Notornis, *2009*, *Vol. 56: 183-189*
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Distribution and habitat use by New Zealand pipits (*Anthus n. novaeseelandiae*) on the Volcanic Plateau

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Abstract The distribution and habitat use of New Zealand pipits (*Anthus n. novaeseelandiae*) in Tongariro National Park on the volcanic plateau of the North I was assessed in Nov 1998 and Mar 1999. Pipits were found at 13 of 22 sites. Surveys between Nov 1998 and Oct 2009 found pipits present all year at Lake Te Whaiau, Mangatepopo Road and Waipakihi Road. Pipits were also seen along the road through the wetland at Erua in winter and summer. At Lake Te Whaiua, pipit presence and use of habitats differed seasonally. The average maximum flock size in summer was 9.7 (se = 1.05, n = 11). Maximum roadside counts outside of the flocking period were 1.13 pipits km^{-1} (*se* = 0.17, *n* = 5) along Waipakihi Road and maximum summer flock sizes there averaged 6.0 (*se* = 1.05, range 2 - 18, *n* = 19) birds.

Beauchamp, A.J. 2009. Distribution and habitat use by New Zealand pipits (*Anthus n. novaeseelandiae*) on the Volcanic Plateau. *Notornis 56(4):* 183-189.

Keywords New Zealand pipit, *Anthus n. novaeseelandiae*, survey

INTRODUCTION

The New Zealand pipit (*Anthus n. novaeseelandiae*) favours open country with emergent shrublands and fern, boggy wetlands and lakes, and sandy rivers or coastlines (Higgens *et al.* 2006). The biology of the pipit in the central volcanic plateau of the North I is interesting as this area has undergone a variety of habitat and land use changes that have likely impacted on the range and abundance of pipits. In 1840, the central volcanic plateau was dominated by mixed manuka (*Leptospermum scoparium*) and monoao (*Dracophyllum subulatum*) shrublands, tussock grasslands, fernlands and bogs as the result of volcanic activity and fire (Bidwill 1840; McKinnon *et al.* 1997). However, between 1920 and 1970 over 300,000 ha of the Bay of Plenty and central volcanic plateau was converted to exotic forestry (Stewart & Hyde 2004). A further 1.2 million ha were converted to pasture beginning in 1935, after it was discovered that cobaltised super-phosphate accounted for nutrient deficiencies (Smallfield 1970; McKinnon *et al.* 1997).

The abundance of pipits appears to have mirrored these land use changes. In the 1940s, flocks of up to 40 pipits were seen near Taupo in winter (Anon 1944), and they were considered plentiful in newly planted exotic forests and areas being prepared for planting (Ryder 1948, Weeks 1949). Pipits were encountered frequently in the central North I until the late 1950s (Sibson 1956, 1961). In Mar 1957, hundreds of pipits were reported and found to be spaced over every hectare above *c.*1520 m on the Kaimanawa Mountains (Sibson 1959). Pipit numbers then declined during the 1960's but the exact magnitude is unknown.

In 1969, a mapping programme was instigated in the Tongariro National Park in order to assess changes in bird numbers and distribution. This system recorded pipits at 73 locations between 1969 and 1989, and at 3 locations between 1989–1998, predominantly below 1500 m (E. Cooper *pers. comm.*; Fig. 1). However, this data was not sufficiently robust to measure habitat use nor record the patterns of pipit presence throughout the year. The objective

Received 8 Aug 2008; accepted 16 Feb 2009
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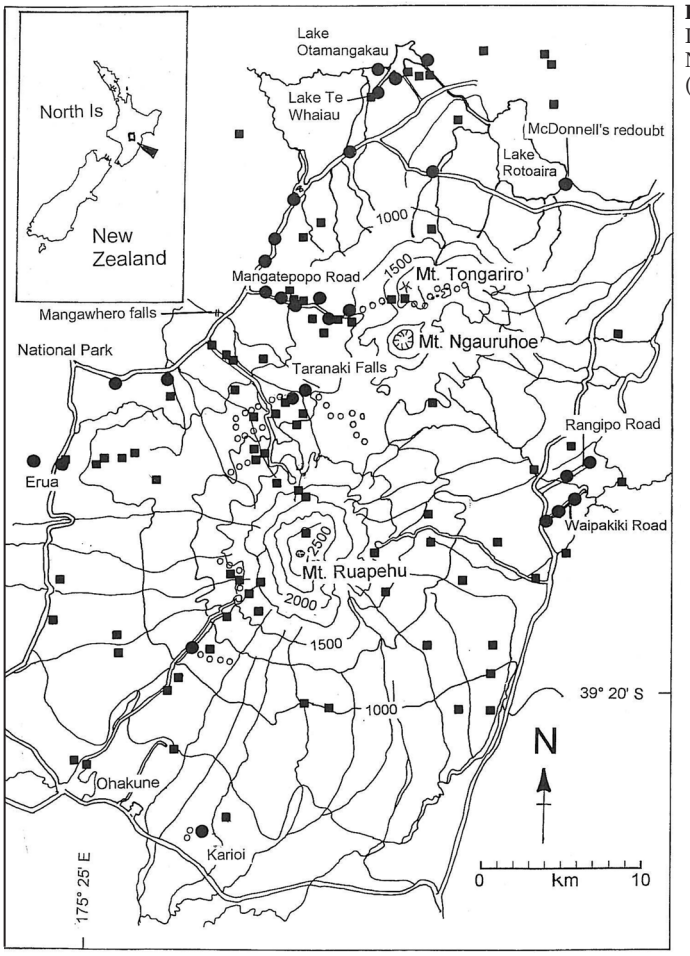

Fig. 1. Pipit distribution on the Volcanic Plateau, North I, New Zealand, 1969-89 (▪) and Nov 1998 - Mar 1999 (●), and the walked routes (o) in 1998 - 1999.

of this study was to assess the presence of pipits at some of the sites where they had been detected in the 1969-89 bird mapping programme, to assess presence at 5 other sites in the region, and to record habitat use at one of these sites, Lake Te Whaiau. I also looked for pipits in >1400 m sections of the nearer Kaimanawa Mountains in Mar 2006.

METHODS

I selected sites to survey based on where the Tongariro National Park bird distribution survey had indicated pipit presence between 1969 and 1989 (Innes *et al.*1982, E. Cooper, *pers. comm.*). From 26 - 29 Nov 1998 and 26 Mar - 1 Apr 1999, I surveyed a variety of accessible sites that differed in altitude, habitat and vegetation features. At each site I recorded the number of pipits observed, and noted the type of habitat in which they were found.

After Mar 1999 I confined my survey to 5 sites with different habitat characteristics. The sites chosen were: (1) Mangatepopo Road as it runs through dense heather (*Calluna vulgaris*), (2) open sand and wetland areas of Lake Te Whaiau, (3) flax (*Phormium tenax*) swampland and adjacent gravel roads at Erua, (4) red tussock (*Chionochloa rubra*) grassland and kanuka (*Kunzea ericoides*), and (5) manaoa (*Dracophyllum subulatum*) margins of the Rangipo Intake and Waipakihi Roads (Fig. 1). Surveys of Mangatepopo, Erua, Rangipo Intake and Waipakihi Roads were conducted from a car moving at < 30 km h^{-1}. The car was stopped when a pipit was detected and it was watched for 5 minutes to ascertain if others were present. Areas between the power lines crossing Rangipo Intake and Waipakihi Roads, and a route at Lake Te Whaiau were also walked and these data were used in calculations of pipits detected per km. Surveys of Lake Te Whaiau were conducted on foot.

In Nov 2006 and in Jan, May and Aug 2007, I assessed the activity of pipits encountered along a route (0.45 km) through 3 habitats: open sand with sedge-lands, rabbit (*Oryctolagus cuniculus*)

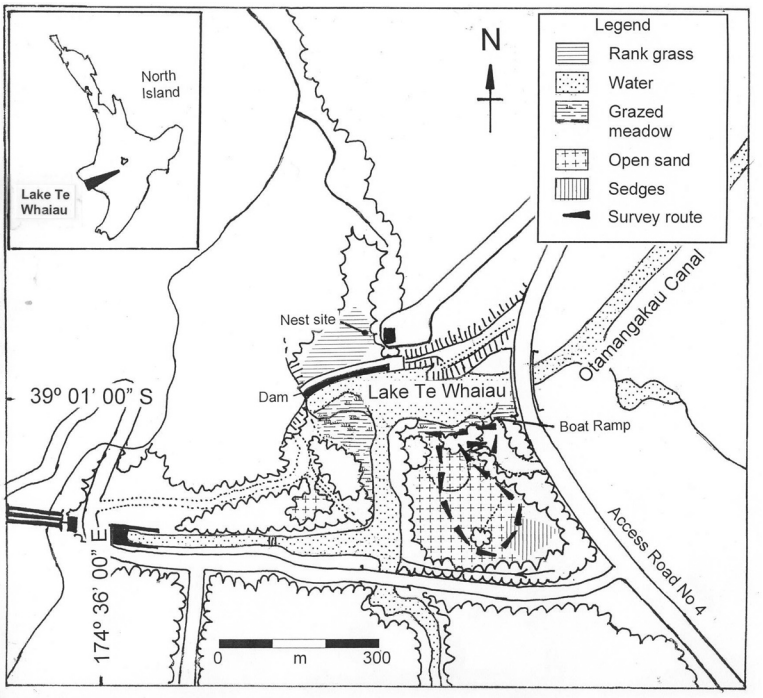

Fig. 2. Habitat type and location of the walking survey route at Lake Te Whaiau, Volcanic Plateau 1998-2007.

grazed turf, and the southern margin of Lake Te Whaiau (Fig. 2). I walked slowly (*c.* <2 km h^{-1}) and counted the pipits in each habitat. I then scored the behaviours of the 1st pipit detected in each habitat every 5 seconds until the pipit was lost, moved to a different habitat, or for a maximum of 15 minutes. If the pipit was out of view it was scored again only when full view could be re-established. If a pipit was lost, I counted the remaining pipits in the habitat and searched each habitat in turn until I found a pipit in a different habitat. If no pipits were detected in a habitat during a slow walk I scored the presence as nil. In this way, there was coverage of the 3 habitats throughout the survey period, and the location of encounters could be used to assess seasonal changes in habitat use. The weather was fine with a light north-westerly (Beaufort 3) during surveys in Nov and Jan, there was a moderate northerly (Beaufort 4) and calm weather in May 2007, and it was overcast with a moderate westerly (Beaufort 4) in Aug 2007.

Pipit foraging behaviours were scored as in a previous study as walking, standing, and feeding (Beauchamp 1998). Feeding behaviour included dashing along the ground and aerial chasing after food (Beauchamp 1998). Body maintenance behaviours were also recorded and included preening, scratching and bathing (Beauchamp 1998). Flying was defined as a movement between foraging areas, and chasing included aggressive movements directed at other birds (Beauchamp 1998). Pipits were not colour banded and some activity data may have involved repeated sampling of the same individuals.

Analysis was carried out using SYSTAT 10 and counts were square root transformed before analysis by ANOVAs.

RESULTS

Pipit distribution and presence

I found 15 pipits in 11 h of searching at 6 sites in Nov 1998, and 56 pipits in 52 h of searching at these sites and a further 16 sites during Mar 1999 in fine and warm search conditions (Table 1). Pipits had been detected at 16 of these sites during the preceding 20 years (Fig. 1), while 4 sites had pipits that were not in the previous database. Pipits were detected in all habitats searched except the lakes with bush margins and the alpine zone lacking vegetation (Table 1).

Subsequent data collection at 5 sites revealed significant differences in the number of pipits detected (Table 2) between seasons (2 way ANOVA: $F = 15{,}838$, $df = 2$, $P<0.001$) and sites (2 way ANOVA: $F = 9.110$, $df = 4$, $P<0.001$). Lake Te Whaiau and its surrounding habitats were used by pipits throughout the year, but pipits were only found at Erua during the flocking period and in winter. Pipits were detected far less often seasonally on Rangipo Intake Road than the more open and less vegetated sites at Lake Te Whaiau or Waipakihi Road.

Table 1. Maximum number of pipits counted at sites within and near Tongariro National Park, Volcanic Plateau, New Zealand, Nov 1998 and Mar 1999.

Location	Altitude (m)	Distance (km)	Habitat	Nov 1998	Mar 1999
Lake Rotopounamu	710	1.8	lake bush margins		0
Lake Te Whaiau	610	0.6	lake open margins	4	11
Lake Otamangakau outlet	610	0.3	lake open margins	3	3
Mangatepopo Road	900-1020	6.5	alpine shrublands	7	6
Erua Road	730	1.2	wetlands	-	7
Rangipo Intake Road	900	3.6	alpine shrublands	-	2
Waipakihi Road	1000	4.0	alpine shrublands	-	9
McDonnell's Redoubt	610	0.3	lake open margins	0	2
Eastern Tongariro crossing to Red Crater	1120 -1886	6.0	alpine	-	0
Taranaki Falls upper track, Whakapapa	1300	3.5	alpine shrublands	1	6
Taranaki Falls & lower margin of Lake Tama	1220-1320	4.0	alpine	0	0
Mangahuia Campsite	940	1.0	wetlands	-	2
Mahuia rapid	940	0.3	river	-	2
Wairehu canal	610	3.8	river	-	3
Silica Rapids Track	1320		river	-	0
Bruce Road to Whakapapaiti junction	1520	2.0	alpine shrubland	-	0
Ohakune Mountain Road to Mangaturuturu Hut	1480-1520	4.2	alpine	-	0
Upper Blyth Track	1150	0.5	wetlands	-	2
Wetlands of Lake Rotokawa	1275	0.2	wetlands	-	0
Mangawhero Falls	1300	0.1	river	-	0
Karioi	700	0.4	pine forest	-	1
Lake Rotokura	750	0.2	lake bush margins	-	0

Habitat use and foraging behaviour of pipits

The number of pipits encountered in the census route at Lake Te Whaiau differed significantly throughout the year (2 way ANOVA: $F = 4.761$, $df = 3$, $P = 0.004$) and there was a trend towards the use of different habitats (lake margin, grazed turf & sand with sedges; 2 way ANOVA: $F = 2.619$, $df = 2$, $P = 0.079$, Table 3). For example, in Nov 2006, pipits were found in all 3 habitats, while in Jan 2007 pipits flocked among the sand and flowering grasses/sedges and fed there and along the lake margin. In May 2007, pipits favoured the flooded margin of rabbit-grazed turf and did not feed in the air, and in Aug 2007 they predominated along the lake margin and used the sand areas infrequently (Table 4).

Foraging behaviour of pipits appeared to reflect the types of foods being taken**.** In Nov 2006 and Jan 2007, foraging included rising flights to catch mayflies, hawking over the lake, dashing along the ground, and short rapid flights (Table 4). In May 2007, all foraging behaviour comprised walking and almost constant pecking on wet ground cushion plants and grazed turf for seeds and small worms (Table 4). In Aug 2007, walking and pecking also included taking food from the froth produced by wave action on the lake margin.

Table 2. Maximum pipits detected in the 5 sites counted since 1999, Volcanic Plateau, New Zealand. Duration of all surveys was 30 minutes, except Erua Road which was only 20 minutes.

Location	Nov 1998	Mar 1999	Aug 2002	May 2005	Mar 2006	Jun 2006	Nov 2006	Jan 2007	May 2007	Aug 2007	Jan 2009	Oct 2009
Season*	b	f	n	n	f	n	b	f	f	n	f	b
Lake Te Whaiau	4	11	8	5	3	1	6	14	5	4	15	7
Mangatepopo Road	7	6	-	1	3	-	2	3	6	0	3	2
Erua Road	-	7	3	0	3	-	0	4	0	0	4	0
Rangipo Intake Road	-	2	-	0	5	0	0	2	0	0	0	2
Waipakihi Road	-	9	-	0	11	0	2	2	2	4	21	3

* b = breeding, f = flocking, n = non-breeding

Table 3. Pipits counted in 3 habitats Lake Whaiau, Volcanic Plateau.

Date	Survey *n*	Coverage	Sand & sedge		Grazed turf		Lake margin	
		h	Mean	*sd*	Mean	*sd*	Mean	*sd*
Nov 2006	6	1330 - 2000	1.17	1.17	3.33	0.82	3.83	1.17
Jan 2007	7	0715 - 1400	10.43	2.88	0.00	0.00	1.14	1.21
May 2007	6	0800 - 1800	0.50	0.55	2.50	0.84	2.50	0.84
Aug 2007	10	0900 - 1750	0.10	0.32	0.40	0.52	1.90	0.74

Non-foraging behaviour included chasing and flying between habitats and body maintenance. Preening periods averaged 2.2 minutes (*se* = 0.83, *n* = 5) and were undertaken at open sites or on objects with good peripheral views. Other body maintenance activities scored were fluffing, wing and body stretching (0.001% of observations, *n* = 2381) and bill cleaning (0.001% of observations, *n* = 2381). No dust bathing, bathing or deliberate drinking from the lake were seen (*n* = 30.75 hours observation).

Detection and flock sizes

Pipits were detected during May to Nov on the Lake Te Whaiau census route at an average of 0.73 birds km^{-1} (se = 0.08, n = 6), and flock sizes in Jan to Mar averaged 9.7 individuals (se = 1.05, n = 11). Eighty two percent (n = 154) of movements after my disturbance resulted in pipits staying within the census habitat or region, or flying across the lake (40 - 90 m) to lake margin and turf habitats. The reminder (n = 34) were flights out of sight.

Pipits occurred along the entire 5.5 km length of Mangatepopo Road between Nov and May at an average of 0.7 birds km^{-1} (*se* = 0.15, *n* = 7). Most sighting were of individuals (75%, *n* = 28), and one flock of 3 birds was seen in Jan 2007. After disturbance, pipits either moved along the road (13%, *n* = 18) or flew >300 m away (77%, *n* = 18) over dense heather.

Pipits congregated in post-breeding flocks of 3 - 7 birds on the Erua Road wetland in Jan and Mar, at an average density of 3.5 birds km^{-1} (*se* = 0.61, *n* = 5). When pipits were disturbed they stayed near the road margin (88%, *n* = 15) rather than dispersing into the extensive flax and shrubs of the wetlands.

Pipits in the period from Jan-Mar were observed on the shrubby margins of Rangipo Intake and open grassland margins at Waipakihi Roads at an average of 0.86 (*se* = 0.44, *n* = 5) and at 1.13 (*se* = 0.17, *n* = 5) individuals km^{-1}, respectively. When approached on foot, pipits flew from the road to vantage points on high vegetation (62%, *n* = 35), dispersed to nearby open areas (22.8%, *n* = 35), and often did not disperse along or return to the road margin. The average maximum number in flocks on Waipakihi Road at this time was 6.4 individuals (*se* = 2.3, *n* = 5).

DISCUSSION

Pipits were recorded as widespread in the North I during the 1969 - 79 survey (Bull *et al.* 1985), and remained widespread and locally common in the central North I into the 1990s (Heather & Robertson

Table 4. Time budget (%) of pipits in various behaviours along the saturated water margin of Lake Te Whaiau, the grazed turf near the lake, and the open sand and sedge area, Volcanic Plateau.

Activity	Water margin				Open sand and sedges				Grazed turf		
	Nov 2006	Jan 2007	May 2007	Aug 2007	Nov 2006	Jan 2007	May 2007	Aug 2007	Nov 2006	May 2007	Aug 2007
Stand search	20.9	20.9	26.4	16.2	20.3	24.7	14.5	4.2	11.3	14.1	30.4
Walk search	34.0	35.4	15.9	45.3	56.7	56.0	52.0	70.7	43.0	53.1	48.0
Hopping/jumping	2.9	-	2.1	1.4	0.8	-	0.3	18.8	3.2	2.2	0.9
Dashing/fly dashing	14.7	-	0.9	1.5	3.8	4.2	-	-	-	3.3	-
Feeding in air	5.2	13.7	-	0.3	1.9	-	-	6.3	10.2	-	0.4
Feeding on ground	17.0	30.0	17.7	28.3	4.2	3.1	27.5	-	17.7	23.0	9.7
Chase	-	-	0.3	0.5	-	2.0	4.2	-	-	0.5	0.4
Fly	1.6	-	3.0	2.6	0.8	2.3	-	-	0.1	3.8	1.3
Preen	2.0	-	16.5	1	11.5	7.7	0.6	-	9.7	-	7.9
Observation bouts	6	4	6	10	6	7	4	1	4	6	8
5 second units	306	245	333	757	261	352	287	32	186	369	227

1996). The 1999-2004 bird distribution survey (Robertson *et al.* 2007) recorded pipits in diverse habitats and still within 62.5% of North I 10 km² squares, and in all of the non-pine (*Pinus* spp.) dominated central volcanic squares.

Historic information from the rhyolite-covered Volcanic Plateau suggests that pipits are less numerous than in the past. Buller (1888) described autumn flocks of 20 - 50 being common, and observed hundreds of pipits flying in front of steam trains using the Napier-Taupo line. In the 1920's Guthrie-Smith (1927) reported pipits all over his farm at Tutira, Hawkes Bay, and considered that they increased in number between 1882 and 1927 (Guthrie-Smith 1999), with hundreds flocking within the pumiceous parts. Flocks of 40 birds were seen near Taupo in the 1940's (Anon 1944). Pipits were still numerous during the 1950's when the Volcanic Plateau was still covered in fern and monono (Oliver 1955). However, in my study I found pipits were less numerous than previous records suggest, and 84.2% of sightings were individuals or pairs (n = 114) while maximum post-summer flocks averaged only 6 pipits (range 2-18, n = 19). Similar patterns are seen in other North I regions. In Northland, in 1999 - 2003, 83% of the records from 20 sites were individuals or pairs (n = 42), and post summer flocks comprised less than 9 pipits (*unpubl. data*).

The likely decrease in numbers of pipits are also indicated in low rates per kilometer in this study. Roadside counts on foot on Chatham I, through habitats similar to that described on the Volcanic Plateau prior to the 1950's (Williams & Walton 2003), detected pipits outside the flocking period at 2.4 km^{-1} (Beauchamp 2002). In contrast, I found a maximum of 1.13 pipits km^{-1} in the best remaining habitat.

Pipits are still present in small isolated patches of fern and monoao within the Volcanic Plateau pine forests (*unpubl. data*), and they disperse into some newly felled cells (< 5 year old trees) in the production forests (Stewart & Hyde 2004). Pipits comprise the 2nd most abundant avian food source of New Zealand falcons (*Falco novaeseelandiae*; Holland & McCutcheon 2007). However, the importance of pipits in the diet of falcons could be indicative of their vulnerability and habitat use (Holland & McCutcheon 2007) rather than their relative density to other birds (Stewart & Hyde 2004).

In the Snowy Mountains of Australia, pipits move from lowlands to above the winter snow line to breed during late Aug to late Sep (Norment & Green 2004). Similar habitat use is suspected to have occurred on the Kaimanawa Mountains in the 1950's. In early Mar 1957, Sibson (1959) found pipits spaced every hectare on the open Kaimanawa Mountains above *c.*1520 m. Breeding at these higher altitudes is now considered unlikely, if late summer pair presence and flocking patterns reflect the level of breeding there. On 8 Mar 2006, I found no pipits during a 5 h search of open habitats in fine weather on the Umukarikari Range, Kaimanawa Conservation Area, at the 1400 m tree-line or above

(*unpubl. data*). This mountain range is the closest to the Desert Road where flocks were present during the previous day.

The apparently stable distribution of pipits in the eastern Tongariro National Park since 1982 (E. Cooper, *pers. comm.*; Innes *et al*. 1982; Fig. 2) might suggest that the dense exotic shrublands, including heather planted there in the early 1900's (Ashdown & Lucas 1987) is not threatening pipits. However, the habitat use information in this study suggests that pipits need partially open habitats to forage and these are in decline below 1200 m on the Volcanic Plateau. Pipits seldom entered dense vegetation and the continued spread of weeds could threaten remaining open habitat. For example, broom is a substantial weed at Lake Whaiau and could easily cover the existing open sand and turf areas. Heather also forms dense cover over much of the eastern National Park and is currently establishing on the Desert Road. Other shrublands are also taking over the western areas of the plateau and if this continues then the pipit population may decline further.

ACKNOWLEDGEMENTS

I thank Evelyn Cooper and the Department of Conservation for records from Tongariro National Park. I also thank Mandy and Dave Harrey for accommodation and Karen Montford and an anonymous reviewer for helpful comments on drafts of this text.

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