

Patterns of calling by shining cuckoo (*Chrysococcyx lucidus*) on Kawau Island, New Zealand

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Abstract I recorded the calling behaviours of shining cuckoos (*Chrysococcyx lucidus*) from 1992 – 2015 on Kawau Island. The 3 most common calls, the upward crescendo “whistling call,” the downward slur “call-note,” and the “call-note” with “chatter” notes, were given from the arrival of adults in late August-early September until early January. After January only the call-note was heard. The upward whistling calls averaged 9.5 notes per calling bout ($se = 0.18$, $n = 721$). There was no significant difference in the number of whistling notes given with or without following notes. Single call-notes from lone cuckoos or groups of birds were restricted to specific sites on ridges. Calling was infrequently heard during evening twilight, and not heard during darkness. There was an increase in the number of cuckoo detections after 2009, and this corresponded with the appearance of communal behaviour and calling.

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Keywords shining bronze-cuckoo; *Chrysococcyx l. lucidus*; calling behaviour

INTRODUCTION

The shining cuckoo (*Chrysococcyx lucidus*) breeds in New Zealand, Norfolk and Chatham Islands (subspecies *C. l. lucidus*), as well as in Tasmania and southern Australia (subspecies *C. l. plagosus*). The subspecies overlap on migration only, with the Australian birds over-wintering in northern Australia, and New Guinea and the Lesser Sundas, and *C. l. lucidus* over-wintering in the New Britain, and the Solomon Islands (Gill 1982b; Higgins 1999). Shining cuckoos have been noted leaving these places by September on their southern migration (Gill 1983; Higgins 1999). Both subspecies pass through Queensland on the way to their breeding sites but it is not known if all migrating New Zealand

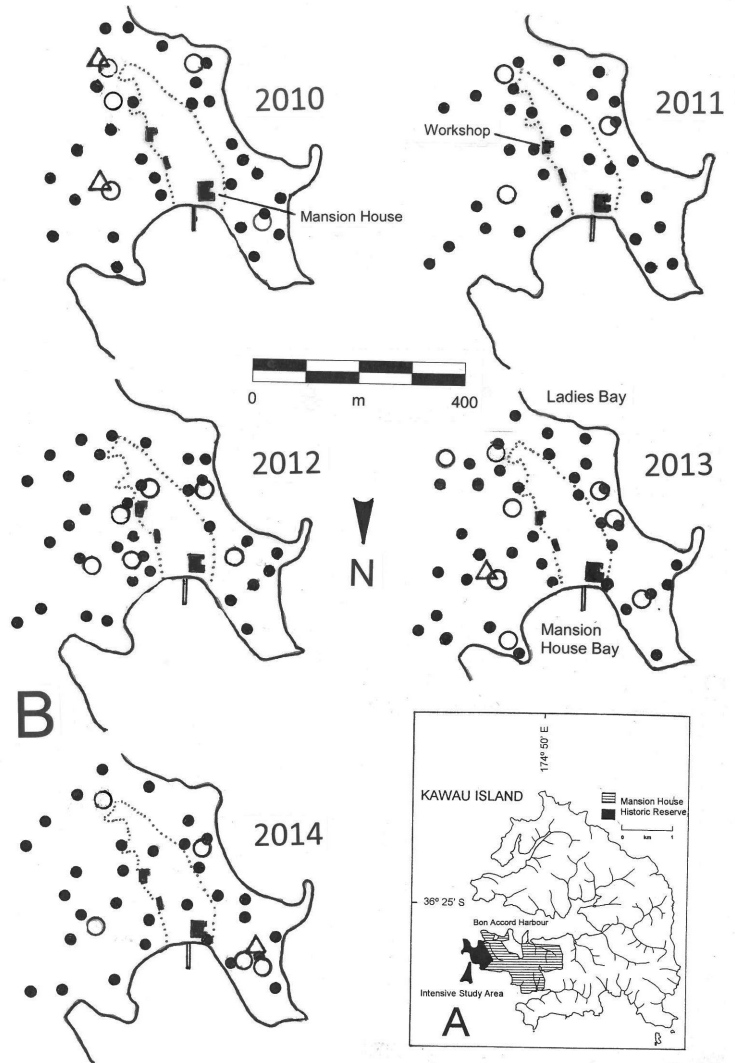
birds stop there on the way back (Higgins 1999; Anon 2014).

Shining cuckoo calls are well described but there is little quantitative data on call timing and call type use (Andersen 1926; St Paul 1976; Higgins 1999). These are largely confined to anecdotal statements about the use of either “whistling calls” or the “call-notes” (Higgins 1999) on arrival in New Zealand (St Paul 1976) and during the breeding season (Andersen 1926), and on the use of “whistling calls”, “call-notes” and “chatter calls” during communal displays and in pre-courtship and pre-copulation displays (Andersen 1926; Fitzgerald 1960; Seabrook-Davison *et al.* 2008; Seabrook-Davison & Anderson 2013; Gill 2013). Repeated downward-slurred “call-notes” have generally been associated with gatherings of birds and may be part of courtship behaviour (Gill 2013).

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Fig. 1. (A) The location of the Kawau Island study area. (B) Locations where shining cuckoos gave “calls notes”, “calls notes with chatter calls” congregations were seen, and the location of calling male grey warblers during each season 2010-2014. O = call-note or call-note and chatter call location. Δ = congregation. ● = grey warbler male calling location.



The first dates of calling of any type have been used as an index of spring arrival of shining cuckoos in New Zealand (Higgins 1999). However, there is some doubt about the status of birds calling before mid-August as some individuals over-winter (Cunningham 1955), are capable of calling from a young age (Fulton 1909), and may be responsible for some records of early calling (MacDonald 1955). The call rate in early spring is considered to be intermittent (Cunningham 1955). From early to mid October resident birds are generally heard daily (St Paul 1976). Shining cuckoo individuals with distinctive and recognisable calls suggest that some birds return to the same sites each year (Michie 1948). The number of cuckoos seen has

been used to index changes in population status (St Paul 1976).

There are no reliable data on the relationship between calling patterns and the date of departure, as cuckoos are generally less vocal late in the breeding season (St Paul 1976). Most adults are considered to leave breeding sites between November and February (St Paul 1976). Groups have been seen at coastal sites in January (Edgar 1961), and large flocks of 200 -300 birds in coastal areas in February (Potts 1946; Cunningham 1985). Shining cuckoos are present on Norfolk Island in February (Schodde *et al.* 1983) and New South Wales and Queensland from February to April (Higgins 1999).

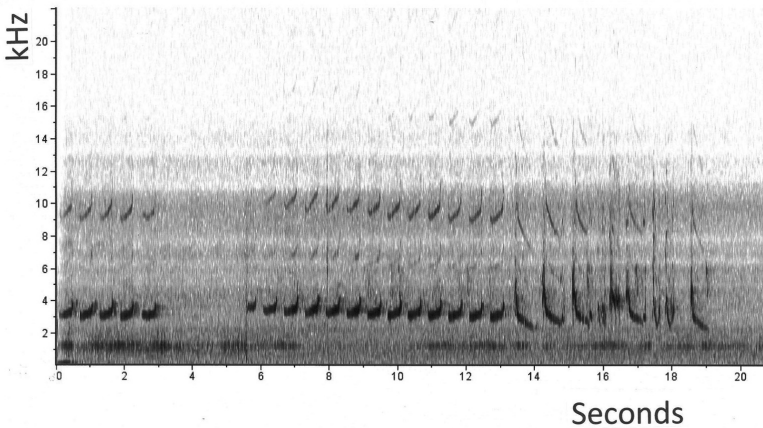


Fig. 2. Sonogram of shining cuckoo calls. From left to right the sequence comprises 5 whistling notes, a gap of just over a second, and then 13 whistling notes, followed by 3 call notes and a chatter sequence that ends with a call note.

Grey warblers (*Greygone igata*) are the preferred nestling host of the shining cuckoo in New Zealand (Gill 1983a; Higgins 1999). Grey warbler pairs are sedentary and only the female builds the nest and incubates (17-21 days). Shining cuckoos lay from mid-October to early January (Gill 1982; Anderson 2009) in nests before completion of the clutch and up to 9 days after the clutch is completed (Gill 1982a & b; Briskie 2007). The number of eggs laid by each female shining cuckoo is unknown, but one female had 4 eggs in her oviduct in various stages of development (Gill 1982a; Cunningham 1985), and potentially up to 16 eggs could be laid per female in nests over the *c.* 20 ha home range of a cuckoo (Gill 1982b). Cuckoo weights at fledging are equivalent to *c.* 3 grey warbler young so only one cuckoo is raised in a grey warbler's nest (Gill 1982c; Wakelin 1967).

In this study, I quantify the timing and composition of shining cuckoo calls at an island site in northern New Zealand. I discuss the information gathered in this study in relation to that from other sites.

METHODS

Study area

Kawau Island is a highly modified island in the Hauraki Gulf (Fig. 1a). The study area at Mansion House Historic Reserve (22 ha) comprised 2 ridgelines at ~70 m altitude (670 m and 500 m long, respectively) that run in a SE-NW direction, and a central valley near sea level.

Vegetation is largely restricted to those species unpalatable to wallabies (Millett 2010). The dominant canopy species on the hillsides in the Mansion House Valley comprises pines (*Pinus radiata*, *P. pinaster*) up to 50-70 m tall, kanuka (*Kunzia ericoides*), pohutukawa (*Metrosideros robusta*), privet (*Ligustrum lucidum*), patches of wattles (*Acacia longifolia*, *A. mearnsii*, *Paraserianthes*

lophantha) and figs (*Ficus macrophylla*, *F. rubiginosa*), Norfolk (*Araucaria heterophylla*) and other pines (*Araucaria* spp.), and brush cherry (*Syzygium australe*), cabbage palm (*Livistona australis*) and other palms and planted specimen trees and shrubs. The understorey is limited; with large areas of ponga (*Cyathea smithii*, *C. dealbata*), pea shrub (*Polygala myrifolia*) and patches of brush cherry, *Agapanthus praecox*, boneseed (*Chrysanthemoides monilifera*), Mauritius hemp (*Furcraea gigantea*) and Cape honeysuckle (*Tecoma capensis*). Thickets of low growing shrubs are restricted to the cliff faces and the areas cleared along roads and under power lines.

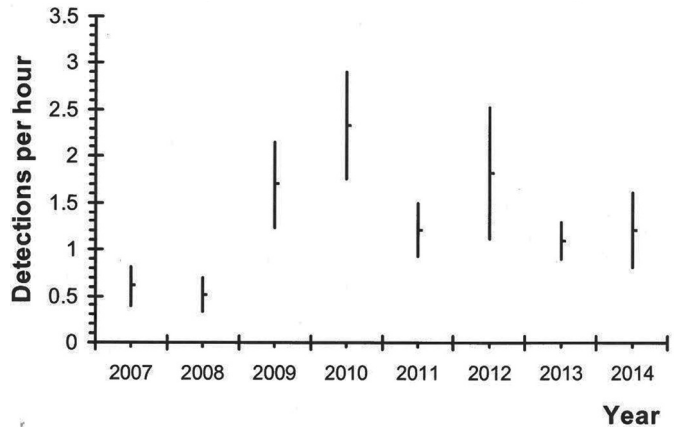
Data collection

The maximum number of shining cuckoos heard or seen was recorded during 205 trips between 1992 and 2015. Each trip was between 1-4 days duration. From 2005 onwards, I maintained records of the time of all calling which included whistling call notes (Higgins 1999, Fig. 2) given by shining cuckoos within the study area (Fig. 1a).

From September 2009, I counted *in situ* the number of notes in "whistling calls", the presence of the "call-notes" (Higgins 1999; referred to as "tiu" in Andersen 1926), or the "chatter calls" complex (Fitzgerald 1960, referred to "tiu and wit" sequences and the "tiu and wit a wit" sequences in Andersen 1926; Fig. 2). I also recorded the incidence of call-notes, and chatter call and call-notes, given without whistling calls and tried to establish the location and number of birds present.

From 2010 onwards, observations began at least 30 minutes before sunrise to at least an hour after sunset. I traversed the 22 ha area multiple times each visit to plot the locations of singing grey warbler males, look for pairs and grey warbler and cuckoo chicks, and establish the locations and number of calling shining cuckoos (Fig. 1b).

Fig. 3. Annual detection rate of shining cuckoo at Mansion House Historic Reserve 2007 - 2014 (Mean, *se*).



RESULTS

Detection and calls

Shining cuckoos were first heard in all years except 1999 between mid September and early October (Table 1). They were generally not recorded after the end of December. However, in 2002 and 2004 there was no trip in November and only a dependent chick and an adult, respectively, were detected in December. In all years, initial detection was almost exclusively by calls (99.9%; $n = 833$). Between 1992 and 2009, the number of cuckoos heard or seen at any one time was less than 3 birds and no congregations were seen. Call rates were lower than in following years where congregations occurred (Fig. 3).

The first calls were given on average 1.57 minutes ($se = 0.57$, range 0 - 3, $n = 7$ days) after sunrise, and the last calls were recorded on average 60.5 ($se = 6.5$ range 17-118, $n = 17$ days) minutes before sunset.

Detections were generally made in the middle of the day in September ($n = 3$ days), however, shining cuckoos were not detected on consecutive days when they were likely to have been present in the study area ($n = 4$ days) based on their detection on a preceding or following day. From October, calls were heard before mid afternoon on all days when I was present at the site. Calls ($n = 836$) were spread widely throughout the day but detection was not evenly spaced throughout the day ($\chi^2 = 302$, $d.f. = 14$, $P < 0.001$; Fig 4a) and averaged 0.69 ($se = 0.07$, range 0 - 2, $n = 71$) calls per hour (Fig. 4b).

Calls comprised groups of whistling notes or groups of whistling notes and call-notes with or without chatter notes (Table 1; Fig. 5). The number of whistling notes that were given without other notes (mean 9.4, $se = 0.23$, range 2-31, $n = 444$) did not differ significantly from calls comprising whistling notes and call-notes (mean = 9.6, $se = 0.34$, range 2-28, $n = 177$; t equal variance = -0.799, $df = 619$, $P = 0.42$), or whistling notes, call-notes and

chatter notes (mean 9.8, $se = 0.54$, range 3-31, $n = 100$; t equal variance = -0.736, $df = 542$, $P = 0.46$). The mean monthly number of whistling notes given without other calls differed significantly between months (One way ANOVA: $F = 3.29$, $df = 4$, $P = 0.011$) but the number of whistling notes preceding the call-note, and the chatter calls and call-notes, did not differ significantly between months (Table 1, $P > 0.05$).

Cuckoos occasionally gave the call-note on their own at sites along the main ridgelines (Fig. 1b). Groups of call-notes were given by birds less than 20 m apart ($n = 17$, Fig. 1b), by birds that were moving together, and when one bird was giving a tail up display and feeding another bird on 3 October 2009. Cuckoos gave repeated call notes with chatter notes when there were 2 or more together between September and January, and throughout the day ($n = 68$, Fig. 6).

The call-note was the only call type recorded in late summer and was given on 15 February 2015, 21 February 2010, 7 March 2009, and 25 March 2005.

Congregations

Congregations of multiple birds were observed from 2009 between 6 October and 15 December, but only during the afternoon (12:53 - 17:20 h). Congregations of cuckoos lasted for an average of 14.4 minutes ($se = 2.86$, range = 5 - 19, $n = 5$). Congregations generally occurred where birds were heard giving call-notes alone on other occasions (Fig. 1b). The numbers of birds involved in congregations varied between 3 - 5. All congregation sites generally were within or on the margins of patches of Tasmanian blackwood (*Acacia melanoxylon*) and flooded gum (*Eucalyptus grandis*) and Paramatta wattle (*A. parramattensis*) within the pine (*Pinus radiata*) forest. The behaviours seen were "fluff-up displays," where the body plumage was fluffed and rapid following movements by birds within 1-3 m of each other occurred in the upper branches of trees.

Table 1. The number of shining cuckoo whistling notes given alone, preceding the call-notes alone, or preceding a series of call and whistling notes, during in each calendar month of the "breeding season".

Notes in calls	September			October			November			December			January		
	mean	SD	n	mean	SD	n	mean	SD	n	mean	SD	n	mean	SD	n
"Whistling" notes alone	7.7	2.7	21	10.4	5.2	186	8.7	5.01	100	8.7	3.8	117	9.4	5.4	20
"Whistling" note followed by "call-note"	9.1	2.9	10	9.8	4.9	40	10.8	5.09	65	9.1	3.8	43	9.4	4.1	19
"Whistling" followed by "call-note" & "chatter" notes	9.3	4.1	20	10.3	5.7	41	8.4	4.04	19	11.3	6.7	16	8.5	4.5	4

Breeding and calling detection

Grey warblers were widely distributed in the study area (22 ha; Fig. 1b) with the average maximum numbers of calling males in the 5 breeding seasons 2010 - 2014 being 27.2 ($se = 2.7$) in September, 28.2 ($se = 3.6$) in October, 22.8 ($se = 2.8$) in November and 8.2 ($se = 2.5$) in December.

Dependent grey warbler chicks were seen on 9-11 October 2010 ($n = 3$), 19-21 October 2012 ($n = 2$), 19-23 October 2013 ($n = 3$), 25-27 October 2014 ($n = 2$), 5-7 November 2010 ($n = 4$), 5-7 December 2014 ($n = 2$) and 31 December 2013 - 2 January 2014 ($n = 3$). Single dependent mobile cuckoo chicks with tails at least half developed, giving loud chick calls and being fed by grey warblers were seen predominantly after adult cuckoos were silent. They were seen on 6 December 2014, 7 December 2002, , 27 December 2014, 27-28 December 2012, 31 December 2008, 5 January 2007 and 24 January 2015 ($n = 2$). On the 28-30 January 2012, 1 grey warbler feed 3 (29 January) and then 4 (30 January) well developed calling cuckoo chicks. A silent independent young cuckoo was seen on 14 January 2006.

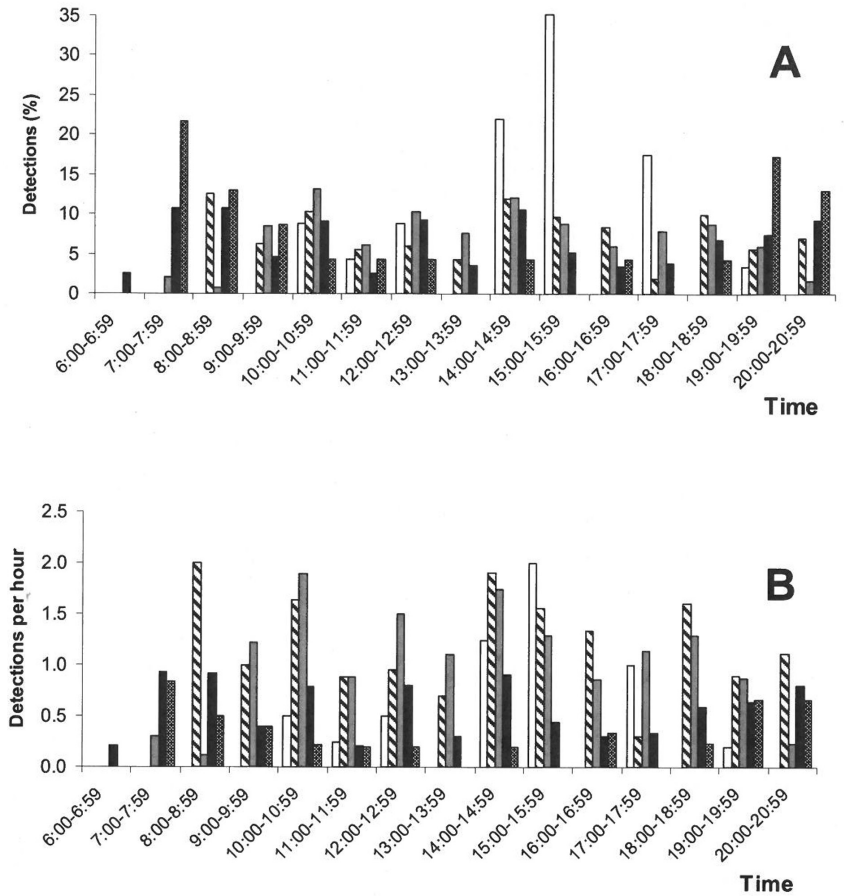
DISCUSSION

Arrival and calling

The pattern of arrival, and the presence of shining cuckoo in New Zealand has attracted considerable attention (Cunningham 1955; Gill 2013). However, dates of arrival can be confused by the presence of birds that over-winter in New Zealand (MacDonald 1955). In this study, no over-wintering birds were detected during 66 visits between 1992 and 2014. The times that shining cuckoo were detected were generally confined to September to early January, with only 4 birds heard in February and another in March. Detection between mid January and mid February were expected to have been more difficult due to interference from the calls of cicada (*Amphipsalta zealandica*), and the normal seasonal decline in calling rates of shining cuckoos (St Paul 1976; Gill 1982b).

In Kaitaia, Marples (1942) indicated that the call rate of shining cuckoos peaked in September, and then declined to December, before increasing again in February. This pattern was not seen at Mansion House where the peak calling was confined to the period of October to December. The difference may be due to migration of cuckoos through Kaitaia on the way to and from more southern sites. Stidolph (1971) recorded call-notes at night by birds moving south between 3 - 30 October at Masterton and by birds moving eastward in November, but did not record similar calling in other months. The call-note appears to be the only call recorded in the non-breeding season in New Zealand (MacDonald 1955).

Fig. 4. Shining cuckoo detection (all calls and sightings) on Kawau Island, 2009 – 2014. (A) Percentage detection based on effort during a calendar month. (B) Number of detections per hour. September white, October hatched, November dark grey, December black, January shaded.



Calls and call indices

The calls and behaviours detected in this study have been reported by others, including the crescendo “whistling calls” with call-note, and the musical chatter notes (Fitzgerald 1960), which were given with the call-note. The maximum number of sequential whistling calls in this study was 33 notes. This number is fewer than the reported maximum of 176 notes reported by Cunningham (1955), and fewer than the sequences reported by Potts (1873; Table 2). Shining cuckoo were not recorded calling at night on Kawau Island either in the half hour before dawn and hour after dark when I was actively listening or at other times when I was awake while resting outside, but were heard at other sites (Potts 1873; Stidolph 1971; St Paul 1976; Table 2).

St Paul (1976) reported that when birds arrived they gave the whistling call or the call-note alone. I recorded the call-note and the chatter calls with whistling calls, and did not record any instances in September where the call-note was given alone.

This study did not also support the anecdotal observation that there was a far higher incidence of call-notes, after whistling call sequences exceeded 15-20 consecutive notes (Dell 1970). Whistling calls were given alone 62% of the time in sequences below 14 notes and 57% of the time during longer sequences. It may well be that there are differences in shining cuckoo call use and frequency between regions and island and mainland sites.

Detection indices

St Paul (1976) recorded counts of birds seen, rather than call rates, at Manganui during 1946-61. He found that the incidence of detection of cuckoos in the 1946-47, 1947-48 and 1960-61 breeding seasons were lower than during the intervening years. He suggested that such changes were likely to be due to losses away from the breeding area. In this study cuckoos were detected in all years but 1999. However, I only visited the study area for 2 days during the usual intensive calling period that year. Monitoring on Kawau Island suggests an increase in numbers or use by shining cuckoos at Mansion

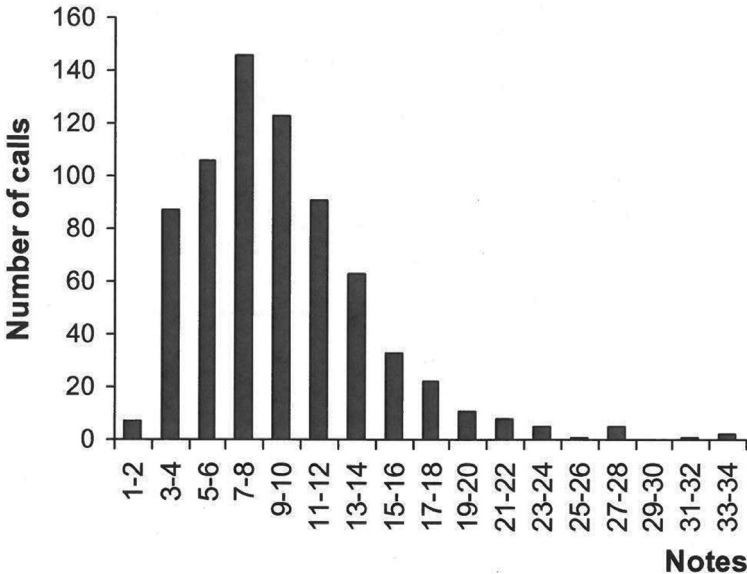


Fig. 5. Number of shining cuckoo "whistling notes" in a call sequence given alone or with other notes, September 2009 to December 2014.

Table 2. Range of whistling calls given by adult shining cuckoos.

Time period	Canterbury* range	Kawau Island	
		range	n (days)
23:30-01:00	14-34	-	-
01:00-03:45	18-41	-	-
3:45-4:45	15-24	-	-
4:45-6:45	13-25	3-17	6
6:45-11:45	-	3-34	42
11:45-12:20	3-42	5-33	6
12:20-16:30	11-35	3-21	48
16:30-18:00	12-44	3-23	11
19:00-21:00	18-68	3-19	6
21:00-22:05	17-64	-	-
22:05-23:00	25-107	-	-

* number of days not able to be determined (Potts 1873).

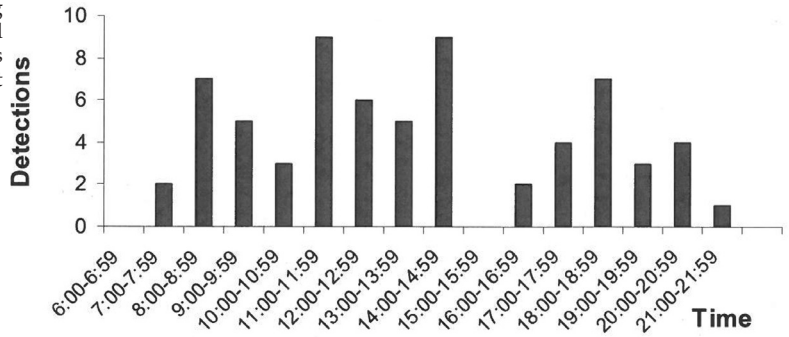
House Valley occurred from 2009-2010, and this has been sustained. Gill (1982b) found one female cuckoo was active over *c.* 20 ha, and assumed from his data that pairs of cuckoos maintained defended territories, but that these may also be over-lapping home ranges. It may be that shining cuckoos have increased in density on Kawau Island, or that they are using the site differently, as there were no changes in the local environment, predator control or hosts that could explain the apparent increase in detection.

Congregations and movement of birds

Cuckoos were very mobile and were followed for over 400 m. Calling frequently took place at the same time or within minutes of each other by birds over 500 m apart.

Congregations and displays by 3-10 shining cuckoos over periods of < 5 to 110 minutes have been reported throughout New Zealand, from mid November to January (Watson & Bull 1950; Parkin 1954; Fitzgerald 1960; Edgar 1961; Blackburn 1962; Stidolph 1971; St Paul 1976). These displays comprise call-notes with some chattering notes, fluffing body feathers and excited following high in the tree tops. The function of communal displays has not been established. Watson & Bull (1950) considered that courtship feeding was involved, but Fitzgerald (1960) did not see feeding. Seabrook-Davison & Anderson (2013) inferred from the timing of displays on 5 November 2010, that it was too early for independent juveniles to be present, so that a display they witnessed where food presentation took place was between adults. However, Edgar (1961) describe a display in mid January 1951 comprising heavily barred adults and browner and more mottled birds that could have been juveniles. In my study, congregations were at sites, beside or within wattles and gums and all involved 3-5 birds. These sites were predominantly those where shining cuckoos gave call-notes during many seasons thought to be related to courtship (Gill 2013). Breeding and congregation records indicate that all birds were adults (Seabrook-Davison & Anderson 2013).

Fig. 6. Number of times shining cuckoo were detected giving call notes or call notes and chatter calls and where a congregation was not taking place.



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