Ecology and breeding of Chatham Island tui

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Abstract

Chatham Island tui (*Prosthemadera novaeseelandiae chathamensis*) were studied on Rangatira Island between late October 1996 and mid-February 1997 with brief visits at other times. Most birds appear to spend the winter on adjacent Pitt Island returning to Rangatira in spring. Until flax flowering was well underway birds commuted to and from Pitt Island on a regular basis but once breeding was underway birds remained on Rangatira.

Flax (*Phormium tenax*) nectar appears to be the most important food for breeding tui. Fruit of ngaio (*Myoporum laetum*), matipo (*Myrsine chathamica*), karamu (*Coprosma chathamica*, mahoe (*Melicytus chathamicus*) and muehlenbeckia (*Muehlenbeckia australis*) were other important foods. We attempted to monitor tui breeding by attaching radio transmitters to adult tui. Although breeding was widespread no radio tagged female tui bred but at least two of three radio tagged males raised young. Adult tui were very intolerant of any intrusion during nesting but an estimation of productivity was made by mapping fledgling groups.

1. Introduction

The Chatham Island tui (*Prosthemadera novaeseelandiae chathamensis*), an endemic subspecies of the New Zealand tui (*Prosthemadera n. novaeseelandiae*), was formerly widespread and common on all of the major islands of the Chatham group (Chatham, Pitt, Rangatira, and Mangere Islands, see Figure 1). The tui is the only member of the honey-eater group of birds remaining on the Chatham Islands; the endemic bellbird (*Anthornis melanura melanocephala*) has been extinct since 1906. Honey-eaters are pollinators and seed dispersers. They are therefore important in the health of a forest ecosystem. Chatham Island tui, with their long distance post-breeding dispersal, and to a lesser extent starlings (*Sturnus vulgaris*), are the most important disperser of seeds on and between the islands of the group. Parea (Chatham Island pigeon, *Hemiphaga novaeseelandiae chathamensis*) which also feed on fruit and disperse seeds are less important dispersers of seed because they tend to be more sedentary and territorial year-round.

1.1 HISTORICAL RECORDS

Tui were formerly abundant throughout the Chatham Islands but by 1938 (Fleming 1939) their range and numbers had been much reduced. Tui were found to be less common in the north of Chatham Island but plentiful in the southern parts. They were reported to be abundant on Pitt Island and in "fair numbers" on Rangatira Island (Fleming 1939). Both their range and numbers continued to decline and by the 1970s they were reported as uncommon on Pitt and Chatham (Merton & Bell 1975) although they were still breeding in the south of Chatham Island (Hugh Robertson pers. comm.). A few tui were usually seen in winter during parea research in the south of Chatham Island in the early 1990s, but in summer it was extremely rare to see a tui (pers. obs.). Recently however, even these few birds have ceased to visit Chatham Island (Paul Johnson pers. comm.)

On Pitt Island it also appears that tui numbers have declined greatly; there is now marked seasonal variation in their abundance. During a botanical survey of reserves in April 1983 few tui were observed (Geoff Walls pers. comm.) but in spring 1994 large numbers of birds were observed feeding on flowering flax (*Phormium tenax*) (Allison Turner pers. comm.). Tui have always been recorded as present on Rangatira Island but numbers were low when the island was grazed. Tui were recorded as rare in 1953 (Bell 1955), seen occasionally in 1954 (Dawson 1955), and 10–12 pairs estimated in 1961 (Merton & Bell 1975). However, since grazing ceased in 1961 and the vegetation has continued to recover, numbers have increased markedly. Tui were the second most conspicuous species recorded during bird counts on Rangatira in 1983 (West 1988), and they were recorded as abundant in the 1990s, being in family groups with a flock of 60+ birds seen in the air over Woolshed Bush (Nilsson *et al.* 1994). Few tui have been observed on the largely deforested Mangere Island, but birds visit on occasions and a pair has bred there recently.

Tui are now common only on Rangatira Island and although birds are seen regularly on adjacent Pitt Island, particularly outside the breeding season, it seems that most of the breeding population is found on Rangatira.

This report presents the results of fieldwork subsequent to that covered in Dilks & Kearvell 1996.

2. Methods

2.1 STUDY AREAS

The climate of the Chatham Islands is mild, windy and cloudy (Thompson 1983). Pitt Island is located approximately 27 km south-east of Chatham Island and Rangatira Island is located 2.5 km off the Southeast coast of Pitt Island (Figure 1).

Rangatira (South East) Island

Rangatira Island (44° 20′ S, 176° 10′ W) at 218 ha in area is the third largest island in the Chatham group, and is of volcanic origin. It slopes gently from the lower land at the northern end to a high point 224 m above steep southern cliffs (Figure 2).

Until the island became a reserve in 1954 it was farmed and held sheep, cattle and goats. The last sheep were shot between 1956 and 1961 (Veitch & Bell 1990) and since then the vegetation has regenerated rapidly, although the former extensive areas of pasture are now largely covered with bracken (*Pteridium esculentum*) and *Muehlenbeckia australis* with small pockets of regenerating forest trees. There are now two large areas of forest; Woolshed Bush at the lower north end of the island, and the more extensive Top Bush centred on Kokopu Creek catchment. The main forest tree species are ribbonwood (*Plagianthus betulinus* var. *chathamica*), ngaio (*Myoporum laetum*), akeake (*Olearia traversii*), matipo (*Myrsine chathamica*), karamu (*Coprosma chathamica*), mahoe (*Melicytus chathamicus*) and hoho (*Pseudopanax chathamicus*) with kawakawa (*Macropiper excelsum*) and supplejack (*Ripogonum scandens*) common in the forest understorey. Ribbonwood and muehlenbekia, which are two major forest components, are both deciduous, meaning that in winter Rangatira Island forests become much more open, exposed and bleak.

Pitt Island

Pitt Island is the second largest island in the Chatham group and is located 25 km south east of Chatham Island and 2.5 km north west of Rangatira. Pitt Island is extensively farmed, with most of the northern half of the island consisting of rolling pasture hills. The southern half of the island has three large reserves: the Southern Reserve, the Central Reserve and covenanted Caravan Bush. Forest tree species are similar to Rangatira but with more hoho and kopi, and extensive groves of nikau (*Rhopalostylis sapida*) in the Central Reserve.

The Central Reserve is grazed by large numbers of Pitt Island sheep (an early Saxon merino breed) and moderate numbers of feral pigs. Southern Reserve has pigs present but Caravan Bush has no grazing animals. Feral cats are found throughout Pitt Island.

The coastal slopes of the Southern Reserve have extensive areas of flax with smaller areas on the steep cliffs around North Head.

FIGURE 1. MAP OF THE CHATHAM ISLAND GROUP.

FIGURE 2. LOCATION OF BIRD COUNT SITES AND FLAX MONITORING PLOTS ON RANGATIRA ISLAND. THE SHADED AREA SHOWS THE EXTENT OF FOREST COVER.

2.2 FIELD STUDY PERIODS

In November 1995 Donald Geddes made a four week visit to Rangatira Island primarily to attach radio transmitters to female tui so that their breeding could be followed through the summer by black robin workers who were on the island for the whole summer. This was the only specific tui research carried out that season.

The summer of 1996/97 was the first time that tui researchers were on Rangatira Island for the whole of the summer. On 24 October Peter Dilks and Derek Onley arrived on Rangatira: PD left on 17 November, and DO left on 17 December. Josh Kemp arrived on Rangatira on 17 December and remained there until 14 February, apart from 26 January until 1 February, when he visited Pitt Island.

On 21 May 1997 Peter Dilks and Belinda Studholme flew to Pitt Island, moving on to Rangatira on 26 May and departing on 9 June.

All of the information presented in this report is the result of research conducted on Rangatira Island. During the short visits to Pitt Island, we tracked down where the radio-tagged birds were living.

2.3 CAPTURE AND BANDING OF BIRDS

Tui were caught using mist-nets mostly set up at flowering flax plants where birds were feeding; or at streams and ponds where birds came regularly to drink and bathe. During breeding when birds were strongly territorial some birds were caught in low nets erected within the forest and in response to recorded tui song and distress calls. One brood of nestlings was banded in their nest.

Nets were set on telescopic aluminium poles using the methods as described by Dilks *et al.* (1995).

All birds were colour-banded and weighed and measured before being released. Some birds had tiny (4 gm) radio transmitters attached with a thin cord harness.

2.4 FOOD AVAILABILITY

Important tui foods were monitored throughout the summer. Permanent plots were set up in areas of flax so we could monitor the length of the flowering period and the numbers of flower spikes produced each year. Plots were located around the island to monitor geographic variation in flowering.

Forest plant foods (flowers, nectar and fruit) were monitored along three transects set up along the island's tracks. An observer walked along the transect and recorded the numbers of each plant species that had either flower buds, flowers or fruit present. This gave an indication of foods available to tui but is only a coarse measure that will show if there are large differences in available foods between seasons and years. Transects were repeated approximately monthly.

2.5 DIET

We recorded feeding observations of tui using the method of Powlesland *et al.* (1992), where every time a bird is encountered the food type, plant species and physical location of the bird in the forest is recorded. Fruit seeds regurgitated or found in faeces produced by birds during banding were also identified and noted.

2.6 RADIO TRACKING

Radio transmitters were attached to 13 tui and the birds tracked using a Telonics TR4 receiver and hand held aerial to provide information on diet, breeding and movements of individuals.

2.7 BREEDING

The onset of tui breeding was monitored by detecting behavioural changes of birds. Nests were found by following birds carrying nest material or by radio tracking. Nests were also found incidentally and by following birds returning to their nest to incubate eggs or feed nestlings.

2.8 POPULATION CENSUS

Two methods were used to monitor the population—each had a different function.

2.8.1 Five-minute and transect counts

These counts are made by recording all birds heard or seen over a five minute period at marked sites in the forest (Figure 2). Five-minute counts made at the same time of year can be compared between years to monitor the relative abundance of tui between years. Counts were repeated at approximately monthly intervals.

When walking between five-minute count sites we also carried out a transect count recording all birds heard or seen until we arrived at the next five-minute count site.

2.8.2 Recorded call counts

These counts were made by stopping at specific sites around the island and playing recorded tui calls. Birds that responded to the tape and could be seen were recorded as banded or unbanded—those that were not seen clearly were recorded as "unidentified". By comparing banded to unbanded bird ratios, and knowing the number of banded birds present, a "mark-recapture" estimate of the population size was made.

3. Results

3.1 CAPTURE AND BANDING OF BIRDS

Over the course of the 1996/97 summer a total of 89 tui were caught, weighed, measured and banded. Thirteen juveniles were banded with a "year code" of metal on one leg and a yellow band on the other and two juveniles were given full colour combinations. Seventy four adult tui were banded with individual combinations. Details of all tui caught on Rangatira Island to date are given in Appendix 1. Initially most birds were caught whilst feeding on flax nectar at various sites around the island, with a few birds caught at a pond in front of the hut where they came to drink and bathe. Later in the summer during an especially dry period in January large numbers of birds were caught at Kokopu Creek the only flowing stream on the island.

Sixty-seven of 151 individually colour-banded tui were re-sighted during the 1996/97 summer and 1997 winter field trips (13 birds have the same yellow/metal year codes). Some birds that were originally banded in January 1995 were first re-sighted in winter 1997 close to the area where they were caught. This shows that a thorough search of the island is needed to detect birds that may remain in discrete territories (some radio tagged birds were regularly found in the same tree day after day).

3.1.1 Age and sex

During the 1996/97 summer we banded 74 adults, 12 juvenile and 3 nestling tui. Ten of the 74 adult tui we caught were one-year old (13.5%) a figure that is fairly close to the seven of 40 (17.5%) caught during January 1995. Table 1 shows the age and sex classes of all birds caught so far.

TABLE 1. AGE AND SEX OF TUI CAUGHT ON RANGATIRA ISLAND (ALL YEARS COMBINED).

AGE	MALE	FEMALE	UNKNOWN	TOTAL
Adult	41	65	–	106
One year	7	14	–	21
Juvenile	18	14	–	32
Nestling	–	–	3	3
Unknown	–	2	–	2
Total	66	95	3	164

We compared the weights of tui caught in January 1995 with those from January 1997. We were only able to test the differences for adults (Table 2).

Although they were slightly heavier in January 1997 there was no significant difference in weights of adult female between years, but adult males weights were significantly heavier in January 1997. A possible reason for this is that breeding started later, and finished earlier in 1996/97 (on 21 January 1995 a nest with c. 5 day old young was observed, but in January 1997 breeding appeared to have finished by this date). In both years females would still be feeding young in January (either fledged or in the nest) but if breeding had finished in January 1997 males would not be defending territories and would spend more time feeding—males feed young less than females do.

TABLE 2. MEAN WEIGHTS (gm) OF ADULT TUI IN JANUARY 1995 AND JANUARY 1997.

	JANUARY 1995	JANUARY 1997	SIGNIFICANCE	
Adult female	107.9 (22 birds)	110.7 (24 birds)	T –1.21 df 44	P = 0.2327
Adult male	154.7 (11 birds)	174.9 (14 birds)	T –4.05 df 23	P = 0.0005

3.2 FOOD AVAILABILITY

3.2.1 Forest phenology

The amount of flowers or fruit on individual trees of the same species varied enormously with some having heavy fruit crops and others none. The only species that seemed to have any consistency between individuals was ngaio, where almost all trees had either fruit and/or flowers at the same time. Matipo was especially variable, with a few trees heavily laden with fruit and many trees with few or none.

Numbers of flowering or fruiting trees were recorded for each plant species on each transect. These figures, when compared between years, will give an indication of the amount of fruit available each year. For muehlenbeckia, however, we could not record individual plants so we only recorded when flowers or fruit were present.

3.2.2 Flax flowering

Flax nectar appears to be the most important food for breeding tui and we monitored both the abundance of flowers and the length of the flowering period. Three plots that had been set up in 1995/96 had flower spike counts from the prolific flax year (1994/95) and these monitoring results are presented in Table 3. At eight sites we set up permanent plots where we counted the number of flower spikes on individual plants and recorded whether they were in sheath, bud, flower or pod throughout the summer. At these sites plus another two (Figure 2) we also carried out a general survey where over a larger area we recorded the same flower characteristics (Table 4). This monitoring was

repeated at intervals from late October until no flowers remained, (early January). Flax spikes were classed as "flower" so long as they had some flowers providing food to tui. The length of the flax flowering period varied at different sites on the island with the exposed sites at the summit of the island and the Trig having a shorter and later flowering period. The more sheltered sites at the Seal Colony and Sealers Point had an earlier and longer flowering period. The monitoring results presented in Figure 3 show results from selected plots. The lower altitude Sealers Point and Skua Point plots have longer flower periods than at the Swamp and the Clears.

TABLE 3. NUMBER OF FLOWER SPIKES IN FLAX PLOTS 1994/95, COMPARED WITH 1996/97.

MONITORING SITE	NUMBER OF FLOWER SPIKES	
	1994/95	1996/97
Skua Gully	42	0
North Summit	93	1
Clears	46	9

3.3 TUI DIET

We only made small numbers of tui feeding observations. We found that birds could be readily observed feeding on flax flowers, and birds were always present in particular fruiting trees, but that these observations gave a highly biased indication of their overall diet. When walking through the forest areas heavily burrowed (by sea-birds) we had to wear petrel boards on our boots—a bit like large snow shoes—and tui would hear us approaching and would usually either be watching us or would fly away. The same problem was encountered when attempting to observe radio tagged birds; they were not often seen. Initially, a lot of effort was put into trying to collect feeding observations, but with little success.

Despite the poor picture of overall feeding preferences it appears that when flax nectar was available it was the most important food for tui (Figure 3 and Table 4). Large numbers of birds congregated at flowering flax and individual birds commuted throughout the day to and from flax plants. When plenty of flowers were available each bird had its own area and specific flax plants. There are large areas of flax around much of the coast of Rangatira, and flowers were available adjacent to most of the forest areas. As flax nectar became patchier birds would travel to the remaining flowering plants from all parts of the island. Birds feeding on flax could be easily identified by orange pollen on their forehead ("flaxheads").

Matipo, karamu, and hoho fruit were other important food sources and were eaten when green or ripe. Matipo and karamu are widespread on Rangatira but there are only small numbers of large fruiting hoho trees. Ngaio was an

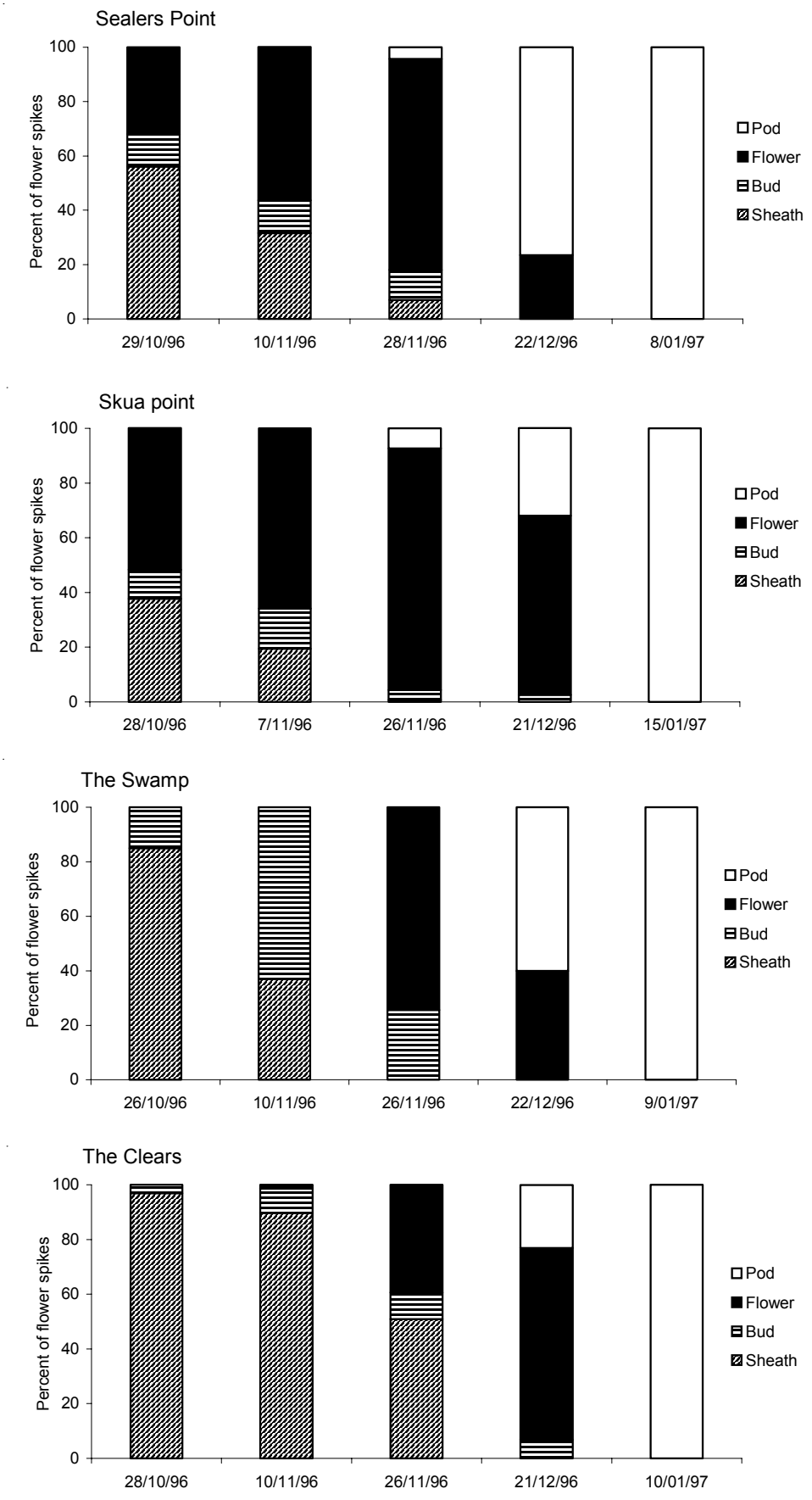

FIGURE 3. FLAX FLOWERING AT SELECTED PLOTS ON RANGATIRA ISLAND.

important food source and birds fed on nectar from flowers and green and ripe fruit. They also appeared to lick sap from bruised and broken branches. Meuhlenbeckia fruit was an important food source and adults were often observed gathering this and feeding it to their chicks.

Birds that were feeding nestlings were observed catching insects in muehlenbeckia foliage and hawking for insects in the air.

During the May/June field trip ngaio fruit was the most important food, but the few fruiting hoho trees all had resident tui. Birds were also observed searching kawakawa for ripe fruit. The same colour-banded birds were regularly observed in the same trees which they defended against other tui.

When mist netting birds to band them they often defecated in the weighing bag. The following foods were identified from faeces of 39 tui mist netted during late January/early February: Meuhlenbeckia fruit = 18, Matipo fruit = 22, Karamu fruit = 16, Unidentified fruit (hoho?) = 2, Nectar = 2 (the presence of nectar was assumed from a clear, liquid dropping).

TABLE 4. LENGTH OF FLOWERING PERIOD FOR FLAX AT VARIOUS SITES ON RANGATIRA ISLAND (PERCENT OF SPIKES IN EACH CATEGORY). SITES ARE PRESENTED IN ORDER OF INCREASING ALTITUDE AND/OR EXPOSURE.

DATE		WEST LANDING	SKUA GULLY	SEALERS POINT	EAST CLEARS	SKUA POINT	RANGA-TIRA TRIG	THE CLEARS	KOKOPU SWAMP	SUMMIT TRACK	NORTH SUMMIT
28/10	sheath	52	53	56	66	38	50	88	85	82	100
1996	bud	25	20	12	16	11	18	10	15	18	0
	flower	23	26	32	18	52	32	2	0	0	0
	pod	0	0	0	0	0	0	0	0	0	0
8/11	sheath	7	13	31	29	20	11	80	52	48	100
	bud	14	13	23	13	15	13	7	48	25	0
	flower	79	74	56	57	65	76	13	0	17	0
	pod	0	0	0	0	0	0	0	0	0	0
28/11	sheath	0	1	7	3	1	0	16	0	2	35
	bud	0.5	1	11	55	4	0	25	26	18	40
	flower	90	96	78	91	88	89	59	74	80	25
	pod	0.5	2	4	1	7	11	0	0	0	0
21/12	sheath	0	0	0	0	0	0	0	0	0	11
	bud	0	0	0	1	3	0	9	0	1	11
	flower	4	7	24	41	64	0	58	40	61	78
	pod	96	93	76	58	32	100	33	60	38	0
7/1*	sheath	0	0	0	0	0	0	0	0	0	0
1997	bud	0	0	0	0	0	0	0	0	0	0
	flower	0	0	0	0	0	0	0	0	0	0
	pod	100	100	100	100	100	100	100	100	100	100

* During 1994/95, the summer of prolific flax flowering, we were still mist-netting tui on flowering flax plants on 13 January 1995.

3.4 RADIO TRACKING

In November 1995 radio transmitters were attached to four female tui on Rangatira Island. It was hoped that the breeding of these birds would be monitored by other field-workers on Rangatira, but little radio tracking was carried out. One transmitter failed as soon as it was attached and the other three birds were mobile around Rangatira during the summer. We are fairly confident that these birds did not breed. One of these females (transmitter 12) was present on Pitt Island during the winter and returned to Rangatira and was tracked through the following summer. In November 1996 transmitter No. 14 was found on the ground in the swamp area (its usual territory during summer). The weak link of the harness had broken some time after May 1996.

In October/November 1996 we attached similar transmitters to nine more birds. One of the 1995/96 birds was still wearing a functional transmitter. In total we had three male and seven female tui wearing transmitters. All birds were caught on the northern end of the island and it was here that all but one established territories. One female, caught in front of the hut, was resident in the Top Bush at upper Kokopu Creek valley.

One of the female tui died after three weeks when its beak became entangled in the transmitter harness but the remaining nine birds were tracked through the breeding season. None of the six surviving females wearing transmitters nested although breeding appeared to be widespread amongst other tui. We assume that wearing a harness somehow interfered with their breeding behaviour. Of three males with transmitters, two bred successfully, the third bird snapped the aerial on the transmitter and as a result "vanished" about the time that other birds started breeding. A weak signal was occasionally reported and he "re-appeared" in his usual area in May, but the transmitter signal had little strength (range); he may have been present there for much of the summer and may have nested successfully.

Birds wearing transmitters were most often recorded as resident in discrete territories even though they did not breed, but later in the breeding season could be found anywhere on Rangatira Island. Initially two of the males were flying regularly to Pitt and stayed there between one and five days but when they commenced breeding they remained on Rangatira. However, as soon as their young fledged they returned alone to Pitt and only occasionally visited Rangatira.

In contrast, radio-tagged female tui remained on Rangatira throughout the breeding season even though they did not nest. Each was regularly found in a very small home range area, often in the same tree, usually a fruiting matipo. As far as we could determine none of these birds attempted to nest although five of the six had a brood patch when we initially caught them. The female that was wearing a transmitter for 16 months had the same summer territory in both years.

Two females with transmitters flew to Pitt in mid-January and up until June 1997 were still resident there in the Central Reserve. Of the remaining four females; one was recaptured and the transmitter removed, and the other three stayed on Rangatira into autumn but then the transmitters failed and we could no longer track them.

3.5 BREEDING

When we arrived on Rangatira in mid October, birds were showing no signs of breeding and males were still visiting Pitt Island. The radio-tagged females all spent considerable time in small, discrete territories and frequently visited flax several hundred metres away to feed. We saw few signs of breeding until mid November when display flights, territorial boundary squabbling and nesting commenced. This year juvenile tui were first caught late in January 1997 compared with early January 1995 and it appears that breeding commenced about two weeks later this year. The start of breeding is likely to be influenced by the start of flax flowering—1994/95 was an especially heavy flax flowering year.

3.5.1 Nest monitoring

We planned to monitor tui breeding by attaching transmitters to females in both the 1995/96 and 1996/97 seasons and then follow them to their nests which we would monitor. However, putting a harness on female tui appeared to prevent them from breeding so we had to abandon this method. Tui proved to be very intolerant of any intrusion during at least the early stages of breeding.

We also tried finding nests by watching for birds carrying nesting material and generally searching in areas where birds were frequently seen. On 14 November 1996 the first female was seen carrying grass but its nest was not found. Also on this date birds were seen performing display flights and a pair was observed copulating. On 15 November 1996 the first nest was found, with three eggs.

Overall only 10 nests were found. The first found was the only one that was followed through from eggs to fledging and from the fledging date of the chicks (Appendix 2) this was one of the earliest nests on the island. The next nest found, with eggs, was immediately deserted; the third being built was deserted and the fourth which had a female incubating eggs failed following very strong winds. A fifth nest, found with eggs, was also deserted, but four nests found when the adults were feeding young all fledged successfully (Appendix 2).

One male (wearing transmitter 22) was known to have nested twice. Initially he was found with an unmarked female but that nest failed following strong winds. He was then found nesting with a banded female and they successfully raised chicks (we don't know if whatever caused the first nest to fail resulted in the death of the original female). However, when the initial laying dates are determined for each nest it appears that this male had two females that were both nesting in adjacent areas, at the same time.

3.5.2 Fledgling monitoring

Although we were unable to find and intensively monitor many tui nests we were able to get some indication as to the success of breeding on Rangatira.

When chicks have recently fledged they remain in a fairly discrete locality for around two weeks. They are also fairly easy to find as they call constantly. Parent tui are especially defensive of newly fledged chicks and if these are approached will scold the observer at close range providing a good opportunity to read colour bands.

The first fledglings were found on 21 December and family groups were mapped through until mid-January (Figure 4). Some of the groups seen in mid January were becoming mobile so we can't be sure that these later ones are all different groups. In total 41 family groups were recorded with a minimum of 74 fledglings between them. If broods where we were confident we saw all young are considered, the average brood size was 2.25 fledglings.

It is likely that many more chicks than were recorded were produced on Rangatira and there could have been twice as many fledglings reared. The detailed results of the family group monitoring that was carried out are shown in full in Appendix 3. The large gaps on the map are mostly areas that could not be searched at the critical time when newly fledged chicks were less mobile.

3.6 POPULATION CENSUS AND MONITORING

3.6.1 Five minute and transect counts

We undertook five minute counts at seven sites in the Upper Bush and seven sites in the Lower Bush in November, December 1996, January and May 1997. Three different observers were involved. We also carried out transect counts which involved counting all tui seen or heard while walking between five-minute count sites. Results showed the same trend for both counting techniques and are presented in Table 5 and 6, and Figure 5. Count sites are shown on Figure 2.

TABLE 5. FIVE MINUTE COUNTS OF TUI ON RANGATIRA ISLAND (LOWER BUSH INCLUDES WEST WOOLSHED BUSH, EAST WOOLSHED BUSH AND ISLAND BUSH).

	SITE	22/11/96	6/12/97	8/1/97	30/5/97
Lower Bush	1	7	6	0	1
	2	2	4	1	0
	3	4	2	1	1
	4	6	2	1	0
	5	3	4	3	2
	6	5	4	4	0
	7	1	3	0	0
	Average	4.0	3.6	1.4	0.6
Top Bush	8	2	2	2	0
	9	4	2	3	1
	10	3	4	4	0
	11	3	1	6	1
	12	5	4	6	4
	13	3	3	5	5
	14	0	3	5	1
	Average	2.9	2.7	4.4	1.7

FIGURE 4. TUI FAMILY GROUPS ON RANGATIRA ISLAND. THE SHADED AREAS SHOW THE EXTENT OF THE FOREST COVER. DETAILS OF EACH FAMILY GROUP ARE SHOWN IN APPENDIX 3.

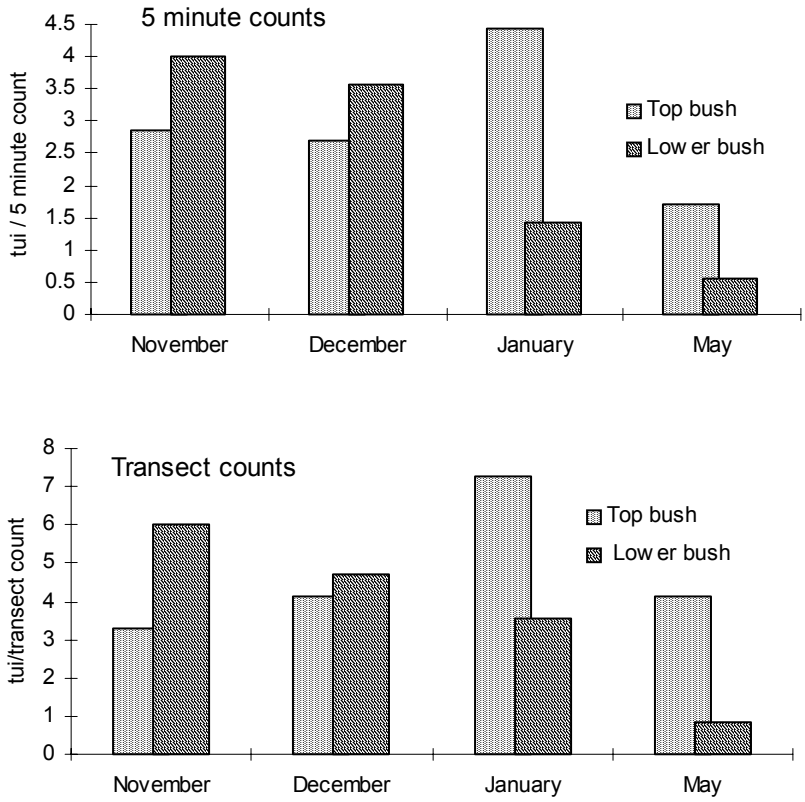

FIGURE 5. TUI COUNTS ON RANGATIRA ISLAND.

TABLE 6. TRANSECT COUNTS OF TUI ON RANGATIRA ISLAND.

	TRANSECT	22/11/96	6/12/96	8/1/97	30/5/97
Lower Bush	A	5	6	0	1
	B	10	7	3	2
	C	3	5	0	0
	D	4	1	2	0
	E	5	4	12	0
	F	6	5	4	0
	G	9	5	4	0
	Average	6.0	4.7	3.6	0.4
Top Bush	H	3	1	6	2
	I	4	4	5	3
	J	4	3	5	3
	K	3	5	4	3
	L	5	8	16	11
	M	1	6	14	7
	N	3	2	1	0
	Average	3.3	4.1	7.3	4.1

3.6.2 Recorded call counts

Recorded call counts were made by walking most of the tracks on the island and playing recorded tui calls at intervals. However, the reaction of birds varied enormously during the year. In summer when birds were breeding and highly territorial, they responded well to an "intruder" but at other times there was little reaction. When we tried this in May/June we had no response from birds on Rangatira even though we could hear, or in some cases see, a bird singing nearby. When we played calls on Pitt at this time we appeared to get a good response but all of the banded birds that responded were young of the year, and it is likely that the unbanded birds were young birds too. A major drawback of this census technique is that birds soon cease to react. So this past summer this technique was only effective in the Top Bush where we had not been playing calls while trying to mist-net birds. During the breeding season this is a good way of determining the approximate breeding territories of colour-banded birds.

Recorded call counts were carried out on Rangatira on three occasions during the summer. In late November 59 tui responded to tapes; in late December it was 66 birds; but in February when breeding was finished only 16 birds responded and 8 of these were juveniles.

As birds did not react to tapes late in the season when we had a large number of colour-banded birds a mark-recapture population estimation could not be made.

4. Discussion

4.1 CAPTURE AND BANDING OF BIRDS

A total of 151 tui have how been individually colour banded with a good spread of birds of different age classes for continued monitoring of mortality and survival. Fifty three of the marked birds are of known age—either banded as young of the year or as one year old.

Morphometric data collected on these birds show that the Chatham Island subspecies is considerably larger than mainland tui (Craig *et al*. 1981, Robertson *et al.* 1983) and that birds can be readily sexed by wing length. There is no overlap between males and females once birds are separated into adults and juvenile/year-old birds.

We will continue to monitor these colour-banded birds on Rangatira and to band more birds over the coming summer. More individually banded birds will allow a better measure of population size to be made. During next winter the tape response surveys will be repeated and some birds that respond caught to see if it is only young of the year that respond to recorded calls during winter.

4.2 FOOD AVAILABILITY

Continued monitoring of flax flowering and of the amount of tui breeding, will over time show just how reliant tui are on the flax food source. Monitoring breeding during a poor flax flowering year would give the best indication of this. It appears that during the breeding season of 1994/95, a year of abundant flax flowers, tui may have nested more than once. The breeding season certainly started earlier and continued longer than in 1996/97.

4.3 DIET

Gathering unbiased data on the diet of tui has proved to be almost impossible. Following birds in the forest on a heavily burrowed island has proved to be difficult and tui can only be readily observed in the more open areas of flax and meuhlenbeckia, or at known fruiting trees. At least during the two years we have monitored, breeding appeared to be very successful, which implies that there is usually adequate food on Rangatira for the breeding birds. However, for some years there are observations of dead and dying juvenile tui being seen in autumn (P. Gardener pers. comm., hut log book) possibly indicating less abundant autumn food sources. It is by this time that many tui have flown to Pitt Island for the winter. Rangatira Island is used as a roost by starlings that fly across from Pitt Island each evening but some birds remain on Rangatira, feeding on fruit, during the day and would directly compete with tui for the food resources.

4.4 RADIO TRACKING

Radio tracking of tui provided useful information on movements of birds around and away from Rangatira Island but as a tool for monitoring breeding and foraging of birds it was a total failure. It is highly unlikely that by chance we chose seven female tui that were not intending to breed when there was widespread breeding on Rangatira and two, possibly all three, of the transmittered males did so.

Wearing a harness did not restrict the mobility of birds, as they ranged widely over Rangatira, commuting to and from distant flax flowers and on several occasions flew back and forth across the 2.5 km of sea to Pitt Island. The female that was recaptured and had its transmitter removed after wearing it for just over two months had gained a little weight (128 gm compared with 120 gm).

It became clear from observations on transmittered males that until flax flowering was well underway on Rangatira birds would commute to Pitt presumably to feed on more abundant and earlier flowering flax there. Both of the males with functioning transmitters departed to Pitt Island in early January soon after their chicks had fledged indicating that food may be more abundant on Pitt at this time.

Further attempts to monitor breeding will be made this summer but using a much lighter (1.3 gm compared with 4.5 gm) transmitter attached to tail feathers with sticky tape as it would be useful to know if birds nest more than once in a season. These transmitters will also be attached to some juvenile tui so we can monitor their survival through winter.

4.5 BREEDING

Detailed monitoring of tui breeding proved to be a problem as along with the non-breeding transmittered females, we found that tui were very intolerant of disturbance during the early stages of breeding. We found only 10 tui nests and spent a large amount of time searching to find these. Tui nests are often built in thick meuhlenbeckia vines draped over forest trees and are very difficult to discover by random searching. A possible reason for such well concealed nests amongst thick cover is that every night during the summer there are tens of thousands of sea-birds returning to the island and crashing through the forest canopy returning to their breeding burrows. By chance, nests in more open locations would be more prone to being hit by a returning sea-bird.

At least during the past summer, tui breeding appeared to be widespread and successful. There are occasionally years with little flax flowering and it would be interesting to monitor the amount of breeding that took place in such a season. As yet we don't know if tui rear more than one brood during a summer and if the amount of breeding is directly related to the extent of flax flowering. Tui may have highly variable breeding success between years depending on the amount of nectar available; and variable juvenile survival due to differing amounts of fruit being available in autumn and winter. This would result in variable recruitment of birds to the breeding population and could result in

large fluctuations in the overall population dependent on good or bad breeding and high or low winter mortality.

4.6 BIRD COUNTS

Five-minute counts of tui carried out over the summer indicated that during the nesting period the northern end of the island (Lower Bush) had higher numbers of tui, however when breeding finished birds moved to the Top Bush. The Lower Bush also holds the majority of breeding black robin pairs even though the Top Bush is a much larger area of forest.

During May, although many tui had gone to Pitt, it was very obvious that there were far more tui in the Top Bush feeding on matipo, hoho, ngaio and kawakawa fruit and very few birds in the Lower Bush.

Five-minute counts we carried out in the Lower Bush gave an average of 4.0 and 3.6 tui per count for November and December respectively (combined = 3.8). West (1988) carried out five-minute counts in the same general area in November/December 1983 and recorded an average of 1.94 tui per count. As these counts were carried out at the same time of year, and in similar weather conditions this difference most likely reflects a continued increase in the tui population on Rangatira from the 10–12 pairs estimated by Merton & Bell (1975) in 1961 as the vegetation continues to recover since grazing ceased.

5. Acknowledgements

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Appendix 1

Details of tui banded on Rangatira Island

BAND	DATE	COLOURS	SITE	SEX	AGE	BILL L.	BILL W.	BILL D.	HEAD

TARSUS	TAIL	WING	WEIGHT	COMMENTS

BAND	DATE	COLOURS	SITE	SEX	AGE	BILL L.	BILL W.	BILL D.	HEAD

TARSUS	TAIL	WING	WEIGHT	COMMENTS

BAND	DATE	COLOURS	SITE	SEX	AGE	BILL L.	BILL W.	BILL D.	HEAD

TARSUS	TAIL	WING	WEIGHT	COMMENTS

Appendix 2

Tui breeding — Rangatira Island 1996/97

Nest Site: West edge of Annex **Grid ref.:** 578/509
Male: Y/R R/M Transmitter No. 24 **Female:** unbanded

DATE	TIME (hrs)	DETAILS
15/11/96	1240	3 eggs
16/11/96	p.m.	??—female on
19/11/96	0840	4 eggs (female on at 0820 hrs)
21/11/96	1350	female on
25/11/96	1440	4 eggs warm—female not on
28/11/96	1215	3 chicks 1–2 days old, 1 egg
1/12/96	1015	3 chicks, 1 egg
4/12/96	0900	3 chicks. Male became very agitated, came almost up to nest flapping and calling. Female nearby in Ngaio. Two other banded birds also very noisy (G/R & G/Y on right). First time male has got upset.
6/12/96	1235–1255	Male feeding chicks on insects caught in canopy of ngaio + meuhlenbeckia. Female went to nest at 1235 and 1251 hrs.
9/12/96	0930	3 chicks. Primaries and wing coverts still in pin—pink skin still showing between feather tracts on neck and back.
11/12/96	p.m.	3 chicks. Primaries out of pin.
12/12/96	1300	3 chicks banded. Coverts wing and tail just out of pin. Y-9332—75 gm yellow right. Y-9333—98 gm yellow right. Y-9334—69 gm yellow right Male very noisy and agitated. All three chicks leapt out of nest as we left. Two replaced but leapt out again. 2 chicks being fed on the ground @ 1415.
13/12/96	1000	At least 2 chicks still being fed by the nest.
23/12/96	1527	2 banded fledglings 10m up in ribbonwood 20m north of nest. Tails half grown—they look about the same size as the youngest fledglings seen elsewhere. Fed by unbanded female at 1528, 1537, 1541, 1552, 1554, 1557 hrs. Male nearby the whole time—not seen to feed chicks.
6/1/97	0900–0930	No sign of birds in nest area.
7/1/97	1210	Male in Top Bush near Rons/Link junction.

Nest site: Whalers track, near Summit Junction. **Grid ref.:** 584/510
Male: unbanded **Female:** unbanded

DATE	TIME (hrs)	DETAILS
15/11/96	1600	3 eggs—female about
16/11/96	p.m.	3 eggs—cold
18/11/96	p.m.	3 eggs—cold
19/11/96	1400	3 eggs cold—deserted??
22/11/96		nest and eggs collected—weighed and measured. 32.9 x 22.2 8.5 gm 31.5 x 22.3 8.6 gm 30.5 x 22.1 8.3 gm

Nest site: Thinornis track near junction with Whalers Bay.
Male: not seen **Female:** unbanded

DATE	TIME (hrs)	DETAILS
19/11/96	1130	female building—c. 3 m in meuhlenbeckia over mahoe in bush sub-canopy. Untidy straw/grass base.
23/11/96	0700	no progress—no birds around.
26/11/96	p.m.	presumed deserted/abandoned.

Nest site: Woolshed bush near junction of Summit and Whalers tracks.
Male?? **Female** ??

DATE	TIME	DETAILS
6/12/96	1330	2.5m in mahoe. 1m under canopy of meuhlenbeckia, coprosma, ngaio and mahoe. Nest empty.
9/12/96	0930	still empty
12/12/96	1400	still empty

Nest site: Swamp track. c. 50 m south of swamp + 30 m west of track.
Male: W/M W/B?? **Female:** unbanded??

DATE	TIME	DETAILS
1/12/96	1630	2 eggs. female tui hanging around near nest. c. 4 m in outer branches of sapling mahoe under coprosma and matipo canopy.
4/12/96	1000	2 eggs cold—leaves in nest—deserted.
5/12/96	1210	2 eggs cold. nest full of leaves. Male W/M W/B nearby—came in close and looked!

Nest site: Thinornis Bay. Bush clump between south end of Island Bush and the coast.

Male: unbanded **Female:** unbanded

DATE	TIME	DETAILS
5/12/96	p.m.	adults feeding young—sound 4–5 days old. Too many leaves to see. 3 m—top of sapling mahoe in thick c. 5 m canopy of meuhlenbeckia—unreachable.
22/12/96	1100	nest empty except for leaves = fledged. One chick seen tail half grown and at least one more heard. 10 m from nest.
1/1/97	1745	2 fledglings around 5 m from nest. One adult size, the other smaller. Both adults about. Chicks voices breaking.

Nest site: Entrance to Swamp. 3 m North of track. **Grid ref.:** 600/140

Male: unbanded **Female:** B/M W/B

DATE	TIME	DETAILS
22/12/96	1230	2 chicks 15–18 days old. Fully feathered. Open nest site 2.5 m in matipo with only matipo leaves to shelter nest.
26/12/96	1600	Still 2 chicks in nest.
27/12/96	0915	Fledged. Two chicks sitting 4 m up in matipo. 3 m from nest. Female came in to feed chicks.
30/12/96	1420	Female twice fed two fledglings 30 m from nest.

Nest site: Track from hut to coast—c. 10 m to West

Male: Transmitter No. 22 **Female:** unbanded

DATE	TIME	DETAILS
18/11/96	1130	c. 6 m in meuhlenbeckia loosely draped over outer branches of akeake—inaccessible. Female on to nest at 1110 hrs —presum ably on eggs.
24/11/96	0700	Female on
27/11/96	a.m.	No activity. Tx 22 moved along coast to west. Nest probably failed due to yesterdays very strong wind.

Nest site: 50 m WSW of hut **Grid Ref.:** 576/240
Male: Transmitter No. 22 **Female:** Y/M Y/B

DATE	TIME	DETAILS
23/12/96	1425	2 chicks c. 18–21 days old. Adults very agitated.
26/12/96	0930	Nest empty. Couldn't find fledglings. Both adults carrying food.
28/12/96	1830	1 chick c. 30 m W of hut. Single chick seen from hut @ 2000 hrs.
2/1/97	2000	1 chick fed by female in front of hut.
3/1/97	2100	2 fledglings. Both adults feeding.
6/1/97	0930	2 fledglings with adults.
7/1/97	1310	Y/M Y/B seen with 2 fledglings in Top Bush near Rons/Link junction. Tx 24 nearby. No sign of birds around hut.
11/1/97	0840	Female with fledglings at hut. Still being fed. Male moving between Top and Lower bush.
13/1/97	1000	Female and fledglings at hut. Chicks still being fed. Male nowhere on Rangatira Island.
14/1/97	2038	Male is on Pitt Island
15/1/97		Female + chicks at hut. Male on Pitt.
16/1/97	0830	Male still on Pitt.

Nest site: Trig — turn left 50 m after Trig on way to Clears.
Male: unbanded **Female:** W/B Y/M

DATE	TIME	DETAILS
26/12/96	1655	3 chicks c. 16–19 days old. Fed at 1655, 1659, 1701, 1703, 1703 hrs. Tails short—quarter grown. Nest 1.5 m in ngaio.
30/12/96	1355	Both adults feeding nestlings.
2/1/97	1000	same
11/1/97	1011	3 fledglings—quite large, not very fluffy anymore. One has beginning of a tassel.
13/1/97	1021	Female still feeding chicks. Male mostly absent but returns every c. 30 min. Not sure if feeds chicks.
15/1/97	1400	Female still feeding chicks. One feeding self. Male mostly absent.
19/1/97	1730	Female still feeding chicks—looked like matipo fruit. No tassels on chicks. No sign of male in 30 minutes.
4/2/97	1100	No sign of tui in general area.

Appendix 3

Tui family groups with fledglings on Rangatira Island 1996/97

(Group numbers are shown on Figure 4.)

NO	DATE	LOCATION	FEMALE	MALE	FLEDGLINGS
1	28/12/96	Hut pair	y/m/ y/b	w/b/ r/m	2
2	12/12/96	Annex (premature fledging)	um	y/r r/m	2
3	23/12/96	Summit / Staceys	um	?	2
4	20/12/96	North Thinornis	um	um	3
5	22/12/96	South Thinornis	um	um	2
6	30/12/96	Jills / Onyx	y/m w/g	?	2
7	2/1/97	below Trig—north side	w/b y/m*	um	3
8	27/12/96	entrance to Swamp	b/m w/b	um	2
9	30/12/96	Old Forest / Rons	um	um	≥ 2
10	25/12/96	Summit track—Top Bush	um	um	2
11	29/12/96	Summit / Fran & Rua	um	um	2
12	28/12/96	Rons / Link	r/w r/m	y/w y/m	≥ 2
13	21/12/96	Margaret's nest box	um	um	2
14	24/12/96	East Clears	1 unbanded	adult	2
15	24/12/96	East Clears	?	?	3
16	21/12/96	Clears—E of track	1 unbanded	adult	3
17	21/12/96	Skua Point	?	?	3
18	1/1/97	Staceys / Thinornis	um	m/y b/w	2
19	1/1/97	Island Bush	b/m /	um	3
20	2/1/97	Trig / Summit	um	um	2
21	6/1/97	Whalers bay	um	r r/y	≥ 2
22	3/1/97	north of Myrsine Track	um	?	2
23	3/1/97	W Woolshed / W.L.	y/g y/m	?	≥ 2
24	3/1/97	Summit / Echo's	um	um	2
25	5/1/97	West Landing	um	?	2

Continued next page >>

NO	DATE	LOCATION	FEMALE	MALE	FLEDGLINGS
26	5/1/97	N. West Landing	um	y/w r/m	2
27	8/1/97	Sealers Point	um	y/m r/b	2
28	15/1/97	Skua Knoll	w/m b/w	um	≥ 1
29	15/1/97	End of Clears Track	um	um	≥ 2
30	13/1/97	Trig / Rons	g/b y/m	?	≥ 1
31	11/1/97	Upper summit Bush	um	?	≥ 1
32	11/1/97	Summits Jctn	um	?	≥ 1
33	18/1/97	middle of upper Marleshes	g/r y/m*	?	≥ 1
34	18/1/97	end of Upper Marleshes	?	?	≥ 1
35	18/1/97	just s of Trig towards Kokopu Ck	um	?	≥ 1
36	?	upper Kokopu Ck—Trig side	?	?	?
37	?	upper Kokopu Ck—Trig side	?	?	?
38	15/1/97	Between Watercress Bay & Skua Pt	?	?	≥ 1
39	11/1/97	Summit Tk, above Kuaka Flat	w/m g/w	um	2
40	10/1/97	Whalers / Summit Tk Jctn	um	?	≥ 1
41	24/1/97	Ikes Bush	w/r b/m*	um	≥ 1

* Banded at a later date.