An Adult Census of North Island Kokako (*Callaeas cinerea wilsoni*) in the Pongakawa Ecological Area, Bay of Plenty

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Frontispiece: Spurdle. N. (2009)

Abstract

An adult census of North Island kokako (*Callaeas cinerea wilsoni*) was carried out in the Pongakawa Ecological Area (Rotorua District) over a three-week period in October 2013.

The main objective of this survey was to record the number of territorial adult kokako within a 650 hectare area of the Pongakawa Ecological Area. The results of this survey can be compared with future and previous adult census surveys, so that population trends can be monitored over time. This is the first survey since 2009.

The 650ha area surveyed has a history of kokako monitoring and management using pest control. Since the 2009 survey, one season of intensive pest control targeting rats (*Rattus rattus*) and possums (*Trichosurus velpecula*) coincided with the 2011/2012 breeding season. Another significant management intervention was the removal of 18 adult kokako in 2009/2010 that were translocated to establish new populations (at Secretary Island in Fiordland, and Otanewainuku near Te Puke).

The census found 129 territorial adult kokako, comprising 50 pairs and 29 single birds. This number compares favourably with previous results and indicates that the population has increased substantially in number.

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1.0 Introduction

An adult census of North Island kokako was undertaken in October 2013, in the Pongakawa Ecological Area, Rotoehu Forest, situated to the north of Lake Rotoehu, within the Bay of Plenty Region. The Ecological Area is located within the Rotoehu Conservation Area, approximately 35 kilometres northeast of Rotorua.

The last adult census for kokako in the area was undertaken in 2007 (Evans 2007). This covered an area of 440ha. The current census surveyed the same 440ha area, and an additional 210ha (total area of 650ha). A walk-through survey was conducted through the same 650ha area in August 2009 (Spurdle 2009).

The Kokako Management Folder (Flux & Innes 2001) recommends that kokako populations be surveyed every three years.

The current survey was undertaken in order to:

(i) monitor outcomes of pest control operations at the site, and
(ii) count the number of territorial adults, in order to monitor population trends.

The survey occurred over a three-week period, from October 1-18, 2013.

1.1 Survey site

The study area is located in hardwood-dominated native forest at an altitude of 195 – 285 meters above sea level. It was logged for podocarps in the 1940s, but now appears to be in good condition, although perhaps with fewer podocarps than were once present. Tawa (*Beilschmiedia tawa*), kohekohe (*Dysoxylum spectabile*), rewarewa (*Knightia excelsa*) and mangeao (*Listea calicaris*) dominate the canopy in much of the survey area. Other common tree species include hinau (*Elaeocarpus dentatus*), pigeonwood (*Hedycarya arborea*), puriri (*Vitex lucens*), mahoe (*Melicytus ramiflorus*), titoki (*Alectryon excelsus*), kamahi (*Weinmannia racemosa*) and pukatea (*Laurelia novae-zelandiae*). Vegetation type and geology are described in more detail by Spurdle (2009) and Wilke (2011; after Leathwick et al. 1983).

The survey area is divided into Western (210ha) and Eastern blocks (440ha; see map x). Pest control has been undertaken in the Eastern block since 1994. Pest control in the Western block commenced in 2008.

1.2 Background

The Rotoehu kokako population was one of the first to be monitored in the North Island. It was intensively studied in the 1990s, as part of the “research by management” programme, to assess the effectiveness of different management regimes for kokako population health. From 1990-1994, an adult census was undertaken every year, but there was no pest control.

1.2.1 Pest control

The population was declining in the absence of pest control. Pest control in the Rotoehu Forest began in the 1994-1995 field season, and continued for three consecutive years.

The treatment area was expanded from an initial 260ha in 1994, to 440ha in 1996, and 650ha from 2008. Limited pest control operations beyond the 440ha core management area were also undertaken in the 1990s[1]. In 2004, widespread aerial 1080 was broadcast over the entire Pongakawa Ecological Area and adjacent forestry areas.

Pest control has mostly used a 100m x 100m bait station network. Earlier operations predominantly used brodifacoum. More recently, bait stations have delivered 1080, pindone and cyanide. Dates and types of pest control are summarised in table 1. Further details are available in North (1997a;1997b) and Wilke (2011).

The Rotoehu kokako population has benefitted from pest control since 1994, to the extent that it has been able to be used as a donor population. 18 adult kokako were translocated from the area in 2009 and 2010 to establish populations elsewhere in the country[2].

1.2.2 Surveys

Adult kokako censuses at Rotoehu were undertaken every year from 1990 to 1997, as part of the 'research by management' programme. The area surveyed has increased over time, as the core management area has expanded (initially 150ha, expanding to 260ha in 1995, 440ha in 1996, and then 650ha from 2004)[3].

The current management objective for the area is to increase the number of breeding pairs of kokako to 50 by 2020 (Wilke 2011).

The current survey (2013) is the first true adult census to be conducted in the 650ha area, where ongoing pest control was extended in 2008. While a walk-through survey in 2009 was undertaken throughout this area, the method does not provide a reliable estimate of population size. This census therefore provides the first reliable count for the entire 650ha treatment area.

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[1] 120ha of the Ecological Area to the west of Hongi's track received partial treatment in 1995-1996, primarily by trapping, followed by an incomplete delivery of brodifacoum via bait stations (North 1997a). Partial treatment of a wider area also occurred in 1996-1997, initially with possum trapping and then brodifacoum, delivered via bait stations (North 1997a, 1997b).

[2] Refer DOCDM-596455. Ten birds translocated to Secretary Island September 2009. Eight birds to Otanewainuku.

[3] Surveys over a wider area of the Rotoehu Forest were also undertaken in 1995 (1360ha, North 1997a; 918ha, North 1997b). Data from these surveys are not included in this report, as the areas are not comparable with the current census.

Table 1. Dates of kokako surveys and other management actions, Pongakawa Ecological Area[4].

This table should not be considered exhaustive. It has been developed based on references available, but it is likely that other information sources exist. Original sources should be consulted if more detail is required.

Year	Area (hectares)	Survey type	Management action
1990-1993	150	Adult census (every year, Sept/Oct)	No control. (Research by management)
1994	260[a]	Adult census	
1994-1995[b]	150		Pest control began (1080)
1995 (Sept)	260[c]	Adult census	
1995-1996	440[d]		Pest control (brodifacoum, cyanide, trapping)
1996 (Nov)	440	Adult census	
1996-1997 [b]	440[d]		Pest control (brodifacoum)
1997 (Jan)	440	Breeding season census	
1997 (Oct)	440	Adult census	
2002 (May)	440	Adult census	
2004	650+		Aerial 1080, by Kaingaroa Timberlands. Entire Ecological Area, and adjacent forestry areas.
2004	440	Roll call	To assess effects of 1080 on kokako population
2007	440		Bait stations (1080)
2007	440	Adult census	
2008	650		Bait stations (1080). Extended to include Western block
2009	650	Walk-through survey*	
2009			10 birds translocated from area
2010			8 birds translocated from area
2011	611**		Bait stations (1080, pindone, pindone/cyanide)
2013	650	Adult census	

[a]Area expanded to increase sample size.

[b] Bands (e.g. 1994-1995) refer to seasonal pest control operations.

[c] Juvenile survey also conducted Jan/Feb 1996.

[d] Partial treatment beyond the 440ha core area also occurred, but was incomplete (North 1997a).

*The 2009 survey is described as a walk-through survey (Spurdle 2009); however, it also included some elements of partial territory mapping as set out in kokako census protocols.

**Bait was delivered across 611ha of the 650ha area; an area of pine plantation in the northwest of the Western block was excluded (Wilke (2011); personal communication, Maurice Wilke, DOC Rotorua District, October 2013. See also DOCDM 665059.

[4] Sources of information, including DOCDM numbers where available: North (2007a); North (2007b); Spurdle (2009), 480237; Chapman (undated), 125250; Wilke (2011), Pestlink Ref: 1112ROT01; Evans (2007), DOCDM-276430. See also summaries of management activities DOCDM-596455 and DOCDM-665059.

2.0 Methodology

2.1 Survey site

The survey was conducted in 650ha of the Pongakawa Ecological Area. The survey area is divided in two blocks: Western and Eastern. The Western block has an area of 210ha. The eastern block has an area of 440ha.

However, it should be noted that the total area included in the survey may be less than 650ha. The northwest of the western block includes a pine plantation that lies outside the ecological area. The plantation area has a high density of blackberry and other pest plants making movement through the area extremely difficult. It would not have been possible to follow kokako through this area. This area was therefore excluded from the current survey area. It was also excluded from the 2009 survey (Spurdle 2009).

In a pest control report for the Pongakawa Ecological Area, Wilke (2011) states that pest control was undertaken in two blocks: Block 1 (450ha) and Block 2 (161ha), a total of 611ha. It is possible that the current survey area follows the same or similar boundaries, and thus also occupies an area of 611ha. It has not been possible to make a reliable comparison between total areas surveyed in 2009 and 2013. Therefore, for the purposes of this survey, an area of 650ha is assumed.

The Eastern block has had pest control since 1994 – initially throughout 150ha, increasing to 260ha in 1995, and 440ha in 1996. Bait lines in the Eastern block generally follow the topography, often running along ridges or gullies.

Pest control in the Western block has only been undertaken since 2008. Bait lines in this block are set in a 100m x 100m grid system.

2.2 Adult census technique

The survey was undertaken in accordance with the protocols for adult census set out in the Kokako Management Folder (Flux & Innes 2001), using the field criteria for adult counts specified by Innes and Speed (2001).[5] The census uses a territory mapping technique to count territorial adults. Censuses should be undertaken from the second half of September and throughout October, and must be completed by 1 November.

This census ran from 1-18 October 2013.

[5] As set out in Kokako Management Folder (Flux & Innes 2001), Section 4. Adult Census – Field Criteria for Accepting Records in Counts of Adult Kokako.

The protocol states that all parts of the survey area must be covered by listening and, if no song is heard, by playing recorded song.[6] Listening stations should be within 300m of all parts of the block.

Survey routes used in this census aimed to keep team members sufficiently close to each other to systematically achieve full coverage of the part of the block being surveyed each day. Occasional overlap of coverage was preferable to leaving gaps.

The grid system in the Western block allows uniform spacing between lines, which are set at an interval of 100m. Surveyors walked every second line, allowing uniform spacing of 200m between surveyors, and thus adequate listening coverage across the block.

Lines in the eastern block are often more than 100m apart, and sometimes more than 200m. Bait lines in the Eastern block tend to follow ridges or gullies. In the eastern block, surveyors generally walked adjacent lines.

In order to ensure systematic coverage across the entire block, and thus avoid potential bias from using different call solicitation techniques across the block, the call playing sequence for the walk-through survey method (Innes and Speed 2011) was used.[7]

Surveyors walked along bait lines, listening continuously for calls. If no calls were heard, recordings of Rotoehu kokako dialect were played using mp3 players and portable speakers. Recordings were played every 200 metres, as follows:

a. 3 mew calls, followed by a 5 minute listening period.
b. 3 mew calls, followed by a 5 minute listening period.
c. 30 seconds of song, followed by a 5 minute listening period.

In some cases, surveyors moved a short distance from a station to play recorded song, if better acoustic coverage could be obtained from a point nearby (e.g. by moving to the top of a ridge).

Surveys began at dawn and generally continued until early afternoon (around 1pm). Surveying ran later than this on some occasions, when long or multiple follows were in progress. Surveying also ended earlier than this on several occasions, due to poor weather, or early completion of survey for a specified area.

If kokako were heard calling at any time (including while walking between stations), surveyors attempted to locate and follow the bird/s, unless ruling it too

[6] OLDDM-746337 5.5 vi “Coverage of the survey area”
[7] OLDDM-746337 5.2 Walk-Through Survey

far in the distance (particularly likely if the area from which calls were heard had already been surveyed, or was scheduled for survey later in the process).
The survey used the inclusion criteria specified by Innes and Speed[8]. For birds to be included in the count, one of the following was required:

- Follows on at least two separate days of at least 10 minutes duration each at the same location (so that follow routes cross each other);
- ***or*** one follow of at least 30 minutes in which one member of the pair expresses full song.

Although other inclusion criteria exist[9], in practice, only those above were used to determine whether a bird qualified for inclusion in the count in the current survey. This was because either a continuous follow of 30 minutes or more was achieved, and thus a follow on a subsequent day was not required; or, a follow in the same area on a different day did not cross the previous follow route.

The protocol also specifies criteria which can be used to count banded or distinctive birds, which are known from recent surveys to be territorial in this location[10]. However, we found very few banded kokako at Rotoehu, and not in sufficient numbers to be useful for this technique.

The follow time commenced once a bird had been located (either sighted or heard very close). GPS tracking was activated and remained on for the duration of the follow. It was discontinued only when contact with the bird/s was lost, or the follow was complete. Longer follows (well in excess of 30 minutes) were often undertaken, to enable surveyors to look for leg bands, listen for song or allow further territory mapping.

Surveyors aimed to follow the bird/s route, keeping as close as possible for a minimum of 30 minutes. Observations recorded included, where relevant:

- compass bearing from which bird(s) were originally heard
- the number of birds sighted or heard.
- types of calls heard during follow (e.g. full song, mews, contact calls).
- plant species that birds were observed feeding on.
- behavioural observations (e.g. courtship feeding, nest building, pair bond displays, chasing juvenile birds).
- presence or absence of leg-bands (when possible)
- description of wattles, plumage condition or any other distinctive features.

Where necessary, stakeouts (using two or more surveyors) were required to investigate whether separate follows in an area were of separate bird(s), or of the

[8] OLDDM-746337 Kokako Management Folder (September 2008), Best Practice. Section 5. Printed 18/07/2013
[9] Additional criteria are listed for (i) banded or distinctive birds, and (ii) shorter follows in the same area on separate days.
[10] Banded or distinctive kokako which are known from at least three observations to be territorial in this place in the previous year.

same bird(s) followed more than once. This is important in order to avoid either double-counting, or under-counting.

3.0 Results

Surveying took place on 13 days, with a core group of four surveyors, yielding a total of 43 individual survey days[11].

Only one full day was lost to bad weather (heavy rain and wind). Weather conditions were otherwise mostly favourable. On two days, surveying took place in windy conditions. This did not appear to affect surveyors' ability to locate and follow birds, but it did make it more difficult. It is possible that fewer birds were detected on windy days.

3.1 Abundance

129 adult kokako were counted in the survey: 50 pairs, and 29 singles. 32 of these birds (15 pairs and 2 singles) were located in the Western block. The remainder (35 pairs and 27 singles) were located in the Eastern block (see table 2).

An additional two pairs and five singles were followed in the survey area, but did not meet inclusion criteria. Therefore, they cannot be reliably counted as territorial adults, and are not included in the final count.

Birds were also followed on the eastern side of Hannons Road, however forest to the east of Hannons Road lay outside the survey area. We did this to distinguish them from birds in the survey area, and to determine whether their territories included habitat inside the survey area. These birds were not observed inside the survey area and therefore they are not included in the final count. However, they were distinct from those in the survey area and are presented in table 2 below. A single bird was observed flying into the survey area from the east of Hannons Road, where it was subsequently followed and was included in the total count.

Another pair was followed outside the survey area, to the east of Hannons Road. As a full follow was not obtained for this pair, they are excluded from table 2.

[11] The calculation of 43 days takes into account dates when a full survey day could not be completed, due to poor weather; and some days in the first week when three core survey teams were operating, not four.

Table 2. Number of territorial adult kokako in the survey area, Pongakawa Ecological Area, October 2013

	Confirmed		Unconfirmed*		Outside survey area**	
Block	**Number of pairs**	**Number of singles**	**Number of pairs**	**Number of singles**	**Number of pairs**	**Number of singles**
Western	15	2	0	2		
Eastern	35	27	2	3	1	2
Total	50	29	2	5		
Total number of birds	**100**	**29**	**4**	**5**	**4**	**2**

*Did not meet criteria for inclusion in count (followed for less than 30 minutes, and/or did not sing full song).
** Full follows were obtained for these birds, on the east of Hannons Road. They did not cross into the survey area during the follow, and so are not included in the survey total.

3.2 Comparison with previous surveys

Table 3 shows numbers of kokako found in previous surveys of the Eastern block, beginning in 1995. These data are also presented graphically in Figure 1.

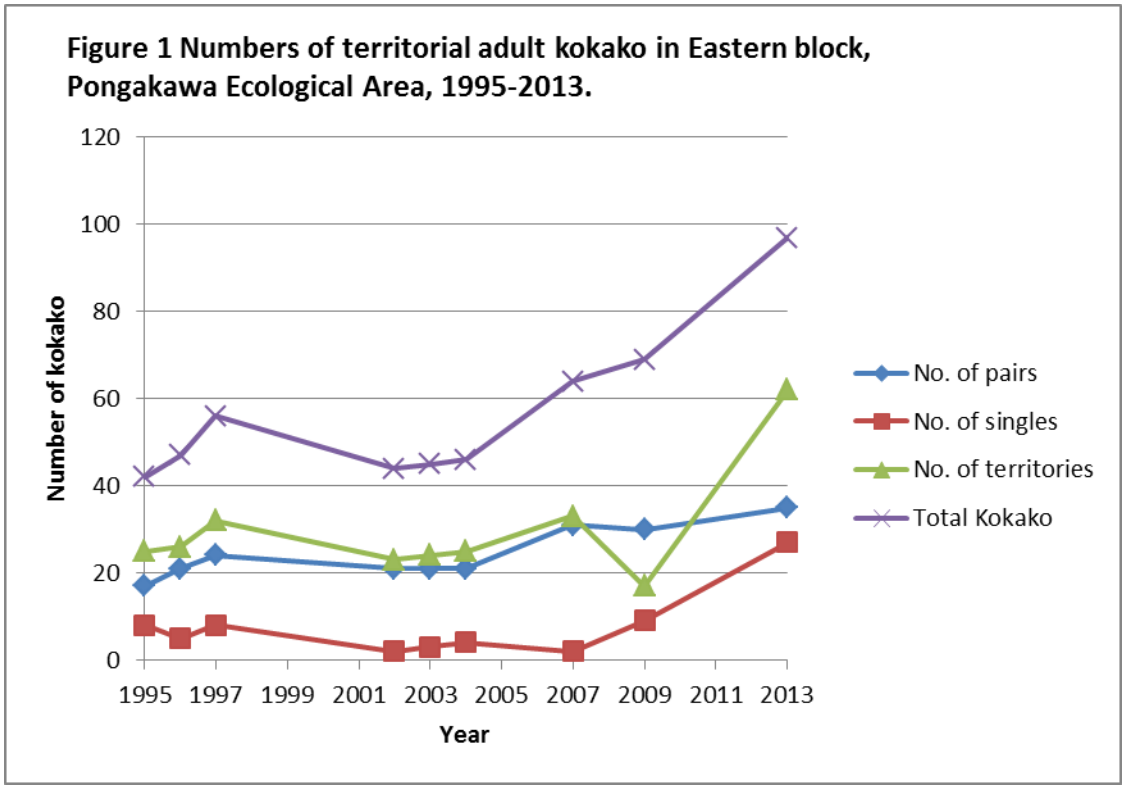
3.2.1 Eastern block

Comparison with previous adult censuses shows a marked increase in the adult kokako population in the Eastern block since the last census: from 64 in 2007, to 97 in the current survey. The increase in the number of pairs appears to have been fairly modest (from 31 to 35). However, the current census shows a marked increase in the number of single birds (from 2 to 27).

Table 3 Numbers of kokako in the Eastern block (440 ha), 1995-2013
The table includes only kokako that met criteria for inclusion in an adult census, with the exception of 2009. Sources: North (1997b); Molles (2002); Evans (2007); Spurdle (2009).

Date	No. of pairs	No. of singles	No. of Territories	Total Kokako
Nov-95	17	8	25	42
Jan-96	13	8	21	34
Nov-96	21	5	26	47
Jan-97	21	4	25	46
Oct-97	24	8	32	56
May-02	21	2	23	44
May-03	21	3	24	45
May-04	21	4	25	46
Oct/Nov-07	31	2	33	64
Aug-09*	30*	2*	17*	69*
Oct-13	**35**	**27**	**62**	**97**

*This was primarily a walk-through survey, but it also included elements of territory mapping (Spurdle 2009). Although some kokako in the 2009 survey met inclusion criteria for an adult census, Spurdle's report does not present separate data for confirmed vs unconfirmed territorial birds. Only total numbers are reported.



All data are from adult censuses, except for 2009.

3.2.2 Western block

This is only the second survey to include the Western block, and the first adult census. The current census (2013) in the Western block found 15 adults and 2 single birds. Results from the two surveys are shown in table 4.

The 2009 survey found 4 pairs and 4 single birds in the Western block. However, it is not possible to make a direct comparison between the results from the current survey and that conducted in 2009, because of methodological differences (Spurdle 2009)[12]. Walk-through survey methods provide less reliable counts, and therefore cannot be directly compared with results from an adult census.

Table 4 Numbers of kokako in the western Pongakawa block (210 ha)

Date	No. of pairs	No. of singles	No. of Territories	Total Kokako
Aug-09*	4*	4*	2	12
Oct-13	15	2	17	32

*Source: Spurdle (2009). Walk-through survey.

[12] The 2009 survey is described in a DOC summary of Rotoehu management actions as a "condensed survey using callback/follows … to gauge success of recent pest control and identify location of birds for translocation". (DOCDM-596455)

3.3 Distribution

Map/figure xx (GPS tracks) shows the GPS tracks recorded during follows of kokako in the current survey. The tracks represent the movements of surveyors while following birds, and thus represent the location of the bird during a follow. The distance of the follow is not relative to the time of the follow, as it depends on the activity of the bird(s) during that time.

Although birds are distributed throughout the survey area, distribution does not appear to be even (see map xx). There are concentrations of birds in some areas, and apparent vacancies in others. Surveyors noted several areas – so-called 'hot spots' - where the density of kokako was particularly high, and stake-outs were required to determine the number of birds present. Vacancies had no discernible pattern, but were largest in the Western block.

3.4 Nest building and related behaviour

Nest building, and related nesting activities, were observed on at least 8 occasions, for 8 separate pairs. Nest building and nest sites were suspected on another seven occasions, based on furtive behaviour and frequent returns to the same tree. However, no firm evidence was obtained in these cases (e.g. observation of a nest, or carriage of nest materials).

The first instance of nest-building behaviour was observed on 1 October, the first day of the survey. Nest building continued to be observed throughout the course of the survey.

Courtship feeding was observed in a number of other pairs.

3.5 Banded bird sightings

Many birds were banded in Rotoehu in the mid-1990s (over 50). The 2002 census found that 23 kokako still carried bands (Molles, 2002). 12 banded birds were seen in the 2007 census (Evans 2007). Both the 2002 and 2007 surveys were for the Eastern block only.

Only three sightings of band combinations were made during the current survey. These were:
M-Y
RM- ? (right leg not seen clearly; appeared to be unbanded)
M-? (colour of right leg unclear – maybe green).

M-Y is likely to be 'Obligato', banded as a nestling in 1995/96.

RM- could be Kahu (RM-B; banded as a nestling in 1995/96), Sequencia (RM-YW) or Tawai (RM-RG; both banded as nestlings in 1996/97). All three of these birds had RM bands on their left legs, and one or two bands on their right legs. It is possible that the bands on the right legs have been lost. However, if so, it may be more likely that the bird is Kahu, who had only one band on the right leg, as

both of the other birds had two bands on the right leg. It appears more likely that one band could have been lost rather than two.

It is not possible to identify the bird with metal on the left leg, as there are too many possibilities. At least 15 birds had metal on their left leg in 1995. If the right band is green, as the observer speculates, it could be Tigger (M-G; recorded as a banded bird in 1995).

Although much time was spent trying to observe and record the presence or absence of bands, and the combinations of banded birds, the lack of banded birds observed meant that the adult census criterion for known distinctive or banded kokako, was of no use to this survey.

It was generally difficult to observe birds' legs clearly, particularly when they were high in the canopy, or very mobile.[13] Thus, it cannot be assumed that the three banded birds observed are the only banded birds remaining in the Rotoehu kokako population.

3.6 Other bird species

Good diversity and abundance of other bird species was noted during the survey. These species included fantails, bellbirds, tui, rifleman, shining cuckoo, whitehead, tomtits, kereru, silvereyes and paradise shelducks. Australasian Harrier were frequently observed, often circling above the canopy. Robins were heard rarely, by some surveyors. Kaka were also heard rarely, by one surveyor. Introduced bird species were frequently heard and included blackbirds, chaffinches, Eastern rosellas and pheasants.

3.7 Plant and animal pests

Generally there was little sign of pest animals. A small amount of deer sign was observed. One stoat was seen crossing Hannons road, heading into the Ecological Area.

Pest plants (montbretia; wild ginger) were observed in only a few places within the Ecological Area. However, blackberry was abundant in clearings, tracks, pine plantations and bush edges, and made access difficult in some areas.

4.0 Discussion

4.1 Abundance

This census found higher numbers of territorial adult kokako in the Pongakawa Ecological Area than previous surveys. Comparison with previous census results shows an increase of both pairs and single birds. This is despite the translocation of 18 birds from the area in 2009-2010.

[13] For at least 30 observations, it was not possible to clearly see both legs of a bird.

The stringent criteria for inclusion in the territorial adult count mean that the total number of kokako found in this survey is likely to be an underestimate. Other birds were observed which were not able to be included in the count, either because follows fell short of 30 minutes, and/or birds did not sing.

Many kokako appeared to be more furtive than usual at this time of year, suggesting an early start to nesting (Sid Marsh, personal communication, 18 October 2013; see also discussion below). Some observations were made of birds more preoccupied with nesting, and less so with singing. In such cases, birds may go undetected, or fail to meet survey criteria during a follow, because full song was not heard.

4.2 Nesting behaviour

As nesting behavior was observed throughout the survey period, some birds may have been undetected because of nesting behaviour. Kokako are known to become furtive during nesting. Kokako census protocols are written to avoid the onset of nesting. The recommended time period for an adult census is from mid-September to the end of October. However, a recent update to the Kokako Management Folder recommends that adult censuses be completed by October 20, if possible, to reduce the chance of pairs beginning to nest during the survey (Flux & Innes 2001).

Our survey was completed on October 18. However, given a mild winter, and a warm spring (personal observations), perhaps nesting was more advanced this year.

4.3 Comparison with previous surveys

4.3.1 2009 survey

Methodological differences between the 2009 walk-through survey, and the adult census technique used for the current survey, prevent robust comparisons with the 2009 results. A walkthrough survey is primarily an indicator of presence/absence, rather than a quantitative measure (Innes and Flux 2008). It can provide a rough estimate of abundance, but only if changes between surveys are large. (Innes and Flux 2008). However, Spurdle (2009) also included an element of territory mapping, so some quantitative comparison is possible.

While described as a walk-through survey, the 2009 survey also included elements of the adult census. Birds were followed, but because of time limitations, follows were limited to a maximum of 30 minutes (Spurdle 2009)[14]. This means that surveyors had limited time to meet the adult census inclusion criterion of a 30 minute minimum follow and full song.

[14] Follows were finished earlier for birds that sang full song, but required a minimum of 15 minutes to be included in the count. Birds were also included in the count if the GPS tracks of follows crossed each other when surveyed on separate days (Spurdle 2009).

The 2009 survey results may provide a more accurate estimate of population size than would be provided by a walk-through survey alone, but it is neither a true walk-through survey, nor an adult census.

The 2009 count is perhaps even less comparable with the current census, because of contrasting survey conditions. The 2009 survey was restricted by time, numbers of surveyors and unfavourable weather conditions. The 2009 survey was conducted over two weeks, compared with three weeks for the present survey. The 2009 survey had a total of 28 individual survey days, compared with 43 days during the current survey.

The 2009 survey had a high proportion of 'possible'/unconfirmed birds, largely because of time limits set by the surveyors (maximum follows of 30 minutes). 17 pairs and 2 single birds met inclusion criteria (from a total of 34 pairs and 13 singles observed; Spurdle 2009).

4.3.2 2007 census

Comparison with the 2007 adult census is more valid than with the 2009 survey. However, the 2007 census was conducted only in the Eastern block (440ha). Therefore, comparisons with the current survey can only be made for the Eastern block.

The number of pairs in the Eastern block does not appear to have changed markedly between 2007 and 2013 (31 and 35 pairs, respectively). However, 18 adult kokako were translocated from the area in 2009 and 2010. Many were taken from the Eastern block[15]. In this context, the true increase in the number of territorial adults (both pairs and singles), since 2007, is much more substantial.

While the increase in pair numbers was comparatively modest, the current census found a far greater number of single birds in the Eastern block (2 in 2007; 27 in the present survey).

The Rotoehu kokako population has not shown such a high proportion of singles to pairs in previous surveys (see table 3). Prior to this survey, the highest was 21 pairs to 6 singles (1996/97); the lowest, 31 pairs to 2 singles (2007).

As nesting was underway when the survey began, it is possible that a number of these apparently single birds were part of a pair, with a mate sitting on a nest. However, observation generally found there was no evidence to suspect this was the case.

Kokako in the Western block did not exhibit such a high proportion of single to paired birds (15 pairs and 2 singles). However, the Western block was surveyed

[15] 2009: 7 birds from Eastern block; one from Western block. Information unavailable for 2010 translocations.

in the first week only. While some nest building was observed in the Western block, it is possible that nesting was further advanced in the second and third weeks, when the Eastern Block was surveyed.

It may have been more difficult to detect both birds in a pair if they had started nesting, meaning that only one of the pair was included in the count. Thus, the number of pairs in the Eastern block could be greater than 35, and the number of singles less than 27. Perhaps this was less of an issue in the first week of the survey for the Western block.

Evans (2007) also noted that the 2007 census may have underestimated the total number of birds, as it continued into the nesting season (16 October to November 9; Evans 2007). The author notes that this made it difficult to reliably determine the number of pairs and singles.

It is also likely that pairs may have been separated during the translocation process. 18 birds were taken from the survey area in 2009-2010. Further investigation would be required to determine how this could have affected the ratio of singles to pairs.

4.3.3 Western Block

Pest control in the Western block began in 2008. The current survey is the first adult census to have been undertaken in this block. The 2009 walkthrough survey found 4 pairs and 4 singles. However, only two of these met the criteria for inclusion in the count.

Meaningful comparison with counts from the 2009 survey is not possible (as explained above). However, the current census' finding of 15 pairs and two singles indicates recruitment of kokako into the Western block. Significant further expansion is possible, as there appear to be large areas currently uninhabited by kokako.

4.4 Distribution

There appear to be areas of greater density, where birds are more closely clustered than elsewhere, particularly in the Eastern block. At a glance, there also appear to be vacancies across the area, where no kokako were confirmed. It appears that both the Eastern and Western blocks still have room for higher densities, but more so in the Western block, particularly in the southwest.

Pest control in the western block only began in 2008. Nevertheless, it appears that kokako are expanding into this area and/or being recruited within it.

4.5 Potential for expansion

While Spurdle (2009) considered it likely that the eastern Pongakawa block has reached its carrying capacity for kokako, this census does not support this

hypothesis. The kokako population has increased in the eastern block since the 2007 survey, and it appears that there may still be vacant habitat (see map xxx). The removal of 18 birds for translocation may have freed up a sizeable number of previously occupied territories. Even so, the large numbers of adult kokako in the current survey represent a substantial increase in the number of territories compared with previous surveys (see table 3),

Innes et al. (1996) found that territory sizes of kokako at Rotoehu ranged from 9 – 14ha, based on surveys prior to pest control (1990-94). However, the authors speculated that territory sizes at Rotoehu may decrease in response to pest control, which could increase the food supply available for kokako (Innes et al. 1996).

A survey in 2004 estimated that most kokako territories at Rotoehu are approximately 5ha in size (Hudson 2004). The current survey estimated territory sizes of 7ha in the Eastern block, and 12.3ha in the Western block.[16]

Carrying capacity is likely to be an increasingly important factor as kokako numbers increase, and is likely to put pressure on birds to disperse. There are a number of areas of native forest adjacent to the survey area that could provide potential habitat for kokako to disperse into as the population grows. It appears that some kokako are already utilising these areas. However, as there is little pest control in these areas, the habitat will most likely offer less protection, and more competition, from pests.

4.6 Management implications

The conservation outcome sought for the Pongakawa Ecological Area kokako population is a minimum of 50 breeding pairs by 2020. The outcome target for the last pest control operation was set accordingly: to increase the number of breeding pairs to 50 (Wilke 2011). This outcome has been achieved, seven years ahead of schedule. It is on track to well exceed the target by 2020, providing pest control is continued.

Prior to the last pest control operation in 2011, the residual trap catch index (RTCI) for possums was below 5% (Wilke 2011[17]). This indicates low possum densities persisting outside pest control seasons. Kokako may be benefiting from apparently low possum densities during interim seasons. Wilke (2011) suggested that this low density might be the result of extensive possum trapping by hunters throughout the Rotoehu Forest. Widespread aerial 1080 use in 2004 may have assisted by preventing reinvasion from adjacent forest. Whatever the reason, kokako appear to have benefited, and such control methods should be encouraged in the future.

[16] Eastern block: 62 territories over 440ha. Western block: 17 territories over 210ha.
[17] 4.63% RTC. 95% confidence interval +/- 5.66%.

The success of achieving the conservation outcome earlier than planned is considered to be a result of the ongoing pest control, which should be sustained.

5. Conclusions

The kokako population in the Pongakawa Ecological Area has grown steadily since the last census, and has reached its management objective. A total of 129 territorial adult kokako were found in the 650ha survey area, comprising 50 pairs and 29 singles.

The population in the Eastern block increased from 31 to 35 pairs, since the 2007 census, despite the removal of 18 adult kokako for translocations in 2009 and 2010. 27 single birds were also found in this block, giving a total of 97 birds, compared with 64 in 2007.

32 birds were found in the Western block (15 pairs and two singles). This is a considerable increase from the 12 kokako estimated to be present in the Western block in 2009 (4 pairs; 4 singles).

The area may not yet have reached carrying capacity, as there still appears to be space for expansion, particularly in the west. However, carrying capacity is likely to be a factor in the area in the long term.

The strong increase in the population, compared with the 2007 census, provides robust evidence for the effectiveness of pest control in the area. Pest control needs to be maintained to sustain population numbers, and allow for future growth.

There appears to be potential for the kokako population to expand, both within the area of current pest control, and into adjacent native forest (in both the Pongakawa Ecological Area and the wider Rotoehu Conservation Area). However, pest control would need to be expanded beyond the current area if kokako are to be successfully recruited and established in additional areas.

6 Recommendations

6.1 Future surveys

Censuses should continue to monitor kokako population numbers in the Pongakawa Ecological Area. The Kokako Recovery Group (KRG) recommends that a census of a kokako population be conducted every three years.

Recommendation 1: Undertake an adult census of the Pongakawa Ecological Area kokako population in September/October 2017 (subject to any potential amendments to census frequency, as may be recommended by the KRG).

Future surveys should commence earlier in the season, so that the census period avoids early nesting. The census protocol states that surveys should be completed before November 1, to avoid the nesting period, as birds become more secretive at this time. A recent update to the Kokako Management Folder recommends that surveys should be completed by October 20, if possible, to avoid the nesting period[18]. However, nest building was already underway when the current census began on (October 1). Thus, it would be preferable to begin future surveys in the second half of September.

Recommendation 2: Commence future surveys of the Pongakawa Ecological Area kokako population in the second half of September.

6.2 Pest control

This census demonstrates the effectiveness of the pest control regime for managing the kokako population in the Pongakawa Ecological Area. Pest control should be continued, following either the methods used to date, and/or any subsequent improvements recommended by the KRG, or other experts.

The last delivery of pest control (bait stations) occurred in 2011. As two years have now elapsed, another round of pest control is strongly recommended in the near future, to prevent reversal of current gains in the population. The Rotoehu Ecological Trust (RET) has been recruited to take on the responsibility for pest control.

It is important to support and include the RET in planning future operations. Community participation has played an integral role in the success of other kokako populations, particularly in Kaharoa (Kaharoa Kokako Trust) and Mangatutu (NZ Native Forests Restoration Trust), and is on track to contribute to the future success of the Rotoehu population.

[18] Page 10, printed 30.10.13

Recommendation 3: continue pest control, ideally beginning in September 2014.

6.3 Consider extending area of pest control

The census found evidence of birds utilising habitat outside the current 650ha management area. This represents a potential area for future population expansion, but this is unlikely to persist without pest control.

The kokako population is growing in the Ecological Area and appears to be expanding. There is scope for the population to grow further if the area of pest control was expanded in adjacent parts of the Ecological Area and Rotoehu Conservation Area. This could have benefits for security of the kokako population, not only in Rotoehu, but elsewhere in the country, through translocations.

The population has the potential to provide a continued source of birds to seed or augment other populations. Expanding pest control to a greater area therefore has the potential to increase the population, to benefit the species nationally as well as locally. However, translocations should be only be considered when absolutely necessary and with high expectations of success. The welfare of the birds should be the primary consideration.

Recommendation 4: consider expanding pest control into adjacent areas of the Pongakawa Ecological Area and Rotoehu Conservation Area.

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