Notornis, 2025, Vol. 72: 128–131 https://doi.org/10.63172/719605cjcrlv
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SHORT NOTE

Monitoring endemic forest birds on Atuanui/Mount Auckland between and within years

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Atuanui maunga is a 615 ha native forest remnant bordering the eastern shore of the southern Kaipara Harbour. It is a remnant of Northland's once widespread coastal kauri – podocarp – broad leaf forest, with mature and regenerating kauri (*Agathis australis*), rimu (*Dacrydium cupressinum*), kahikatea (*Podocarpus dacrydioides*), tōtara (*P. totara*), taraire (*Beilschmiedia tarairi*), karaka (*Corynocarpus laevigatus*), pūriri (*Vitex lucens*), kohekohe (*Didymocheton spectabile*), kōwhai (*Sophora tetraptera*) and rewarewa (*Knightia excelsa*). When Atuanui maunga was returned to Ngāti Whātua o Kaipara in 2013 as part of their Treaty of Waitangi Settlement Claim, a systematic pest control programme was initiated to return the maunga to health and provide suitable habitat for any kiwi-nui (*Apteryx mantelli*) that might disperse from a translocated population at the nearby Mataia Restoration Project.

Monitoring of birds on Atuanui has been undertaken for 20 years, with results previously reported by Michaux (2009) and Michaux & Taparau (2019). This note updates the data reported in Michaux & Taparau (2019) for territorial male miromiro (*Petroica macrocephala toitoi*) counts along a 3.5 km ridgeline transect, and includes encounter rates of other common forest endemics along the same transect. Encounter rate data were derived by recording all birds seen or heard whilst walking the transect (Michaux 2009; raw data are available from eBird https://ebird.org). The results of a year-long monthly 5-minute bird count (5MBC) (Dawson & Bull 1975) study carried out in 2023 are also reported on.

There has been an intensification of pest control at Atuanui during the years covered by this report, as the programme run by the kaitiaki employed by Nga Maunga Whakahii o Kaipara Development Trust (NMWK) has been augmented by trapping carried out by the Forest Bridge Trust (FBT) (https://www.theforestbridgetrust.org.nz/). The FBT carry out pest control on a landscape scale with the aim of connecting kiwi-nui populations at Mataia, Mount Tamahunga (Warkworth) and Tāwharenui by transforming 54,000 hectares of North Auckland into kiwi-safe habitat. Because of the importance of Atuanui as potential kiwi-nui habitat and its proximity to Mataia (1.3 km at the closest point), the FBT installed four circuits of DOC 200s (80 traps), DOC 250s (53 traps), AT220s (28 traps), and 12 SA cat traps. In addition the FBT employ a kaitiaki for 2 days a week to maintain the trap circuits. The kaitiaki of NMWK have also installed 60 AT220s - multi-species, automated traps that increase the efficiency of pest

Received 14 February 2025; accepted 5 May 2025
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control by decreasing the effort per kill. In 2023, 30 of these traps were set along the reserve's northern boundary (in a transect parallel to the Hoteo River) and a further ten along the Mangatū Stream, which flows into the Hoteo River. Five additional traps were integrated along each of the FBT circuits in 2024. Fallow deer (*Dama dama*) and pigs (*Sus scrofa*) periodically invade the reserve and are hunted as soon as their presence is detected.

The number of territorial miromiro counted each year between 2005/06 and 2024/25 is shown in Fig. 1, with the trend line indicating a significant growth rate of 0.25 territories/year (t = 2.86, P = 0.01). However, only 31% of the variance in territory numbers can be explained by year. While we have used a linear model to analyse the change in miromiro encounter rates, the graph may indicate a stepwise response, with the population oscillating around a higher equilibrium after pest control effort was increased in 2018.

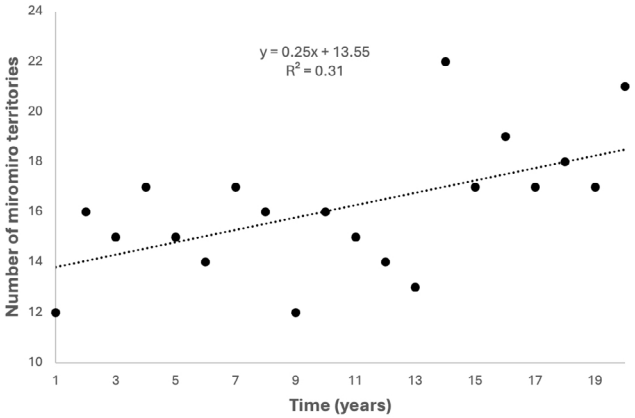

Figure 1: Estimated number of miromiro territories 2005/06 – 2024/25. Dotted line = best fit trend line, R^2 = coefficient of determination, which measures the proportion of variation in the y-values explained by the x-values. Year 1 = 2005/06 breeding season.

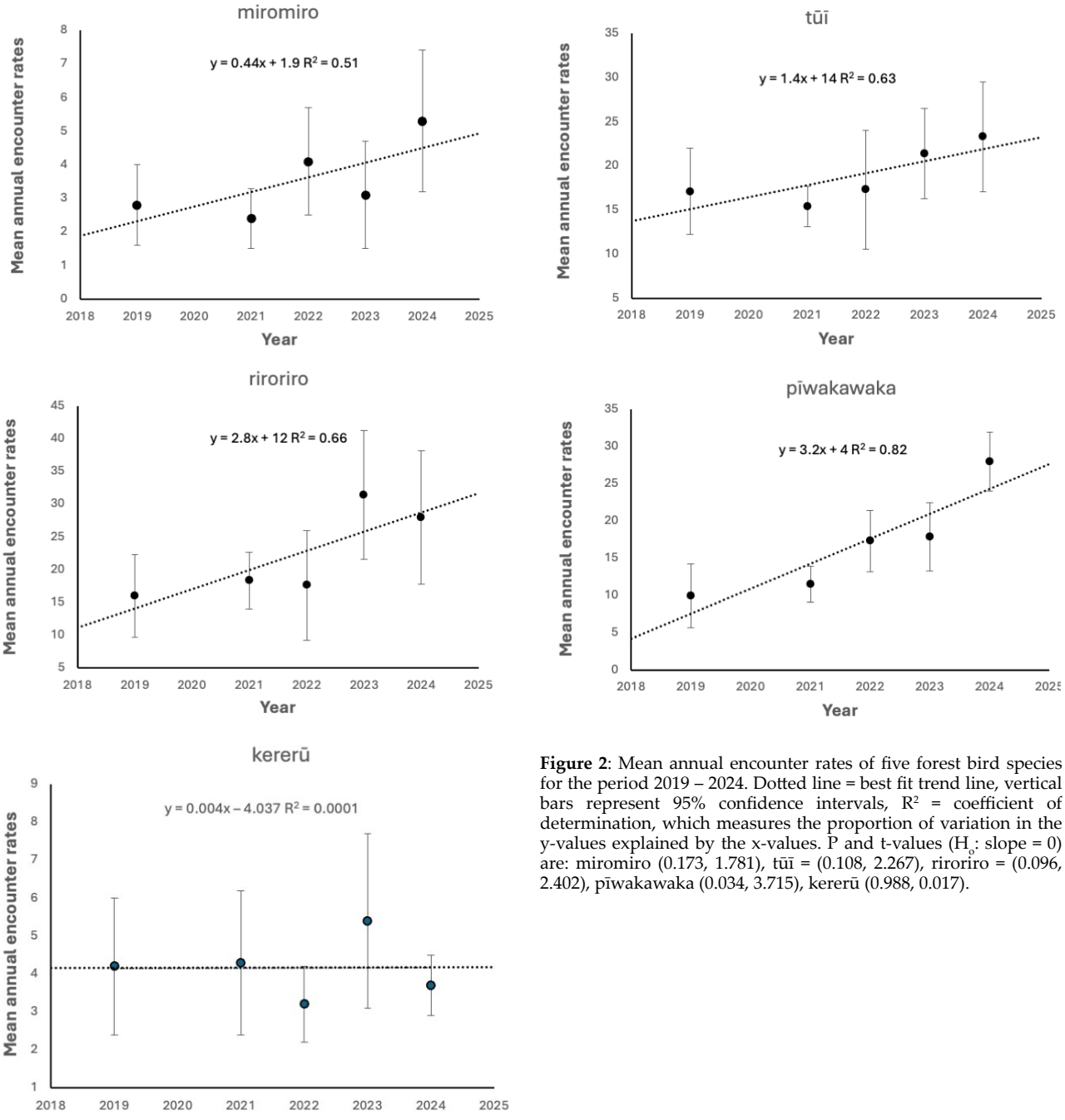

Figure 2: Mean annual encounter rates of five forest bird species for the period 2019 – 2024. Dotted line = best fit trend line, vertical bars represent 95% confidence intervals, R^2 = coefficient of determination, which measures the proportion of variation in the y-values explained by the x-values. P and t-values (H_o: slope = 0) are: miromiro (0.173, 1.781), tūī = (0.108, 2.267), riroriro = (0.096, 2.402), pīwakawaka (0.034, 3.715), kererū (0.988, 0.017).

Mean encounter rates (± 95% CI) of five endemic species for 2019–24 are presented in Fig. 2. Data for 2020 have been omitted due to covid lockdowns that limited counts to spring months, leading to biased results because of seasonal changes in encounter rates described below. Kererū (*Hemiphaga novaeseelandiae*) remained stable over the 6 years, contrasting with the previous 7 years when the population growth rate was estimated at +0.2 birds/year (Michaux & Taparau 2019). Kererū are highly mobile and able to travel long distances to access seasonal food resources (Innes *et al*. 2022), and so local encounter rates may be influenced by landscape-scale food availability. Miromiro, rironiro (*Gerygone igata*), and pīwakawaka (*Rhipidura fuliginosa*) all had growth rates approximately double that recorded by Michaux & Tapurau (2019), while tūī (*Prosthemadera novaeseelandiae*) had growth rates that were similar to those reported over the previous 7 years.

Variable population responses by New Zealand forest species to mammalian pest control have been reported in other studies (Innes *et al*. 2004; O'Donnell & Hoare 2012; Binny *et al*. 2021; Lovegrove & Parker 2023). Binny *et al*. (2021) concluded that 'deep endemics' such as tīeke (*Philesturnus rufusater*) and hihi (*Notiomystis cincta*), which belong to endemic families, had the highest response rates after pest control, followed by endemic genera, and then endemic species. Non-endemic species (including introduced species) tended to decline over time as deep endemic species increased. Fea *et al*.'s (2021) meta-analysis reported that large-bodied endemics such as kākā (*Nestor meridionalis*) and kererū responded most strongly to pest control, with rironiro, pīwakawaka and tauhou responses either neutral or declining. The decline in these three small insectivores following pest eradication in Zealandia (Karori Wildlife Sanctuary) was also reported by Miskelly (2018), who concluded that rironiro, pīwakawaka, and tauhou were outcompeted when a full suite of endemic insectivores was present.

Fea *et al*.'s (2021) results indicate that predation by the common brushtail possum (*Trichosurus vulpecula*) may impact the abundance of indigenous species, because low-intensity pest control (which is effective against possums but not ship rats *Rattus rattus*) produced low but still positive responses for several endemic species. This may explain the persistence of Atuanui's miromiro population prior to 2013, when DOC managed the forest by using ground-based cyanide poisoning targeting possums on a 5-year cycle (although there may have been secondary kills of other pests). Confirmation that targeted possum control can result in an increase in abundance of indigenous birds comes from a 22-year-long study in the Waitakere Ranges, Auckland, which revealed an overall increase in bird numbers and in the proportion of endemic bird species (Lovegrove & Parker 2023). Tūī and rironiro increased significantly, while kererū and pīwakawaka remained stable. The response of miromiro was more complex, with an initial increase followed by a levelling off and then a decline. Introduced species either had a neutral response or declined (Lovegrove & Parker 2023).

In 2023, BM conducted a year-long study at Atuanui using 5MBC to track changes in bird conspicuousness throughout the year, to inform the best time of year to undertake monitoring. Fourteen listening stations placed 250 m apart along the ridgeline transect were visited monthly. Atuanui has been closed to the public since 2018 to protect kauri from *Phytophthora agathidicida*, a soil-borne fungus that causes kauri dieback disease, and so there

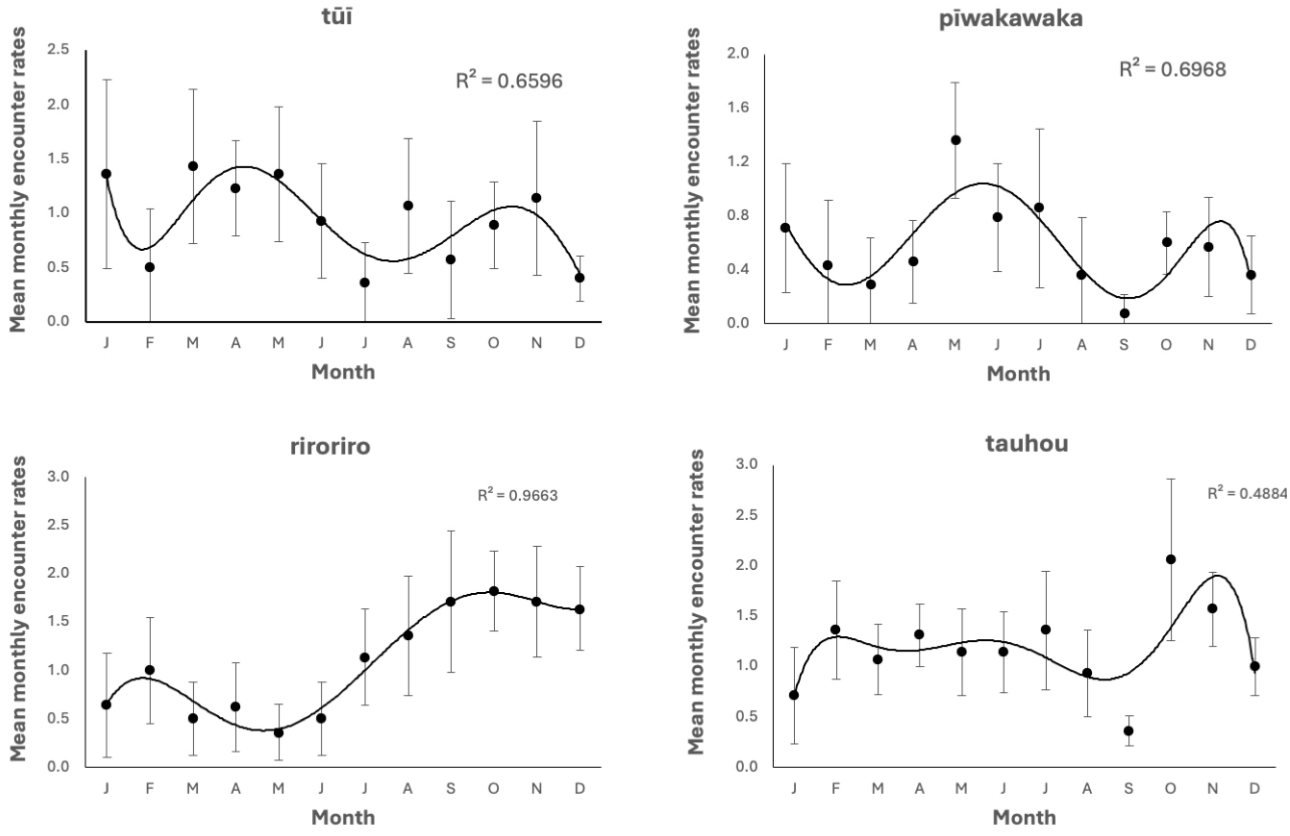

Figure 3: Seasonal variation in mean monthly encounter rates of four forest bird species during 2023 based on 5-minute counts. Curve = best fit polynomial (order 6), vertical bars represent 95% confidence intervals. R^2 = coefficient of determination, which measures the proportion of variation in the y-values explained by the x-values.

was minimal disturbance that may have affected bird behaviour and altered the probability of detection. Every bird heard or seen during 5 minutes was recorded for each station (raw data available on request). The mean monthly encounter rates (average number of individuals encountered per visit, with 95% confidence intervals) was 59.4 ± 7.6, the mean species' richness (average number of species counted per visit with 95% confidence intervals) was 8.0 ± 1.3, and dominance measure (average ratio of indigenous species to total species with 95% confidence intervals) was 0.82 ± 0.06. While some exotics such as chaffinch (*Fringilla coelebs*), blackbird (*Turdus merula*), myna (*Acridotheres tristis*), and eastern rosella (*Platycercus eximius*) were relatively common, Atuanui's avifauna was dominated by a restricted range of indigenous species, as reported for other forested restoration sites (Bell 2015; Miskelly 2018).

Monthly changes in encounter rates of tūī, riroriro, pīwakawaka, and tauhou (*Zosterops lateralis*) are shown in Fig. 3, with best fit curves (polynomial, order 6) shown for each species. Tūī and pīwakawaka exhibited a bimodal pattern, while riroriro and tauhou had a single spring peak, which was the same pattern observed for these four species at Zealandia (Bell 2015). These results indicate that spring is the best time to monitor these endemic bird species, followed by autumn if resources allow.

The pest control programmes run by NMWK and FBT do not specifically target rats, and are primarily designed to control stoats (*Mustela erminea*) and other mustelids. NMWK also target possums and feral cats (*Felis catus*). Our monitoring has revealed that pest control has led to an increase in abundance of resident birds on the maunga. However, unless effective rat control is implemented, it is unlikely that other more vulnerable endemic bird species could re-establish at the site.

ACKNOWLEDGEMENTS

Our thanks to John Innes and Josh Kemp for helpful reviews of an earlier draft, Colin Miskelly for his editorial efforts, and to Matu Booth, Operations Manager, Forest Bridge Trust.

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Keywords: mammal pest control; miromiro; species recovery; tomtit; forest bird