Forest bird population trends at Martins Bay, Hollyford Valley, Fiordland

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Objective

Forest birds were monitored at Martins Bay to determine their response to an intensive predator control programme carried out by the Hollyford Conservation Trust (HCT). Initial bird monitoring was conducted in September 2014, before any management was undertaken. Counts were repeated annually. We report on changes in bird population trends between 2014 and 2019.

Methods

Sampling techniques

To report on the response of a wide range of forest bird species, bird counts were conducted using two methods: (1) line-transect based distance sampling (Buckland et al. 2001; Buckland 2006) to estimate population densities and monitor density trends of five key forest bird species, and (2) encounter rates (mean number of detections per km) to monitor gross changes in population size and composition for all forest bird species.

Study species

Bellbird (*Anthornis melanura*), kereru (*Hemiphaga novaeseelandiae*), South Island rifleman (*Acanthisitta chloris chloris*), South Island tomtit (*Petroica macrocephala macrocephala*) and tui (*Prosthemadera novaeseelandiae*) were monitored more intensively because these species represent several important guilds for the healthy functioning of forest ecosystems. They are vulnerable to predation by possums, rats and stoats, and therefore are good species to indicate the success of predator control. Other forest bird species were also monitored, although less intensively, to reveal gross changes in population size and composition resulting from management.

Transect establishment

Monitoring was undertaken using line-transects. Transects on the true right of Lake McKerrow and the Hollyford River were established in 2014; using a random design, transects on the true left were established in 2015; using a systematic sampling design with a random start point. A total of 36 transects; 18 on the true right and 18 on the true left, 450 m

in length and at least 200 m apart were sampled between 2015 and 2017. In 2018 and 2019, a selection of transects were extended or combined, increasing the total transect length across the study site to 17.5 km, spread over 26 transects.

Data collection

Data was collected annually between September and October, during fine weather only (no rain or strong winds). Data was collected by the same observer (IB) between 2015 and 2017. In 2018, data was collected by two observers (IB and HB), and in 2019 data was collected by three observers (IB, LB and SS) working on opposite sides of the lake and river. Data was collected between 0800 hours and 1800 hours.

Observers approached each transect with caution to avoid flushing undetected birds at or near the transect start point. Transects were walked at a slow and constant speed. Each time a transect was walked, a selection of weather variables including temperature, rain, wind and cloud cover were recorded at the end of the transect according to guidelines outlined in Dawson and Bull (1975).

Horizontal distances perpendicular from the transect line to each bellbird, kereru, rifleman, tomtit and tui were recorded to the nearest meter within 30 m of either side of the defined line, using a laser rangefinder with built-in inclinometer. Distances less than 5 m (minimum focal distance for a rangefinder) were estimated visually. Distances to those birds only heard, or not clearly seen, were estimated by measuring the distance to vegetation at an equivalent distance to the estimated position of the bird. The observers did not move away from the transect for more than a few meters to locate a heard bird. This was to ensure that birds on or near the transect were not missed. To prevent estimating distances to the same birds more than once, observers paid attention to the movements of the birds seen. Particular attention was paid to ensure that distance estimates were made to their first position of detection. Birds that flew into, or over the transect area, were ignored to avoid overestimating densities.

All other forest bird species seen or heard from the transects were counted regardless of their distance from the transect. If a bellbird, kereru, rifleman, tomtit or tui was seen or heard beyond 30 m of either side of the transect, this was also recorded.

Data analysis

Distance sampling data was analysed in the software Distance 6.2 (Thomas et al. 2009) using Conventional Distance Sampling (CDS). Data was first pooled across surveys to increase the sample size and then post stratified by survey to estimate the population density for each species and survey, based on a global detection function.

No distinction was made between male or female birds or birds detected by sight or their call during data analysis. Data were not truncated more than the limit set in the field (30 m) as further truncation did not improve model fit. Data were not grouped into interval classes for analysis. Detection probability histograms were constructed for each species and survey. Robust detection functions were fitted to the histograms based on guidelines in Buckland et al. (2001), and population density estimates were derived.

The following details were compared for each analytical approach: Akaike's Information Criterion (AIC), visual inspection of the detection probability histograms, Q-Q

plots, accuracy of calculated density estimates and corresponding confidence intervals and Cramer-von Mises (CvM) GoF statistics, from which a preferred model was selected, and density estimates were derived.

Simple indices of relative abundance were estimated for all species by calculating the mean number of birds counted per km per survey using the software R version 3.1.2 (R Core Team, 2013).

A linear regression model was fitted to the distance sampling and encounter rate data for each species to determine the population trend over the monitoring period.

Results

Density estimates

- All key species showed a positive population trend over the monitoring period (2014-2019) and a remarkable increase in density estimates compared to pre-operational levels (2014, Table 1, Fig.1).
- Bellbird density estimates in particular have increased largely over the monitoring period.
- Kereru densities increased less rapidly.
- Rifleman, tomtit and tui densities increased over the first five years of monitoring, rifleman and tui showed a stable (no increase or decrease) between 2018 and 2019, while tomtit densities decreased slightly.

Table 1. Population density estimates ($\hat{D}$) for bellbird, kereru, rifleman, tomtit and tui at Martins Bay between September 2014 and October 2019.

Species	Year	$\hat{D}$	$\hat{D}$ 95% lower CI	$\hat{D}$ 95% upper CI
Bellbird	2014	1.20	0.74	1.95
	2015	3.01	2.19	4.13
	2016	3.86	3.14	4.75
	2017	3.06	2.45	3.83
	2018	4.08	3.36	4.97
	2019	6.05	4.80	7.62
Kereru	2014	0.27	0.12	0.64
	2015	0.49	0.32	0.76
	2016	0.72	0.37	1.4
	2017	0.45	0.26	0.75
	2018	0.50	0.30	0.8
	2019	0.54	0.34	0.88
Rifleman	2014	0.36	0.12	1.10
	2015	0.38	0.15	0.95
	2016	0.81	0.33	1.98
	2017	0.47	0.17	1.31
	2018	1.41	0.93	2.14
	2019	1.36	0.82	2.26
Tomtit	2014	1.36	1.04	1.77
	2015	2.71	2.27	3.23
	2016	3.72	3.08	4.50
	2017	4.06	3.37	4.90
	2018	4.21	3.42	5.18
	2019	3.03	2.15	4.26
Tui	2014	0.35	0.13	0.92
	2015	0.20	0.09	0.41
	2016	0.10	0.04	0.30
	2017	1.62	1.03	2.56
	2018	1.80	1.15	2.83
	2019	1.55	1.04	2.31

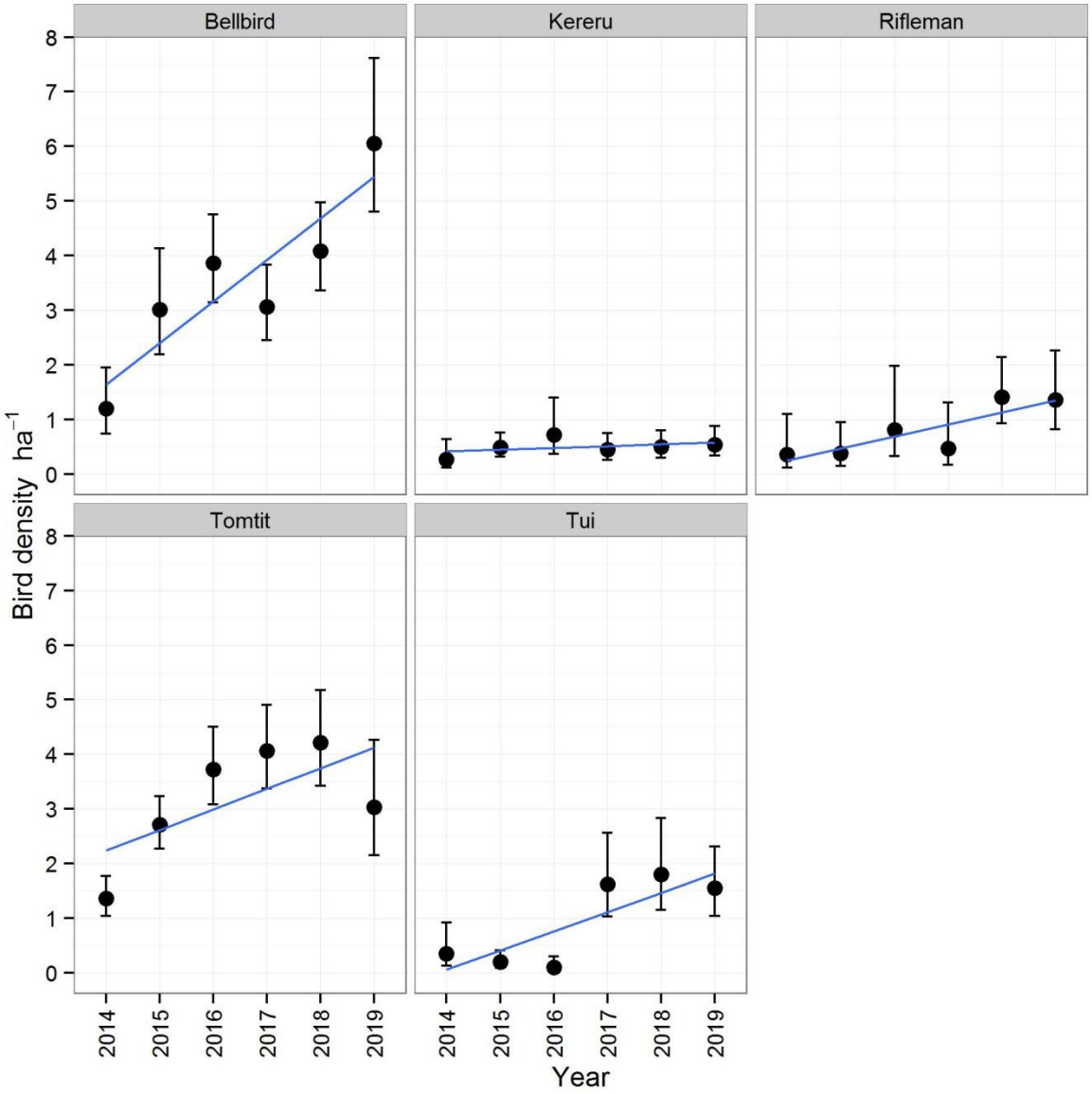

Figure 1. Population density estimates for bellbird, kereru, rifleman, tomtit and tui (birds/ha ± 95% CI) at Martins Bay between September 2014 and October 2019. A linear regression model fitted to the data (blue) shows the population trend for each species over the monitoring period.

Encounter rates – key species

Encounter rate data collected on bellbird, kereru, rifleman, tomtit and tui includes observations made during distance sampling data collection (detections ≤ 30 m from the transect), and also includes additional detections to these species made further from the transect (>30 m).

- The population trends derived from the encounter rate data (detections per km) shows almost identical trends for each species compared to the population trends resulting from the distance sampling data (Fig. 2).

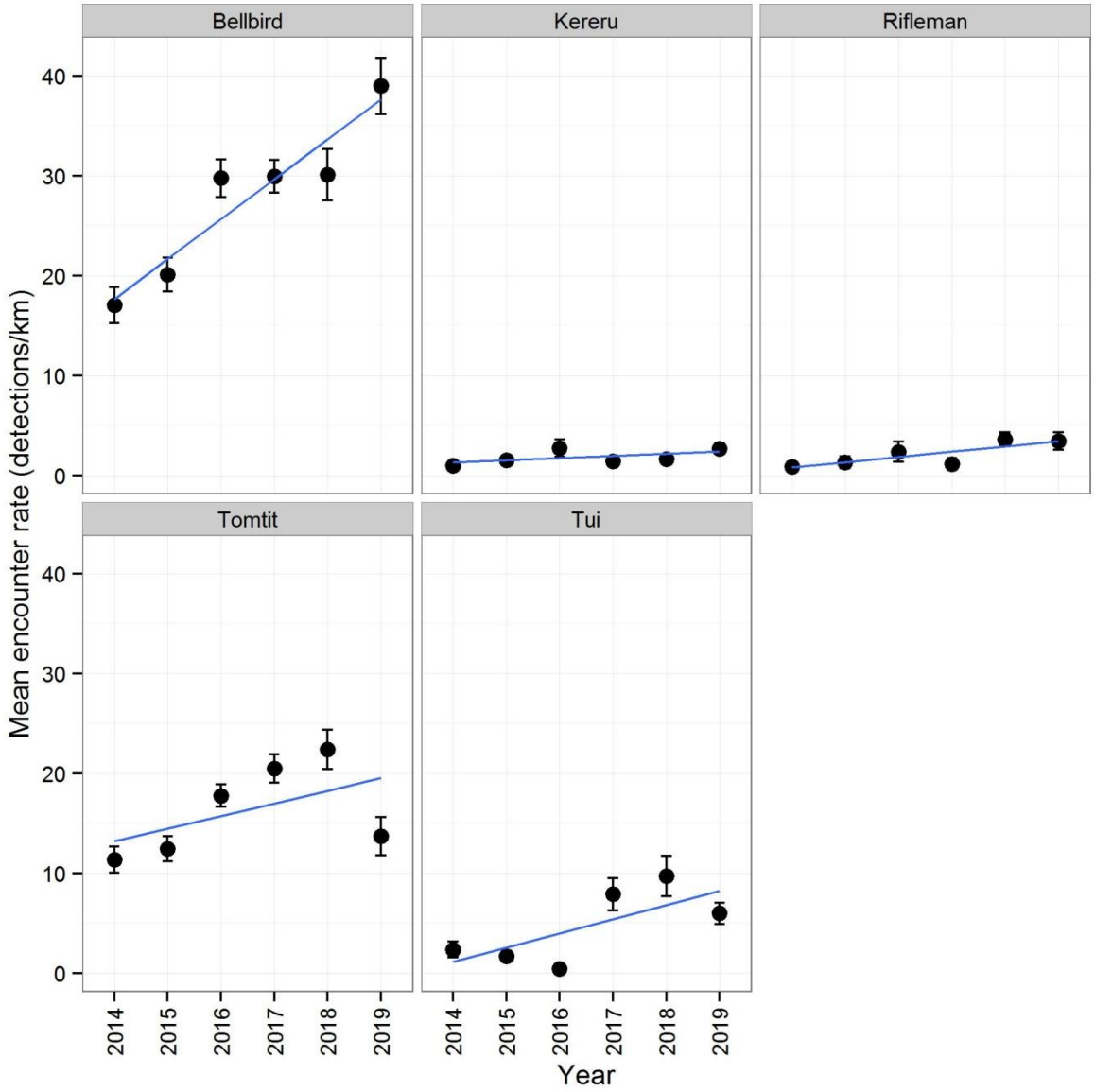

Figure 2. Mean encounter rates for key native forest bird species detected from transects at Martins Bay between September 2014 and October 2019. Encounter rates are presented as the mean number of birds detected per kilometre and include all birds seen or heard regardless of their proximity from the transects. A linear regression model fitted to the data (blue) shows the population trend for each species over the monitoring period.

Encounter rate data – other native forest bird species

Encounter rate data was collected on other native species including brown creeper, fantail, grey warbler, kaka, yellow crowned parakeet, robin and silvereye. More detailed distance sampling data was not collected for these species because they were either rare when monitoring started in 2014 (brown creeper, kaka, yellow crowned parakeet and robin), or not a good indicator species for predator control (grey warbler and silvereye), or their behaviour not thought to be suitable for distance sampling data collection (fantail).

- Encounter rate data collected for brown creeper, fantail, kaka, yellow crowned parakeet and robin showed a positive population trend over the monitoring period (2014-2019).
- Grey warbler and silvereye showed a negative trend (Fig. 3).

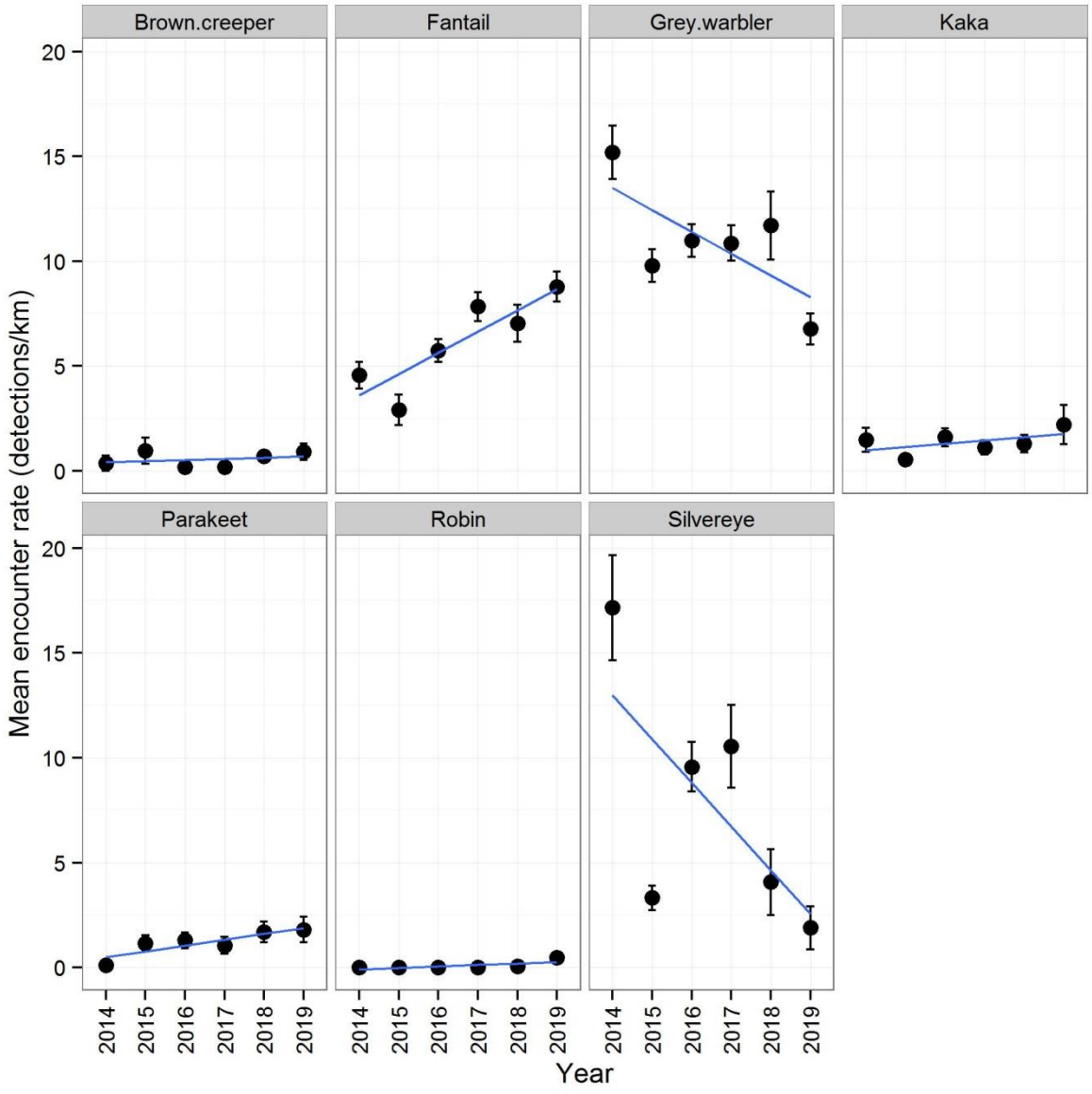

Figure 3. Mean encounter rates for other native forest bird species detected from transects at Martins Bay between September 2014 and October 2019. Encounter rates are presented as the mean number of birds detected per kilometre and include all birds seen or heard regardless of

their proximity from the transects. A linear regression model fitted to the data (blue) shows the population trend for each species over the monitoring period.

Encounter rate data – all native forest bird species

Figure 4 shows the combined encounter rate for all key bird species (bellbird, kereru, rifleman, tomtit and tui), the combined encounter rate for all other native birds (excluding the self-introduced silvereye) and the combined encounter rate for all native birds (key bird species plus other native birds).

- Encounters of key species nearly doubled over the monitoring period, from 33 encounters per km in 2014 to 65 encounters per km in 2019.
- Encounters of other native birds, less vulnerable to predation, only showed a slight increasing trend over the monitoring period.
- Encounters of all forest bird species combined increased from 54 encounters per km in 2014 to 86 encounters per km in 2019.

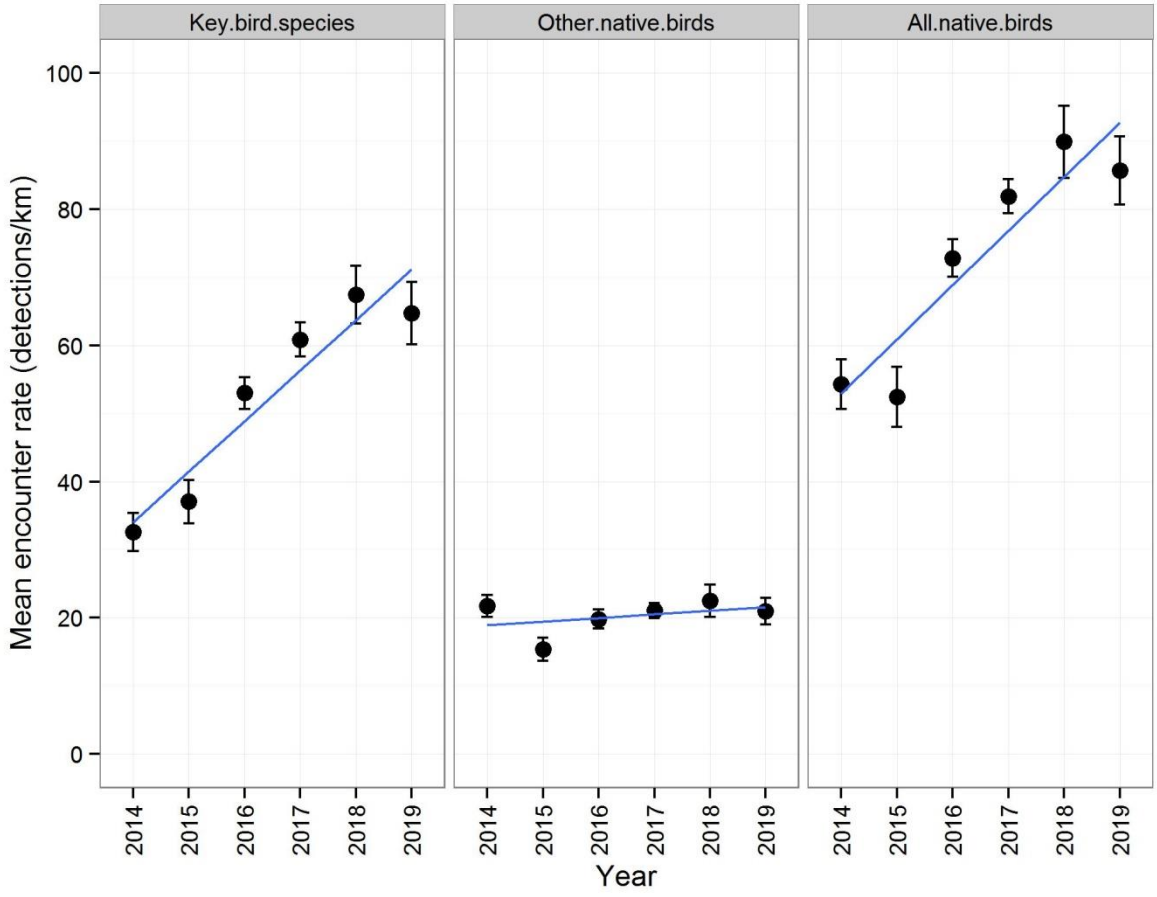

Figure 4. Mean encounter rates for key bird species (bellbird, kereru, rifleman, tomtit and tui), other native forest bird species, and a combined encounter rate for all native species (key species plus other native birds) detected from transects at Martins Bay between September 2014 and October 2019. Encounter rates are presented as the mean number of birds detected per kilometre and include all birds seen or heard regardless of their proximity from the transects. A linear regression model fitted to the data (blue) shows the population trend for each species over the monitoring period.

Encounter rate data – introduced species

- Encounter rate data collected on the introduced blackbird and chaffinch showed a positive population trend over the monitoring period
- Greenfinch, redpoll and song thrush showed a negative trend (Fig. 5).

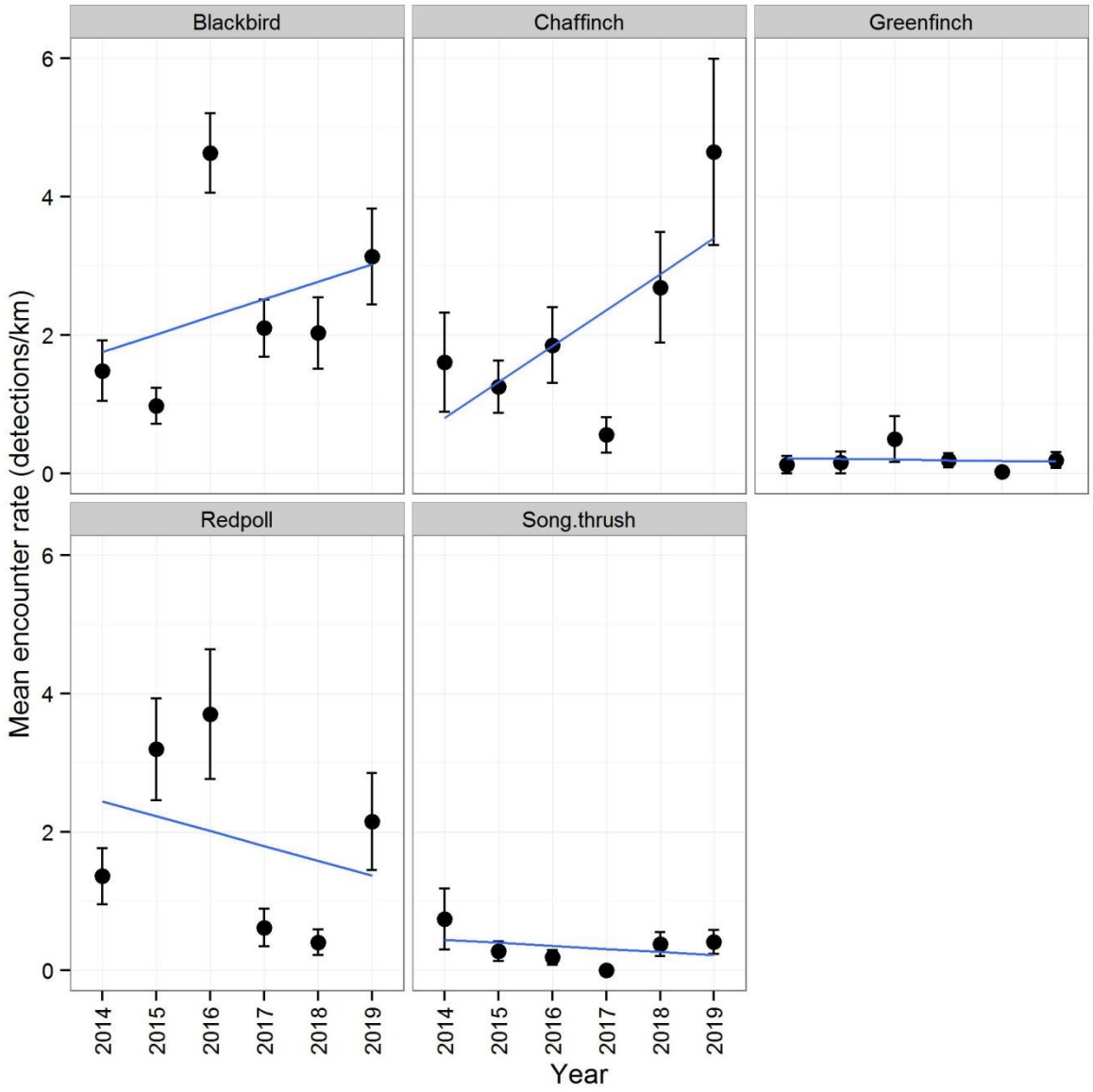

Figure 5. Mean encounter rates for introduced forest bird species detected from transects at Martins Bay between September 2014 and October 2019. Encounter rates are presented as the mean number of birds detected per kilometre and include all birds seen or heard regardless of their proximity from the transects. A linear regression model fitted to the data (blue) shows the population trend for each species over the monitoring period.

Discussion

Intensive predator control carried out by the Hollyford Conservation Trust between 2014 and 2019 has resulted in an impressive increase of many native forest bird species at Martins Bay, in particular those species that are most vulnerable to predation and competition from introduced predators. The forest has recovered well following the control of possums to very low levels; many podocarp species are flowering and fruiting prolifically, providing an excellent food source for nectar and fruit eating bird species in particular.

Key species

- Estimated densities for 5 key forest bird species that are known to be particularly vulnerable to predation by introduced predators (bellbird, kereru, rifleman, tomtit and tui) have increased markedly since intensive predator control started at Martins Bay in 2014.
- Distance sampling data collected for all five key species showed a positive population trend over the monitoring period (2014-2019).
- Encounter rate data (detections per km) collected on the same species confirmed the same positive population trend for each species. This builds further confidence in both distance sampling and encounter rated methods and confirms that the trends seen are likely to be real.
- Encounters for these 5 species combined nearly doubled between 2014 and 2019.
- Estimated densities for bellbird in particular are now higher at Martins Bay than at most South Island mainland sites where similar monitoring is currently undertaken.
- Bird numbers are however expected to reach carrying capacity at some stage, data collected in 2019 indicates that this level may have been reached for some species including rifleman, tomtit and tui. Future monitoring is necessary to confirm this.

Other native forest bird species

- Other native species monitored in less detail, including brown creeper, fantail, kaka, yellow crowned parakeet and robin also showed a positive population trend over the monitoring period.
- The increase in their abundance was not as great as for the 5 key species that are more vulnerable to predation.
- Grey warbler and silvereye showed a negative population trend over the monitoring period. Their abundance measurements over the monitoring period were erratic. Grey warbler and silvereye are not as vulnerable to predation, and are therefore not expected to benefit from predator control as much as the other native species monitored. Changes in their abundance are likely related to other factors, and their numbers could potentially have declined because of increased competition from more dominant species such as tui and bellbird.

Introduced forest bird species

- Introduced species that might have benefited from predator control at Martins Bay are blackbird and chaffinch.

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References

Buckland ST 2006. Point-transect surveys for songbirds: robust methodologies. The Auk 123: 345–357.

Buckland ST, Anderson DR, Burnham KP, Laake JL, Borchers DL, Thomas L 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press.

Dawson DG, Bull PC 1975. Counting birds in New Zealand forests. Notornis 22: 101–109.

R Core Team 2013. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. http://www.R-project.org/.

Thomas L, Laake JL, Rexstad E, Strindberg S, Marques FFC, Buckland ST, Borchers DL, Anderson DR, Burnham KP, Burt ML, Hedley SL, Pollard JH, Bishop JRB, Marques TA 2009. Distance 6.2. Release 1. St Andrews, Scotland, Research Unit for Wildlife Population Assessment, University of St Andrews. http://www.ruwpa.stand.ac.uk/distance/.