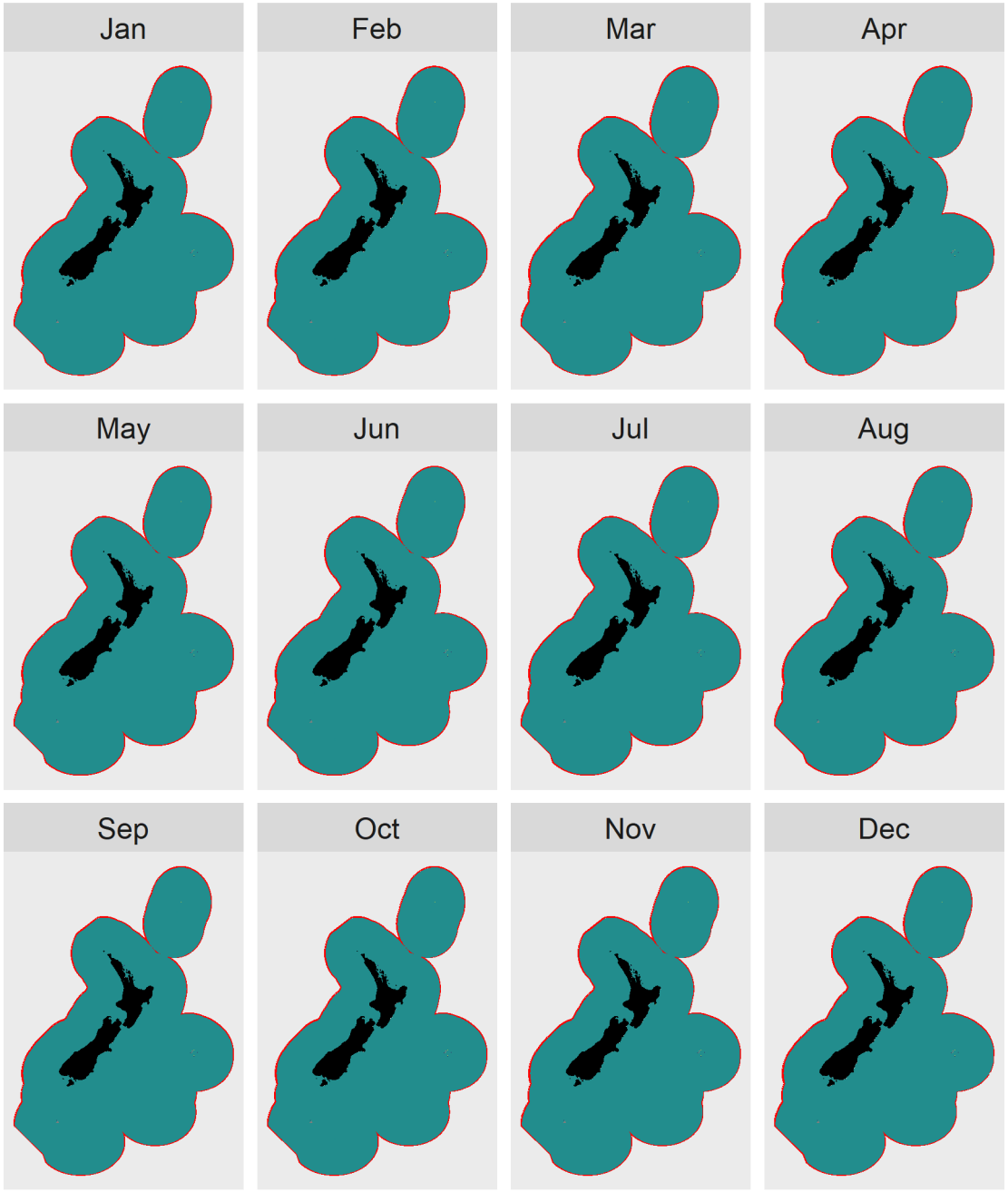

Figure 56: Relative density maps of adult Masked booby by month (proportion of individuals per square kilometre). Breeding takes place during: Jan,Feb,Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 182: Input covariate probabilities for Masked booby.

Month	Probability in EEZ	Probability on nest	Season
Jan	1.00	0.50	Breeding
Feb	1.00	0.50	Breeding
Mar	1.00	0.50	Breeding
Apr	1.00	0.50	Breeding
May	1.00	0.50	Breeding
Jun	1.00	0.50	Breeding
Jul	1.00	0.50	Breeding
Aug	1.00	0.50	Breeding
Sep	1.00	0.50	Breeding
Oct	1.00	0.50	Breeding
Nov	1.00	0.50	Breeding
Dec	1.00	0.50	Breeding

Table 183: Prior distributions of demographic parameters for Masked booby.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	240	0.200
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	2	4
Current adult survival rate	logit-normal	0.85	0.03
Optimal adult survival rate	logit-normal	0.85	0.03
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 184: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Masked booby. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	240	158–348	Pairs
Proportion of adults breeding	0.888	0.746–0.964	Proportion
Age at first reproduction	3	2.05–3.95	Years
Current adult survival rate	0.848	0.781–0.9	Proportion
Optimal adult survival rate	0.848	0.783–0.901	Proportion
Juvenile survival rate	0.391	0.216–0.561	Proportion
Population size (adults)	542	349–805	Individuals

4.57 Pied shag (*Phalacrocorax varius varius*)

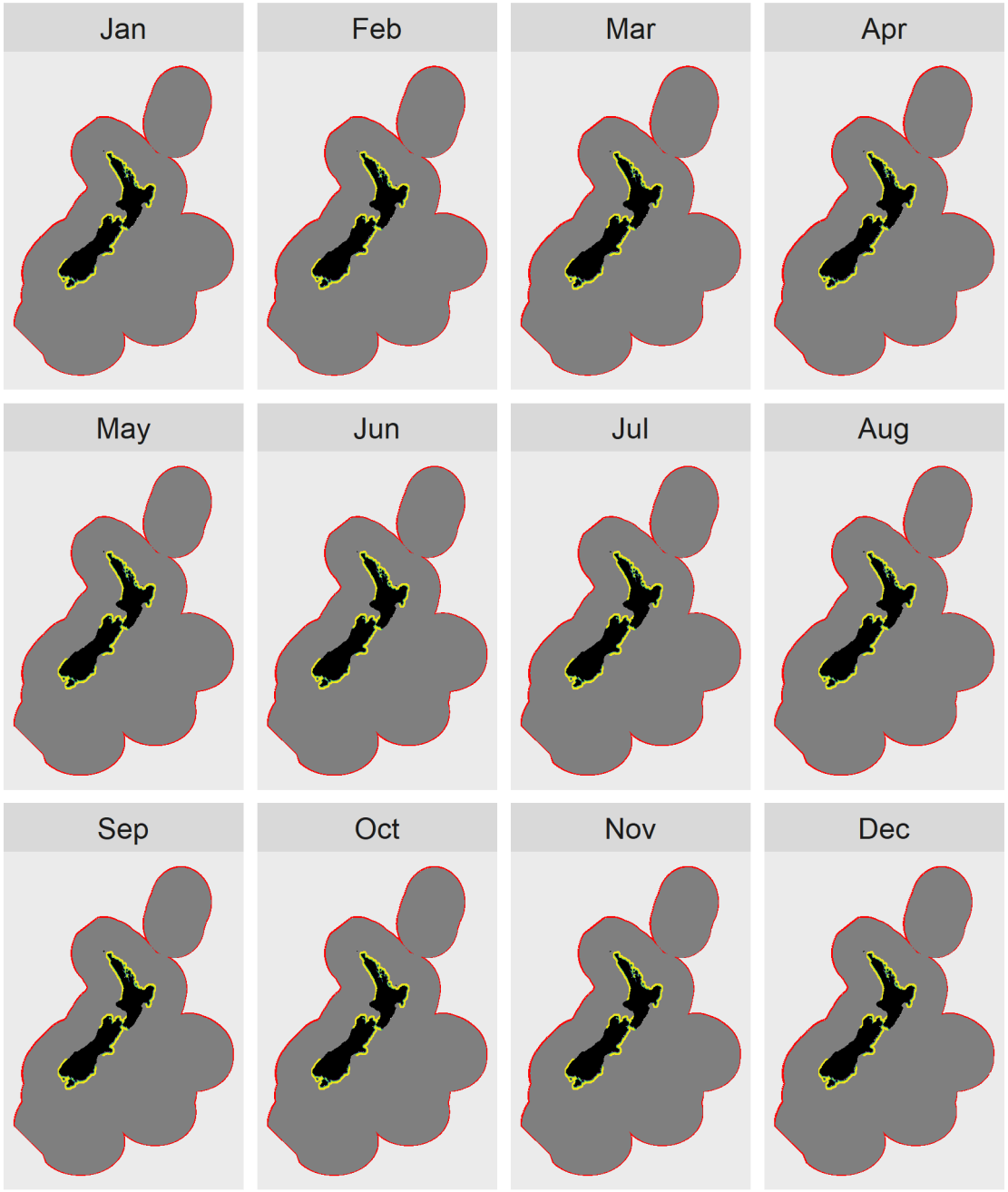

Figure 57: Relative density maps of adult Pied shag by month (proportion of individuals per square kilometre). Breeding takes place during: Jan,Feb,Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 185: Input covariate probabilities for Pied shag.

Month	Probability in EEZ	Probability on nest	Season
Jan	1.00	0.50	Breeding
Feb	1.00	0.50	Breeding
Mar	1.00	0.50	Breeding
Apr	1.00	0.50	Breeding
May	1.00	0.50	Breeding
Jun	1.00	0.50	Breeding
Jul	1.00	0.50	Breeding
Aug	1.00	0.50	Breeding
Sep	1.00	0.50	Breeding
Oct	1.00	0.50	Breeding
Nov	1.00	0.50	Breeding
Dec	1.00	0.50	Breeding

Table 186: Prior distributions of demographic parameters for Pied shag.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	6 400	0.100
Proportion of adults breeding	logit-normal	0.999	0.001
Age at first reproduction	uniform	2	3.33
Current adult survival rate	uniform	0.859	0.897
Optimal adult survival rate	uniform	0.859	0.897
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 187: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Pied shag. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	6 400	5 240–7 710	Pairs
Proportion of adults breeding	0.998	0.993–1	Proportion
Age at first reproduction	2.66	2.03–3.29	Years
Current adult survival rate	0.878	0.86–0.896	Proportion
Optimal adult survival rate	0.878	0.86–0.896	Proportion
Juvenile survival rate	0.466	0.313–0.595	Proportion
Population size (adults)	12 800	10 500–15 400	Individuals

4.58 Little black shag (*Phalacrocorax sulcirostris*)

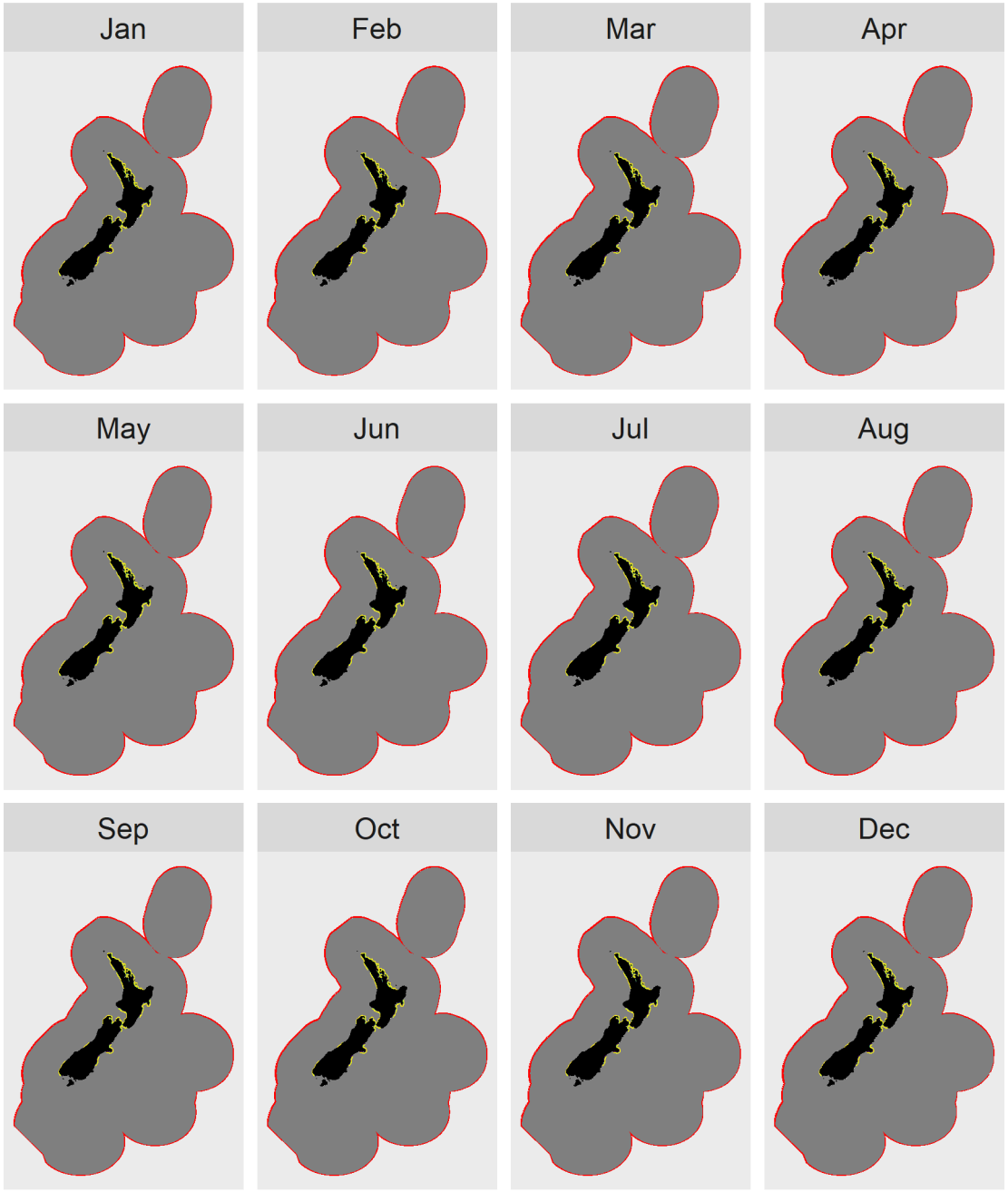

Figure 58: Relative density maps of adult Little black shag by month (proportion of individuals per square kilometre). Breeding takes place during: Oct,Nov,Dec. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 188: Input covariate probabilities for Little black shag.

Month	Probability in EEZ	Probability on nest	Season
Jan	1.00	0.00	Non-breeding
Feb	1.00	0.00	Non-breeding
Mar	1.00	0.00	Non-breeding
Apr	1.00	0.00	Non-breeding
May	1.00	0.00	Non-breeding
Jun	1.00	0.00	Non-breeding
Jul	1.00	0.00	Non-breeding
Aug	1.00	0.00	Non-breeding
Sep	1.00	0.00	Non-breeding
Oct	1.00	0.50	Breeding
Nov	1.00	0.50	Breeding
Dec	1.00	0.50	Breeding

Table 189: Prior distributions of demographic parameters for Little black shag.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	1 500	0.300
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	1	3
Current adult survival rate	uniform	0.859	0.897
Optimal adult survival rate	uniform	0.859	0.897
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 190: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Little black shag. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	1 500	807–2 600	Pairs
Proportion of adults breeding	0.888	0.747–0.965	Proportion
Age at first reproduction	2	1.06–2.95	Years
Current adult survival rate	0.878	0.86–0.896	Proportion
Optimal adult survival rate	0.878	0.86–0.896	Proportion
Juvenile survival rate	0.55	0.367–0.718	Proportion
Population size (adults)	3 400	1 780–5 950	Individuals

4.59 New Zealand king shag (*Leucocarbo carunculatus*)

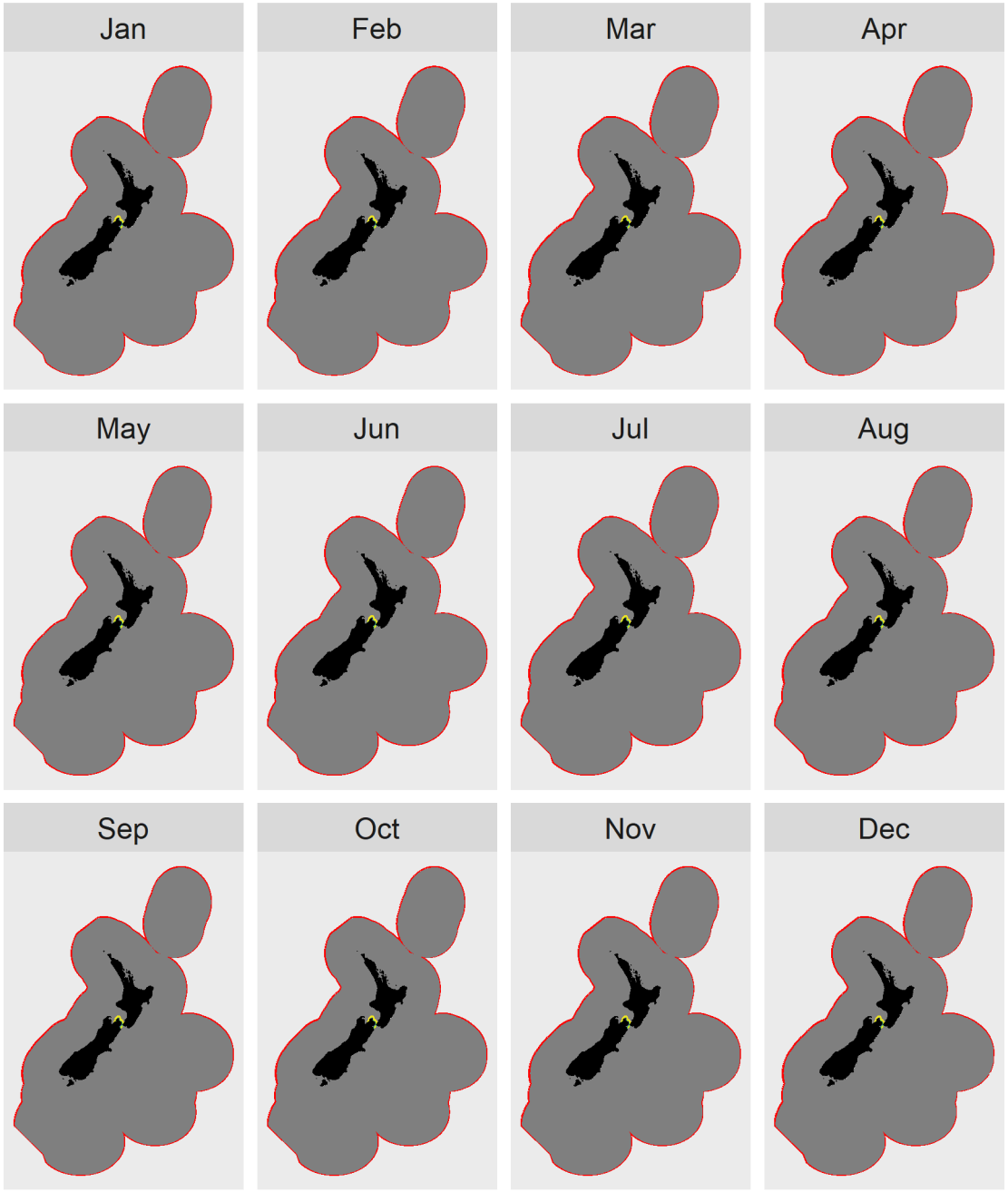

Figure 59: Relative density maps of adult New Zealand king shag by month (proportion of individuals per square kilometre). Breeding takes place during: Mar,Apr,May,Jun,Jul,Aug,Sep,Oct. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 191: Input covariate probabilities for New Zealand king shag.

Month	Probability in EEZ	Probability on nest	Season
Jan	1.00	0.00	Non-breeding
Feb	1.00	0.00	Non-breeding
Mar	1.00	0.50	Breeding
Apr	1.00	0.50	Breeding
May	1.00	0.50	Breeding
Jun	1.00	0.50	Breeding
Jul	1.00	0.50	Breeding
Aug	1.00	0.50	Breeding
Sep	1.00	0.50	Breeding
Oct	1.00	0.50	Breeding
Nov	1.00	0.00	Non-breeding
Dec	1.00	0.00	Non-breeding

Table 192: Prior distributions of demographic parameters for New Zealand king shag.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	187	0.100
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	3	5
Current adult survival rate	uniform	0.859	0.897
Optimal adult survival rate	uniform	0.859	0.897
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 193: Summary statistics for prior distributions of demographic parameters, and derived quantities, for New Zealand king shag. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	187	152–227	Pairs
Proportion of adults breeding	0.889	0.753–0.964	Proportion
Age at first reproduction	4	3.05–4.95	Years
Current adult survival rate	0.878	0.86–0.896	Proportion
Optimal adult survival rate	0.878	0.86–0.896	Proportion
Juvenile survival rate	0.34	0.18–0.481	Proportion
Population size (adults)	422	333–537	Individuals

4.60 Otago shag (*Leucocarbo chalconotus*)

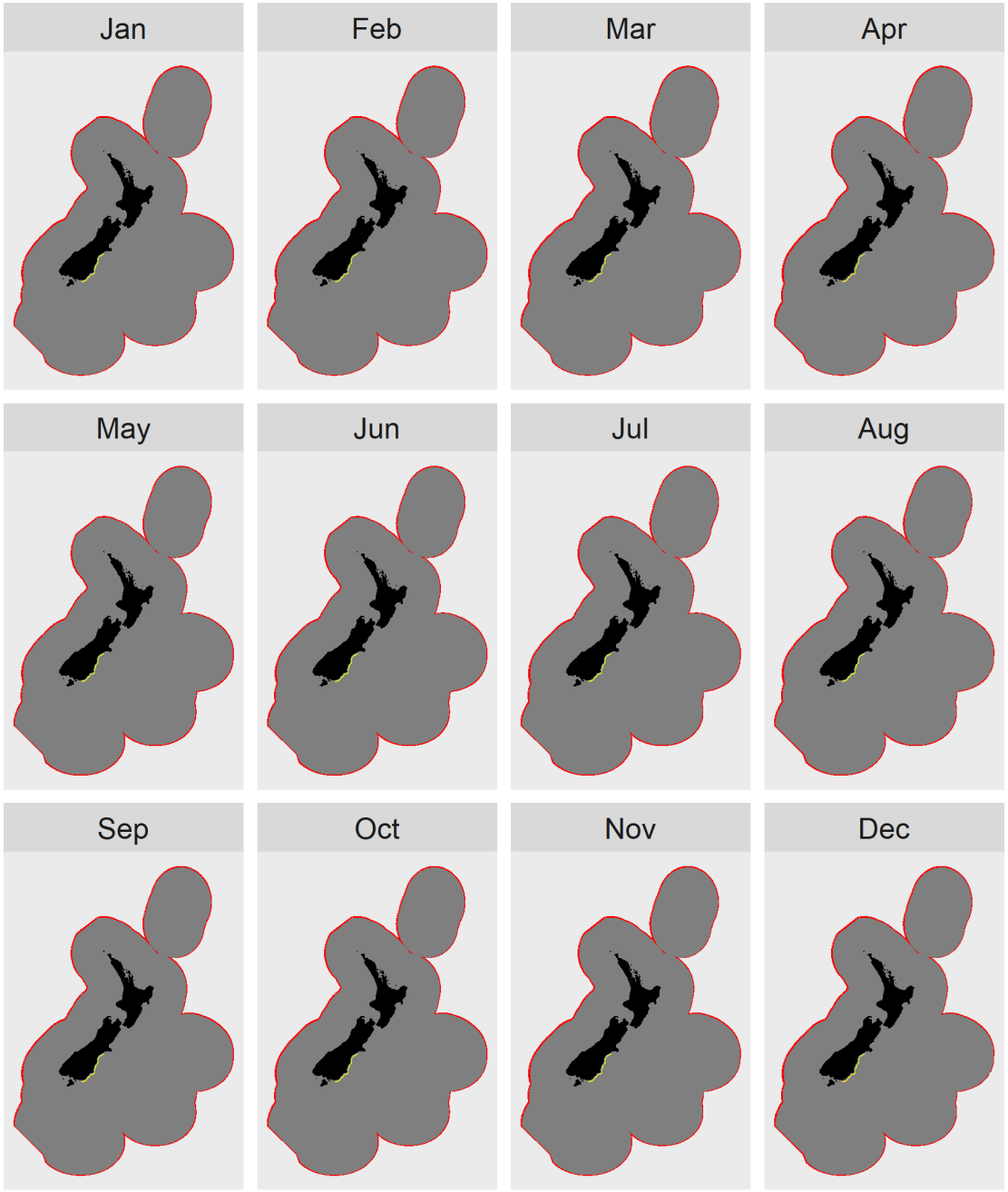

Figure 60: Relative density maps of adult Otago shag by month (proportion of individuals per square kilometre). Breeding takes place during: Aug,Sep,Oct,Nov,Dec,Jan,Feb,Mar. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 194: Input covariate probabilities for Otago shag.

Month	Probability in EEZ	Probability on nest	Season
Jan	1.00	0.50	Breeding
Feb	1.00	0.50	Breeding
Mar	1.00	0.50	Breeding
Apr	1.00	0.00	Non-breeding
May	1.00	0.00	Non-breeding
Jun	1.00	0.00	Non-breeding
Jul	1.00	0.00	Non-breeding
Aug	1.00	0.50	Breeding
Sep	1.00	0.50	Breeding
Oct	1.00	0.50	Breeding
Nov	1.00	0.50	Breeding
Dec	1.00	0.50	Breeding

Table 195: Prior distributions of demographic parameters for Otago shag.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	1 230	1 400
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	3	5
Current adult survival rate	uniform	0.859	0.897
Optimal adult survival rate	uniform	0.859	0.897
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 196: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Otago shag. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	1 320	1 230–1 400	Pairs
Proportion of adults breeding	0.888	0.75–0.964	Proportion
Age at first reproduction	4	3.05–4.95	Years
Current adult survival rate	0.878	0.86–0.896	Proportion
Optimal adult survival rate	0.878	0.86–0.896	Proportion
Juvenile survival rate	0.34	0.182–0.483	Proportion
Population size (adults)	2 970	2 630–3 550	Individuals

4.61 Foveaux shag (*Leucocarbo stewarti*)

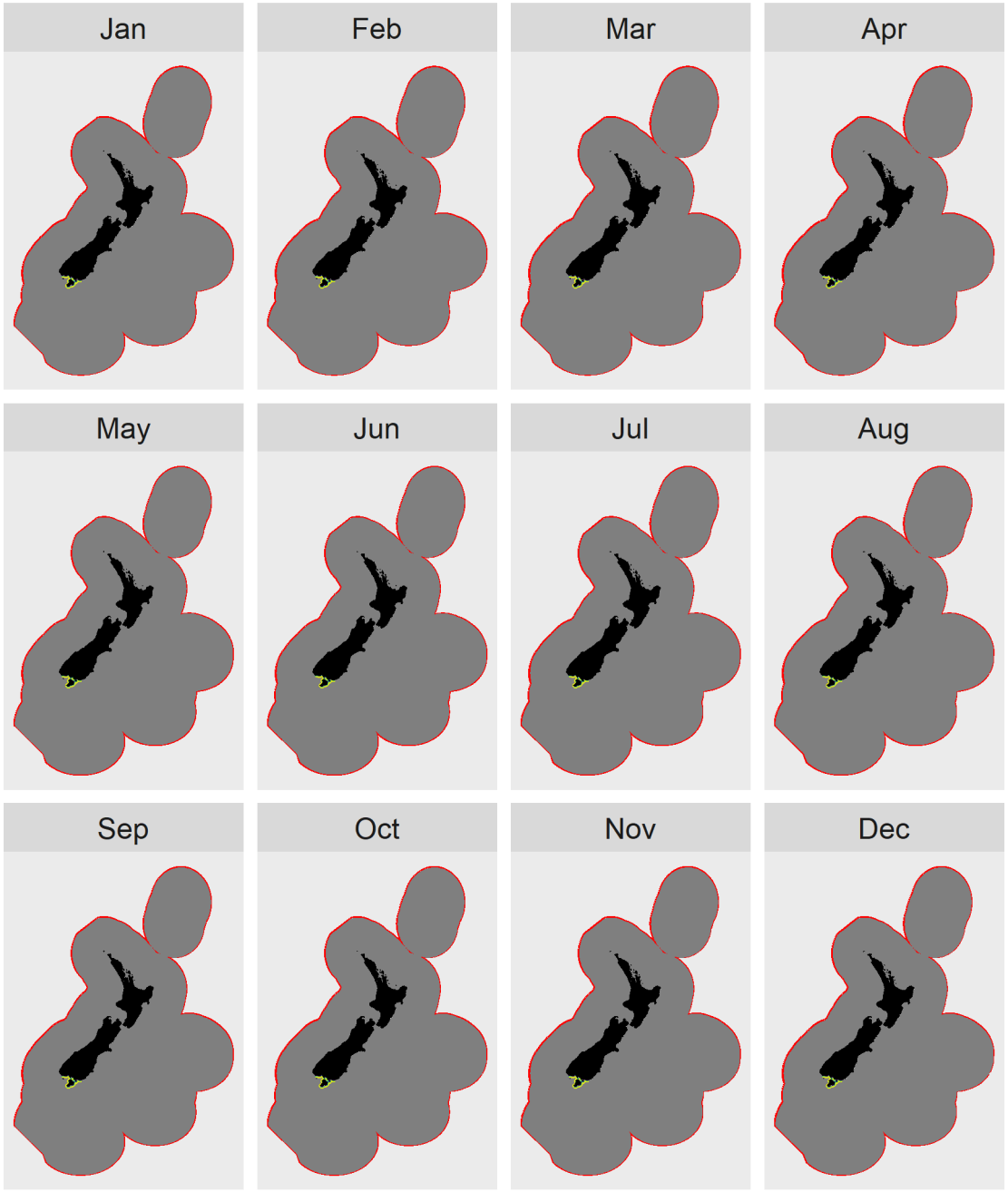

Figure 61: Relative density maps of adult Foveaux shag by month (proportion of individuals per square kilometre). Breeding takes place during: Aug,Sep,Oct,Nov,Dec,Jan,Feb,Mar. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 197: Input covariate probabilities for Foveaux shag.

Month	Probability in EEZ	Probability on nest	Season
Jan	1.00	0.50	Breeding
Feb	1.00	0.50	Breeding
Mar	1.00	0.50	Breeding
Apr	1.00	0.00	Non-breeding
May	1.00	0.00	Non-breeding
Jun	1.00	0.00	Non-breeding
Jul	1.00	0.00	Non-breeding
Aug	1.00	0.50	Breeding
Sep	1.00	0.50	Breeding
Oct	1.00	0.50	Breeding
Nov	1.00	0.50	Breeding
Dec	1.00	0.50	Breeding

Table 198: Prior distributions of demographic parameters for Foveaux shag.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	840	1 080
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	3	5
Current adult survival rate	uniform	0.859	0.897
Optimal adult survival rate	uniform	0.859	0.897
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 199: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Foveaux shag. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	961	847–1 070	Pairs
Proportion of adults breeding	0.889	0.75–0.964	Proportion
Age at first reproduction	4.01	3.05–4.95	Years
Current adult survival rate	0.878	0.86–0.896	Proportion
Optimal adult survival rate	0.878	0.86–0.896	Proportion
Juvenile survival rate	0.339	0.178–0.48	Proportion
Population size (adults)	2 170	1 820–2 660	Individuals

4.62 Chatham Island shag (*Leucocarbo onslowi*)

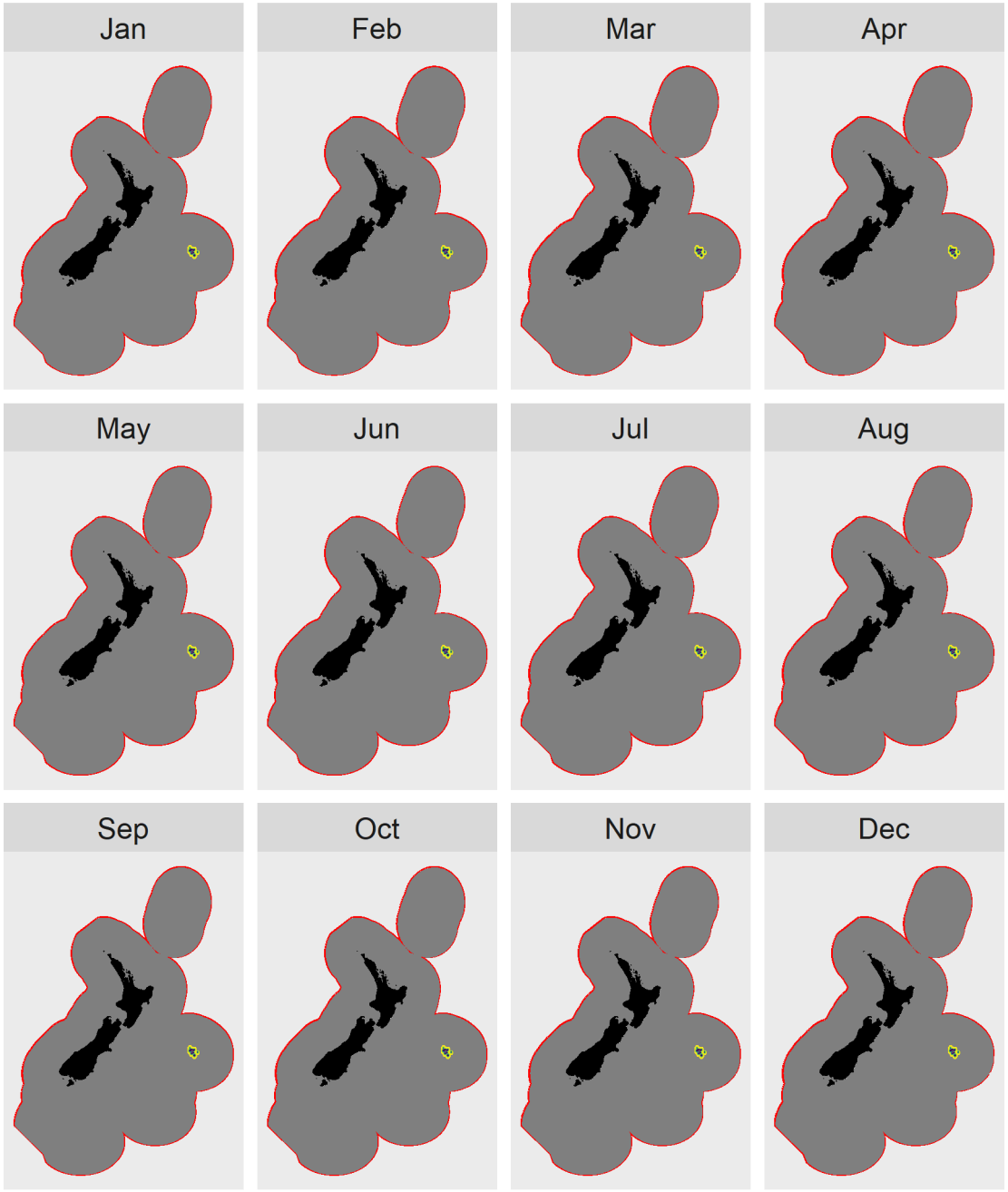

Figure 62: Relative density maps of adult Chatham Island shag by month (proportion of individuals per square kilometre). Breeding takes place during: Sep,Oct,Nov,Dec,Jan,Feb. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 200: Input covariate probabilities for Chatham Island shag.

Month	Probability in EEZ	Probability on nest	Season
Jan	1.00	0.50	Breeding
Feb	1.00	0.50	Breeding
Mar	1.00	0.00	Non-breeding
Apr	1.00	0.00	Non-breeding
May	1.00	0.00	Non-breeding
Jun	1.00	0.00	Non-breeding
Jul	1.00	0.00	Non-breeding
Aug	1.00	0.00	Non-breeding
Sep	1.00	0.50	Breeding
Oct	1.00	0.50	Breeding
Nov	1.00	0.50	Breeding
Dec	1.00	0.50	Breeding

Table 201: Prior distributions of demographic parameters for Chatham Island shag.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	355	0.100
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	3	5
Current adult survival rate	uniform	0.859	0.897
Optimal adult survival rate	uniform	0.859	0.897
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 202: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Chatham Island shag. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	355	291–430	Pairs
Proportion of adults breeding	0.889	0.754–0.964	Proportion
Age at first reproduction	4	3.05–4.95	Years
Current adult survival rate	0.878	0.86–0.896	Proportion
Optimal adult survival rate	0.878	0.86–0.896	Proportion
Juvenile survival rate	0.339	0.175–0.484	Proportion
Population size (adults)	801	637–1 020	Individuals

4.63 Bounty Island shag (*Leucocarbo ranfurlyi*)

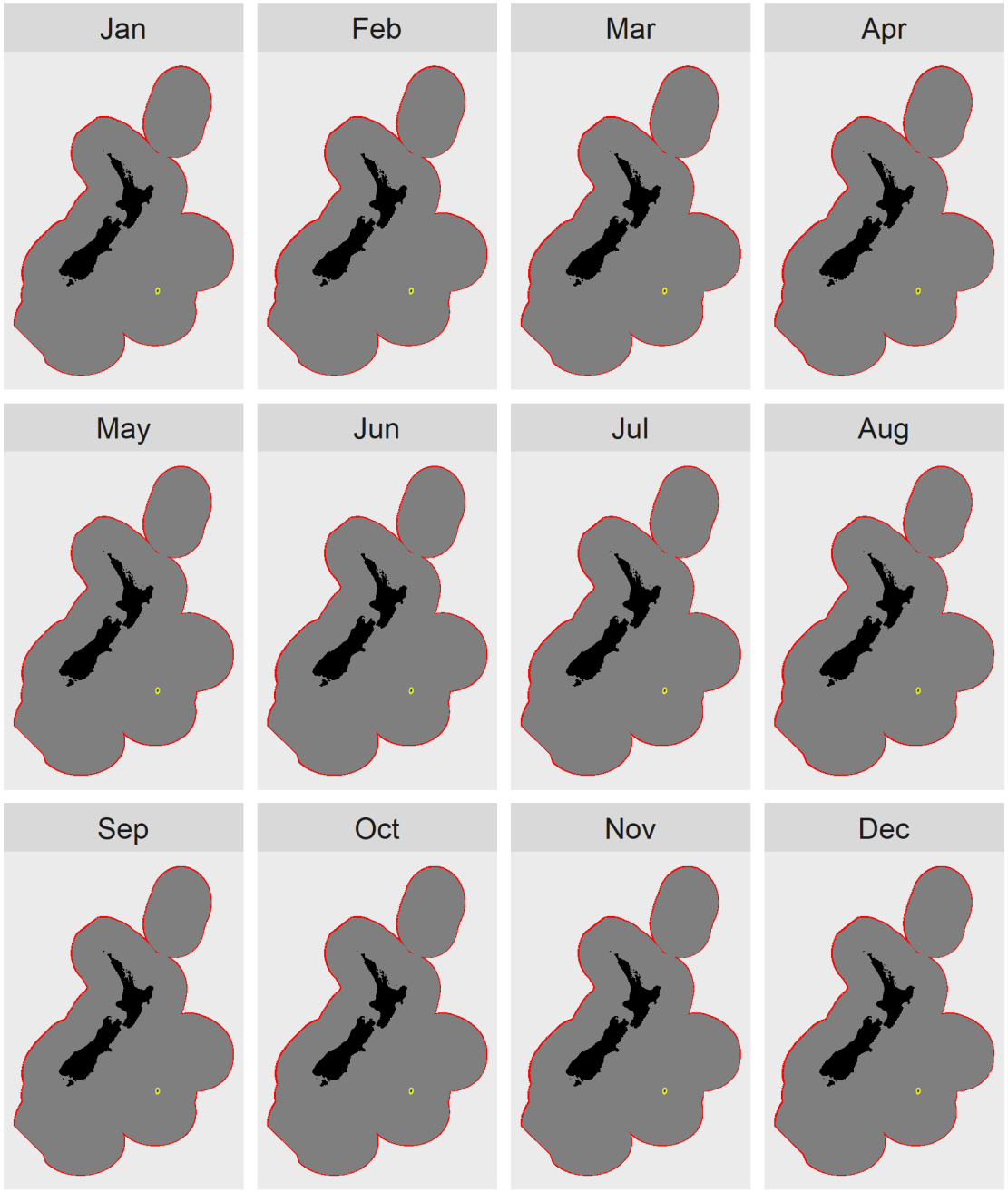

Figure 63: Relative density maps of adult Bounty Island shag by month (proportion of individuals per square kilometre). Breeding takes place during: Oct,Nov,Dec. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 203: Input covariate probabilities for Bounty Island shag.

Month	Probability in EEZ	Probability on nest	Season
Jan	1.00	0.00	Non-breeding
Feb	1.00	0.00	Non-breeding
Mar	1.00	0.00	Non-breeding
Apr	1.00	0.00	Non-breeding
May	1.00	0.00	Non-breeding
Jun	1.00	0.00	Non-breeding
Jul	1.00	0.00	Non-breeding
Aug	1.00	0.00	Non-breeding
Sep	1.00	0.00	Non-breeding
Oct	1.00	0.50	Breeding
Nov	1.00	0.50	Breeding
Dec	1.00	0.50	Breeding

Table 204: Prior distributions of demographic parameters for Bounty Island shag.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	120	0.200
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	3	5
Current adult survival rate	uniform	0.859	0.897
Optimal adult survival rate	uniform	0.859	0.897
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 205: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Bounty Island shag. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	120	78.9–176	Pairs
Proportion of adults breeding	0.889	0.75–0.964	Proportion
Age at first reproduction	3.99	3.04–4.95	Years
Current adult survival rate	0.878	0.86–0.896	Proportion
Optimal adult survival rate	0.878	0.86–0.896	Proportion
Juvenile survival rate	0.339	0.178–0.484	Proportion
Population size (adults)	272	175–404	Individuals

4.64 Auckland Island shag (*Leucocarbo colensoi*)

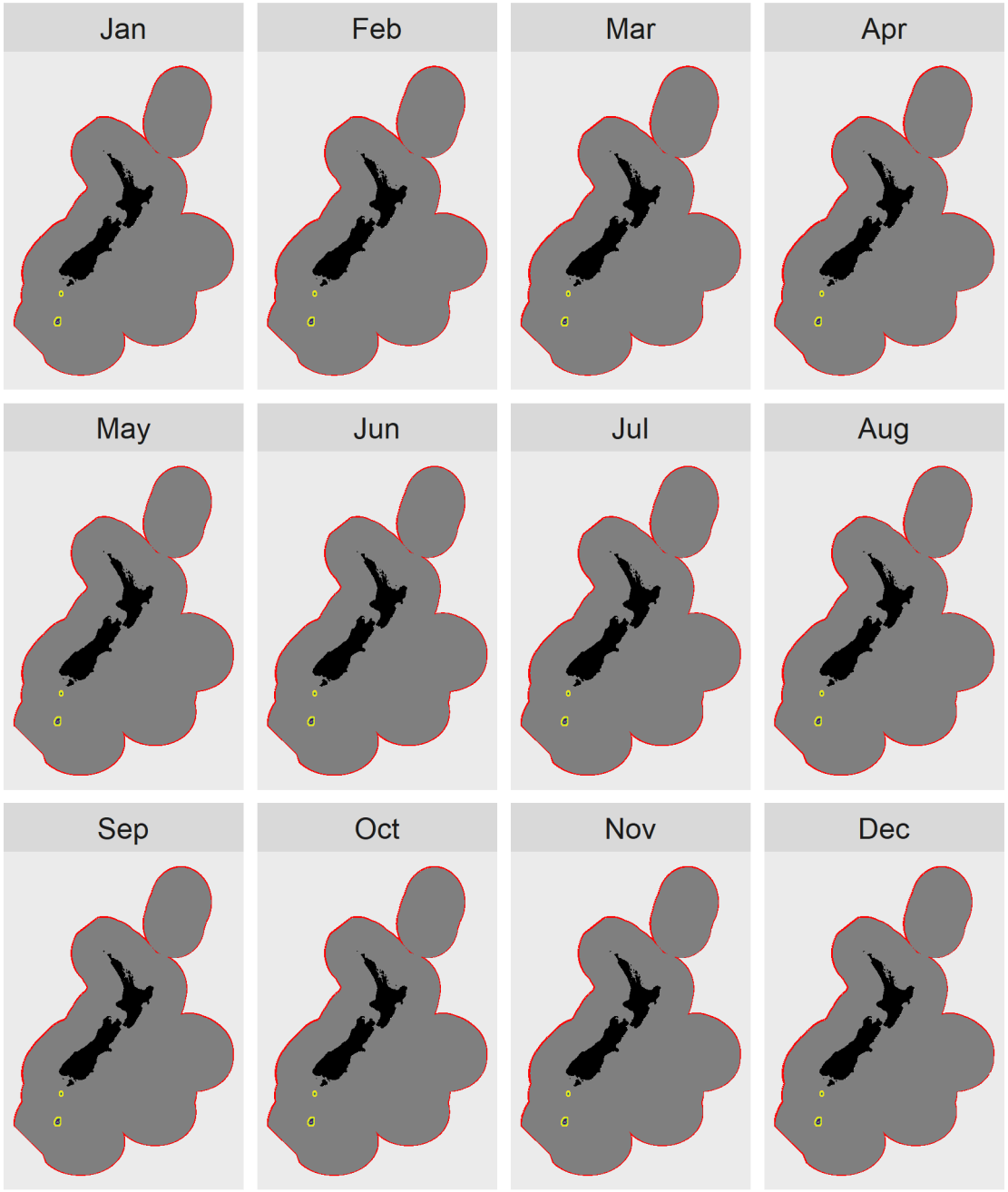

Figure 64: Relative density maps of adult Auckland Island shag by month (proportion of individuals per square kilometre). Breeding takes place during: Nov,Dec,Jan,Feb,Mar. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 206: Input covariate probabilities for Auckland Island shag.

Month	Probability in EEZ	Probability on nest	Season
Jan	1.00	0.50	Breeding
Feb	1.00	0.50	Breeding
Mar	1.00	0.50	Breeding
Apr	1.00	0.00	Non-breeding
May	1.00	0.00	Non-breeding
Jun	1.00	0.00	Non-breeding
Jul	1.00	0.00	Non-breeding
Aug	1.00	0.00	Non-breeding
Sep	1.00	0.00	Non-breeding
Oct	1.00	0.00	Non-breeding
Nov	1.00	0.50	Breeding
Dec	1.00	0.50	Breeding

Table 207: Prior distributions of demographic parameters for Auckland Island shag.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	956	4 098
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	3	5
Current adult survival rate	uniform	0.859	0.897
Optimal adult survival rate	uniform	0.859	0.897
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 208: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Auckland Island shag. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	2 540	1 040–4 020	Pairs
Proportion of adults breeding	0.889	0.75–0.963	Proportion
Age at first reproduction	4	3.05–4.95	Years
Current adult survival rate	0.878	0.86–0.896	Proportion
Optimal adult survival rate	0.878	0.86–0.896	Proportion
Juvenile survival rate	0.34	0.178–0.485	Proportion
Population size (adults)	5 750	2 330–9 370	Individuals

4.65 Campbell Island shag (*Leucocarbo campbelli*)

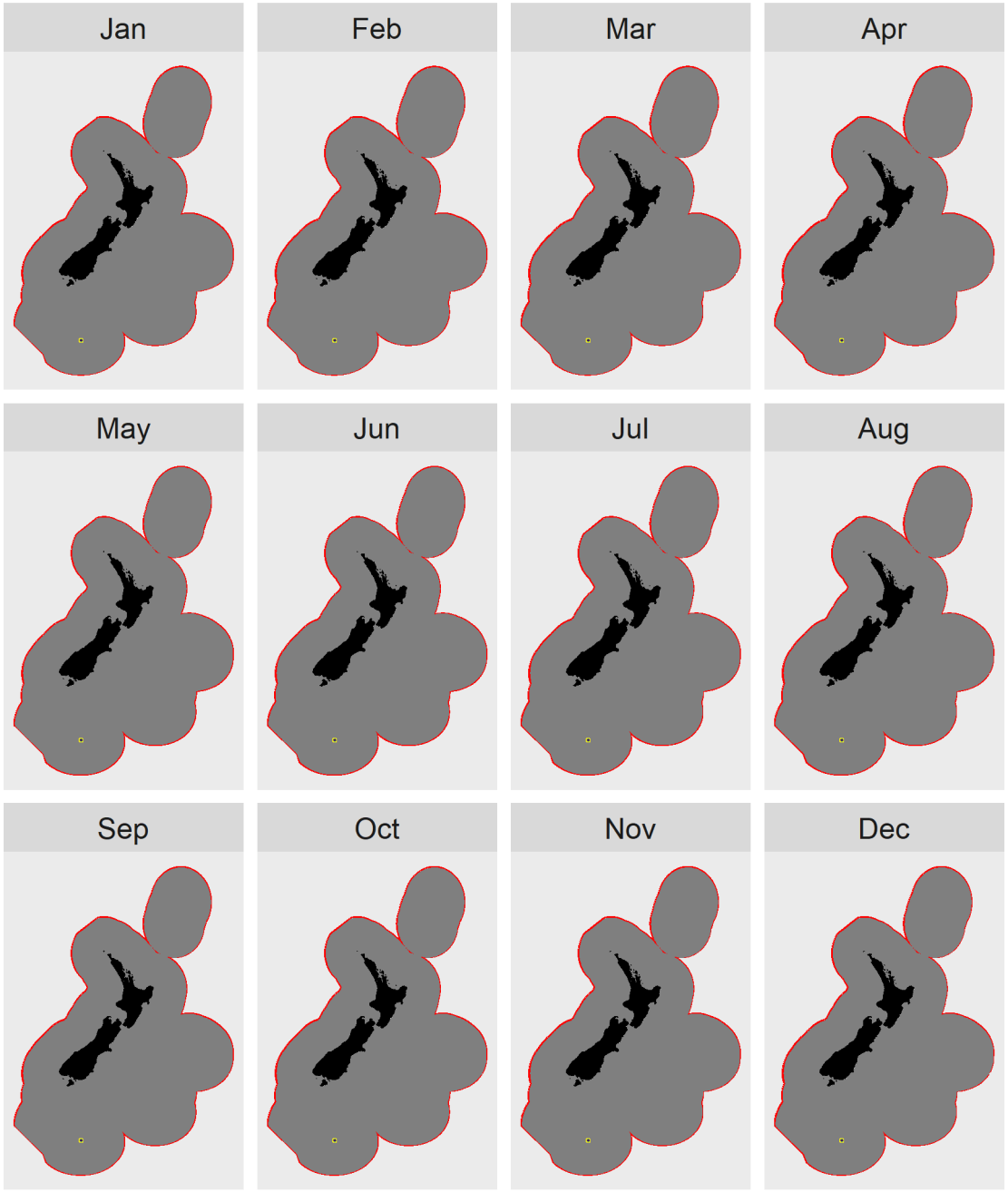

Figure 65: Relative density maps of adult Campbell Island shag by month (proportion of individuals per square kilometre). Breeding takes place during: Nov,Dec,Jan,Feb. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 209: Input covariate probabilities for Campbell Island shag.

Month	Probability in EEZ	Probability on nest	Season
Jan	1.00	0.50	Breeding
Feb	1.00	0.50	Breeding
Mar	1.00	0.00	Non-breeding
Apr	1.00	0.00	Non-breeding
May	1.00	0.00	Non-breeding
Jun	1.00	0.00	Non-breeding
Jul	1.00	0.00	Non-breeding
Aug	1.00	0.00	Non-breeding
Sep	1.00	0.00	Non-breeding
Oct	1.00	0.00	Non-breeding
Nov	1.00	0.50	Breeding
Dec	1.00	0.50	Breeding

Table 210: Prior distributions of demographic parameters for Campbell Island shag.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	2 000	0.300
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	3	5
Current adult survival rate	uniform	0.859	0.897
Optimal adult survival rate	uniform	0.859	0.897
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 211: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Campbell Island shag. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	1 990	1 070–3 380	Pairs
Proportion of adults breeding	0.889	0.752–0.964	Proportion
Age at first reproduction	4	3.06–4.95	Years
Current adult survival rate	0.878	0.86–0.896	Proportion
Optimal adult survival rate	0.878	0.86–0.896	Proportion
Juvenile survival rate	0.339	0.178–0.484	Proportion
Population size (adults)	4 490	2 370–7 820	Individuals

4.66 Spotted shag (*Stictocarbo punctatus*)

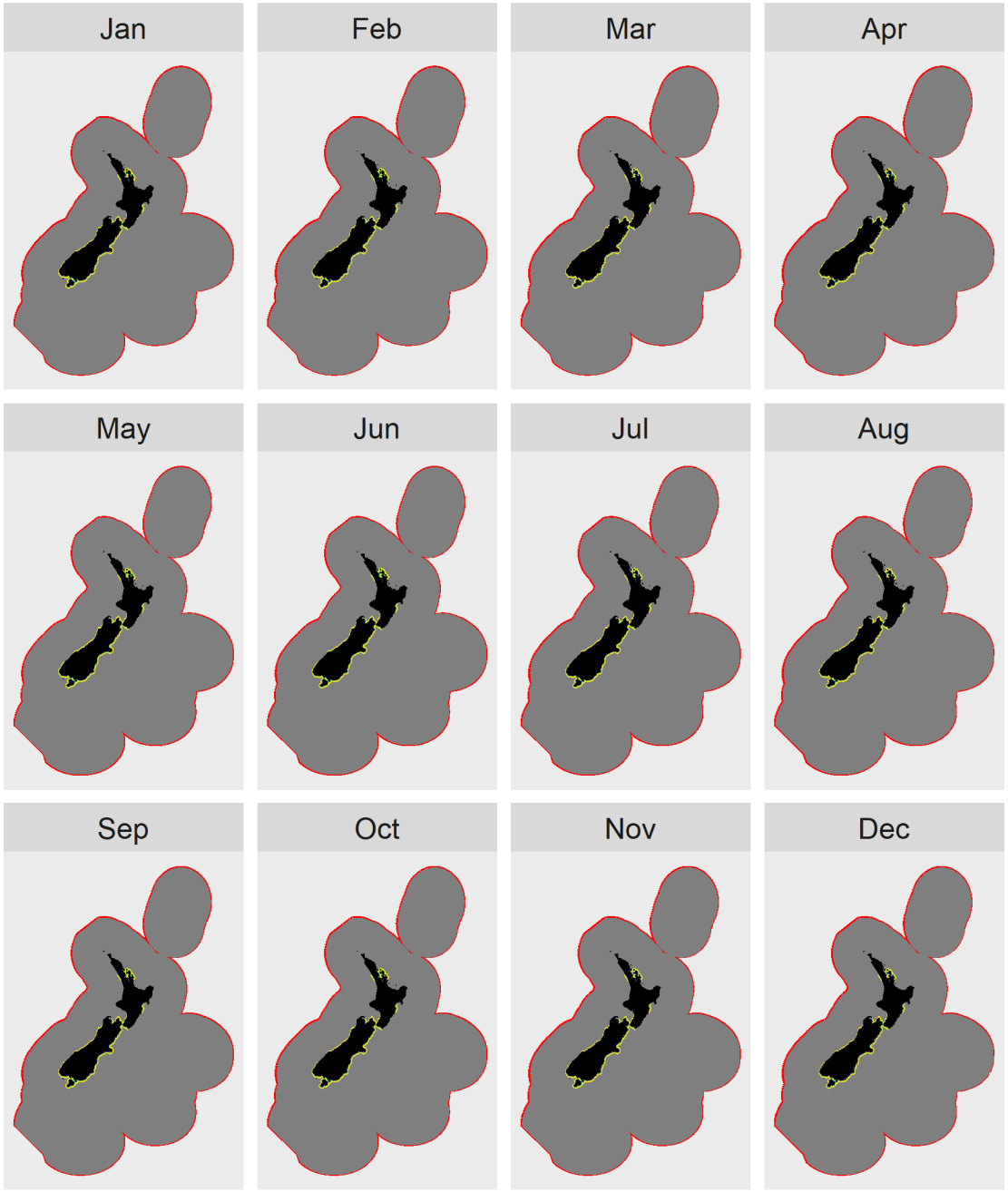

Figure 66: Relative density maps of adult Spotted shag by month (proportion of individuals per square kilometre). Breeding takes place during: Jan,Feb,Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 212: Input covariate probabilities for Spotted shag.

Month	Probability in EEZ	Probability on nest	Season
Jan	1.00	0.50	Breeding
Feb	1.00	0.50	Breeding
Mar	1.00	0.50	Breeding
Apr	1.00	0.50	Breeding
May	1.00	0.50	Breeding
Jun	1.00	0.50	Breeding
Jul	1.00	0.50	Breeding
Aug	1.00	0.50	Breeding
Sep	1.00	0.50	Breeding
Oct	1.00	0.50	Breeding
Nov	1.00	0.50	Breeding
Dec	1.00	0.50	Breeding

Table 213: Prior distributions of demographic parameters for Spotted shag.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	10 000	30 000
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	1	3
Current adult survival rate	uniform	0.859	0.897
Optimal adult survival rate	uniform	0.859	0.897
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 214: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Spotted shag. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	20 000	10 500–29 400	Pairs
Proportion of adults breeding	0.889	0.753–0.965	Proportion
Age at first reproduction	2	1.05–2.95	Years
Current adult survival rate	0.878	0.86–0.896	Proportion
Optimal adult survival rate	0.878	0.86–0.896	Proportion
Juvenile survival rate	0.55	0.368–0.716	Proportion
Population size (adults)	45 100	23 400–68 600	Individuals

4.67 Pitt Island shag (*Stictocarbo featherstoni*)

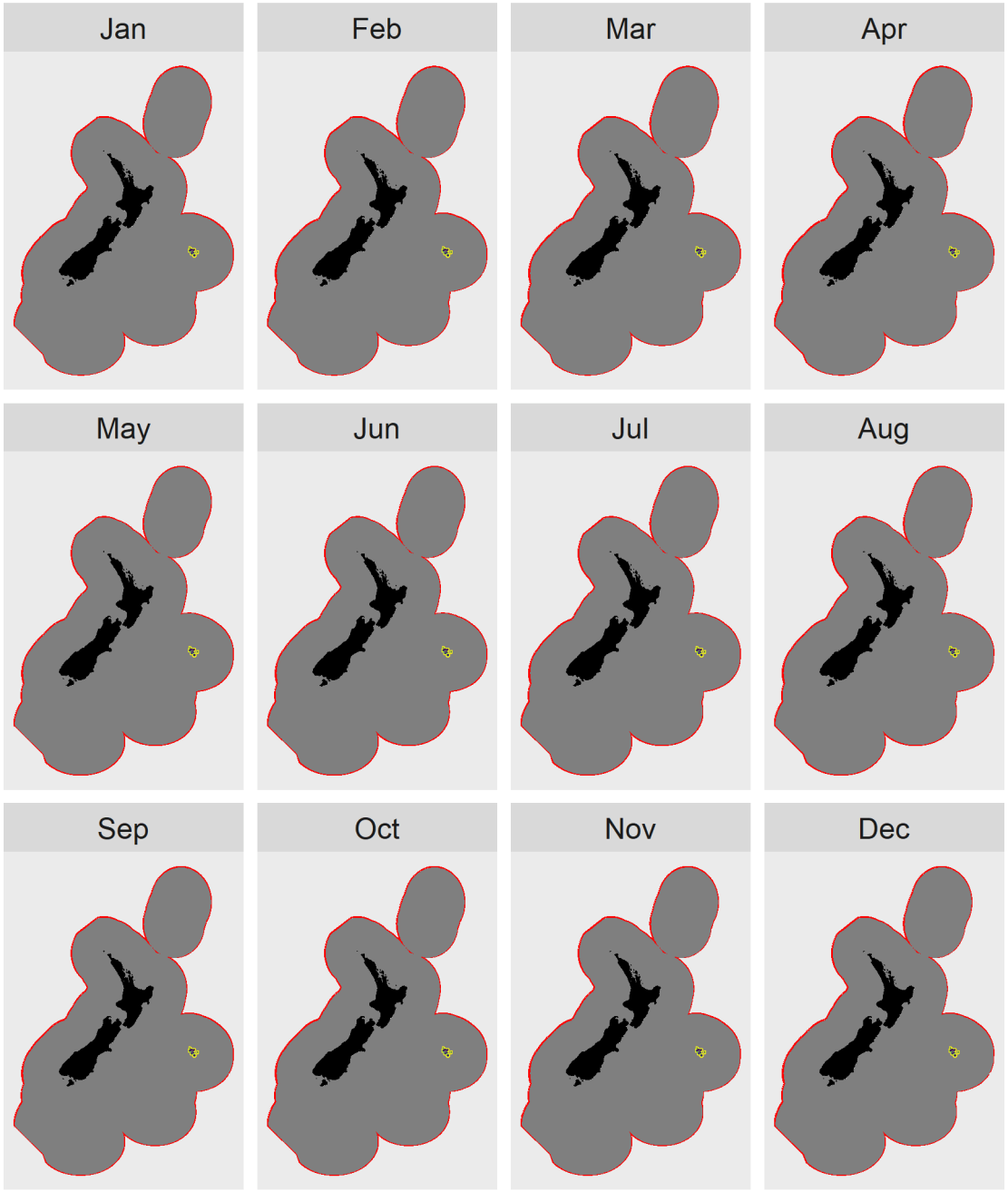

Figure 67: Relative density maps of adult Pitt Island shag by month (proportion of individuals per square kilometre). Breeding takes place during: Sep,Oct,Nov,Dec,Jan,Feb. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 215: Input covariate probabilities for Pitt Island shag.

Month	Probability in EEZ	Probability on nest	Season
Jan	1.00	0.50	Breeding
Feb	1.00	0.50	Breeding
Mar	1.00	0.00	Non-breeding
Apr	1.00	0.00	Non-breeding
May	1.00	0.00	Non-breeding
Jun	1.00	0.00	Non-breeding
Jul	1.00	0.00	Non-breeding
Aug	1.00	0.00	Non-breeding
Sep	1.00	0.50	Breeding
Oct	1.00	0.50	Breeding
Nov	1.00	0.50	Breeding
Dec	1.00	0.50	Breeding

Table 216: Prior distributions of demographic parameters for Pitt Island shag.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	338	0.100
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	3	5
Current adult survival rate	uniform	0.859	0.897
Optimal adult survival rate	uniform	0.859	0.897
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 217: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Pitt Island shag. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	338	276–410	Pairs
Proportion of adults breeding	0.889	0.751–0.964	Proportion
Age at first reproduction	3.99	3.05–4.95	Years
Current adult survival rate	0.878	0.86–0.896	Proportion
Optimal adult survival rate	0.878	0.86–0.896	Proportion
Juvenile survival rate	0.34	0.177–0.485	Proportion
Population size (adults)	764	605–970	Individuals

4.68 Subantarctic skua (*Catharacta antarctica lonnbergi*)

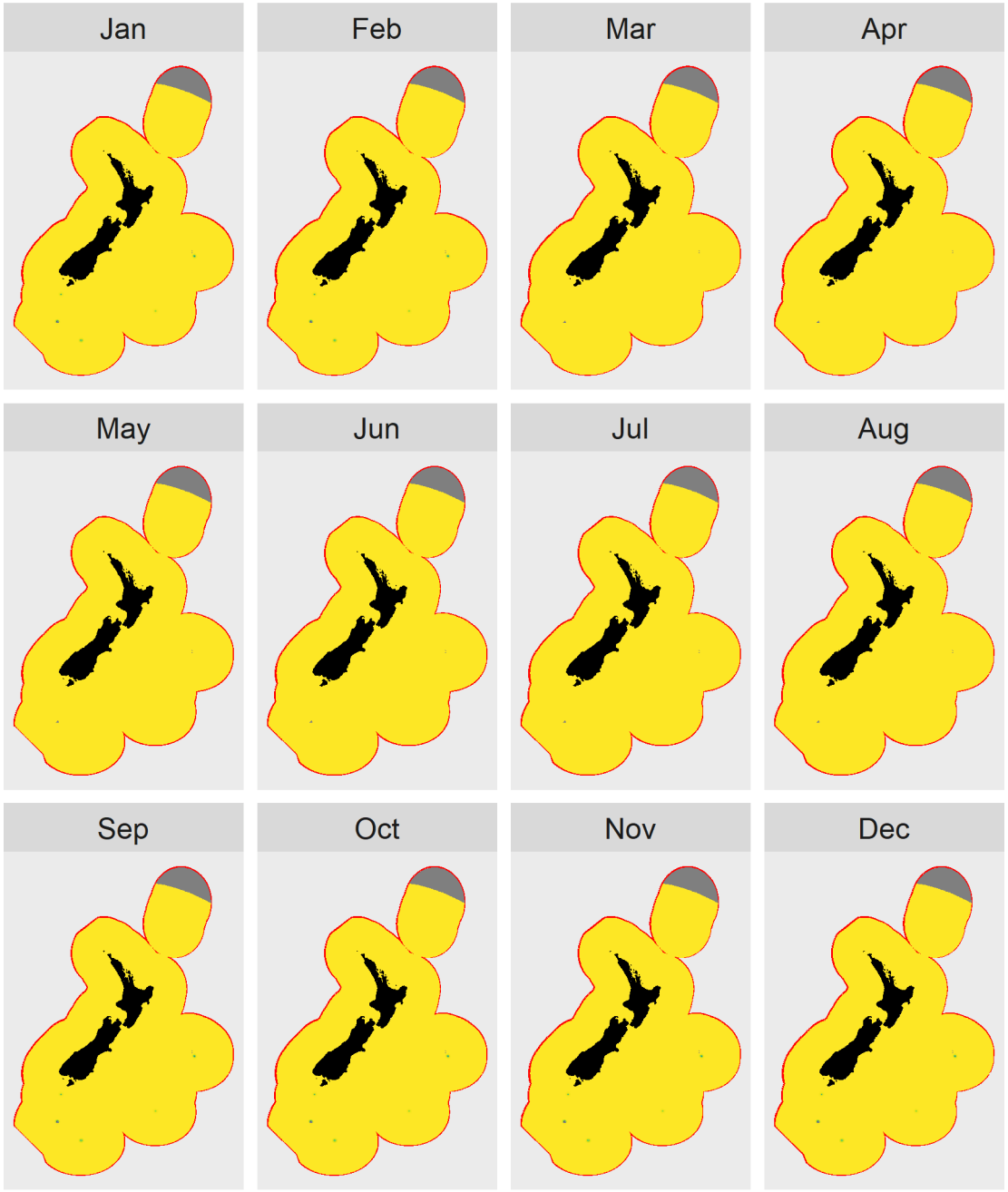

Figure 68: Relative density maps of adult Subantarctic skua by month (proportion of individuals per square kilometre). Breeding takes place during: Sep,Oct,Nov,Dec,Jan,Feb. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 218: Input covariate probabilities for Subantarctic skua.

Month	Probability in EEZ	Probability on nest	Season
Jan	0.95	0.50	Breeding
Feb	0.95	0.50	Breeding
Mar	0.50	0.00	Non-breeding
Apr	0.50	0.00	Non-breeding
May	0.50	0.00	Non-breeding
Jun	0.50	0.00	Non-breeding
Jul	0.50	0.00	Non-breeding
Aug	0.50	0.00	Non-breeding
Sep	0.95	0.50	Breeding
Oct	0.95	0.50	Breeding
Nov	0.95	0.50	Breeding
Dec	0.95	0.50	Breeding

Table 219: Prior distributions of demographic parameters for Subantarctic skua.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	450	470
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	7.62	8.44
Current adult survival rate	uniform	0.91	0.97
Optimal adult survival rate	uniform	0.91	0.97
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 220: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Subantarctic skua. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	460	450–469	Pairs
Proportion of adults breeding	0.889	0.753–0.964	Proportion
Age at first reproduction	8.03	7.64–8.42	Years
Current adult survival rate	0.94	0.912–0.969	Proportion
Optimal adult survival rate	0.94	0.912–0.969	Proportion
Juvenile survival rate	0.23	0.0634–0.422	Proportion
Population size (adults)	1 040	949–1 220	Individuals

4.69 Southern black-backed gull (*Larus dominicanus dominicanus*)

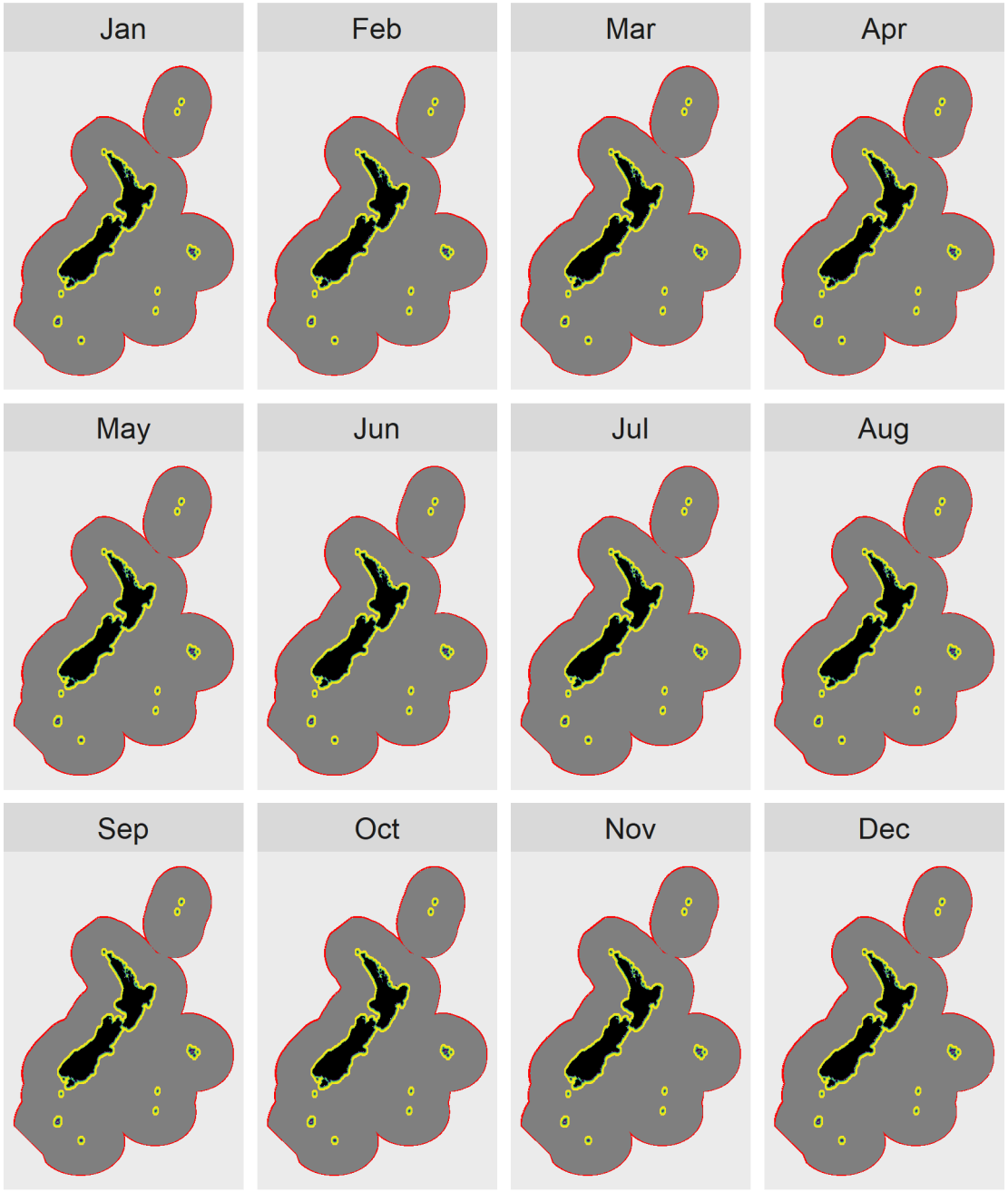

Figure 69: Relative density maps of adult Southern black-backed gull by month (proportion of individuals per square kilometre). Breeding takes place during: Sep,Oct,Nov,Dec,Jan,Feb,Mar. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 221: Input covariate probabilities for Southern black-backed gull.

Month	Probability in EEZ	Probability on nest	Season
Jan	1.00	0.50	Breeding
Feb	1.00	0.50	Breeding
Mar	1.00	0.50	Breeding
Apr	1.00	0.00	Non-breeding
May	1.00	0.00	Non-breeding
Jun	1.00	0.00	Non-breeding
Jul	1.00	0.00	Non-breeding
Aug	1.00	0.00	Non-breeding
Sep	1.00	0.50	Breeding
Oct	1.00	0.50	Breeding
Nov	1.00	0.50	Breeding
Dec	1.00	0.50	Breeding

Table 222: Prior distributions of demographic parameters for Southern black-backed gull.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	700 000	3 000 000
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	3	5
Current adult survival rate	logit-normal	0.81	0.03
Optimal adult survival rate	logit-normal	0.81	0.03
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 223: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Southern black-backed gull. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	1 860 000	759 000–2 950 000	Pairs
Proportion of adults breeding	0.889	0.752–0.964	Proportion
Age at first reproduction	3.99	3.05–4.95	Years
Current adult survival rate	0.808	0.744–0.862	Proportion
Optimal adult survival rate	0.808	0.742–0.862	Proportion
Juvenile survival rate	0.248	0.114–0.394	Proportion
Population size (adults)	4 200 000	1 700 000–6 870 000	Individuals

4.70 Caspian tern (*Hydroprogne caspia*)

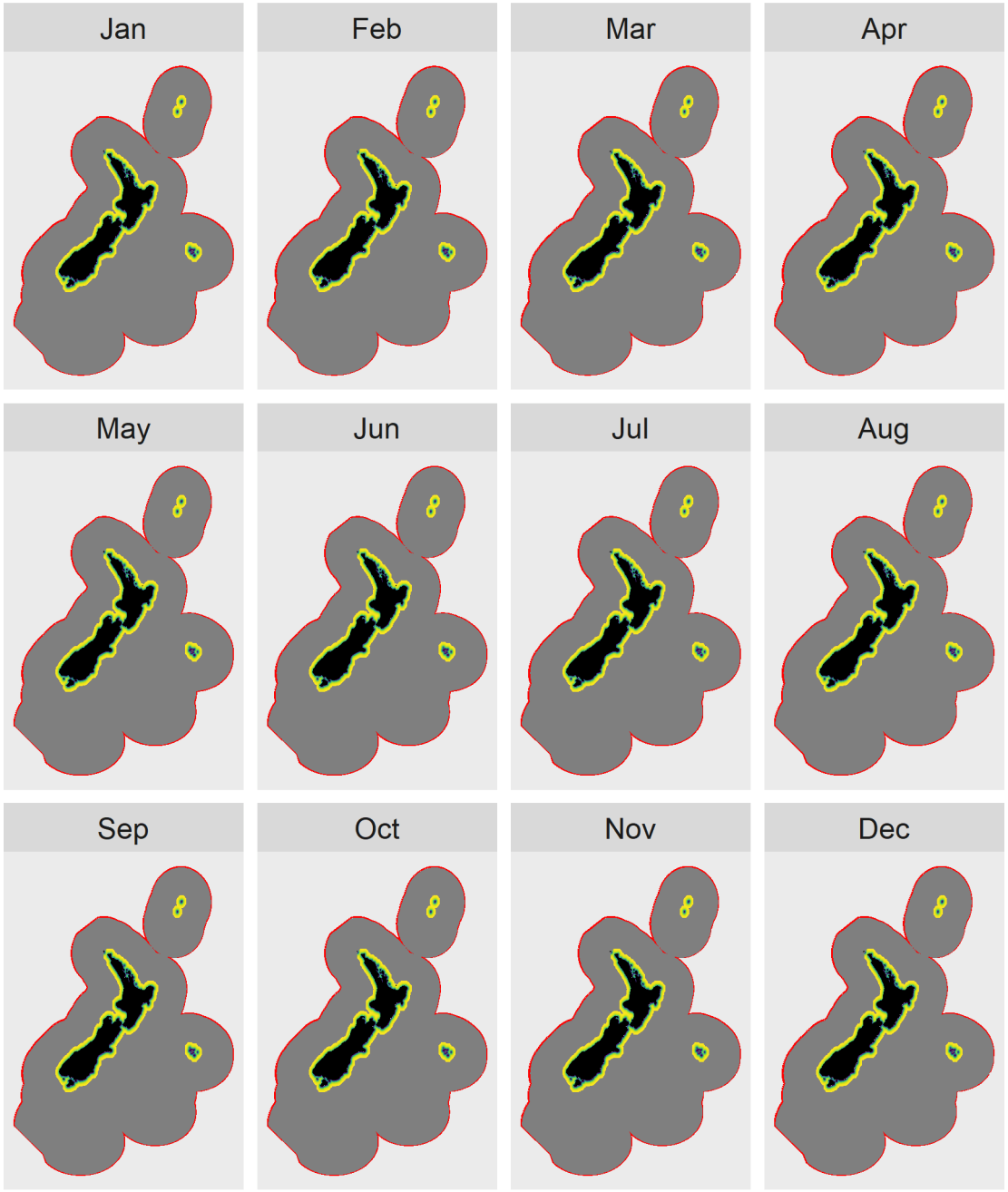

Figure 70: Relative density maps of adult Caspian tern by month (proportion of individuals per square kilometre). Breeding takes place during: Sep,Oct,Nov,Dec,Jan. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 224: Input covariate probabilities for Caspian tern.

Month	Probability in EEZ	Probability on nest	Season
Jan	1.00	0.50	Breeding
Feb	1.00	0.00	Non-breeding
Mar	1.00	0.00	Non-breeding
Apr	1.00	0.00	Non-breeding
May	1.00	0.00	Non-breeding
Jun	1.00	0.00	Non-breeding
Jul	1.00	0.00	Non-breeding
Aug	1.00	0.00	Non-breeding
Sep	1.00	0.50	Breeding
Oct	1.00	0.50	Breeding
Nov	1.00	0.50	Breeding
Dec	1.00	0.50	Breeding

Table 225: Prior distributions of demographic parameters for Caspian tern.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	log-normal	1 000	0.200
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	2	4
Current adult survival rate	uniform	0.816	0.937
Optimal adult survival rate	uniform	0.816	0.937
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 226: Summary statistics for prior distributions of demographic parameters, and derived quantities, for Caspian tern. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	998	664–1 440	Pairs
Proportion of adults breeding	0.889	0.753–0.964	Proportion
Age at first reproduction	3	2.05–3.95	Years
Current adult survival rate	0.876	0.819–0.934	Proportion
Optimal adult survival rate	0.877	0.819–0.934	Proportion
Juvenile survival rate	0.431	0.235–0.617	Proportion
Population size (adults)	2 250	1 470–3 360	Individuals

4.71 White tern (*Gygis alba candida*)

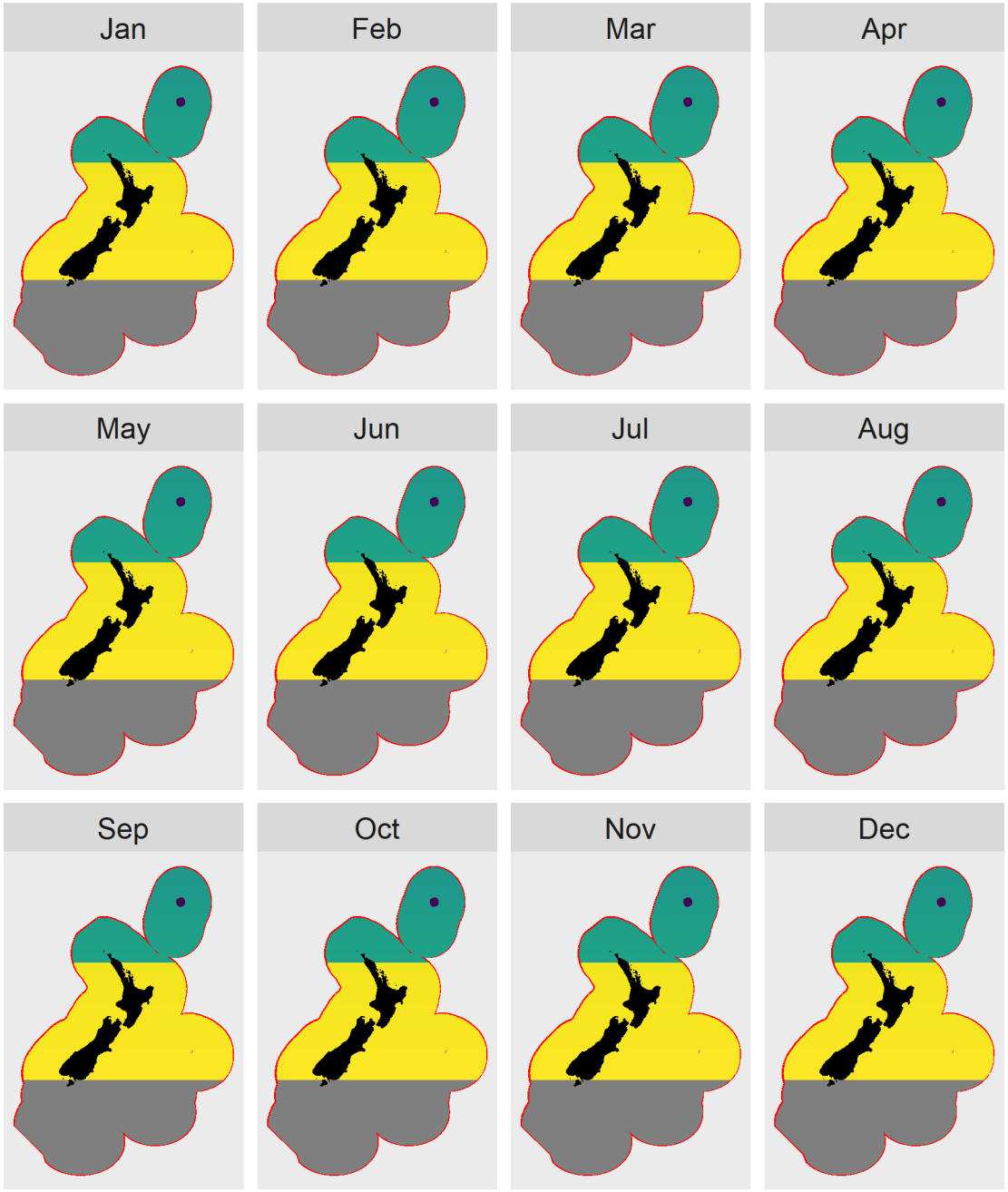

Figure 71: Relative density maps of adult White tern by month (proportion of individuals per square kilometre). Breeding takes place during: Sep,Oct,Nov,Dec,Jan,Feb,Mar,Apr. Cells with low, medium and high densities are yellow, green and purple, respectively. Grey cells indicate a density of 0. All panels share the same colour scale, but the colour scale is species-specific.

Table 227: Input covariate probabilities for White tern.

Month	Probability in EEZ	Probability on nest	Season
Jan	1.00	0.50	Breeding
Feb	1.00	0.50	Breeding
Mar	1.00	0.50	Breeding
Apr	1.00	0.50	Breeding
May	1.00	0.00	Non-breeding
Jun	1.00	0.00	Non-breeding
Jul	1.00	0.00	Non-breeding
Aug	1.00	0.00	Non-breeding
Sep	1.00	0.50	Breeding
Oct	1.00	0.50	Breeding
Nov	1.00	0.50	Breeding
Dec	1.00	0.50	Breeding

Table 228: Prior distributions of demographic parameters for White tern.

Parameter	Distribution	Parameter *a*	Parameter *b*
Annual breeding pairs	uniform	60	100
Proportion of adults breeding	logit-normal	0.9	0.05
Age at first reproduction	uniform	3	5
Current adult survival rate	uniform	0.78	0.83
Optimal adult survival rate	uniform	0.78	0.83
Egg survival rate multiplier	logit-normal	0.8	0.05
Juvenile survival rate multiplier	logit-normal	0.9	0.05

Table 229: Summary statistics for prior distributions of demographic parameters, and derived quantities, for White tern. Juvenile survival refers to the survivorship to the age at first breeding.

Parameter	Mean	95% CI	Unit
Annual breeding pairs	80.1	61–99.1	Pairs
Proportion of adults breeding	0.889	0.756–0.965	Proportion
Age at first reproduction	4	3.05–4.95	Years
Current adult survival rate	0.805	0.781–0.829	Proportion
Optimal adult survival rate	0.805	0.781–0.829	Proportion
Juvenile survival rate	0.242	0.119–0.368	Proportion
Population size (adults)	181	133–237	Individuals

5. ACKNOWLEDGEMENTS

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