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by
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ABSTRACT

This report describes the results from the third year of a five-year research programme on the effects of large scale mammal control upon the productivity and survival of the North Island kokako (*Callaeas cinerea wilsoni)* at Mapara Wildlife Management Reserve.

The total kokako population of the reserve was estimated at 50 to 60 birds. Sixteen pairs were present during the November 1991 to March 1992 breeding season. At least six pairs attempted to breed, but only three nests were successful, these nests fledged two, two and three chicks respectively. No re-nests were recorded. Observations on feeding and movements of kokako are presented along with a record of the mammal control effort.

1. INTRODUCTION

The purpose of this report is to summarise information gathered about kokako during the 1991/1992 year's study at Mapara Wildlife Management Reserve and Cowan Wildlife Refuge. An earlier unpublished report by the same authors [1991: Kokako *(Callaeas cinerea wilsoni)* productivity at the Mapara Wildlife Management Researve over the 1989/90 and 1990/91 breeding seasons as determined by visual observations] describes the previous two years work.

Mapara Wildlife Management Reserve is located approximately 35 kilometres southwest of Te Kuiti in the Central North Island. The reserve comprises three large forest blocks (North, Central and South blocks). The latter two blocks are continuous along a small shared portion of their boundary whilst the North block is separated by 200 m of pasture.

Kokako research at Mapara is part of a national "research by management" plan (instigated in 1989) which is described by Hay (1991) and Innes (1992). At Mapara the object is to assess any response of the kokako population to introduced mammal control over a five year period. The extent of this mammal control activity has been similar from year to year and the current year's effort is outlined below.

Food availability and quality are likely to be key factors in kokako productivity, thus monitoring was considered important. If a link between phenology and kokako breeding can be demonstrated it may be possible to predict "poor kokako breeding seasons" from winter/ spring flowering observations and thus limit animal control when it may be unnecessary.

At Mapara introduced small mammals have been reduced in numbers by aerial application of 1080 pollard baits. Fenn traps spaced along ridge tracks throughout the reserve provided some level of year round mustelid and rat control. Deer were not present and goats and pigs were maintained at very low levels by shooting.

2. METHODS AND RESULTS OF KOKAKO WORK

2.1 Banding and transmitters

The banding effort at Mapara is ongoing and aims at achieving a population of known individuals. Birds were lured into mistnets using taped calls. Initially calls recorded within the territories of the bird(s) to be netted were used. At times, however, response was greater to calls of other birds. Tarsometatarsus length and weights were recorded during banding. Plastic bands ("e" size) were glued with Super Glue to prevent unravelling. Banding records are summarised in Table 1.

To aid in following birds movements and nest location five birds had transmitters attached (Table 1). We had to remove a transmitter within an hour of fitting it when the bird's bill became entangled in the harness.

Three transmitters functioned throughout the season; one vanished without trace after two months and the other was shed after three months due to harness fraying. In general, transmitters were found to be useful in increasing efficiency of worker's time. These birds could be located and followed at any time of day regardless of whether or not they were calling. It was possible to follow radio-tagged birds for longer than un-tagged birds when required. Nest location was greatly simplified, especially where the incubating (female) bird,was radio-tagged.

2.2 Population monitoring

Birds were usually located during their dawn song period or, occasionally, by their response to recorded song. Kokako were then followed as inconspicuously as possible and their number, identity, activities and location recorded whenever possible. Prior to the onset of breeding all known pairs and most singles were checked to note any partner losses or gains since last season.

From November until late January follows were confined to the nine South-block pairs and were aimed at identifying nesting attempts and following the fate of any nests located. To this end we attempted to follow each pair for two hours each week (Table 2). During follows, notes on movements, behaviour and feeding were recorded. Information was recorded on follow-maps (see Fig. 1).

During late February/early March and late April/early May all pairs in the three blocks were followed to record presence/absenee of juveniles (see Table 3).

As of 30 October 1991 we knew of a total of 14 pairs and 17 single kokako in Mapara W.R. We believed there to be at least one additional pair and several singles. By February 1992 we had confirmed 49 kokako, 16 pairs and 17 singles. The distribution was:

North Block	-	0 pairs, 6 singles
Central Block	-	7 pairs, 6 singles
South Block	-	9 pairs, 5 singles.

Table 1 Mapara banded kokako.

Grid references from NZMS 260 map S17. Colour bands coded as: red (R), yellow (Y), green (g), blue (B), white

Date	Name	Left	Right	Age	Weight	Tarso.	Tx.	Grid Ref.
29/6/79	Skeptic E13748 WIG	Adult	259	71.8				
11/4/90	Nerak	R	E177101/R	Adult	235	71.7		054 944
10/6/90	L-Nino	W	R/E177103	Adult	249	70.3		067 940
10/6/90	L-Nino 2	Y	R/E177102	Adult	234	69.85		067 940
20/9/90	Rumple	Y/B	R/E177104	Adult	204			093 927
21/9/90	Shriekback	Y/R	Y/E177105	Adult	254			070 940
14/11/90	Swiveltrout	B	Y/E177106	Adult	242	68.1		090 900
16/11/90	Singleton	B	B/E177107	Adult	254			068 944
08/2/91	Hinau	E177109	Y	Nestling	180			096 895
19/2/91	Turnpike	R	E177110	Adult	235			093 899
21/2/91	Archie	W	E177111	Adult	245			086902
22/2/91	Angel	G	E177112	Adult	219			086902
31/7/91	Purplcrain	G/Y	B117113	Adult	240	67.9		094898
03/8/91	Majora	B	E177114	Adult	235	67.8		097 893
04/8/91	Morning glory	W/B	E177115	Adult	233	67.9		086 903
05/9191	Mar7ba	R	G/E177116	Adult	243	66.5	57	092 907
05/9/91	Moro	R/Y	E177117	Adult	210	62.4		092 907
08/9/91	Marama	R	B/F177tI9	Adult	223	61.6	59	095 896
11/9/91	Nice	B	R/E177119	Adult	223	64.8	55	097 904
04/10/91	Gian	W	Y/E177120	Adult	275	67.7	53	098 908
31/10/91	Battagooli.Bird	RIG	E177121	Adult	191	60.2	39	086 903
06/3/92	Eureka	G	R/E177122	Adult	225	61.8		093 935
06/3/92	Archimedes	Y	Y/E177123	Adult	241	67.35		093 935
27/3/92	Sleazy	B/Y	E177124	Adult	217	63.45		097 904
28/3/92	Cuckoo	R/B	E177125	Adult	222	61.25		097931
28/3/92	Stinky	G/W	Y/E177126	Adult	212	67.65		097 931

Date = date on which bird was banded. Tarso. = tarsometatarsus length. Tx. = transmitter frequency. E123456 = number of metal band

Table 2 Mapara follow times in minutes.

P = pair S = single

Week ends	Archie/ Angel	Crystal-fire/ Marama	Nice/ Sleazy	Tui/ Tui	Swivel-trout/ Manga	Gian/ Duja	Skeptic/ Skathe	Marzba/ Moro	Morning Glory/ Battagooli
08/11/91		P 140	P 153			P 86		P 50	P 50 min.
15/11/91			P 40			P 90			
22/11/91		P 80						P 120	P 60 min.
29/11/91		P 110	1' 90 S 90			P 90		TX. fault	P 260
06/12/91		P 150	P 30 S 135			P 170			P 120
13/12/91						P 30			
20/12/91	P 30	P 148	P 67	**NEST** (building 17-20/12/91)	P 211	S48	P 120	P 35 S/P 94	P 120
27/12/91	P 270	P 116	P 30			P 50	P 20	P 75	P 161
03/01/92	P 70	p 120	P 10	P 25	P/S 60	P 130	S 50	P 65	P 50
10/01/92	P 240	**NEST** (6/1/92)		P 60	P 78 S95	P 95	**NEST (10/1/92)**	P 255 S 44	P 90
17/01/92	S? 60	NEST	JUVS. (16/1)	P 35 S 80	P 60	S45	NEST	P 40 (+unk. pair) S70	P 140
24/01/92	P 280	NEST	P + 2 JUVS. 60	P 25		P 85 S35	P 120	P 180	P 140
31/01/92	P 120	NEST		P 55	P 115	P 120	P 165	P 120	P 90
07/02/92	P 345	P 230 (Nest left -1/1/92)	P + 2 JUV	P 165	P 65	P 120	P 110		P 210
14/02/92		P 120	P + 2 JUV	P 45		S 135	P 40	P 80 S15	
21/02/92		P 100	P + 2 JUV	P 75	P 110	P 120	P 150	P 120	P 120
13/03/92		P 110		P 60	P 60	S45	P 60		P 50

Observations of colour-banded kokako lead to the identification of the following pair changes during 1991/92. Where birds have disappeared we cannot be sure whether they have died or moved elsewhere.

- Neither of the Nerak & Nivek pair were found.
- Shriekback pair reduced to a single (banded) individual.
- Grimble & Etak pair reduced to one (unbanded) individual.
- Mystar-E single now a pair (neither banded) range as previously.
- Morning Glory (single) paired up with an unbanded bird during August 1991, range unchanged.
- Swiveltrout single moved 2 km to replace one of unbanded Manga/Hoanga pair. In this case the range seems to be similar to that used previously by this pair.
- Oslo & Meslo now a single, unbanded.
- New pair confirmed near Cuckoo/Stinky during March 1992 (both unbanded)
- Pair confirmed as Doublevision during early May 1992 (both unbanded)
- Marzba, previously paired to Moro, replaced by Turnpike during December 1991. Range remains that of Moro.
- Skeptic, banded in 1979 as an adult, replaced during January 1992 by an unbanded bird, pair range remains that of ex-partner Skathe.

Since last breeding season we have lost one member from each of four pairs In two pairs one member has been substituted. Two singles have formed new pairs and one new pair has been identified. Overall, one less kokako pair was present than last breeding season. We do not know the fate of any of the "missing" birds, no dead kokako have been recovered.

2.3 Breeding

Unfortunately a shortage of staff resulted in some gaps in our records during November and early December. Central block pairs were not followed during the breeding season. Breeding-related activities are summarised below.

Nice/Sleazy

- Possible copulation week ending (= w.e.) 7/11/91.
- Courtship behaviour w.e 14/11/91.
- Long single-bird follow w.e 30/11/91.
- Long single-bird follow w.e 7/12/91.
- Only short follows during January 1992.
- Fledgling seen 16/1/92, allowing 50 days for incubation and chick rearing we can estimate laying occurred in late November.
- Two fledglings with parents during February and March.

Tui pair

- Nest building 17,18,19 & 20/12/91.
- Nest abandoned w.e 30/12/91.
- No egg fragments or other sign found in this nest.
- Copulation observed w.e 14/1/92.

Gianduja pair

- Collecting nest material (ceremonial ?) 4/11/91.
- 48 min. single-bird follow w.e 21/12/91.
- 75 rein. single-bird follow w.e 21/1/92.
- 145 min. single-bird follow w.e 14/2/92.

Skeptic/Skathe

- 50 min. single-bird follow w.e 7/1/92.
- Nest found 10/1/92.
- Incubation by unbanded bird.
- Nest abandoned 23/1/92, not able to climb to nest. Skeptic replaced by an unbanded kokako sometime around this date.

Moro/Turnpike

- Long single-bird follow w.e 21/12/91.
- 45 min. single-bird follow w.e 14/1/92, (also 255 min. pair obs.).
- 70 min. single-bird follow w.e 21/1/92, (also 205 min. pair obs.).

Crystalfire/Marama

- Nest located7/1/92.
- Incubated for about 25 days then abandoned.
- Incubated by Marama, the banded, transmitter bearing (female) bird.
- 2 eggs found in nest, both undeveloped, one cracked.

Swiveltrout/Manga

- 95 min. single-bird follow w.e 14/11/91.(also 78 min as pair).

Throughout the season, Archie/Angel and Morning glory/Battagooli were always together as pairs during follows.

2.4 Nests

The following notes describe our observations of nests

1. Crystalfire/Marama 1990/1991.
   Situation: ridge crest
   Height above ground: 12 m.
   Height to canopy: 2 m.
   Vegetation: dense climbing rata in Hinau conceals nest from above.
   Construction: rough foundation of large sticks (up to 30 cm.) lined with soft, fine plant matter.
   Nest fledged single chick, Hinau on or about 13/2/91.

2. Crystalfire/Marama 1991/1992.
   Situation: ridge crest
   Height above ground: 16 m.

Height to canopy: 3 m.
Vegetation: dense climbing rata in hinau. Nest well concealed from all angles.
Construction: large sticks of hinau and rata lined with fine fern, moss, lichen and mamaku scales.
Eggs measure: 26.05 by 37.35 mm, weight 12 g when collected.
26.75 by 38.00 mm, cracked and empty.
(Note: eggs measured 6/2/92, after 25 days incubation, no embryo development had occurred. Eggs were blown and lodged with the National Museum, Wellington.)

3. Tui 1991/1992.
Situation: ridge crest
Height above ground: 22 m.
Height to canopy: 1.5-2 m.
Vegetation: tall slender tawa with tangle of supplejack around nest. Nest well concealed from below, but exposed to north-east above (70% cover above).
Construction: tawa twigs up to 45 cm in length form large platform. Lined with Astelia leaf, moss, lichen and mamaku scales.

4. Skeptic/Skathe 1991/1992.
Situation: side of ridge, aspect north-east.
Height above ground: 16 to 20 m.
Vegetation: large, old tawa laden with epiphytes.
Nest could not be reached.

5. Nice/Sleazy 1991/1992.
(the nest itself was not seen, though site was.)
Situation: ridge crest
Vegetation: large hinau with epiphyte clumps.

2.5 Juvenile surveys

Two complete juvenile surveys were conducted, one during the final week of January and first three weeks of February, the other during the final week of April and the first three weeks of May (Table 3). Each pair was followed for a minimum of two hours in increments greater than 30 minutes. Notes on the juveniles found are below:

January-February survey

1. Cuckoo/Stinky, three fledglings, (first two were seen 7/2/92, there were later found to be three, on 28/3/92)
2. Eureka/Archimedes, two fledglings. (24/1/92 parents repeatedly visit a certain tree. Both juveniles following parents 9/2/92)
3. Nice/Sleazy, two fledglings, (first seen 16/1/92)

April-May survey

1. Cuckoo/Stinky, three fledglings

Table 3 Mapara juvenile surveys.

Pair Name	Jan./Feb. Contact Time (miss.)	Comments	Apr./May Contact Time (mins.)	Comments
Archie/Angel	270+165+180	PAIR ONLY	60+60	PAIR ONLY
Crystalfire/Marama	230+120+100	NEST TILL 1/2/92, THEN PAIR ONLY	93+28	PAIR ONLY
Nice/Sleazy	60+	2 JUVS,+PAIR	27	PAIR + ONE JUV
			135	PAIR ONLY
Tui/Tui	55+165+45+75	PAIR ONLY	120	PAIR ONLY
Swiveltrout/Manga	115+65+110	PAIR ONLY	126	PAIR ONLY
Gian/Duja	85+120+120	USUALLY PAIR, 135 MIN. ALONE	121	PAIR ONLY
Skeptic/Skathe	165+110+150	PAIR ONLY	60+90	PAIR ONLY
Marzba*/Moro	120+65+120	USUALLY PAIR, 15 MIN. ALONE	35	PAIR ONLY
			60+60	TURNPIKE ALONE
Morn.glory/Battagooli	90+210+120	PAIR ONLY	131	PAIR ONLY
Rumple/Stiltskin	180	PAIR ONLY	124	?AIR ONLY
Eureka/Archimedes	110+100	PAIR ONLY, NEXT FOLLOW 2 JUVS.	120	PAIR ONLY
Cuckoo/Stinky	180+	2 JUVS,+PAIR	129	STINKY ONLY,
			33	3 JUVS.+ PAIR
Bamboozled/Bam.2	30+90	PAIR ONLY	54+41+45	PAIR ONLY
Mystar-E/Matabee.	35+30+124	PAIR ONLY	37+105	PAIR ONLY
Kalirnbo./Asimbo.	20	PAIR ONLY	125	PAIR ONLY
Doublevision/Doub.2			46	PAIR ONLY

+ symbols separate the tracking durations of successive encounters.

2. Nice/Sleazy, one fledgling being evicted 27/4/92, then pair alone on subsequent follows

With juveniles unbanded it was impossible to distinguish between siblings. The following general observations will, however, illustrate something of parental behaviour.

1. During January follows of Cuckoo and Stinky it was noted that each juvenile was fed repeatedly by a particular adult, though the family moved as a group (only two juveniles were sighted on this occasion). On the 28 March this pair was observed for over 2 hours with three juveniles moving as a family group. Two days later the same pair was observed for 90 minutes with one juvenile only. In April Stinky was followed alone for over 2 hours; on the following day Stinky sang alone for a half hour before moving to join its mate and three juveniles.

3. Nice and Sleazy moved as a cohesive group with their two young during January, February and early March. Since late March only one juvenile has been seen with the pair. On 27 April one adult was vigorously attempting to evict this juvenile and by 1 May the pair was followed alone for over 2 hours.

During January it was noted for all juveniles that they received most food from their parents. Juvenile activity was mainly limited to following parents and occasional bouts of running and chasing. In mid February the Nice and Sleazy juveniles fed themselves and experimented with foods (green pigeonwood fruit) as well as receiving occasional feeds from their parents. After this date juveniles fed themselves entirely but the family group remained together while feeding.

2.6 Feeding observations

Observations of feeding were recorded during follows when the food consumed was clearly seen. Observations are, therefore, biased toward open, low growing species such as shrub-hardwoods. Kokako spent much time amongst epiphytes and high canopy where they and their foods were rarely identifiable. In many cases the "food" most apparent to the observer was not what was being sought; a kokako visiting rata flowers was not observed to consume any floral product, but was feeding on insects visiting the flowers. Small insects were taken very rapidly, often before the observer could see the prey. Hence insects which we recorded being eaten were usually the large species which the birds could not swallow intact.

To date we have little knowledge of the nutritional value of kokako foods so interpretation of feeding observations is problematical.

Food types eaten are summarised into two-monthly periods for all feeding observations recorded during 1991 and 1992 in Table 4.

Table 4 Food types recorded for kokako during 1991 and 1992.

January/February		March/April		May/June	
MAHOE (FLW)	(1/1)	SUPPLEJACK (RFT)	(8/7)	PASSIONFLOWER (RFT)	(2/1)
(LEA)	(2/2)	MAHOE (LEA)	(2/2)	MAHOE (RFT)	(2/1)
PIGEONWOOD (LEA)	(3/3)	(RFT)	(6/4)	PATE (RFT)	(1/1)
(RFT)	(13/13)	PASSIONFLOWER (LEA)	(1/1)	MAPAU (RFT)	(1/1)
WINEBERRY (RFT)	(8/5)	TAWA (RFT)	(3/3)	PIGEONWOOD (RFT)	(2/1)
TAWA (LEA)	(3/3)	PIGEONWOOD (RFT)	(1/1)	KANONO (RFT)	(1/1)
(FBU)	(2/2)	(LEA)	(3/2)	MOSS CAPSULES	(1/1)
SUPPLEJACK (RFT)	(2/2)	KANONO (UFT)	(1/1)	INVERTEBRATES:	
KANONO (LEA)	(1/1)	(RFT)	(1/1)	–Stick-insect	(1/1)
PUKA (LEA)	(1/1)	MIRO (RFT)	(2/2)	–Bagmoth	(1/1)
(UFT)	(2/2)	ASPLENIUM FLAC. (FR)	(2/2)	–Unid. Insect	(1/1)
CLEMATIS PAN. (SEE)	(1/1)	PHYMATOSORUS DI. (FR)	(1/1)		
MAPAU (RFT)	(5/4)	INVERTEBRATES:			
HINAU (UFT)	(1/1)	–Bagmoth	(1/1)		
MOSS	(1/1)	-Unid. insect	(1/1)		
LICHEN	(1/1)				
INVERTEBRATES:					
–Leaf-roller	(1/1)				
–Caterpillar	(9/2)				
–Spider	(1/1)				
–Bagmoth	(2/2)				
–Unid.Insects	(11/8)				

July/August		September/October		November/December	
TAWA (LEA)	(1/1)	REWAREWA (SEE)	(2/2)	MAHOE (yLEA)	(1/1)
EARINA Sp (LEA)	(1/1)	PASSIONFLOWER (LEA)	(2/2)	(nLEA)	(1/1)
PASSIONFLOWER (RFT)	(1/1)	TAWA (nLEA)	(1/1)	HINAU (yLEA)	(1/1)
INVERTEBRATES:		MAPAU (RFT)	(1/1)	(mLEA)	(1/1)
–Bagmoth	(1/1)	EARINA AUT. (LEA)	(1/1)	(FLW)	(3/3)
		ASPLENIUM FLAC. (FR)	(1/1)	(FRT)	(1/1)
				REWAREWA (SEE)	(4/4)
				METROSIDEROS COL.	
				(yLEA)	(1/1)
				TAWA (RFT)	(2/1)
				SUPPLEJACK (mLEA)	(2/2)
				PIGEONWOOD (LEA)	(2/2)
				(UFT)	(1/1)
				(RFT)	(2/1)
				TARATA (mLEA)	(1/1)
				HEKETARA (FLW)	(1/1)
				EARINA Sp (FLW)	(3/3)
				PUKA (LEA)	(2/1)
				(UFT)	(1/1)
				PITTOSPORUM COR. (FRT)	(1/1)
				MAPAU (RFT)	(3/3)
				MIRO (yLEA)	(1/1)
				ASPLENIUM FL. (FR)	(6/6)
				PHYMATOSORUS (FR)	(2/1)
				INVERTEBRATES:	
				-Scale-insect	(5/2)
				–Spider	(1/1)
				–Caterpillar	(1/1)
				–Unid. insects	(3/2)

FBU = Flower bud
FLW = Flower
FRT = Fruit
FR = Frond
LEA = Leaf (n = new, m = mature, y = yellow)
RFT = Ripe fruit
SEE = Seed
UFT = Unripe fruit

(x/y): X = Total number of observations of kokako taking this food, Y = Number of independent (different bird and/or date) observations

2.7 Movements

Most observers did not know the reserve thoroughly enough to report accurate locations of each tracking. Where this information was collected, the furthest point reached in any direction was mapped (Fig. 1). Only records where the bird(s) colour bands were identified were plotted. Sufficient information was available for mapping ten territories. Five of the pairs were fitted with radio transmitters (asterisk) which enabled tracking for longer durations. Tracking of pairs without transmitters usually started at the pair's usual morning song perch, and continued for up to two hours, so these plots represent predominantly morning movements. Polygons formed by linking outer limits of several tracking periods were measured to give an estimate of area used. Home range areas ranged from 1.85 ba (based on only 3 trackings) to 11.06 ha (based on 6 trackings). Areas based on six or more trackings ranged between 4.5 and 10 ha. These estimates are not corrected for topography, which means actual areas are considerably larger. Further tracking, especially out of the breeding season, is likely to increase these estimates. It must be acknowledged that the birds' usage of the areas within such polygons is far from uniform.

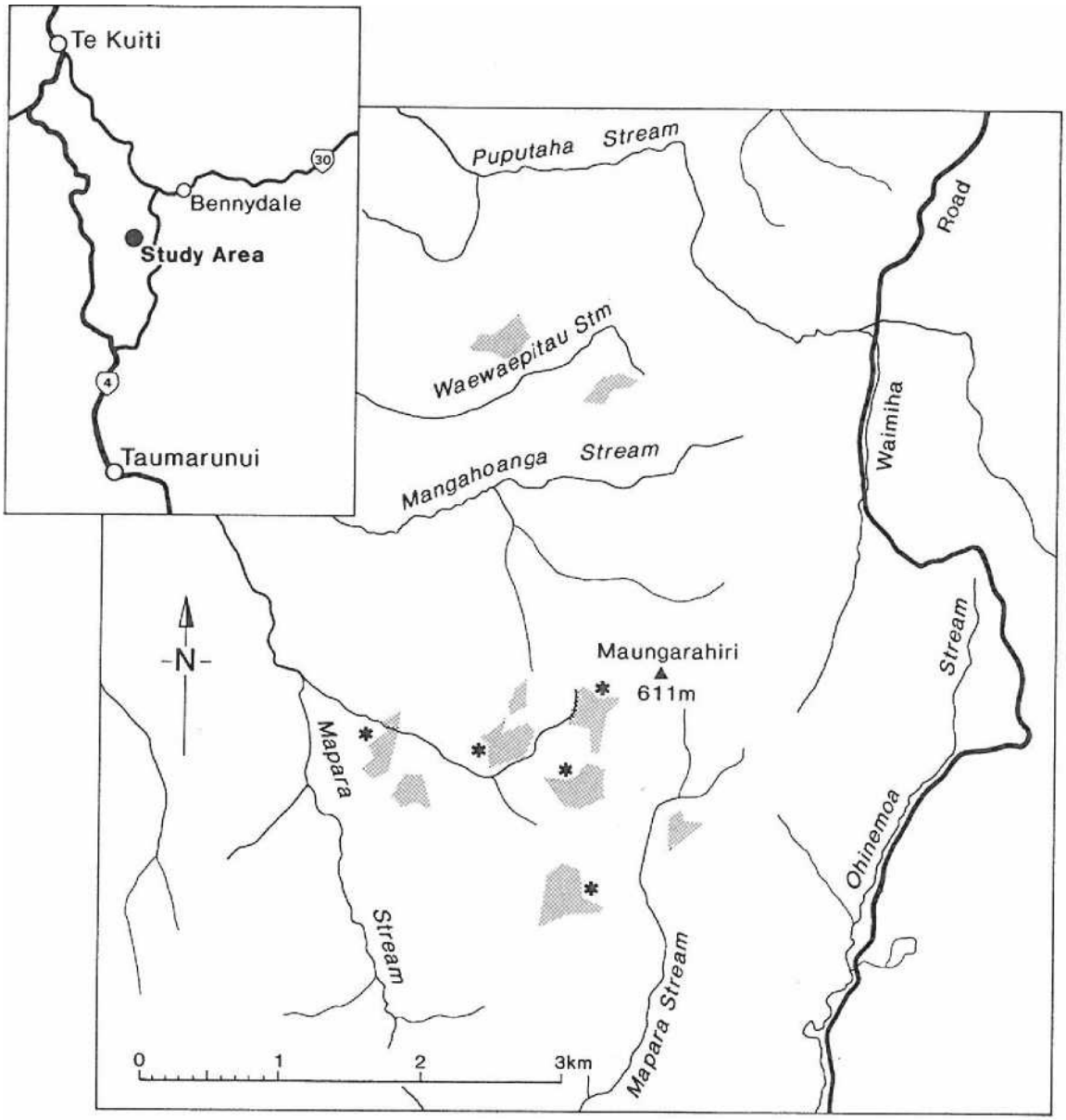

Figure 1 Mapara kokako movements from August 1991 to March 1992, showing minimum areas utilised by 10 pairs. Five of the pairs were fitted with radio transmitters (asterisk).

3. MAMMALS

Mammal control and monitoring work will be fully presented elsewhere (see Bradfield 1993, Stevens 1992), but is reported here in brief as background information.

1080 ("Wanganui" No.7 pollard baits containing 0.08% sodium monofluoroacetate) was spread by helicopter at a rate of 8-10 kg/ha on 19 October 1991. Though primarily intended to control possums 1080 has greatly reduced rodent populations. Trapping and shooting were used to control other introduced mammals.

3.1 Possums

A pre-poisoning survey of possums at Mapara conducted in August 1990 estimated 77.1 (± 19.2, 95% confidence interval) "trapable possums" per 100 traps. Note that "trapable possums" are a statistic related to the total catch by an estimate of the probability of capture. Trapping and poisoning prior to 1990 had already reduced the population, however, the August 1990 figure is used as a baseline for current monitoring.

The poison operation in September 1990 resulted in a reduction by 79% to 16.2 "trapable possums/100 trap-nights" (± 6.8, 95% confidence interval). The population increased slightly to 30.4 (± 9.3, 95% confidence interval) "trapable possums/100 trap-nights" because of immigration and/or recruitment by September 1991. A poison drop in October 1991 resulted in only a small additional reduction on this figure to 25.7 (±9.7, 95% confidence interval) "trapable possums/100 trap-nights".

3.2 Rats

Rat numbers were monitored using tracking tunnels. In each area four lines, each of 25 tunnels spaced at 50 m intervals, were baited with peanut-butter and set for one night on each of 4 occasions. The first monitoring session was 20 days prior to the poison drop and subsequent sessions were one, three, and five months following poisoning. The Cowan Block figures demonstrate the variability of the index in a non-poisoned population (Table 5). Mice were also recorded but are not reported here. Bradfield (1993) gives further details on mammal control work.

Table 5 Percentage of tunnels tracked before and after the Mapara 1080 application on 19 October 1991.

	Pre-1080 30/9/91	1st. Post-1080 21/11/91	2nd. Post-1080 21/1192	3rd. Post-1080 17/3/92
Mapara	57%	7%	41%	67%
Cowan	18%	50%	34%	41%

3.3 Goats

During July 1991 hunters spent 28 person-days within the reserve and 30 person-days on adjacent land; 24 and 204 goats were shot in these respective areas. Subsequently a further 38 (in reserve) and 88 (buffer) were shot (Philip Bradfield pers. comm.).

3.4 Mustelids

Between mid April 1991 and mid April 1992 138 Fenn traps have been set and regularly checked. Eight ferrets, 27 weasels and 40 stoats were killed (Philip Bradfield pers. comm.).

3.5 Cats

During the period 1 July 1991 to 30 June 1992 three cats were killed in the reserve and five more were killed within one kilometre of the reserve boundary. Those in the reserve were trapped, the rest were shot (Philip Bradfield pers. comm.).

3.6 Bait trials

Every second Fenn trap was baited with half a raw egg within the trapping tunnel and either side of the trap. Baits were replaced every five to ten days depending upon their condition. These traps had hitherto rarely been baited. A total of 2849 baited trap-nights and an equal number of control trap-nights were recorded between 31 October 1991 and 10 March 1992. The numbers of animals caught were too few to allow any statistical inference about the influence of trap baiting on small mammal captures (Table 6).

Table 6 Numbers of small mammals caught in baited versus unbaited traps at Mapara, 31 October 1991 to 10 March 1992.

Catch	Baited	Unbaited
Hedgehog	1	1
Norway rat	2	0
Ship rat	30	38
Mouse	1	1
Ferret	4	1
Stoat	5	2
Weasel	3	0
Rabbit	3	2
Sprung trap	10	7

4. PHENOLOGY

The phenology of 10 kokako food species was recorded monthly at Mapara for the past two years. A permanent sample of 15 tagged trees of each of the 10 species have been monitored (3 species have smaller samples). For dioecious species only female plants were monitored. Each month plants were scored on a scale of 0 to 4 for features such as, buds, flowers, unripe, ripe, and dry fruit. This information will be presented in a separate report.

Flowering and fruit set were very different between the two years. Passionflower, pigeonwood, rewarewa and mapau, all fruited heavily during spring/summer 1990/91. These species have produced virtually no ripe fruit during the 1991/1992 summer. Tawa and pigeonwood had large crops of unripe fruit which should ripen during the spring and summer of 1992/1993. Hangehange, supplejack, kanono and puka have shown little change in the two years whilst mahoe this autumn has fruited heavily. Mahoe fruit will be one of the only fruit types available this coming winter and early spring.

5. DISCUSSION

The effort put into introduced mammal control at Mapara was similar to that in 1990/91. Results were also similar: possums remained at low numbers and mustelid catch rates changed little, rat numbers remained higher and recovered faster. Cat sightings or trappings are too infrequent to provide an index. We assume some secondary poisoning of predators by 1080 probably occurs. The L.D.50 for cats, for example is 0.3 to 0.5 mg/kg (Rammell and Fleming 1978). Seven to ten grams of bait would yield 0.6-0.8 mg of 1080, enough to kill a small cat. Predators would be exposed to poison if stomach contents of rodents, live or recently dead, were consumed.

Within the managed area of Mapara 16 pairs of kokako were present in 1991/92 from a total population of 50 to 60. Over and above the census figure of 49 territory holding kokako we believe there to be a number of kokako without fixed territories. These elusive individuals were very difficult to count or capture. It is assumed that juveniles form part of this group. Seven young were produced from three successful clutches. The greater frequency of observations this year gives us confidence that few kokako went uncounted (cf. 1990/91 when some confusion has been reported). The Doublevision pair was only confirmed in April. Several short observations suggest, however, that they did not rear any juveniles.

Because of considerable gaps in our data for November and early December 1991 we can be less certain that all nesting attempts were noted. Nevertheless, at least six pairs attempted to breed. One pair (Morning Glory) made no attempt and Gianduja pair probably made no attempt. If they did, the attempt must have failed within a week. Three nests resulted in the successful rearing of seven chicks; these nests were initiated between the last week of November and mid December.

The three known failed nests were initiated on or about 17 December 1991, 2 January 1991, and 10 January 1991. For two nests the reasons for failure are unknown. One was incubated for about seven days before desertion, and the other was probably never laid in. The third failed nest was incubated for 24 days before abandonment (the usual incubation period is 21 days). Two eggs found in it were found to be infertile. None of these failed pairs were known to attempt re-nesting.

If any of the three remaining South block pairs did nest in the early part of the season their attempts had failed by 13 December 1991. No further nesting was observed after this date. The four remaining pairs are in the Central block (including two pairs which we did not locate until late in the season) were not followed during the nesting season.

The collection of information on which pairs attempted to breed, and the fate of each attempt is essential to the interpretation of results. Follows of at least two hours in both February and April were sufficient to determine the number of broods raised to fledging, though might underestimate the total number of chicks fledged.

Slightly less high quality food (such as fruits) seemed to be available during the 1991/92 kokako breeding season than during the 1990/91 season, a lack of pigeonwood

fruit and rewarewa flowers being the obvious differences. We do not know the number of kokako breeding attempts in 1990/1991 and so cannot determine whether differing food availability influenced kokako breeding.

Mustelid catches from egg-baited traps appear to have been slightly higher than in unbaited traps. Egg baits decompose quite rapidly and their weekly replacement adds considerably to the cost of trapping. It is hoped to continue trials with a more durable bait.

In the coming season we will attempt to monitor nesting attempts of all Mapara kokako with the aid of up to eight radio transmitters (weather for netting permitting!) Methods used will be essentially the same as those described for the 1991/92 year.

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