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SHORT NOTE

Update on North Island tomtit (*Petroica macrocephala toitoi*) at Atuanui, Mount Auckland

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Since an initial study of North Island tomtit (miromiro; *Petroica macrocephala toitoi*) at the 615 hectare Atuanui Scenic Reserve (36.447°S, 174.459°E) reported in Michaux (2009), a number of pest control programmes have been carried out. The Kaipara branch of Forest and Bird sponsored the Atuanui Restoration Project, and established 632 bait stations set out on two 100m X 100m grids (east and west of the ridge track), and baited with Ratabate™ (active ingredient diphacinone), for a three year period from 2007–2009 (Forest and Bird, 2009). Fifty-five DoC-250 stoat traps were also placed around the boundary and an unspecified number of Timms traps for common brushtail possum (*Trichosurus vulpecula*) control were set up in conjunction with the bait lines. Rat (*Rattus* spp.) numbers were monitored from 2007–2010 using 100 tracking tunnels arranged on ten randomly selected lines. The percentage of tunnels visited by rats and the number of possums caught in Timms traps were recorded. In April 2008 an Auckland Regional Council (ARC) possum control programme was carried out over an extended area which included the reserve. Atuanui was returned to Ngati Whatua o Kaipara as part of their Treaty of Waitangi Settlement in 2011. Nga Maunga Whakahii o Kaipara Development Trust was set up to manage the reserve, with the aim of restoring Atuanui's ecology and eventually releasing North Island brown kiwi (*Apteryx mantelli*). Pest control was re-established in 2014 and continues to the present (April, 2019). The bait station grid established by Forest and Bird was baited with Pindone™, and supplemented with 150 DoC-200 stoat traps and Sentinel possum traps arranged in four circuits.

Numbers of occupied miromiro territories were estimated using the method described by Michaux (2009) and compiled for the years 2012–2018. Counts of all birds seen or heard while walking the main track, a distance of approximately 3 km, were also recorded. All data were gathered by the same observer and every effort was made to minimise double counting of mobile species such as tūī (*Prosthemadera novaeseelandiae*) and New Zealand pigeon (kererū; *Hemiphaga novaeseelandiae*). The number of visits each calendar year varied between eight and thirteen, spread throughout the year. Because there are pronounced seasonal differences in species' abundance and conspicuousness, and visits were undertaken when possible rather than systematically, some of the variation in counts may be due to a seasonal effect. Data were entered into eBird (Scofield *et al.* 2012) and summary

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Table 1. Numbers of miromiro territories counted at Atuanui over 14 seasons between 2005 and 2019. Rat tracking indices are shown as % tunnels with rat prints present. Possum data show number of possums caught annually in Timms traps over 5 seasons. Miromiro figures in square brackets are based on fewer visits. nd = no data.

Season	Number of miromiro territories	Rat tunnel %	Number of possums trapped
2005/6	12	nd	nd
2006/7	16	15	23
2007/8	15	17	21
2008/9	17	23	0
2009/10	15	30	8
2010/11	14	73	25
2011/12	17	nd	nd
2012/13	16	nd	nd
2013/14	12	nd	nd
2014/15	16	nd	nd
2015/16	15	nd	nd
2016/17	[14]	nd	nd
2017/18	[13]	nd	nd
2018/19	22	nd	nd

statistics generated for the years 2012–2018.

Table 1 shows the estimated number of miromiro territories between 2005/6 and 2018/19. The estimations are based on calls and/or sightings recorded between July and July rather than over a calendar year, because the breeding season usually runs from August to December and better represents an annual cycle (i.e. breeding season to breeding season) for the birds. The percentage of tracking tunnels visited by rats and the number of possums trapped for 2007–2011 are also shown in Table 1. The success of possum control undertaken by the ARC during 2007 is clearly shown by the zero possum tally for 2008/9. Miromiro territory counts show only a weak negative correlation with possum numbers ($r^2 = 0.44$). Rat numbers were suppressed during 2007–2009 when Forest and Bird bait and trap lines were operational, but thereafter rat numbers increased rapidly. Again, there was only a weak negative correlation with miromiro territory numbers ($r^2 = 0.48$). A stronger negative correlation was seen when rat and possum numbers were combined ($r^2 = 0.66$). The most obvious feature of the data is the stability of the number of miromiro territories between 2005/6 and 2017/18 (range 12–17). The two territory count figures for 2016/17 and 2017/18 (shown in square brackets in Table 1), are based on fewer visits and may be underestimates. Natural variability in the number of breeding pairs in the reserve is possibly related to other factors such as weather and food supply, in addition to predation by introduced mammals.

The highest number of miromiro territories in the 15 years over which numbers have been recorded was in 2018/19 and may be the result

Table 2. Mean number of four common bird species (± standard error) recorded at Atuanui during 2012–2018. n = number of counts, P-values calculated from chi squared test.

Year (n)	kererū	tūī	riroriro	pūwakawaka
2012 (12)	3.6 ± 0.9	10.8 ± 2.4	10.8 ± 2.2	4.8 ± 1.0
2013 (13)	2.6 ± 0.7	7.8 ± 1.4	11.0 ± 1.6	6.4 ± 1.1
2014 (10)	5.7 ± 1.4	18.6 ± 2.1	19.4 ± 5.2	7.1 ± 1.2
2015 (12)	4.4 ± 1.1	17.1 ± 1.8	19.8 ± 3.0	14.9 ± 1.6
2016 (8)	4.3 ± 1.1	11.5 ± 2.4	16.0 ± 1.5	11.4 ± 3.0
2017 (9)	4.9 ± 0.9	16.0 ± 3.3	14.2 ± 2.2	11.6 ± 1.2
2018 (12)	4.5 ± 1.1	19.0 ± 1.6	23.3 ± 3.0	14.9 ± 1.6
P-value	0.97	0.25	0.23	0.13

of pest control carried out since 2014. Further indication of the control programme's efficacy is shown by the trend of increasing numbers of kererū, tūī, grey warbler (riroriro; *Gerygone igata*), and New Zealand fantail (pīwakawaka; *Rhipidura fuliginosa*). Table 2 shows the mean number of these four bird species encountered per visit (± standard error, n = number of visits), and probability values for each species. These data and their regression lines are also displayed in Figure 1. While the variability of the data resulted in low r^2 values for the regression lines and non-significant differences in average numbers observed, the four species do show a trend of increasing abundance.

Miskelly (2018) suggested that common and widespread native birds were only weakly limited by mammalian predation at Zealandia (Karori Sanctuary) in Wellington, while endemic birds outcompeted them when predatory mammals were removed. Baber *et al.* (2009) studied population sizes of common endemic species in the Hunua Ranges, South Auckland, following control undertaken to protect kōkako (*Callaeas wilsoni*). They showed that in areas with high intensity pest control there were significant

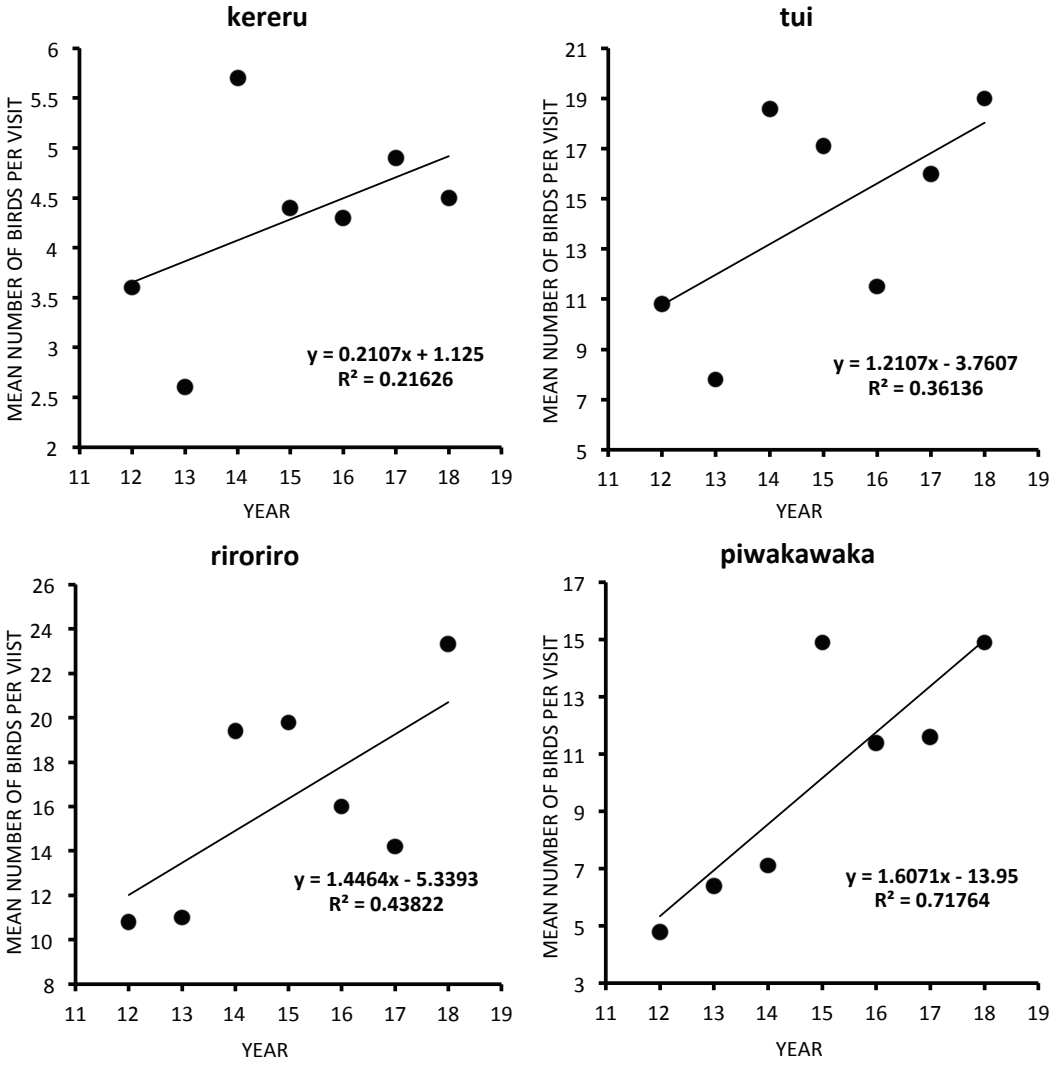

Figure 1. Mean number of four common bird species at Atuanui during 2012–2018, showing regression lines and equations.

increases in numbers of tūī, kererū, and miromiro. Tūī and kererū also appeared to benefit most at sites where pests had been eradicated in a regional-scale study reported by Ruffell & Didham (2017), and kererū nesting success increased at a Northland site when both ship rat *Rattus rattus* and possum levels fell below 4% (Innes *et al.* 2004). Robertson *et al.* (2019) showed that there was an increase in fantail nesting success following landscape-scale application of 1080 to protect North Island brown kiwi, although breeding success decreased in the years following 1080 application. The differing responses of various forest bird species to pest control is probably context-dependent (Ruffell & Didham 2017), that is they reflect the levels of pest removal or control that can be achieved, i.e. near-eradication of all pest mammals (Zealandia), compared with control of some of them (Tongariro, Atuanui).

Our study suggests a recovery of populations of widespread endemic forest birds, as forest ecology rebalances following control of some mammalian predators. How much these populations will continue to grow, and how the proportions of various species that comprise Atuanui's avifauna might change following ongoing intensive pest control and any future translocations, is unknown. Anecdotal observations certainly suggest that abundance and diversity of the undergrowth have increased with seedlings of palatable species such as hangehange (*Geniostoma ligustrifolium*), *Pseudopanax* spp, pigeonwood (*Hedycarya arborea*), and greenhood orchids (*Pterostylis* sp.) now noticeable, and skinks (unidentified species) commonly observed. As the ecosystem recovers and more resources become available for birds, carrying capacity would be expected to increase and the numbers of some species of birds could continue to rise, until they reach a new equilibrium.

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