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New Zealand pipit (*Anthus novaeseelandiae*) presence and breeding status using car and walk surveys near Whangarei, New Zealand

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Abstract Pipit (*Anthus novaeseelandiae*) numbers and distribution were assessed at 7 sites near Whangarei, Northland. Foot surveys located significantly more pipits than car surveys at my study site on Ormiston Road. Car-based surveys identified Ormiston Road as a pipit site 88% of the time in summer, and other subsequent car surveys recorded pipits at rates of 0.06 - 0.07 birds/km on Whangarei roads. Calling and breeding behaviours commenced in August but no fledged young were seen before January. Monitored pairs fledged between 0 and 1 young per pair between 1999-00 and 2002-03. Pipits were generally recorded during the breeding season at densities of less than 1.6 birds/km, but up to 16.7 birds/km post breeding.

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INTRODUCTION

The New Zealand pipit (*Anthus novaeseelandiae*) occurs across a range of habitats, including beaches, bracken (*Pteridium aquilinum*) fernland, shrubland in rough farmland, young pine (*Pinus* spp.) forests, wetlands, and lake margins in the North I (Beauchamp 1995, 1998). Pipits are 1 of 2 native species of passerine in New Zealand of northern hemisphere origin (Sibley & Ahlquist 1990) and predate human settlement (Worthy & Holdaway 1996). Pipits have received limited attention in New Zealand as they are considered to have a widespread international distribution and are not currently endangered (Biondi *et al.* 1995). However, Foggo *et al.* (1997) indicated that the current taxonomy of the "*novaeseelandiae*" clade needs revision, and it is possible that the New Zealand taxa may warrant specific designation although genetic analyses are so far inconclusive (Arctander *et al.* 1996; Leonovich *et al.* 1997; Higgens *et al.* 2006).

In New Zealand, pipits are potentially adapted to introduced predators and human-induced habitat changes given their assumed close phylogenetic relationships and similarities in life history traits to continental populations of congeners. However, there is limited data on the breeding biology of this species in New Zealand to back up this suggestion (McEvery 1949, 1952; Norment & Green 2004). If New Zealand pipits retain much of their adaptations to mammalian predators, one might expect to see fledging success similar to that of other species of pipits: meadow pipit (*Anthus pratensis*) in Poland at 1.9 fledglings per nest (Halupka 1998), meadow pipit,

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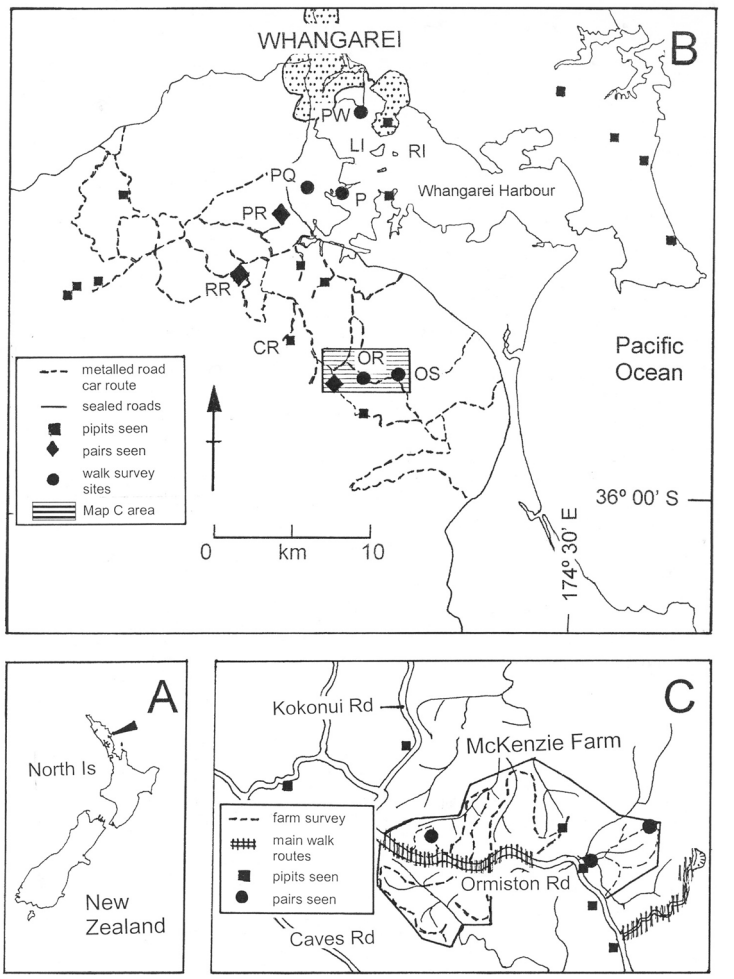

Fig. 1. Location of the 7 pipits survey sites in Northland, on the North I (arrow in A). Sites near the city of Whangarei are shown in B: 1, Port Whangarei (PW); 2, Portland Wetland (P); 3, Portland Quarry (PQ); 4, Ruarangi Road (RR); 5, Caves Road (CR); 6, Ormiston Road (OR); and 7, Ormiston Subdivision (OS). Dotted (- - -) lines are the location of the unsealed roads used in car surveys; ■ = remote pipit location. Limestone I (LI), Rat I (RI). C: Ormiston Road and Ormiston Subdivision routes. Hashed lines show route coverage.

rock pipit (*A. spinoletta*) and tree pipit (*A. trivialis*) in Britain with on average 2.2, 2.48 and 3.5 fledglings per successful nest, respectively (Rose 1982), and American pipit (*A. rubescens*) at 1.25, 2.64 and 2.43 fledglings per female per year on Baffin Island, Beartooth Plateau (Wyoming) and Guanella Pass (Colorado), respectively (Sutton & Parmelee 1954; Verbeek 1970; Conry 1978; Verbeek & Hendricks 1994).

Historically, it is likely that pipits had a more restricted distribution during stable climatic phases that favoured forest (Grant 1994, 1996), and more expansive distributions when the climate favoured tussocks and scrub (Grant 1996; Monin 2001; Worthy & Holdaway 1996, 2002). However, after the Maori arrived in New Zealand fire and climatic events probably maintained areas of permanent bracken and grassland in New Zealand (Hill 1965; Beever 1981; McGlone 2001; Williams & Walton 2003; Wilmshurst *et al.* 2004) and management of bracken fern probably favoured pipits (Worthy & Holdaway 1996; Beauchamp 2002). Pipit numbers likely increased further between 1880 and 1927 when additional forests, shrubland and fernland were converted to rough pasture (Myers 1923; Guthrie-Smith 1927, 1999). The highest recorded post-1955 interception rates recorded in a survey were 31 pipits/km in reverting farmland in South Auckland at Moumoukai (Edgar 1972).

Until the 1940s, pipits in Northland appeared to favour areas of shrubland, swampland and bare ground that were maintained by the limited drainage of swamps, poor fertility soils, the annual burning of *Danthonia* dominated pastures, and the slow development and management of dense pasture (Smallfield 1970). However, from the 1920s land improvement through aerial top dressing reduced marginal lands (Briscoe Moore 1969). By the 1980s, pipits were still widely distributed in open dry land and rough pastures in Northland, but were probably not as common as in other parts of New Zealand (Ogle 1982). Despite much of the

land being converted to forestry by 1996, pipits were still considered widespread and locally common in open country (Heather & Robertson 1996).

Recently, pipits have been found to occupy only 62% of the 10,000 m atlas squares covering the North I and that they have declined in distribution since 1979 (Robertson *et al.* 2007). In New Zealand, pipits have not been studied systematically enough to provide useful protocols on the time of year or methods for surveying population size or levels of productivity. Such methods are needed to better monitor populations and whether the declines noted to date are likely to continue.

In this study I determined the presence of pipits in 1999 and then used some of these routes to later ascertain interception rates and the usefulness of walking and car surveys to measure the presence of pipits. I also assessed the usefulness of walk surveys in defining pipit breeding status and fledging success.

METHODS

Study sites

Seven principal sites in Northland, New Zealand were used for pipit surveys. Car surveys took place along sealed roads (Fig. 1) and other sites, including those on Panekiara Road (NZMS 260, Q07 267973) and Monk Road (Q07 288940), were visited to check on the breeding status of known pairs.

Car surveys

A total of 49 car-based surveys took place on Ormiston Road during the afternoons (1300 h and 1800 h) between Feb 1999 and Feb 2003, before or after foot surveys, to assess whether car surveys could detect pipits as well as foot surveys (Table 1). The car was driven at less than 30 km per hour.

More widespread car-based surveys were conducted on 122 km of unsealed roads between 1-10 Jan in 1999 to 2002, respectively. The roads used were: Waipu Caves Road, Ormiston Road, Mangapai Caves Road, Roundtree Road, Ngatoka Road, Graham Road, Ruarangi Road, North Road, Waikiekie Road, Springfield Road, Whittle Road, Knagg Road, Kukunui Road, Monk Road, Ormandy Road, Panekaira Road, Haward Road, O'Carroll Road, Old School Road, Porter Road, Bint Road, Snooks Road, Codlin Road and Otuhi Road (Fig. 1). Surveys took place between 1300 h and 1630 h in fine weather. The car was stopped when a pipit was seen to verify a sighting. On each occasion I attempted to check the pipit's age class (adult or sub-adult, as defined by Oliver 1955) and searched for other pipits within 100 m of the sighted bird. I defined pipit sites as being within a valley, or on spurs, ridges or saddles.

Table 1. The percent (%) of car surveys on Omiston Road in which at least 1 pipit was detected in relation to habitat category and season.

Season	No. surveys	Habitat category			
		Road	Paddock	Air	Tree or post
Summer	18	78	17	44	72
Autumn	13	54	23	23	46
Winter	8	25	63	38	50
Spring	14	71	21	43	36

Table 2. Pipit detections on Ormiston Road between Jan 1999 - Jan 2003.

Season	No. counts	By car		By walk	
		Mean	*SD*	Mean	*SD*
Summer	15	2.3	1.7	4.4	2.3
Autumn	13	1.4	1.7	1.9	1.0
Winter	8	0.8	1.2	3.0	1.9
Spring	13	1.8	1.9	3.2	2.5

Walking surveys

Walk surveys were conducted during all seasons along unsealed roads and dirt tracks along 4 main routes, Ormiston Road, Ormiston subdivision, Port Whangarei and Portland Wetland, as well as less frequently at other sites. The habitat at the point of detection was recorded for each bird seen within 30 m of the route. Each bird was observed for 5-15 minutes, to define its residency and breeding status, describe calls and ascertain its age class (adult, sub-adult or dependent juvenile). The residency status of pipits was checked using a tape of *..tjwsee…* and *…tjwsit..* calls, and resident pipits were defined as those that flew towards the tape or started search behaviours for intruders within 10 m of the tape recorder. The routes taken by each pipit were mapped and care was taken to not count birds twice.

Tail length was used to define the age of young pipits, and all young were followed for 30-90 minutes to assess the number of siblings and to ascertain if both parents were feeding them. Breeding was deemed successful when young had tails over two-thirds of full adult length, as this was the time that they left the natal area.

Invertebrates held by pipits in their bills during the breeding season and when giving *…tjwsee..* calls from fence posts and banks were identified. The period of availability of some of these invertebrates was assessed along Ormiston Road between Dec 2001 and Feb 2003.

Table 3. Number of pipits located during car surveys of 122 km of roads outside and within Ormiston Road, Jan 1999 to Jan 2002.

Year	Outside site			Within site
	total	pairs	trios	total
1999	9	1	0	1
2000	7	1	0	2
2001	8	1	1	2
2002	7	1	1	3

RESULTS

Car surveys

At least 1 pipit was first detected on the road surface 78%, 54%, 25% and 71% of summer, autumn, winter and spring foot surveys, respectively, along Ormiston Road (Table 1). Surveys from the car before or after these foot surveys recorded pipit presence 88%, 66%, 43% and 90% of the time during these seasons. The average car count of 1.74 (*SD* = 1.76) pipits per survey was significantly lower than the 3.23 (*SD* = 2.36) during foot surveys (t = -6.008, df = 51, $P < 0.0005$; Table 2).

Car-based surveys of 122 km of road through farmland near Whangarei during Jan 1999-2002 inclusive (Fig. 1) located pipits at 15 locations and 6 of these locations were identified as occupied by pipits in consecutive years. The route comprised 49.5% valley and 50.5% spur/ridgeline habitats, and significantly more pipit detections occurred on spurs/ridgelines (χ^2 = 9.94, df = 1, $P < 0.05$). Surveys gave an interception rate of 0.06-0.07 pipits per km (Table 3).

Foot surveys

Pipits were first detected visually significantly more frequently than they were heard (χ^2 = 174.7, df. = 1, $P < 0.0001$) and only an average of 1.4% (*SD* = 1.5, n = 7) of birds that were heard were not seen subsequently. The average detection of pipits per km varied significantly between the walked sites (single factor ANOVA: $F_{1, 6}$ = 37.14, P = 0.005; Table 4). The Ormiston rural ridgeline sites and the Portland quarry site were occupied permanently, while the other sites were used intermittently as habitats became available (Table 4).

Ormiston Road had significantly fewer pipits per kilometre than Ormiston subdivision (unequal variance; t = -8.48, df = 39, $P < 0.0005$). The seasonal encounter rates at Ormiston Road (Kruskal Wallis 1-way ANOVA of ranks: H = 9.65, df = 3, $P < 0.022$) and Ormiston subdivision (Kruskal Wallis 1-way ANOVA: H = 10.9, df = 3, $P < 0.012$) also differed significantly (Table 5). The highest counts were associated with pairing in early spring, and flocking after breeding. At both Ormiston sites some breeding home ranges were occupied by at least 1 bird throughout the year, but tape use could not verify residency status outside the breeding season (Table 6). Pipits averaged between 7 and 20% of the passerine fauna at the sites where pipits were detected all year (Table 4).

The changes in numbers at Port Whangarei and Portland wetland were more closely aligned with the creation and then loss of open habitat. At Portland the numbers seen in Jun 1999-Dec 2000 (mean = 1.76, *SD* = 0.52, n = 13 counts) declined significantly by Jun 2001-Dec 2002 (mean = 0.30, *SD* = 0.15, n = 10; unequal variance t = 3.26, df = 27, $P <$ 0.003). This decline coincided with the revegetation of the clay cap on a dump site. Similarly, at Port Whangarei numbers increased significantly after March 2001 (unequal variance t = 2.42, df = 18, P = 0.026) when pipits occupied newly created open mud on a settlement pond.

Pipits were detected within the habitats surrounding Caves Road intermittently in all seasons. Ruarangi Road was only occupied in summer (Table 4).

Vocalisations, pairs and breeding patterns

The long-distance communication *..tzree..* call (Secker 1955) occurred throughout the year (range = 40 - 71% of detections per month, n = 43), but was most frequent during Apr - Jul (Table 7). Pairs were detected at Ormiston Road, Ormiston Subdivision, Portland Quarry, Port Whangarei and Panekaira Road. Pipits gave courtship song (n = 13 occasions) and courtship arch displays (n = 6 occasions) in flight from late Aug to early Feb (Table 4 & 7). All courtship arch displays were seen at the Ormiston sites and courtship song was also recorded at Caves Road, Portland Wetland and the Portland Quarry.

Throughout Dec and Jan, pipits gave *..tjwsee..* and *..tjwsit..* calls while holding common copper butterflies (*Lycaena salustius*), large flies, grass cicadas (*Kikihia* spp.) and locusts (*Locusta migratoria*) in their bills. The invertebrates displayed were available over long periods and their numbers peaked at Ormiston Road during the post fledging period (Table 8).

Young pipits were only detected with parents near the Ormiston Road and at the Ormiston subdivision sites, and all were seen between late Dec and early Mar. Sight recovery of sub-adults also took place at Port Whangarei, and Monk Road in Mar but these could have been birds raised at other sites. The overall breeding success of the pairs monitored in the rural environment in the 5 seasons 1998-99 to 2002-03, was conservatively estimated as: 0 (n = 3), 0.42 (n = 7), 0.66 (n = 3), 0.42 (n = 7) and 1.00 (n = 3) young per pair, respectively.

Pipits did not form flocks at the end of the breeding season at all sites (Table 4). The maximum

Table 4. The detection of pipits during walk counts at 7 Northland sites.

Attribute	Walk survey route						
	Ormiston Road	Ormiston Subdivision	Portland	Portland Quarry	Port Whangarei	Ruarangi Road	Caves Road
Wallk surveys (*n*)	53	44	35	8	34	13	23
Survey period	Jan 99-Feb 03	Oct 99-Dec 02	Jun 99-Feb 03	Oct 99-Jan 02	Jan 99-Dec 02	Jan 99-Jan 02	Jan 99-Dec 01
Distance (km)	2.1	0.9	1.1	2.8	3.6	0.3	0.2
Pipit detections	150	244	48	75	59	5	11
Surveys where ≥ 1 pipit(s) detected (%)	82.5	100	69.5	100	70.1	12.5	29.0
Detections where pipits 1st seen (%)	79	72	93	78	62	80	80
Detections where pipits heard but not seen (%)	3	3	0	3	1	0	0
Pipits detected per km (mean, *SD*)	1.6, 1.0	6.9, 3.4	1.2, 1.5	3.4, 1.2	0.5, 0.5	0.4, 0.7	0.5, 0.9
Months with courtship calls, arch displays and partner protection	Feb 99, Aug 99, Oct 99, Dec 00, Jan 01, Dec 01, Jan 02, Dec 02	Dec 99, Jan 00, Sep 00, Oct 01, Nov 01, Sep 02, Dec 02	Jan 02	Jan 02	Aug 01, Jun 02	-	-
Months young pipits detected	Feb 02	Mar 00, Jan 01, Feb 02		Feb 00, Mar 01	Jan 02	-	-
Months pipits displayed with food in bill	Aug 99, Dec 00, Jan 01, Jan 02	Dec 99, Jan 02	Dec 02	-	-	-	Jan-99
Post breeding maximum flock size	5	11	7	0	3	0	0
Percent of passerine detections that were pipits between Jan 1999 and Dec 2001 (mean, *SD*, *n*)	7.0, 8.2, 13	20.7, 8.2, 13	1.0, 0.9, 9	18.6, 4.3, 4	1.0, 0.9, 9	4.3, 7.7, 12	11.6, 23.9, 23

size of mixed age flocks was 11 at Ormiston subdivision on 12 Mar 2000.

DISCUSSION

Survey method and indices

Pipits congregate on open and sparsely vegetated habitats, including roads, throughout New Zealand (Beauchamp 2009). Car surveys are potentially useful when surveying large distances to find pipit concentrations. Car surveys identified the 2.1 km section of Ormiston Road as occupied (at an average walk count of 3.2-4.6 pipit) 88-90% of the time in spring-summer, indicating that this is the best time for surveys. More widespread surveys also located other areas as occupied by pipits over multiple years. However, my surveys indicate that at known sites, repeated walk surveys were more likely to locate significantly more birds, and gather information on the breeding status of birds at the site.

Abundance indices

Heather & Robertson (1996) considered pipits were still widespread and locally common in open country in Northland, and the central hill country, but not in Wellington. However, there is currently limited data on the abundance of pipits relative to other species in New Zealand and various indices have been used in the past to estimate abundance.

In this study, pipits at 7 sites comprised an average of between 0.7% and 20.7% of the land birds counted during any survey, while on the Wellington coastlines they were between 0% and 55% of the land birds counted (*unpubl. data*).

In this study, 90% of the detections were individuals and pairs and only 1 flock exceeded 8 birds. At 22 other Northland sites, during 1999 - 2003, 83 % (n = 42) of observations were individuals or pairs, and all flocks were less than

Table 5. Pipits counted per walk survey at the Ormiston sites in each season.

	Ormiston Road				Ormiston Subdivision			
	mean	*SD*	range	*n*	mean	*SD*	range	*n*
Spring	3.2	0.6	0 - 7	17	4.6	0.6	1 - 7	10
Summer	4.6	0.6	1 - 10	16	8.0	0.8	4 - 13	15
Autumn	1.9	0.3	0 - 3	13	6.7	1.0	2 - 15	12
Winter	3.0	0.6	0 - 6	8	3.7	1.0	1 - 7	6

Table 6. Pipit breeding habitat use at the Ormiston sites, Dec 1998 – Feb 2003.

	Ormiston Road					Ormiston subdivision			
	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	1999-2000	2000-2001	2001-2002	2002-2003
Pair home ranges occupied in winter	-	1	1	1	1	-	3	2	2
Pipits seeking partners in spring **	-	5	0	1	1	3	3	2	1
Pair home ranges in breeding season *	2	2	1	2*	1*	5	2	4*	2*
Known young pipits fledged	0	0	0	0	0	3	2	3	3
Pipits seeking partners in summer **	1	1	3	2	2	4	3	3	2
Maximum number of independent young seen	0	2	1	1	0	5	2	5	3

**, minimum number as indicated by ..*tjwee*.. and ..*tjwit*.. calls ;*, as checked by response to ..*tjwsee*.. and ..*tjwsit*.. taped calls.

9 pipits (*unpubl. data*). On the roads of the Central Volcanic Plateau, single birds and pairs were also most frequently detected (82%) and maximum post summer flock sizes averaged 6 pipits (Beauchamp 2009).

Another index used to assess status of pipits is the interception rates per km (Beauchamp 1995, 1998). In this study, the interception rates averaged between 0.4 - 6.9 birds per km and the highest interception rate for any count was 16.7 birds per km at the Ormiston Subdivision site. Interception rates on central Volcanic Plateau roads averaged between 0.7 and 1.1 pipits per km (Beauchamp 2009). Counts along the Northland west coast beaches during 1999 - 2000 gave interception rates between 0.2 - 0.6 pipits per km (P. Smith & Beauchamp, *unpubl. data*; Parrish 2002). These Northland interception rates were not greatly different from those in Wellington on the Eastbourne Coast Road (mean = 1.1, *SD* = 0.3, range = 0.7 - 1.4, *n* = 6) and between Owhiro Bay and Sinclair Head (mean = 1.2, *SD* = 1.1, range = 0 - 2.5, *n* = 4) between May 1999 and Jun 2000 (*unpubl. data*).

The results of this study suggest that pipits are generally no more common in the habitats near Whangarei than at some other regions in New Zealand.

Habitat use

Pipits appear to be fairly mobile and appeared to quickly find suitable habitat when it was created. Other pipits occupied breeding areas and grazed pasture sites throughout the year. Occupancy in other habitats was confined to areas which had substantial bare ground, low stature plants and low cropped vegetation. These habitats or sites were deserted or used less frequently after they became overgrown. Bare ground generally did not persist for more than 2 years without erosion, flooding, salt spray, herbicide use or other management that destroyed introduced weeds (Beauchamp & Parrish 1999).

Breeding period and productivity

The pairing and breeding calls recognised in pipits at Whangarei were similar to those previously identified by Secker (1955) in Wellington, and on Kapiti I (Wilkinson & Wilkinson 1952; Wilkinson 1957).

In the 1940s on Kapiti I, breeding began in Sep and lasted 6 - 7 months (Wilkinson 1957). In the Wairarapa, Stidolph (1971) found clutches were laid between Sep and Dec. Guthrie-Smith (1927) reported that pipits at Tutira, Hawkes Bay, could breed from Aug, however, nests were more common in late summer and early autumn than spring. In this study, walk surveys of breeding sites recorded courtship behaviours in Aug but successful fledging was not detected until Dec, and generally not until Feb - Mar.

Table 7. Number of adult pipits per survey and the proportion giving calls and undertaking courtship behaviours at the Ormiston Road and Ormiston Subdivision sites between Jan 1999 - Dec 2002.

Month	No. walk surveys	Total adults detected	Mate attraction & courtship calls				Home range defence, courtship & pair behaviours			
			tzree	*tjwsee*	*tjwsit*	*tzjueeoot*	Pair circling	Arch flight	Flight chase	Food in bill
Jan	10	78	0.004	0.019	0.013	0.003	0	0.001	0.004	0.004
Feb	6	38	0.009	0.013	0.022	0.004	0	0.004	0.013	0
Mar	7	48	0.015	0	0	0	0	0	0.003	0
Apr	9	20	0.044	0	0	0	0	0	0.006	0
May	6	15	0.078	0	0	0	0	0	0.011	0
Jun	3	7	0.238	0	0.048	0	0	0	0.095	0
Jul	8	27	0.051	0.005	0.009	0	0	0	0	0
Aug	3	12	0.056	0.139	0	0.028	0	0	0.028	0
Sep	10	29	0.017	0.021	0.014	0.003	0.003	0.003	0	0
Oct	9	38	0.012	0.026	0.018	0	0.003	0.003	0.003	0
Nov	6	27	0.043	0.031	0.037	0.019	0	0.006	0.012	0
Dec	10	52	0.013	0.025	0.013	0.002	0	0	0	0.010

Table 8. Presence on Ormiston Road of the flying insects that were held in the bills of calling pipits.

Month	Blue & copper butterflies	Grass moths (Crambidae)	Large flies	Locusts
Dec 2001	0	0	3	0
Jan 2002	0	0	40	0
Feb 2002	0	8	46	0
Mar 2002	87	0	17	1
Apr 2002	110	0	24	0
May 2002	0	0	2	0
Jun 2002 *	0	0	0	1
Jul 2002	0	0	0	0
Sep 2002	2	0	1	2
Oct 2002	0	0	0	0
Dec 2002 *	4	0	19	1
Jan 2003	4	0	28	0
Feb 2003	0	5	119	0

* road margins and clover sprayed

In Australia, Norment & Green (2004) found that 54% of nests of *A. novaeseelandiae* in the upper alpine areas of the Snowy Mountains fledged an average of 1.43 young from 37 successful nests. In this study, I did not attempt to find nests. However, if I assumed that all the pairs attempted to nest at least once, and that only 8 (34%) of the 23 pairs monitored fledged any young, then the productivity per pair found in this study appeared to be lower than that in Australia and other countries.

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