

Kōkako Survey Report

Rotoehu 2019

Summary Report Prepared for the Rotoehu Ecological Trust

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1. EXECUTIVE SUMMARY

North Island kōkako (*Callaeas wilsoni*) belong to the endemic New Zealand wattlebird family *Callaeidae*, an ancient family of birds which includes the extant North Island tīeke / saddleback (*Philesturnus rufusater*) and South Island tīeke (*Philesturnus carunculatus*), the data deficient South Island kōkako (*Callaeas cinerea*) and the extinct huia (*Heteralocha acutirostris*). Prior to human habitation, North Island kōkako were common in forests across the island. As a consequence of historical forest clearance and depredation by introduced mammalian predators, the population reduced dramatically to around 330 pairs across a reduced range by 1999 (Innes, 2013). All extant populations must be protected against introduced mammalian predators by sustained pest control (Flux and Innes, 2001). Effective pest control has led to a recovery of the species nationally, with an increase to over 1,700 pairs by 2018. The North Island kōkako is now classified as 'at risk - recovering' (Robertson *et al.*, 2017).

This report summarises the results of a kōkako survey undertaken at Rotoehu, in the eastern Bay of Plenty, between April 4 and May 8, 2019. The Rotoehu kōkako population is nationally significant as one of 11 relict sites. Rotoehu is classified as one of the five Priority One sites by the Kōkako Specialist Group (KSG); sites at which populations have not bottlenecked below 40 individuals. The Rotoehu Ecological Trust (RET) commissioned a team of expert kōkako contractors to undertake the 2019 survey, following best practice guidelines (Flux and Innes, 2001). Contractors, assisted by volunteers on several days, walked transects using pre-recorded local kōkako song to elicit a response from territorial kōkako and to determine territories within the survey area.

The 2019 survey area encompassed approximately 3,200 hectares; a significant increase from previous surveys. Within the total 998 hectare core area survey, of land under management by RET, 126 kōkako pairs and 8 singles were recorded. This included an increase from 50 to 92 pairs within the approximately 600 hectare area last surveyed in 2013 (Hunt and Jones, 2013). A further 2,200 hectares of adjacent native forest, and forest fragments linked by pine corridors, were also surveyed less intensively to determine the distribution of kōkako established beyond the RET area. 31 pairs and 5 singles were recorded in these areas, bringing the total kōkako recorded to 157 kōkako pairs and 13 singles for the entire Rotoehu survey. These results are compared to the results from previous surveys, and recommendations for future management at Rotoehu are made.



2. METHODOLOGY

2.1. Study Site:

Rotoehu Forest is situated approximately 35 kilometres northeast of Rotorua, and north of Lake Rotoehu, in the Bay of Plenty Region. Rotoehu Forest Conservation Area (including Pongakawa Ecological Area), and adjacent native forests owned by Ngāti Mākino included in this survey, were mostly logged for podocarps, principally rimu (*Dacrydium cupressinum*), in the early 1940s. The area is now dominated by tawa (*Beilschmiedia tawa*) with areas of unlogged podocarp emergents, and associated kohekohe (*Dysoxylum spectabile*), rewarewa (*Knightia excelsa*) and pukatea (*Laurelia novae-zelandiae*). Patches of eucalypt (*Eucalyptus spp.*) and regenerating kamahi (*Weinmannia racemosa*) forest are also present. Survey areas are largely surrounded by pine plantations or farming. The area surveyed encompassed an elevation range from 180 to 390 metres above sea level.

The Rotoehu kōkako population was studied intensively in the 1990s as part of the Research by Management programme to assess the effectiveness of different pest control methodologies on kokako population dynamics (see Innes et al., 1996). Pest control utilising the ground-based application of toxins across a 100m by 100m bait station network began in Rotoehu Forest in 1994 over 150 hectares, and control has been undertaken intermittently since, using different toxins and traps (see Appendix Two). The area managed through ground control was expanded to 440 hectares in 1995-96 and again to 650 hectares in 2008. The Rotoehu Ecological Trust (RET) was established in 2013, and have since increased the area under management to 998 hectares by May 2019. Ground control has been supplemented with aerial 1080 operations over the entire Rotoehu Forest in 2004 and 2017.

The last kōkako survey was undertaken in 2013 (Hunt and Jones, 2013). This survey covered approximately 600¹ hectares of native forest within Pongakawa Ecological Area, which was the total area under management at that time. 50 pairs and 27 singles were recorded in this survey, to total 127 territorial kōkako. The 2019 kōkako survey was conducted intensively over 998 hectares of

¹ The Main Block (Eastern) and Northern Pongakawa (Western) blocks surveyed in 2013 encompassed 650ha, of which approximately 50 hectares of Northern Pongakawa was planted in exotic pine and not surveyed.



Rotoehu Forest under management by the Rotoehu Ecological Trust, including the 600 hectare area surveyed in 2013.

In addition to the core area survey conducted over 998 hectares, a wider area survey was conducted less intensively over a further 2,200 hectares of adjacent or linked native forest, mostly comprising Rotoehu Forest, administered by the Department of Conservation, but also including Ngāti Mākino land, and further Ngāti Mākino land managed by Timberlands and PF Olsen.

2.2. Survey Technique:

The 2019 kōkako survey at Rotoehu was conducted over 22 survey days between April 4 and May 8. The survey was carried out by three experienced kōkako contractors, who were supported by volunteers on five of the survey days.

This survey followed the standard adult census methodology detailed by Flux and Innes (2001). Survey transects within the 998 hectares under RET management followed marked bait lines, with a maximum of 200 meters between transects. The wider-area survey comprised approximately 2,200 hectares, and transects surveyed were further apart (up to 600+ meters; see Figure One). Transects were walked slowly whilst listening for kōkako.

When kōkako were not heard adventitiously, pre-recorded local dialect was broadcast using Foxpro NX4 playback units at 200 meter intervals along each transect, to elicit a response from territorial kōkako. New recordings were made for this survey, using a Sony Linear PCM recorder and an Azden shotgun microphone. As dialect was observed to differ through the survey area, recordings were made in different locations.

Playback at each survey point consisted of:

- 1) 3 Rotoehu 'mew' calls, followed by a 5 minute listening period; then,
- 2) 3 Rotoehu 'mew' calls, followed by a 5 minute listening period; then,
- 3) 30 seconds of Rotoehu song, followed by a 5 minute listening period.



All birds seen or heard were followed to determine whether they were territorial, and whether they were single or paired. Follows were recorded using Garmin GPS units (Oregon 700 series) to record territories and determine territory boundaries. Following Flux and Innes (2001), birds were determined to be territorial if the following was achieved:

- a) One follow of at least 30 minutes, during which a bird (single or at least one of a pair) sung full song, or;
- b) Two follows of at least 10 minutes each on two different days in the same location, during which a bird (single or at least one of a pair) sung full song.

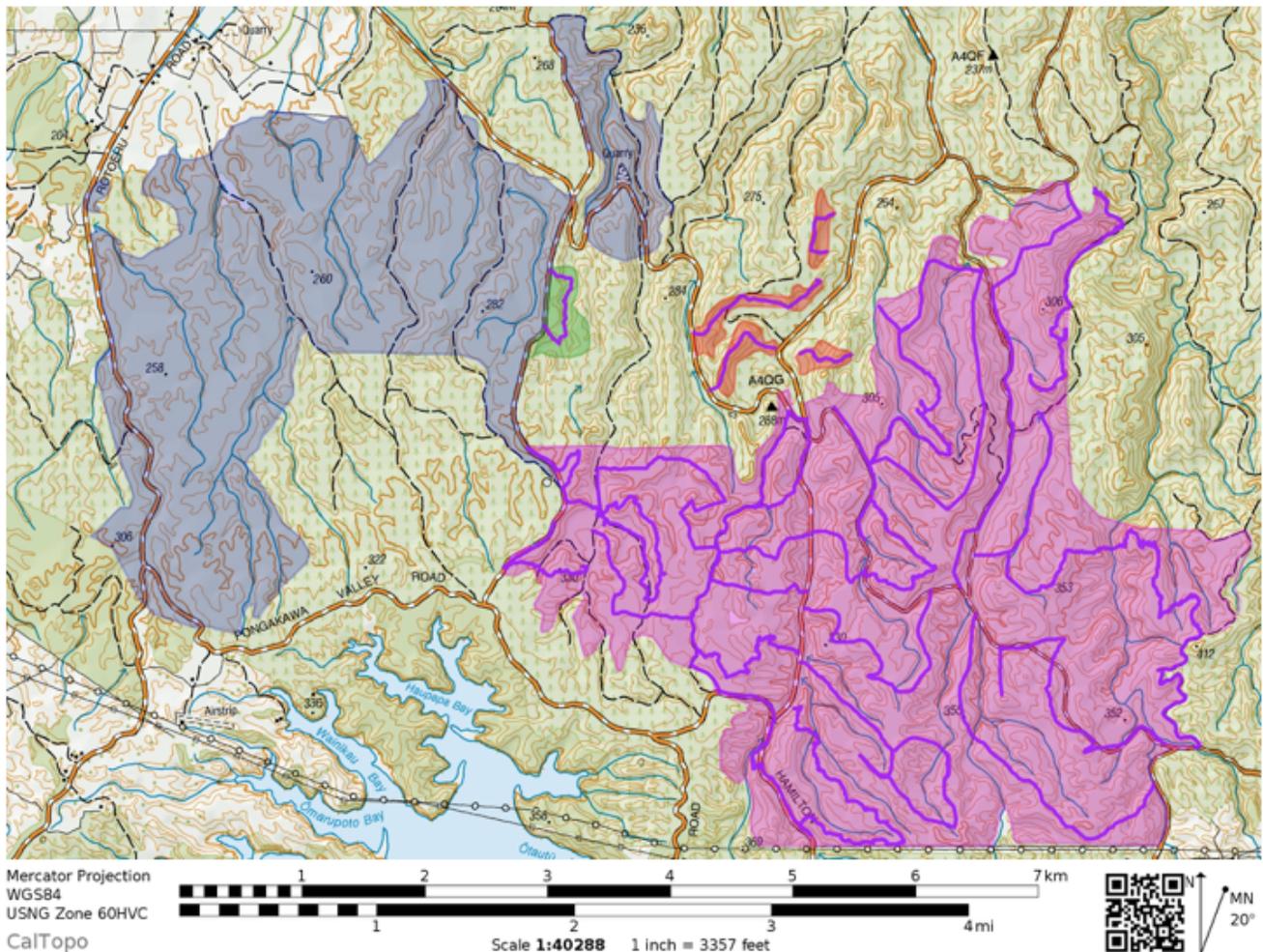


Figure One: Rotoehu wider area survey transects (Purple routes) through the wider Rotoehu Forest (pink), Ngāti Mākino land (green), and Ngāti Mākino land managed by Timberlands (orange). The core area survey (blue) followed marked bait lines at 200m intervals through RET blocks.



Given the density of kōkako pairs, and the fact that no kōkako were observed to be colour banded at Rotoehu during this survey, additional methods further to those outlined in Flux and Innes (2001) were utilised to delineate pairs.

First, survey teams worked in parallel along survey transects, and were in radio communication. Where adjacent pairs were followed simultaneously by survey teams, they could be determined to be separate. Second, all past follows were saved on GPS units. Where surveyors could not determine whether the pair being followed was different to a previously located pair, the birds were 'dragged' using playback across the previous follow. If the pair being followed sung full song in an area where another follow had previously been recorded, and no other pairs were heard or seen in the vicinity, these two follows were assumed to be the same pair. Conversely, where pairs were not able to be 'dragged' over a previous follow, an effort was made by the survey team to re-sight the previously identified pair within their territory to delineate the two observations. These methods helped avoid possible inaccuracies from double counting or clumping of sightings.

3. RESULTS

The 2019 Rotoehu survey was completed over 63 contractor days between April 4 and May 8. The 998 hectare RET managed area was surveyed in 43.5 contractor days (261 hours; mean= 15.7 mins/ha), whilst the 2,200 hectares of wider area was surveyed in 19.5 contractor days (117 hours; mean= 3.2 mins/ha). Weather during the 2019 survey period was mostly settled, with precipitation on two days leading to postponements in surveying, but little wind over the entire survey period.

The 2019 survey result of 327 territorial kōkako, comprising 157 pairs and 13 singles (see Table One, also, Figure Five) was a significant increase in the number of territorial kōkako from 127 detected in the 2013 survey, when 50 pairs and 27 singles were observed. However, the 2019 survey was conducted over a much larger area than that surveyed in 2013, and preceding surveys. Comparisons can be made between the survey results within Main Block (Eastern) [PEA1] and Northern Pongakawa (Western) [PEA2] in the 2019 survey result and previous years. Similarly, the survey result for Otari block can be compared to a 2015 survey of this block.



Table One: 2019 Rotoehu Kōkako Survey Results

Block	Area surveyed (ha)	Kōkako Pairs	Kōkako Singles	Total No. Kōkako
Main Block (Eastern) [PEA1]	439	70	3	143
Northern Pongakawa (Western) [PEA2]	168	22	2	46
Southern Pongakawa [PEA2B]	261	22	2	46
Otari	94	9	0	18
Rotoehu Forest West [RFW]	36	3	1	7
Subtotal - RET Managed	998	126	8	260
Rotoehu Forest	ca. 2134	26	5	57
Ngāti Mākino	27	2	0	4
Timberlands managed area	39	2	0	4
PF Olsen managed area	N/A*	1	0	2
Subtotal - Wider Area	ca. 2200	31	5	67
TOTAL	ca. 3200	157	13	327

*One kōkako pair was adventitiously recorded in the PF Olsen managed area, which is contiguous with Rotoehu Forest, after being heard calling by a surveyor in Rotoehu Forest.

The Main (Eastern) block has the longest history of kōkako protection and surveying. In this block the kōkako population has increased from 35 pairs in 2013 to 70 pairs in 2019 (Figure Two), with a decrease in the number of singles recorded over the same period from 27 to 3. In Northern Pongakawa (Western) block, an increase from 15 pairs to 22 pairs was recorded between 2013 and 2019, with two singles recorded in each survey (Figure Three). Northern Pongakawa has been included in the predator control area since 2008, with the first (walk-through) survey in 2009.

Otari block was not included in the 2013 survey as it was not part of the managed area at that stage, but was surveyed between August and September 2015, when four pairs and five singles were recorded. This has improved to nine pairs (and no singles) in 2019.

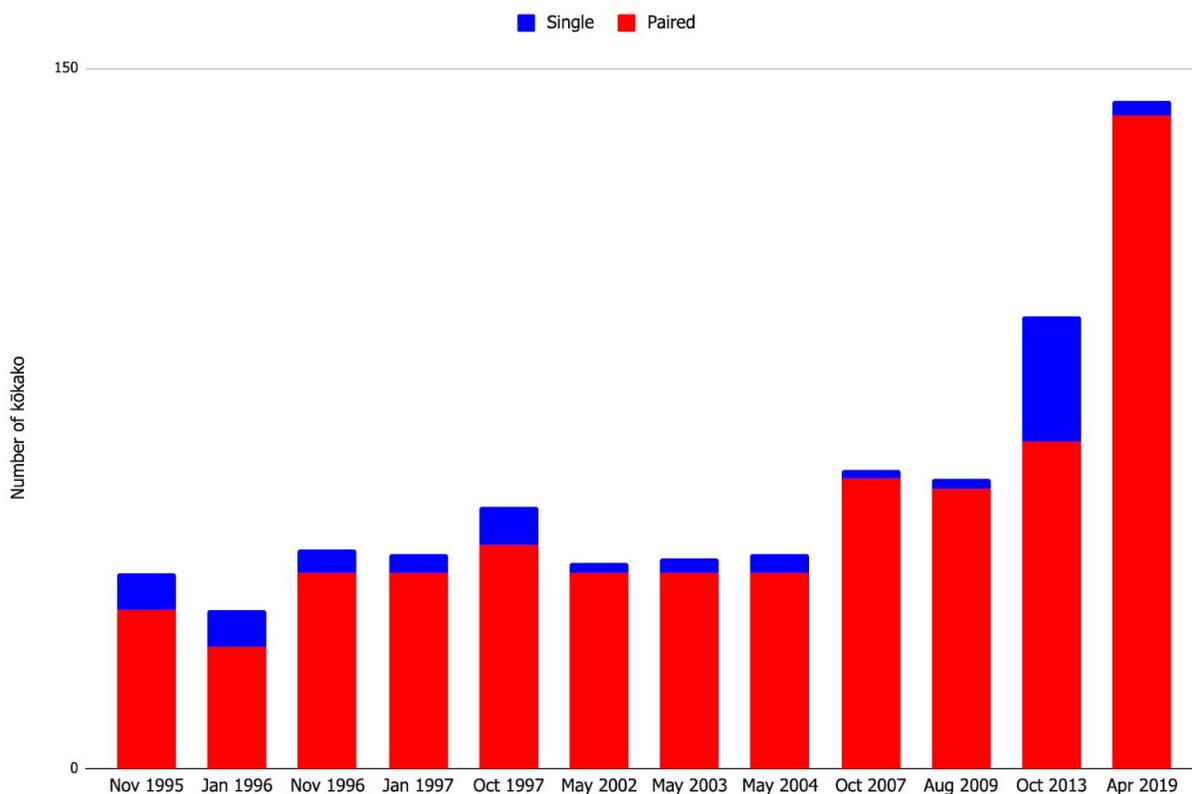


Figure Two: Main Block (Eastern) kōkako survey history. Results are shown for all surveys between 1995 and 2019. Surveys followed adult census methodology, with the exception of 2009, which was a walk-through survey.

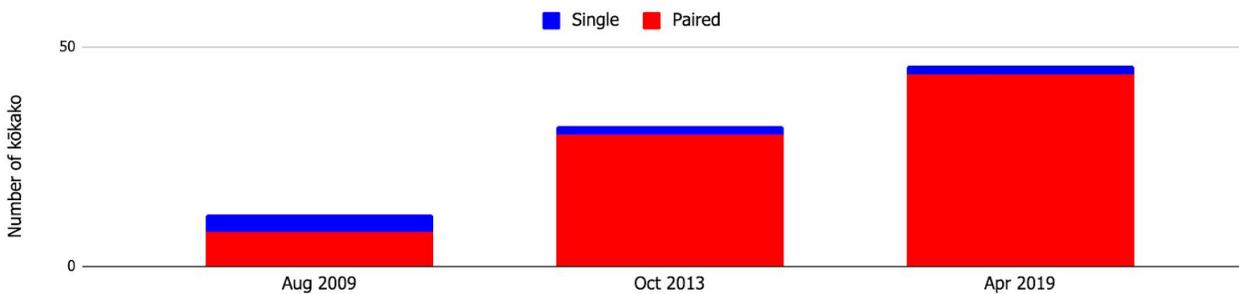


Figure Three: Northern Block (Western) kōkako survey history. Results are shown for all surveys (2009 was the first survey recorded for this area). Surveys followed adult census methodology, with the exception of 2009, which was a walk-through survey

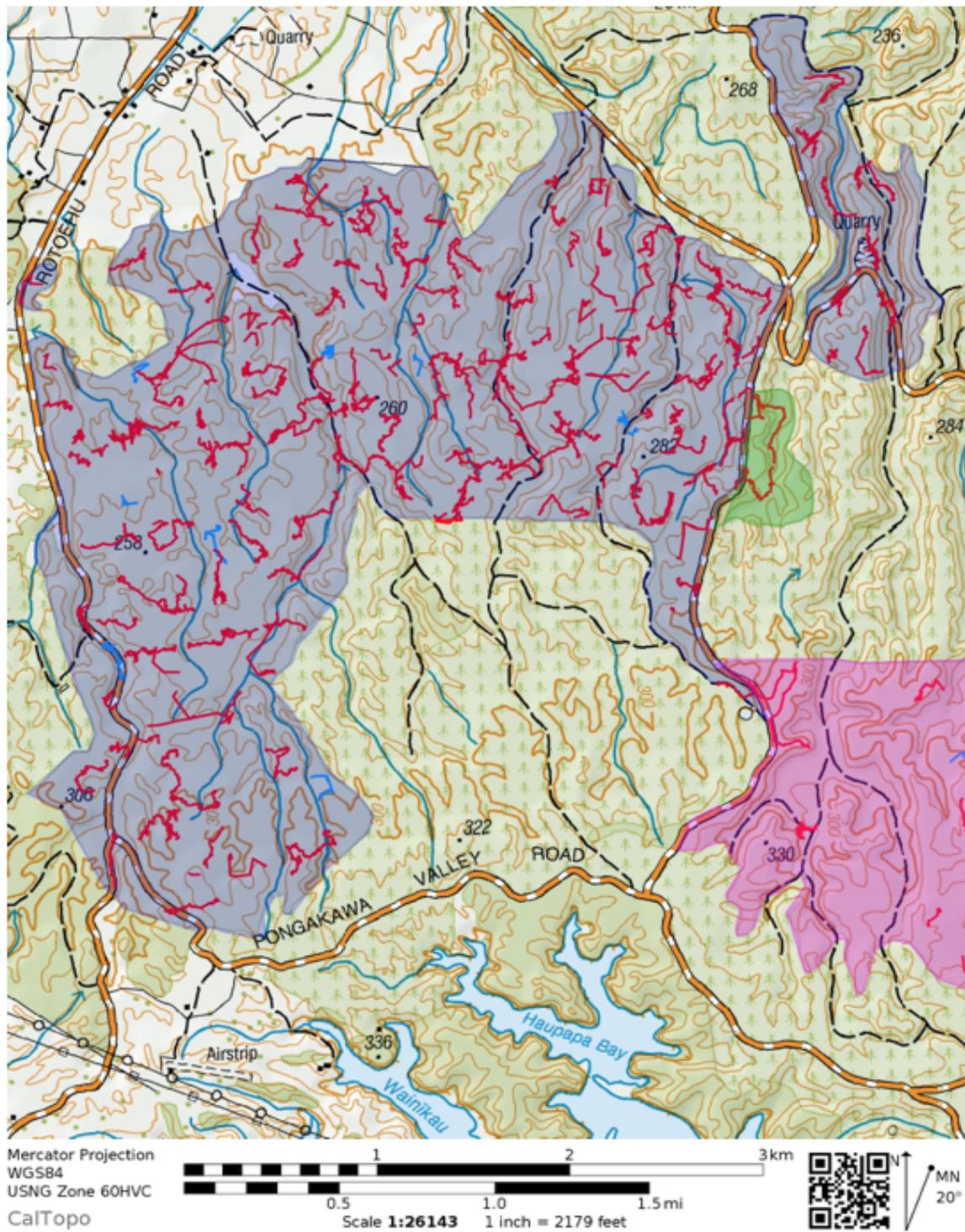


Figure Four: Follows of kōkako pairs (red) and singles (blue) within RET managed area (blue shading), Ngāti Māhino forests (green shading) and part Rotoehu Forest (pink shading).



126 kōkako pairs and 8 singles were recorded within the core survey area covering the 998 hectares under management by RET (Table One, also, Figure Four). The mean kōkako density across the RET managed areas was 7.92 hectares per pair. However, kōkako density varied by block, with the highest density in the Main Block, which has the longest history of pest control (6.27 ha/pr), and the lowest densities in Southern Pongakawa and RFW blocks (11.86 and 12 ha/pr respectively).

A further 31 kōkako pairs and five singles were recorded across the wider survey area covering an additional 2,200 hectares of native forest under management by DOC, Ngāti Mākino, Timberlands and PF Olsen (Figure Five). The average density of kōkako pairs in the wider survey area not receiving ground control (70.97 ha/pr) was markedly lower than that within the core survey area.

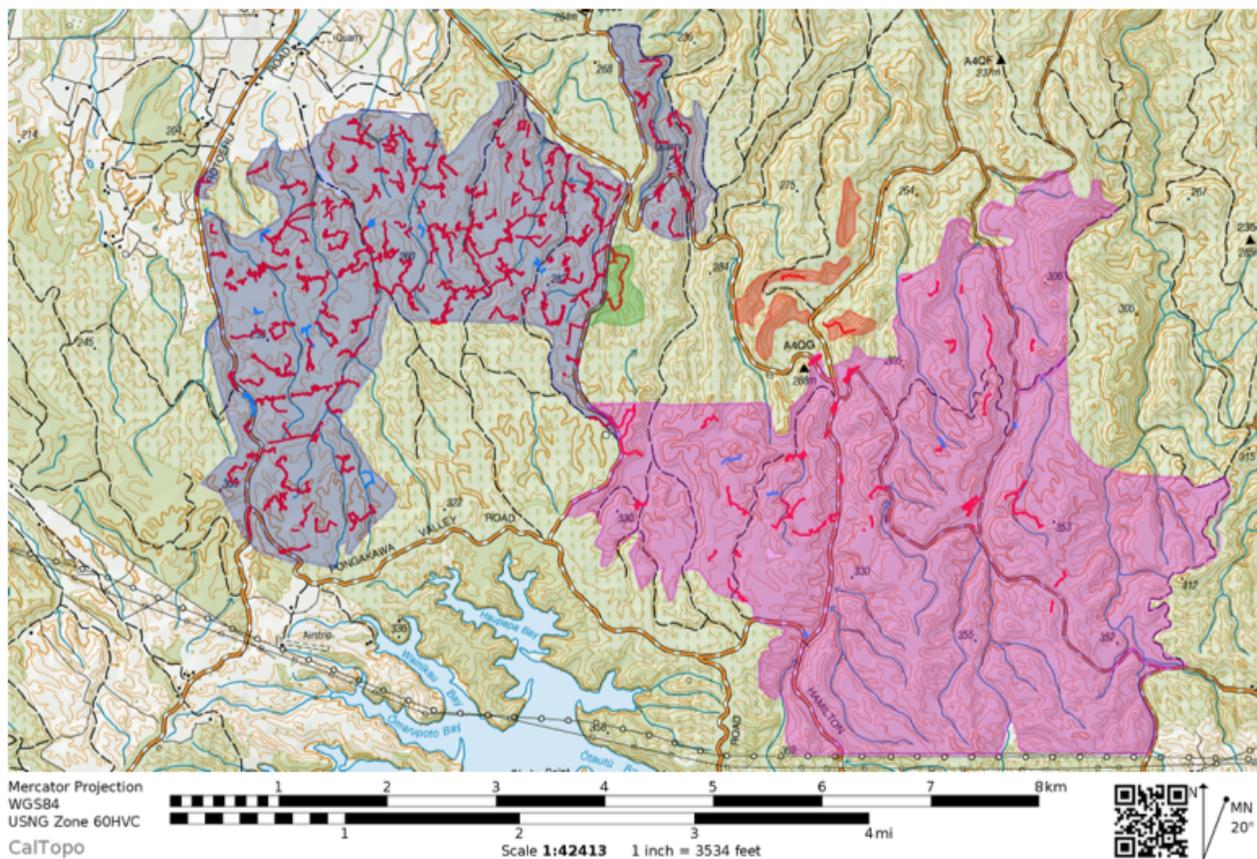


Figure Five: Follows of kōkako pairs (red) and singles (blue) over the total survey area, including RET managed areas (blue shading), Ngāti Mākino land (green shading), Rotoehu Forest outside RET management (pink shading), and Ngāti Makino land managed by Timberlands (orange shading).



Fledglings were frequently observed during the survey, both with territorial pairs and independently. However, the adult census methodology differs from the standard fledgling survey methodology. Fledgling surveys require longer follows of known kōkako pairs (up to two hours), to confirm the presence of fledglings. Further, independent fledglings are highly mobile and as such it is possible to count a single fledgling multiple times in different locations. Therefore, our observations reported for this survey do not include fledgling counts.

A variety of other native bird species were observed by surveyors throughout the survey area. Kārearea were observed on several days. Tītīpounamu were observed to be widespread but uncommon, whilst toutouwai were scarce. Pōpōkatea, tūī, korimako, tauhou, pīwakawaka, miromiro, riroriro and kererū were observed frequently throughout the survey area. A kākā was heard on one occasion. Kōtare, kahu and ruru were also observed during the survey period.

4. DISCUSSION

The results of population monitoring are important for ecological managers and kaitiaki. Understanding both the rate of population growth or decline, and the distribution of kōkako can allow managers to adapt their decision making processes to promote the species' recovery (Parker *et al.*, 2013).

To maintain consistency in survey methodology, surveys at each site are typically conducted either before or after the breeding season, but timing is often determined by the availability of kōkako contractors. Whilst kōkako surveys can be conducted any month, results may be harder to interpret between October and March, when kōkako may be nesting or moulting, leading to a reduction in responsiveness (Flux and Innes, 2001). The 2013 kōkako survey report states that nest building was observed from the first day of surveying on October 1 (Hunt and Jones, 2013), thus the onset of kōkako nesting may have affected survey results. In the 2013 survey, 27 single kōkako and 35 pairs were recorded in the Main block. This high proportion of singles to pairs is much greater than in preceding surveys and in the 2019 survey, and is improbable in a forest with a long history of mammalian predator control. This may indicate that some of these singles were in fact males paired



to incubating or brooding females. As such, the number of kōkako pairs present in 2013 may have been higher than the 50 recorded in the survey.

Recent genetic work (Weiser, 2015) indicates that rapid population growth is necessary to retain as much genetic diversity at each site as possible, until a target of 500 unrelated adults is reached. To determine how close Rotoehu is to reaching this target, it is useful to examine kōkako densities within the currently managed blocks.

Kōkako defend territories between 4-25 hectares in size (Innes, 2013) depending on the availability of suitable habitat and the density of territorial kōkako. At Rotoehu, the high density of kōkako territories recorded across RET managed areas (7.92 ha/pr), and particularly in Main Block (6.27 ha/pr), indicates that these areas may be tending toward carrying capacity. Where predator control is continued, other blocks with a shorter history of pest management (and a lower kōkako density) may be able to support a similar density of kōkako to that of Main Block in the future. Thus, the 998 hectares currently receiving management may be able to support at least 160 pairs, but are unlikely to be able to support 250 pairs (500 individuals). However, if the ground control area is expanded to protect kōkako pairs that have established territories in the wider area, growth across the total Rotoehu population will be more rapid, and the target of 500 unrelated individual kōkako is more likely to be attained.

In the absence of regular predator control, kōkako population growth in the wider area is expected to be slow, and likely the result of spillover from managed areas, rather than successful breeding in the wider area. At another kōkako population, Mapara, in years when no mammalian predator control was carried out only 8% of kōkako nests were successful, and 15% of nesting females were depredated (Flux et al., 2006). Working with DOC, iwi, forestry companies, local communities and other stakeholders to expand ground control at Rotoehu to include territories of known kōkako pairs in the wider area, in conjunction with frequent 1080 operations over the entire area, would promote improved survival and breeding success for these pairs.

The target outcome for kōkako recovery is to reduce ship rat and possum abundance to a 1% residual trap catch (RTC) for possums and a 1% ship rat tracking index (RTI) by November annually, with sustained reductions of ship rats below 5% RTI over the kōkako breeding season (Flux and Innes, 2001). Suppressing mammalian predators to these levels promotes improved breeding



success for kōkako, maximising genetic variation within the population by increasing the retention of rare alleles. Maintaining genetic diversity is important for long term population persistence as it defines evolutionary potential - the capacity of a population to adapt to new selection pressures (Franklin and Frankham, 1998).

The increase in the Rotoehu kōkako population between 2013 and 2019 reflects the successful predator control efforts during this period (see Appendix Two), where the target indices, detailed above, were largely met. Thus, it is recommended that the current two-years-on, one-year-off schedule of predator control applied to RET managed areas is continued, at a minimum. However, a pulsed predator control approach will result in slower population growth than annual control, and allows for increased female depredation, leading to a potential male bias, which further slows productivity. As such, it is recommended that if target rat and possum indices are not met following a pest control operation in any one year, another pest control operation is carried out over the subsequent season (i.e. the 'off' year), to avoid compounding the effects on kōkako of two seasons without sufficient predator control.

Following the Kokako Recovery Plan, the next kōkako survey at Rotoehu should be conducted in 2023, and at 4 yearly intervals thereafter. However, given the high density of kōkako within the Main and Northern Pongakawa blocks, and the low likelihood of significant growth in either block as they tend towards carrying capacity, it may be prudent to follow a sub-sampling methodology in these blocks, to reduce labour costs. A full survey following the adult census methodology should be completed over the remainder of the RET managed blocks, in conjunction with a wider area survey to detect further spill-over.

Consideration should also be given to the possibility of working with landowners, managers and kaitiaki to survey areas of adjacent forest on private land not covered in this survey, where kōkako may be present. Such relationships would have advocacy benefits and may help to inform land management decisions that affect kōkako survival and dispersal, such as setting traps and creating forest corridors.



5. RECOMMENDATIONS

1. Predator control over the RET managed areas to be continued in a two-years-on, one-year-off schedule (at a minimum), with a target of reducing ship rat and possum indices to 1% RTI and RTC respectively by 1 November, and continued suppression of rats below 5% RTI throughout the breeding season.
2. Work together with partners towards an expansion of the ground control network to protect known kōkako territories in the wider area, to promote breeding success for these pairs, and to protect sufficient habitat for the recovery of the population to 500 individuals.
3. Conduct the next kōkako survey at Rotoehu in 2023, following a sub-sampling methodology for Main Block and Northern Pongakawa, and a full territorial adult survey in the remainder of the RET managed areas, along with a wider area survey.
4. Consider the possibility of surveying other areas of adjacent native forest where kōkako may have established, in order to advocate for positive outcomes for any kōkako found.

ACKNOWLEDGEMENTS

Firstly, thanks to the Rotoehu Ecological Trust, in particular to Sarah Orton for facilitating this survey and to Roger Bawden for providing excellent mapping assistance. We are also appreciative of the ongoing support by Ngāti Mākino. We wish to acknowledge the work put in over the years by DOC, RET staff, contractors and volunteers, without which this result would not have been so successful.

We would like to thank our wonderful volunteers Tom Brown, Celia Edwards, Chris Hannent, Waira Hutching and Antoni Nicolas for their help with surveying, and also thank their families and colleagues for sharing them with us.

RET would like to acknowledge the Department of Conservation Community Fund, Kōkako Coffee, Timberlands Ltd, Western Bay of Plenty District Council and the Bay of Plenty Regional Council for providing the funding for this important work.

Ngā mihi mahana - Dave, Amanda and Joel.



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APPENDICES

Appendix One: Kōkako Specialist Group reporting

	2019	2013	1995
Date of Survey Period	4 Apr - 8 May	1-18 October 13	?
Area Surveyed (ha)	998 (+2200)	~600	~440
Number of person hours used to survey	261 (+117)	258?	?
Number of Surveyors	3 + volunteers	4 + volunteers	?
Total Pairs	126 (+31)	50	17
Total Singles	8 (+5)	29	8
Total Juveniles	-	-	-
Did you follow Standard methods*?	Y	Y	?
Survey type used*	TA survey (+walkthru)	TA survey	TA survey
Did you record and use new/this years song	Yes	?	?
Comments: Figures in parentheses are for the wider area			



Appendix Two: Pest Control History at Rotoehu

Year	Method [Area covered]	Rat Index (Pre)	Rat Index (Post)	Possum Index (Pre)	Possum Index (Post)
1994-95	1080 - bait stations [150 ha]	n/a	n/a	n/a	n/a
1995-96	Brodifacoum - bait stations, cyanide, possum traps [440 ha]	n/a	n/a	n/a	n/a
1996-97	Brodifacoum - bait stations [440 ha]	n/a	n/a	n/a	0.7%
2004	1080 - aerial [3000+ ha]	69%	0%	23.2%	2.5%
2007	1080 - bait stations [440 ha]	n/a	0%	23.3%	0.7%
2008	1080 - bait stations [650 ha]	n/a	3%	n/a	0%
2011	1080 - bait stations [600+ ha]	56%	1%	4.6%	0%
2014	1080 - bait stations [600+ ha]	n/a	6%	4%	1.5%
2015	DOC200 traps [94 ha]	n/a	n/a	n/a	n/a
2016	DOC200 traps [94 ha]	n/a	n/a	n/a	n/a
2017	1080 - aerial [3000+ ha], DOC200 traps [94 ha]	83%	3%	4%	1.5%
2018	Pindone - bait stations [700+ ha], DOC200 traps [94 ha]	73%	11%	n/a	n/a