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## COMPARATIVE ECOLOGY OF TWO *OLIGOSOMA* SKINKS IN COASTAL CANTERBURY: A CONTRAST WITH CENTRAL OTAGO

**Summary:** Baited pitfall traps were used to sample *Oligosoma maccanni* and *Oligosoma nigriplantare polychroma* at Birdlings Flat, on Kaitorete Spit, Canterbury, New Zealand. The two species of skink showed distinctive patterns of habitat use with *O. maccanni* being almost entirely confined to dunelands while *O. n. polychroma* was invariably captured in the shrub-covered terraces behind the dunes. This is in direct contrast to what has been documented for these species in central Otago. Habitat partitioning appears to have also influenced the patterning and colouration of the two species which is also opposite to what has been documented for these species in Central Otago. Other factors examined did not show the same degree of deviation from what has been documented for these species elsewhere. The Birdlings Flat populations of *O. maccanni* and *O. n. polychroma* are diurnally active summer breeders, and dietary generalists.

**Keywords:** skinks; *Oligosoma maccanni*; *Oligosoma nigriplantare polychroma*; population biology; habitat use; diet; activity; Canterbury.

### Introduction

In 1990 the common skink (*Leiolopisma nigriplantare maccanni*) as it was then known was reclassified into four species (*L. maccanni*, *L. microlepis*, *L. notasaurus*, *L. inconspicuum*) and one subspecies (*L. nigriplantare polychroma*) (Patterson and Daugherty, 1990). This division was carried out largely on the basis of allozyme electrophoresis, morphology and the ecology of populations in central Otago, Stewart Island and the central North Island. In 1995 all New Zealand *Leiolopisma* were referred to the resurrected genus *Oligosoma* (Patterson and Daugherty, 1995).

Discrimination between species in this taxa using colouration and patterning (particularly between *O. n. polychroma*, *O. maccanni*, *O. inconspicuum*) is difficult because of the general morphological similarity and intraspecific colour polymorphism within and between locations (Patterson and Daugherty, 1990; pers. obs.). This extensive variation precludes the construction of a key based on colour and morphology. As a result of this ecological analysis of sympatric species is needed to see if habitat and other ecological partitioning occurs in conjunction with

differentiation in colour and patterning (Daugherty *et. al.*, 1990).

This study investigated a number of ecological factors associated with two "common" skink species (*Oligosoma maccanni* and *Oligosoma nigriplantare polychroma*) present at Birdlings Flat on Kaitorete Spit, Canterbury. The object was to determine if their population density, habitat use, diurnal activity patterns and diet were comparable to those of the populations used in the original description of these new species, particularly populations in Central Otago. There, *O. maccanni* was predominantly found amongst herbs, shrubs and rock outcrops while *O. n. polychroma* tended to be an inhabitant of tussock grassland (Patterson, 1992). It was concluded by Patterson (1992) that microhabitat use and to a lesser degree diet (prey size and taxa) were the most important factors separating these two species in the field.

The populations at Birdlings Flat were chosen for two reasons; this area was thought to have a high density of both species and individual lizards from Birdlings Flat had been used in the original analysis by Patterson and Daugherty (1990). The latter point is important as it meant that the taxonomic identity of the two cryptic species at this site was known.

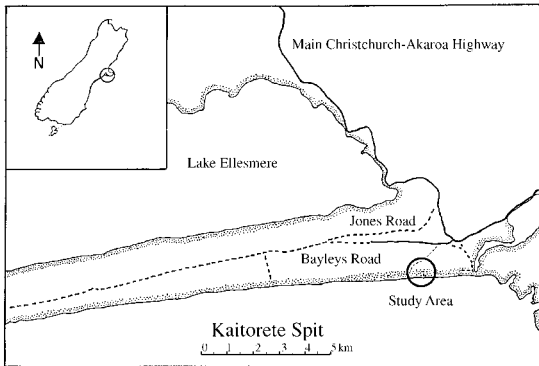


Figure 1: Location of study area on Kaitorete Spit.

### Study Area

Kaitorete Spit is a narrow strip of land which extends for 28 km in an east - west direction, south of Banks Peninsula, Canterbury (Fig. 1). It is a barrier beach that has been formed by deposition and subsequent long shore drift of river gravels. Most of the width of the Spit is made up of shingle terraces dominated by pasture interspersed with areas of scrub. Shrub species present on the terrace ridges include *Coprosma propinqua*, *Meliclytus alpinus*, *Muehlenbeckia complexa*, *Rubrus squarrosus*, *Discaria toumatou* and occasionally *Carmichaelia violacea* (Wardle, 1991). Interspersed with the scrub vegetation are herbaceous species such as *Asplenium flabellifolium*, *Haloragis erecta*, *Einada allanii*, *Oxalis exilis*, *Geranium microphyllum* and the grasses *Stipa nodosa*, *Rytidosperma* sp, *Holcus lanatus* and *Dactylus glomeratus* (Wardle, 1991).

Seaward of the terraces are a series of parallel dune ridges which flatten into foredunes before descending on to a steep shingle beach. The dunes are dominated by the native sandbinder pingao (*Desmoschoenus spiralis*). A large area of introduced marram grass (*Ammophila arenaria*) is present at the eastern end of the Spit, with other smaller colonies elsewhere on the Spit. The study area at the base of the Spit, near the township of Birdlings Flat, encompassed both shrub and dune habitat types.

There are four species of lizard present on Kaitorete Spit; *O. maccanni*, *O. n. polychroma* and *O. lineoocellatum* and the gecko *Hoplodactylus maculatus*. All four species were recorded in the study area at Birdlings Flat.

## Methods

### Habitat Use, Body Size and Sex Ratios

The lizard populations were sampled using pitfall traps made from plastic containers 170 mm by 170 mm by 190 mm. Each was buried so that the bottom of two lids (separated by a 10 mm piece of wood) was at ground level. This lower lid had a hole that enabled lizards to gain access to bait placed at the bottom of the trap. The top lid was intact and protected animals caught from predation and weather. When not in use lids were removed and sticks left in the traps to enable captured lizards to climb out.

Because the initial trap layout did not sample *O. n. polychroma* habitat the number and layout of traps was adjusted during the first field season from 60 in three 4x5 grids to 90 in six 3x5 grids. Ten metres separated the trap lines laterally while there was a five metre gap between individual traps longitudinally. Trapping was undertaken from November to March in 1991-1992 and 1992-1993. At the beginning of each trapping session the traps were baited with 1cm cubes of tinned pears (Whitaker, 1967). Meat-based lizard baits (cf. Southey, 1985) were not used to avoid attracting predators to the traps.

All lizards captured were permanently marked with an individual toeclip combination. No more than a single toe was removed from any foot, with up to three toes being removed when necessary. Natural toe loss, which was common, was integrated in to the system to avoid removing toes unnecessarily. Species, trap location, snout vent length (SVL; measured to the nearest 1 mm) and weight to the nearest 0.1 g were noted. Mature males were identified by averting the hemipenes, mature females were assumed to be those lizards without hemipenes that had a SVL longer than the smallest gravid female. Once all this information had been recorded lizards were released beside the trap in which they had been captured.

### Population Density

The density of the most abundant species, *O. maccanni*, was calculated using a 'removal sampling' method. This method is used as an alternative to mark-recapture sampling to estimate the size of a closed population (Manly, 1992). It was modified for the present study in that the animals were not physically removed from the study area.

Instead, individuals were marked on the first capture and subsequently ignored if recaptured. Data from the period 28 Jan -10 March 1993 were chosen for analysis as these had the highest and lowest capture rates and thus were assumed to provide an upper and lower value for population density. Lizards captured before this period and subsequently recaptured during the census period were assumed to be 'new' for the purposes of estimating density.

### Activity

Diurnal activity was assessed on the second day of each field session during the 1992/93 field season to compare the diurnal activity patterns of the two skink species. The pitfall traps were checked five times a day at 3 h intervals, starting at dawn and ending at dusk ('time since sunrise'; Pianka, 1973). Catch rates were assumed to be correlated with lizard foraging. This is a reasonable assumption as both species are 'widely foraging' rather than 'sit and wait predators' (pers. obs.).

### Diet

Faecal pellet analysis was used to compare the diets of *O. maccanni* and *O. n. polychroma*. While this method is less accurate than stomach contents analysis this avoids the need to kill animals. Faecal pellets were collected from lizards that defecated while being measured or while they were held captive overnight. Because of small sample sizes the results from the 1991/92 and 1992/93 seasons were combined.

Pellets were stored in 70 % ethanol for later analysis. In the laboratory samples were teased apart under a binocular microscope at 20x and 40x magnification. Arthropod prey items were identified to at least ordinal level. The number of each prey type per pellet was estimated by counting specific body parts that belonged to individual animals. Where there was doubt over the exact number of prey items the lowest estimate was used.

Food availability at the study site was assessed in the 1992-1993 field season using pitfall and yellow pantraps. Two insect traps were placed in each of the six trap grids (total 12) for a period of three weeks in November-December 1992 and two weeks in February-March 1993. The insect traps were filled initially with ethyl glycol and later with a combination of alcohol, water and detergent. The arthropods collected were identified and counted.

## Results

### Population Size, Sex Ratios and age of Maturity

A total of 574 lizards were captured in the pitfall traps. By far the most common species captured was *O. maccanni* (n=510) followed by *O. n. polychroma* (n=54) and *H. maculatus* (n=10). No *O. lineocellatum* were captured. Forty percent (n=203) of *O. maccanni* were recaptured at least once, whereas only 4 % (n=2) of *O. n. polychroma* were recaptured. No *H. maculatus* were recaptured.

The heaviest skinks tended to be gravid females so the maximum SVL did not necessarily equate with the heaviest animal. For example, the heaviest *O. maccanni* (4.5 g) was a gravid female with a SVL of 60 mm. Most *O. maccanni* (75 %; n=12) which weighed over 4g were gravid females. The heaviest *O. n. polychroma* (5.3 g) was a male of 66 mm SVL.

The size at which *O. maccanni* and *O. n. polychroma* on Birdlings Flat become sexually mature can be estimated from the size of the smallest gravid female captured (Table 1). For *O. maccanni* this was 49 mm (from 45 gravid females) and for *O. n. polychroma* 63 mm (from 3 gravid females). In the summer of 1991/92 the last gravid individual to be captured was on 18 December, and on 8 January seven females were captured which had previously been gravid but no longer were. Similarly, in the summer of 1992/93 the last gravid individual to be captured was on 8 January, and on 28 January four individuals were captured which had previously been gravid. The smallest *O. maccanni* (27-28 mm SVL) were captured in mid January in the 1991/92 season and in mid February in the 1992/93 season.

These were obviously newborn because of their small size and lack of scaring and skin wear obvious in older animals. The three gravid *O. n. polychroma* were all captured on 12 November and none were subsequently recaptured. The smallest *O. n. polychroma* (31 mm SVL) captured during the 1991/92 season were present in traps on

Table 1: *Snout vent length (SVL) of O. maccanni and O. n. polychroma captured in traps and by hand.*

Species	Min-Max SVL (mm)	Adult Range (mm)	Adult Mean	s.e.	n
<i>O. maccanni</i>	27-65	49-65	54.5	3.5	259
<i>O. n. polychroma</i>	31-66	50-66	58.0	4.2	45

Table 2: *Habitat utilisation by the three species as indicated by lizard pitfall trap captures per 100 trap nights.*

Habitat	Trap Grids	<i>O.maccanni</i>	<i>O.n.polychroma</i>
Duneland	1	29	0
	2	31	0
	3	26	0
	4	41	0
	5	25	0.4
Shrubland	6	2	7
	7	1	11
	8	0	3
	9	0.4	7
	10	0.8	3

23 January. During the 1992/93 field season one *O. n. polychroma* that appeared to be young of that year (31 mm SVL) was captured on 18 February.

To calculate sex ratios for *O. maccanni*, only individuals the same size or larger than the smallest gravid female were counted. Lizards below this size were assumed to be immatures. As only three gravid *O. n. polychroma* were captured, animals with SVL of 50 mm or larger were used for the purposes of sex ratio calculation. This is the length at which Barwick (1959) suggests this species becomes mature. The sex ratio of *O. maccanni* captured in pitfall traps was 1 : 1.2 (123 males, 141 females). The sex ratio of *O. n. polychroma* captured was 1 : 2.3 (12 males, 27 females).

Removal method density estimates for *O. maccanni* varied between 1050 ha<sup>-1</sup> (0.105 m<sup>-2</sup>) and 1850 ha<sup>-1</sup> (0.185 m<sup>-2</sup>). Because of the small sample size and lack of recaptures for *O. n. polychroma*, the only practical way of calculating population density for *O. n. polychroma* was by the minimum alive method (the total number of individual animals captured in an area, in this case the trap grid, over a defined period of time (Hitchmough, 1982; Southey, 1985). This method assumes that the individuals captured at the start of the period were still alive at the end of the trap period. Data from the 1992/93 field season, which had the highest and lowest catches of *O. n. polychroma* (16 vs. 8, respectively) gave density estimates for this species of between 200 ha<sup>-1</sup> and 400 ha<sup>-1</sup> (0.02 m<sup>-2</sup> and 0.04 m<sup>-2</sup>) in the shrubland grids.

### Habitat Use

Most (504/510) *O. maccanni* were captured in duneland, whereas most *O. n. polychroma* (53/54) were captured in shrubland. When the figures are adjusted to compensate for differences in trap effort (by calculating the number of lizards captured per

Table 3: *Number of O. maccanni and O. n. polychroma captured for each time period.*

Species	Hours after sunrise				
	0-3	3-6	6-9	9-12	12-15
<i>O. maccanni</i>	25	34	11	13	0
<i>O. n. polychroma</i>	0	6	9	2	0

100 trap nights; Table 3), the data show a significant difference in habitat use between the two morphologically similar *Oligosoma* (Mann-Whitney test for the effect of habitat on relative numbers of the two species; P=0.012; n=10).

### Diurnal Activity Patterns

A total of 83 *O. maccanni* and 17 *O. n. polychroma* were captured over the period that activity patterns were examined. All of the *O. maccanni* captured were in the dunelands and all of the *O. n. polychroma* captured were in the shrublands. Diurnal activity patterns of the two species at Birdlings Flat differed significantly ( $\chi^2 = 16.5$ , d.f.=3, p<0.001) (Table 4). *O. maccanni* were active earlier in the day than *O. n. polychroma* with 71 % of captures occurring in the first six hours after sunrise. In contrast, most *O. n. polychroma* (53 %) were captured in the middle of the day, peak activity for this species occurring 6-9 h after sunrise as opposed to 3-6 h for *O. maccanni*.

### Diet

Dipteran parts were the most frequently found items in *O. maccanni* pellets. They occurred in 69 % of 29 pellets, and made up 63 % of the 205 items collected from *O. maccanni* pellets (Table 4).

The most frequently found items in *O. n. polychroma* faecal pellets were Araneae (70 % of 10 pellets). However, the highest proportion of items found in this species' pellets were Diptera (n=17, 43 % of total). Other prominent food items included Hemiptera and Araneae (in *O. maccanni*), Hemiptera and unidentified arthropod eggs (in *O. n. polychroma*). Plant matter other than fruit was present in many pellets but was not considered as a food item as it was probably ingested accidentally by the lizards as they caught and swallowed prey items. Similarly, a high proportion of pellets from *O. maccanni* (62 %) and *O. n. polychroma* (50 %) had sand in them.

The most obvious difference in the diets is the relative importance of Diptera and Hemiptera.

For *O. maccanni* these two groups make up 74 % of the total items identified while for *O. n. polychroma* the combined total is only 48 %. In comparison, spiders made up 18 % of the items identified for *O. n. polychroma* and only 7 % for *O. maccanni*. Arachnida as a whole made up 21 % of items collected from *O. n. polychroma* as opposed to 11.5 % for *O. maccanni*. Two other important differences were unidentified arthropod eggs which made up 18 % of the items found in *O. n. polychroma* pellets but only 3 % in *O. maccanni*, and fruit which did not feature at all in the pellets of *O. maccanni* but made up 8 % of items in *O. n. polychroma* pellets. All fruits were from *C. propinqua*.

A comparison of the items found in the lizard pellets with those potential prey items captured in the insect traps indicates that some selective foraging is taking place. The most extreme example was the complete absence of collembola from *O. n. polychroma* faecal pellets. Collembola were very abundant in the shrublands. For example, one trap had over 10 000 individuals. Another example of negative selection was the low value for lepidoptera (0.5 %) in *O. maccanni* faecal pellets compared to the value for this group in the duneland insect traps (12 %). Similarly, Hemiptera (11 %), Lepidoptera (3 %) and Acarina (3 %) were under represented in *O. n. polychroma* faecal pellets compared with the density of these groups as indicated by insect traps in the shrublands.

Table 4: Percentage occurrence and number of food items in faecal pellets of *O. maccanni* ( $n=29$ ) and *O. n. polychroma* ( $n=10$ ).

Food Item	<i>O.maccanni</i>		<i>O.n.polychroma</i>	
	%	No.	%	No
Insecta				
Diptera	69	130	50	17
Hemiptera	41	22	20	2
Coleoptera	24	7	-	-
Hymenoptera	17	12	-	-
Lepidoptera	3	1	10	1
Orthoptera	-	-	10	1
Dermaptera	-	-	10	1
Collembola	3	1	-	-
Unid. Larvae	3	1	-	-
Arachnida				
Araneae	41	14	70	7
Acarina	3	1	10	1
Pseudoscorpiones	24	9	-	-
Arthropoda				
Unid. cocoons	3	3	-	-
Unid. eggs	7	4	20	7
Vegetation	14	-	20	7
Fruit	-	-	20	3

For two groups this trend is reversed. *O. maccanni* appeared to preferentially select Hemiptera as they made up 11 % of items in faecal pellets whereas they made up < 1 % of the items caught in insect traps. Similarly, spiders appear to be preferentially selected by *O. n. polychroma* as they comprised 18 % of items in faecal pellets but only 5 % of prey items collected in insect traps.

## Discussion

### Growth and Reproduction

The smallest *O. maccanni*, which were the young of their respective years, had SVLs ranging from 25 mm to 35 mm. Animals in their second year had SVLs of 41 mm to 48 mm. Above this age, overlap between adjacent age classes made definition of cohorts impossible. For *O. n. polychroma* the smallest cohorts had a SVL of 31 mm and 36 mm SVL in their respective years. However, the next cohort of lizards, starting at 54 mm SVL, may not have been animals in their second year. Barwick (1959) found that *O. n. polychroma* reached an adult size of 50 mm SVL during their second summer. If this was the case for *O. n. polychroma* at Birdlings Flat one would expect there to be more animals between 50 mm and 54 mm SVL captured during the month of February. Both *O. maccanni* and *O. n. polychroma* are summer breeders. In Central Otago young of both species are born in January and February (Patterson and Daugherty, 1990), and in the south of the North Island (Wellington and Manawatu) young of *O. n. polychroma* were produced in January (Barwick, 1959; Gill, 1976). Morris (1974) found that *O. zealandica* (*O. maccanni*) from Kaitorete Spit give birth from the first week in December through to February with most new-born lizards appearing late December to early January. In the present study *O. maccanni* gave birth between mid December and late January while *O. n. polychroma* appeared to give birth between late January and early February.

### Population Density

The density estimates for *O. maccanni* (1050 ha<sup>-1</sup> to 1850 ha<sup>-1</sup>) are in contrast to that made for a population of *O. maccanni* in central Otago of 15 ha<sup>-1</sup> before parturition and approximately 26 ha<sup>-1</sup> after all juveniles had appeared. However, the density estimate is similar to that found for other

'common' skink species in New Zealand. For example, Porter (1987) estimated the maximum density of *Cyclodina aenea* as 1111 ha<sup>-1</sup> in an area of open grassland and rock in Auckland City.

The density of *O. n. polychroma* varied between 200 ha<sup>-1</sup> and 400 ha<sup>-1</sup> in the shrublands. This density is considerably less than that calculated for this species at Pukerua Bay (4919 ha<sup>-1</sup>) (Towns and Elliott, 1996) and a Wellington cemetery (2200 ha<sup>-1</sup>) (Barwick, 1959). General observations support this density estimate; *O. n. polychroma* never appeared to be common and was certainly at a far lower density than *O. maccanni* in the dunelands. It is not known why this species should be at such a low density. At Pukerua Bay, *O. n. polychroma* is present in high numbers in habitat similar to that at Kaitorete Spit, old beach terraces covered with *C. propinqua* and *M. complexa* (Towns and Elliott, 1996). The low density would not appear to result from competition with *O. maccanni*, as this species was at such a low density (25 - 50 ha<sup>-1</sup>) in the shrublands that it seems unlikely that it could have a major impact on *O. n. polychroma*.

*O. n. polychroma* at Pukerua Bay share their coastal habitat with four other species, none of which appear to have affected *O. n. polychroma* greatly as it is the most common species at that site (Towns and Elliott, 1996).

Patterson (1985) suggested that the removal method was unsuitable for calculating the density of *O. maccanni* in central Otago as consecutive captures were seldom in the same trap and the population did not appear to be closed. This was not the case at Birdlings Flat where 60 % of *O. maccanni* recaptures during the period when density estimates were calculated were captured in the same trap consecutively while a further 20 % were captured in traps next to their original capture point. Furthermore, throughout the study no animal that had been marked was captured outside of its original trap grid.

### Habitat Use

*O. maccanni* and *O. n. polychroma* at Birdlings Flat showed well defined patterns of habitat use with 99 % (n=504) of *O. maccanni* captured in dunelands, and 98 % (n=53) of *O. n. polychroma* captured in shrubland. Only one *O. n. polychroma* was captured in the dunelands. The distribution of these two species as indicated by trap captures was confirmed by observations outside the study area. Further up the Spit, *O. n. polychroma* was observed in shrub covered dunes but was not observed in nearby dunes which were covered with pingao.

This contrasts with the habitat utilisation of these two species in Central Otago. There, the majority (70 %, n=34) of *O. n. polychroma* were captured in grassland (usually tussock) while *O. maccanni* were almost invariably associated (95 %, n=61) with herbs/shrub habitat, rocks and rock outcrops (Patterson, 1992).

This apparent contradiction in habitat utilisation between the lizards at Birdlings Flat and Central Otago indicates that the distribution of these two species may be dependent on factors other than just habitat structure. Substrate moisture content has been cited as an important influence on distribution of a number of New Zealand skink species (Rowlands, 1975; Gill, 1976; Mainwaring, 1980; Porter, 1987). In the case of *O. maccanni* and *O. n. polychroma*, it is thought that the former prefers drier, more arid habitats while the latter prefers more moist environments (G. Patterson, pers. comm.). In the present study *O. maccanni* is most abundant in very arid dunelands where there is no soil development and little moisture retention on the surface (Courtney, 1983; pers. obs.) and *O. n. polychroma* was associated with shrubland covered substrates that have greater water retention capacities and are more moist (Peace, 1975; Courtney, 1983; pers. obs.).

Both of these species are easily distinguished at Birdlings Flat, with *O. maccanni* having a striped dorsal colour pattern and *O. n. polychroma* a speckled dorsal pattern. This is opposite to the patterning of these two species in central Otago where the striped, grassland inhabiting species is *O. n. polychroma* and the speckled, shrubland inhabiting species is *O. maccanni* (Patterson, 1985; Daugherty *et al.*, 1990). It has been suggested that the colour patterns of common skinks in Central Otago camouflage them in their preferred microhabitats; striped animals occurring predominantly in grass habitat, and speckled and spotted animals being associated with rock and shrub habitat (Patterson, 1985). This explanation is consistent with what was found at Birdlings Flat where the striped species *O. maccanni* occurred predominantly in association with the grass marram and the grass-like pingao on the duneland while the speckled species, *O. n. polychroma*, occurred almost exclusively where the habitat was dominated by shrub vegetation over a stony substrate.

The dorsal patterning of both species may decrease the risk of predation especially from avian predators that rely on vision. Today this would include harriers (*Circus approximans*) and magpies (*Gymnorhina tibicen*) both of which are known lizard predators (McIlroy, 1972; Pierce, 1987). At

Birdlings Flat there were at least two resident magpie pairs that were often observed “stalking” prey both in the dunes and amongst the shrublands. Harriers were regularly seen quartering the study site, especially in the summer of 1991/92 when rabbit numbers were high. In the past avian predators would probably have included a host of now extinct bird species, particularly raptors and rails.

### Activity Patterns

Of the four lizard species present at Birdlings Flat, only the gecko is nocturnal (*H. maculatus*). The three skink species are all diurnal (Robb, 1986; Patterson, 1991; Freeman, 1994). *O. maccanni* activity peaks early in the morning before tailing off over the rest of the day whereas *O. n. polychroma* appear to be most active in the middle of the day. Morris (1974) suggested *O. maccanni* tended to be crepuscular in summer in the dunes but this is not supported by the present study. While *O. maccanni* does show a morning peak in activity, no second peak is apparent in the evening as would be expected if this species was truly crepuscular. In central Otago there was no detectable difference in the diurnal activity patterns of *O. maccanni* and *O. n. polychroma* (Patterson, 1992).

### Diet

*O. maccanni* and *O. n. polychroma* consume a variety of arthropod prey. Insecta appear to dominate the diets of these two species although Arachnida, particularly spiders, are also important. Similar dietary patterns have been described for these species elsewhere. For example, Patterson (1985) found that *O. maccanni* and *O. n. polychroma* in central Otago were largely insectivorous, insects being the most important food items followed by spiders and fruit. Similarly Barwick (1959) described the most important food items for *O. n. polychroma* in a number of localities around Wellington and Marlborough Sounds as; spiders, hemipterans, copepods, coleopterans, lepidopterans and amphipods. While a more thorough analysis of the prey taxa may highlight more subtle differences in prey usage it is unlikely to change the overall picture of the two species as dietary generalists.

Differences in dietary preference between *O. maccanni* and *O. n. polychroma* at Birdlings Flat

appear to be largely related to the type of prey available in each of the two habitats. Both species are dietary generalists that show some degree of selectivity. Similar selectivity has been documented in other New Zealand skinks. For example, *Cyclodina* and *Oligosoma* skinks have been found to avoid eating ants (Fawcett, 1964; Patterson, 1985). However the degree to which specific groups are selected for or against is also affected by two other important factors: to what degree the survey method under or overestimates prey densities and whether this estimate relates to how a lizard encounters prey. It is likely that the method used in the present study to assess prey density over estimated flying arthropods while underestimating terrestrial arthropods. This may partially explain the strong negative correlation between Leiodoptera in both *O. maccanni* and *O. n. polychroma* faecal pellets and insect traps.

### Conclusion

Habitat use appears to be the major difference between *O. maccanni* and *O. n. polychroma* at Birdlings Flat and these species in Central Otago. At Birdlings Flat *O. maccanni* and *O. n. polychroma* are largely confined to habitat types opposite to those in which they occur in Central Otago. Both species also show a higher degree of habitat specificity than has been documented in these species in Central Otago (Patterson, 1992). None of the other factors examined showed a significant deviation from what has been documented for *O. maccanni* and *O. n. polychroma* elsewhere.

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