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Response of Eastern Barn Owls *Tyto alba delicatula* to changes in prey abundance in north-western Victoria

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Abstract. The diet of the Eastern Barn Owl *Tyto alba delicatula*, and the owls' response to changes in its prey population, were studied by JGM in north-western Victoria in 1987-88 by owl pellet analysis, owl population survey and live-trapping of House Mice *Mus musculus*. The owls preyed almost entirely on House Mice (96%, n = 867 items in 217 pellets) during high mouse densities and a subsequent crash in mouse numbers. The owls increased their consumption of mice during winter as the mouse population declined; the few other dietary items were also taken after the crash. Owl numbers tracked changes in mouse density; owls did not breed on the study site after the mouse crash, and the owls ultimately left the site. Barn Owls did not regulate the mouse population on the site at high mouse densities.

Keywords: Barn Owl *Tyto*, mouse *Mus*, populations, predation, prey dynamics

INTRODUCTION

The diet of the Eastern Barn Owl *Tyto alba delicatula* (hereafter Barn Owl) has been studied exhaustively in Australia by pellet analyses, mostly in the arid zone, with fewer studies in the sheep-wheat belt (reviewed by Charley *et al.* 2025, Debus 2009, Debus and Tsang 2023, Higgins 1999, Kearney *et al.* 2022). One such study in the northern Victorian wheat belt (Fitzsimons *et al.* 2008) overlooked dietary data for north-western Victoria, summarised by Higgins (1999) from an unpublished thesis (McLaughlin 1994). There, as elsewhere in the south-eastern Australian wheat belt, the Barn Owl preys mostly on the introduced House Mouse *Mus musculus*, a serious domestic and agricultural pest (e.g. Baker-Gabb 1984, Debus and Rose 2004, Debus and Tsang 2023, Fitzsimons *et al.* 2008, Fleay 1968, Hutton and Brickhill 1985, Morton 1975, Rose 1996).

Owls may respond to changes in prey availability by a numerical response (i.e. change in predator density) and/or a functional response (i.e. change in prey consumption patterns, e.g. prey-switching) (e.g. Heywood and Pavey 2002, Jaksić *et al.* 1992). Throughout its global range, the Barn Owl complex preys primarily on small mammals (e.g. del Hoyo *et al.* 1999, Higgins 1999, König and Weick 2008, Roulin 2020). A related question is whether Barn Owls can control rodent populations (e.g. Olsen 1989, Sinclair 1989, Sinclair *et al.* 1990).

House Mouse populations in the semi-arid wheat belt of Australia undergo irregular fluctuations, from low densities to 'plague' numbers (Mutze *et al.* 1990, Newsome and Corbett 1975, Newsome and Crowcroft 1971, Saunders and Giles 1977, Singleton 1989, Singleton and Redhead 1989). Such plagues have been characterised as triphasic: during periods of low mouse density (representing 'phase A' or year 1) the proportional mortality imposed by predators should be density-dependent, and therefore regulatory; and when mice reach high to very high densities ('phase B' or years 2 and 3 – year 3 being the plague year) the mortality caused by predators should be inversely density-dependent, and therefore non-regulatory (Redhead 1988, Sinclair *et al.* 1990, Singleton 1989).

Mobile raptors track changes in prey populations of small mammals rapidly; because regulation of prey populations occurs when mortality imposed by predators is density-dependent, and because time-lags in predator-prey systems may cause instability, nomadic specialist predators may stabilise rodent populations by truncating population peaks (e.g. Jaksić *et al.* 1992). In Australia, Barn Owls may similarly be able to control House Mice at low mouse densities (Sinclair 1989; Sinclair *et al.* 1990).

At the start of the present study (1987-88) House Mouse densities were high, and expected to produce a plague in the following year (1988-89) (C. Tann, J. Griffiths, pers. comm.), but a plague did not eventuate. During 1988 mouse densities declined to low levels, and remained depressed for the remainder of the study period. Presented here is the detail supporting the summary statements of Higgins (1999), on Barn Owl diet, that cited McLaughlin (1994), as well as an investigation of Barn Owl feeding and population ecology in relation to changes in the mouse population. JGM investigated the response of a Barn Owl population from high to low densities of its major prey, the only such quantified study on Australian Barn Owls at the time, although Barn Owls have since been shown to switch prey types in response to a decline in rodent numbers (Debus *et al.* 2008, Heywood and Pavey 2002, McDowell and Medlin 2009).

The primary aim of the present study was to assess the effects of changing prey densities on the ecology of the Barn Owl. A secondary aim was to assess whether Barn Owl predation might regulate House Mouse populations, at least at low mouse densities.

STUDY AREA AND METHODS

Study site

Barn Owls were studied by JGM from December 1987 to October 1989 in the semi-arid Mallee wheat-belt of north-western Victoria, on intensively managed agricultural land (1030 ha) at the Mallee Research Station at Walpeup (3508′S, 14202′E), ~30 km west of Ouyen. Regionally, >50% of the original vegetation of the area has been cleared for agriculture, with <20% of the original vegetation remaining in intensively farmed areas. Land use is dryland cropping of winter cereals, mainly wheat *Triticum aestivum* with some barley *Hordeum vulgare*. Mean annual rainfall is 250-400 mm and winter-dominant. Summer temperatures frequently exceed 34C, often 40C, and winter minima are often below 2C.

The site consisted of 805 ha of cleared land (intensive cropping ~300 ha, pasture or fallow 500 ha, grazed by 500 sheep) and ~20 ha of retained shelter belts and woodland patches. Native vegetation consisted of medium to tall (5-12 m) mallee eucalypts, most notably Oil Mallee *Eucalyptus oleosa* and White Mallee *E. gracilis* on sandy soils, and Belah *Casuarina pauper* and Slender Cypress-pine *Callitris preissii*, often with Cattlebush *Alectryon oleifolius*, on loamier soils; both had an understorey of chenopods and exotic grasses.

House Mouse census and analysis

House Mice were live-trapped in Elliot traps from January 1988 to October 1989 inclusive. Traps were placed in habitats likely to be hunted by Barn Owls (see McLaughlin and Debus 2025a). Trapping grids (comprising 25 traps spaced at 10-m intervals), or traplines in linear habitat, were established in paddocks under crop or pasture ('field' habitat) or along roadside verges, dam banks and a water channel ('verge' habitat). A long-term House Mouse monitoring program was concurrently conducted by CSIRO at and in the vicinity of the Mallee Research Station (C. Tann, pers. comm.), and some mouse ear-tags were recovered in Barn Owl pellets collected during the present study.

Each trapping session comprised 150-200 trap nights, over 3-4 consecutive nights, with equal trapping effort in 'field' and 'verge'. Trapping was usually conducted at monthly or bimonthly intervals, except for two intervals of three and four months. Because trapping success never exceeded 22%, frequency-density transformation of trapping data was not undertaken. At frequencies up to ~0.2, frequency is almost linear on density and no correction is necessary (Caughley 1977). Trap success was therefore used as an index of mouse density. Trapping sessions were undertaken in the same month as Barn Owl censuses and pellet collections, except for one case (April 1988), when trapping was conducted in the preceding and following month and mouse density therein averaged.

Because mouse densities at the beginning of the study were high, but declined to a continuous period of low densities, the study period was divided into two phases (i.e. high and low), and data analysed accordingly. However, a limitation is that, with only two years of data, the peak in mouse density is an assumed peak (hereafter 'peak') from an unknown density pre-1988, and the magnitudes of both low and high densities (phases A and B) were greater in the study of Sinclair *et al.* (1990) than those at Walpeup. Therefore, the analogy of phases A and B is not strictly applicable in the present study.

Study species

The Australian Barn Owl is currently classified as subspecies *delicatula* of the global *Tyto alba*, although the complex consists genetically of three distinct species: *T. alba* of Europe, the Middle East and Africa; *T. furcata* of the Americas; and *T. javanica* of India/South-East Asia to Australasia (including subspecies *delicatula* of Australia) (Aliabadian *et al.* 2016, Jønsson *et al.* 2013, Uva *et al.* 2018).

Barn Owl census

Counts of Barn Owls on the study site were made from December 1987 to October 1989, at monthly or bimonthly intervals, except for no counts in March-May 1989, when high rainfall hampered access. The number of owls present on the Research Station was determined mainly from daytime checks of known and potential tree hollows, most of which were located during a systematic survey of the area in September-November 1987 (see McLaughlin and Debus 2025b). Owls were also located during searches for their foliage roosts, and from nocturnal call records, responses to playback of recorded calls and direct spotlight searches for active owls. Counts were conservative, with each count representing a minimum number of owls present at the time.

Pellet collection and analysis

The diet of the Barn Owl at the study site was assessed by the analysis of skeletal material in regurgitated pellets, recognisable as *Tyto* pellets by their 'glazed' dark mucous coating (e.g. Hollands 2008, Schodde and Mason 1980). As Barn Owls were the only *Tyto* owl that occurred on the study site, all such pellets were ascribed to this species.

Pellets and pellet material were collected during inspections and searches for Barn Owl roost and nest sites, from below roost and nest trees and from within occupied tree hollows, including a few from within active nest hollows where feasible or the risk of disturbance was low (e.g. advanced owlet stage). Only whole pellets were included in the analysis. Because sites were cleared of prey remains during each visit, subsequent deposits were assumed to have accumulated since the previous inspection. All recently deposited pellets collected each month were pooled to yield a monthly pellet 'assemblage'.

Pellets were graded into four age classes (A, B, C, or D) based on the degree of deterioration of the mucous coating, following Morton *et al.* (1977) and Morton and Martin (1979), and compared with collected pellets of known age. Group A were recently deposited, allocated to the month in which they were collected. Group B pellets were slightly older and were assigned to the previous month's assemblage. If no collection had been made in the previous month (three cases), the pellets were excluded from analysis. Pellets in categories C and D were of uncertain age but most likely older than 1-2 months, and also excluded from analysis. In the field, whole pellets were placed in individual plastic vials with naphthalene flakes to prevent insect damage.

Table 1

Details of sample size, sample weight, mean weight, and prey component of Barn Owl pellets collected between December 1987 and February 1989 near Walpeup, north-western Victoria.

Year, Month	N pellets	Mean pellet weight (g) (s.d.)	Sample weight (g)	MNI (all taxa)	MNI mice (%)	MNI birds (%)	MNI invertebrates (%)	MNI Amphibia (%)
1987								
Dec	21	4.5 (1.7)	95	94	94 (100)	–	–	–
1988								
Jan	12	4.0 (1.8)	47.7	46	46 (100)	–	–	–
March	22	3.8 (1.5)	84	84	84 (100)	–	–	–
April	46	3.9 (1.4)	178.8	181	180 (99)	–	1 (1)[A]	–
May	28	4.0 (2.0)	111.8	106	106 (100)	–	–	–
June	27	4.0 (1.9)	107.2	104	104 (100)	–	–	–
July	9	1.9 (0.6)	17.2	17	17 (100)	–	–	–
Aug	17	3.9 (1.7)	66.2	90	63 (70)	–	24 (27)[B]	3 (3)[C]
Oct	10	2.8 (1.1)	28.2	29	27 (94)	1 (3)[D]	1 (3)[E]	–
Nov	9	4.4 (0.8)	39.2	40	40 (100)	–	–	–
1989								
Jan	6	4.9 (1.0)	29.3	28	28 (100)	–	–	–
Feb	10	4.9 (1.2)	49.2	48	48 (100)	–	–	–
Total	217	3.9 (1.7)	853.8	867	837 (96)	1 (<1)	26 (3)	3 (<1)

[A]Blattodea; [B]Coleoptera; [C]Salientia (*Limnodynastes* sp.?); [D]Unidentified passerine; [E]Orthoptera

In the laboratory, pellets were either air or kiln dried (at 80ºC) to constant weight. Dry weight and maximum width and length were measured. Pellets were soaked overnight in warm water before being placed in a water-filled tray and teased apart (with forceps) under a desk-mounted magnifying glass. All vertebrate mandibles, cranial remains (consisting primarily of the nasal, premaxilla and maxilla) and pelves were examined, and the minimum number of individuals (MNI) per pellet determined using standard methods, i.e. the most abundant skeletal element (typically the left or right mandible) (e.g. Morton 1975, Morton and Martin 1979, Morton *et al.* 1977, Sinclair *et al.* 1990). Depending on the taxa present, the MNI for invertebrates was obtained by counting either mandibles or elytra (e.g. Valente 1981).

Numerical, functional and total Barn Owl response

The Barn Owl numerical response was measured by counting the number of Barn Owls known to be present on the study site. To assess the functional response of Barn Owls, the mean minimum number of mice per pellet was used, assuming that the rate of pellet production remained constant over the study period and each pellet represented a night's hunting (e.g. Morton and Martin 1979, Morton *et al.* 1977, Smith and Cole 1989). Barn Owls may produce two pellets per 24-hour period: one at the diurnal roost (the pellet usually collected) and a small pellet at night, typically on the hunting grounds (e.g. Bunn *et al.* 1982, with field evidence in support by Morton 1975).

Total predatory response is the product of the numerical and functional responses (Sinclair *et al.* 1990). In this study, the total Barn Owl response was estimated as the count of Barn Owls multiplied by the mean minimum number of mice recorded per pellet. An index of the proportional mortality imposed by Barn Owls is given as the total Barn Owl response divided by the mouse density index. In determining the direction of mortality imposed by Barn Owls on the House Mouse population, the number of mice consumed by Barn Owls was not assessed, because the relationship between predation and mouse density, not absolute numbers, is important (see Sinclair *et al.* 1990).

Data analysis

Spearman rank correlations were used to examine the relationship between House Mouse densities and the numerical, functional and total responses of Barn Owls. Levels of significance for ranked correlations were indicated by the Bartlett chi-squared statistic as given by *SYSTAT* (Wilkinson 1988). Chi-squared tests with one degree of freedom incorporated Yates' correction for continuity (Fowler and Cohen 1987). Two-sample *t*-tests (Fowler and Cohen 1987) and Mann-Whitney *U*-tests (Siegel 1956) were used to examine aspects of Barn Owl pellet production and content.

RESULTS

Barn Owl prey

In total, 217 whole pellets were included in the analysis, representing 867 individual prey items (Table 1). House Mice were by far the dominant prey recorded, comprising 96% (n = 837) of all prey by number. The remaining 4% (n = 30) included invertebrates (predominantly beetles, Coleoptera) 3% (n = 26), amphibians <1% (n = 3), and birds <1% (n = 1). Because House Mouse weights vary through the year (C. Tann, pers. comm.), biomass consumed by Barn Owls was not assessed, but mice probably contributed >96%. Minimum numbers of mice per

Table 2

Details of House Mouse live-trapping program, Mallee Research Station near Walpeup, north-western Victoria, by habitat type and for all data combined. For definition of field and verge habitats, see text.

Year	Month	*N* trap nights		Trap success (%) (*n*)		Overall trap success
		'Field'	'Verge'	'Field'	'Verge'	(%)
1988	January	75	75	16 (12)	24 (18)	20
	March	100	50	19 (19)	28 (14)	22
	May	50	100	22 (11)	18 (18)	19
	June	75	75	12 (9)	17 (13)	15
	July	100	75	0 (0)	3 (2)	1
	August	75	75	0 (0)	0 (0)	0
	September	100	50	0 (0)	0 (0)	0
	October	75	75	0 (0)	0 (0)	0
1989	January	75	75	3 (2)	3 (2)	3
	February	75	100	0 (0)	2 (2)	1
	June	75	75	0 (0)	0 (0)	0
	August	100	100	0 (0)	0 (0)	0
	October	100	75	2 (2)	7 (5)	4
Total		1,075	1,000	5 (55)	7 (74)	6 (overall)

Table 3

Index of mouse density, number of Barn Owls present, number of pellets collected, mean number of mice per pellet, index of total Barn Owl response and index of mortality imposed by Barn Owls on the House Mouse population near Walpeup, north-western Victoria. Mouse population numbers are based on trapping results. Asterisk (*) = total Barn Owl response is number of owls multiplied by mean number of mice per pellet. Index of Barn Owl imposed mortality(#) is total Barn Owl response divided by mouse density index. Numbers in square brackets derived from an estimate of mouse density for April 1988 (based on results for March and May 1988).

Year	Month	Mouse numbers	Index of mouse density	Mean no. mice per pellet	Number of Barn Owls	Total Barn Owl response*	Barn Owl imposed mortality#
1987	December	High	–	4.5	9	40.5	–
1988	January	High	20	3.8	5	19	0.95
	February	High	–	–	–	–	–
	March	High	22	3.8	4	15.2	0.69
	April	High	[21]	3.8	7	26.6	[1.29]
	May	High	19	3.8	7	26.6	1.4
	June	Declining	15	3.9	5	19.5	1.3
	July	Low	1	1.9	2	3.8	3.8
	August	Low	0	3.7	2	7.4	–
	September	Low	0	–	–	–	–
	October	Low	0	2.7	3	8.1	–
	November	Low	–	4.4	2	8.8	–
	December	Low	–	–	–	-	–
1989	January	Low	3	4.7	2	9.4	3.13
	February	Low	1	4.8	1	4.8	4.8
	March	Low	–	–	–	–	–
	April	Low	–	–	–	–	–
	May	Low	–	–	–	–	–
	June	Low	0	–	0	0	0
	July	Low	–	–	0	0	–
	August	Low	0	–	0	0	0
	September	Low	–	–	–	–	–
	October	Low	4	–	0	0	0

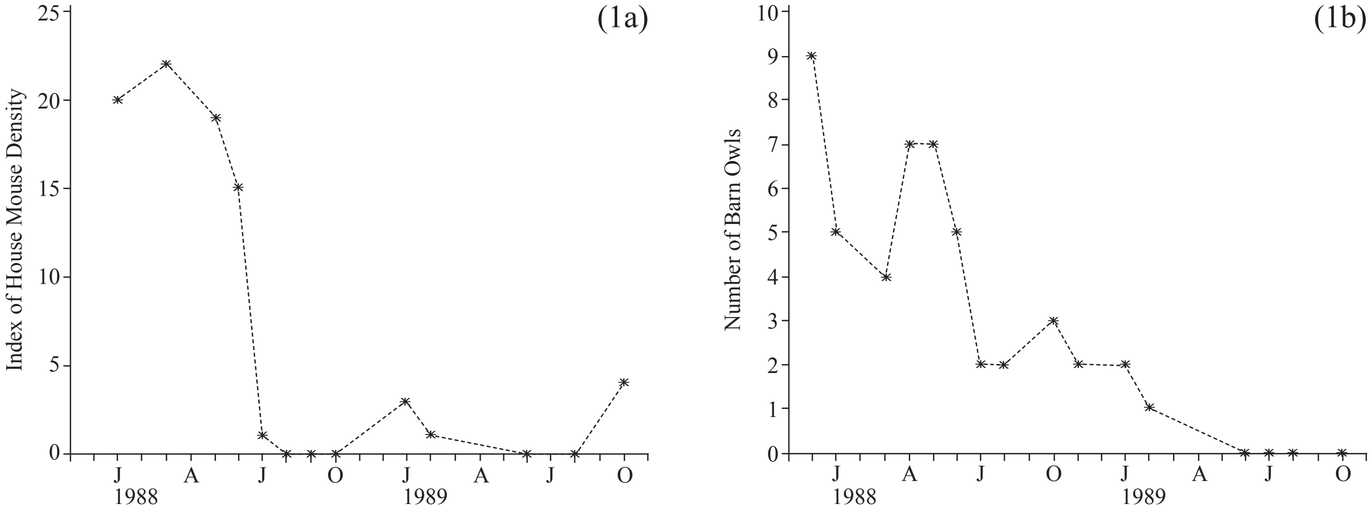

Figure 1. *(a) Variation in House Mouse density over the study period, Walpeup, north-western Victoria; (b) variation in the total number of Barn Owls present on the study site over the study period.*

pellet ranged from one to 13 (mean 3.9, s.d. 1.6). Mean dry weight of pellets was 3.9 g (s.d. 1.7); they measured 20.8-99.2 mm (mean 37.1, s.d. 10.1) ×13.3-29.2 mm (mean 26.4, s.d. 3.2). Pellet dry weight was strongly correlated with the minimum number of mice per pellet (r = 0.93, P<0.001, n = 217), and both pellet length (r = 0.89, P<0.001, n = 217) and width (r = 0.69, P<0.001, n = 216).

Five House Mouse ear-tags from the CSIRO trapping program were found in pellets, indicating that Barn Owls roosting on the study site were hunting nearby, evidence supported by field observations (McLaughlin and Debus 2025a).

Changes in mouse density

Trap success during December 1987-July 1988 (when 90% [n = 116] of the total number of mice captured were trapped) did not differ between 'field' and 'verge' habitat types (2_1 = 2.85, 2 × 2 contingency table, P>0.05) (Table 2). Therefore, all trapping data for each session were combined to provide an overall index of mouse density (Table 3). During the study period mouse densities were greatest during late summer and autumn 1988 (Fig. 1a). Densities declined rapidly during winter 1988 (population 'crash') and remained depressed for the rest of the study. This crash was also reflected in CSIRO trapping data (C. Tann, pers. comm.). Mice were apparently increasing in abundance at the conclusion of the study. House Mice were the only small mammals trapped, and no ear-tagged mice were captured.

High densities prevailed in December 1987-June 1988 followed by a decline to low population levels in August 1988-October 1989 (Fig. 1a).

Numerical response of Barn Owls

The number of Barn Owls recorded on the study site was highest in December 1987 and no individuals were located after February 1989 (Table 3, Fig. 1b). The decline from December 1987 to March 1988 most likely represented dispersal of juveniles from one nest (see McLaughlin and Debus 2025b), and the increase between March 1988 and April-May 1988 was mainly related to a subsequent nesting event. Dispersal of juveniles from this nest coincided with the crash in mouse density. Following the crash, Barn Owls did not breed again at the study site for the remainder of the study and were last detected in February 1989 (observations continued until October 1989).

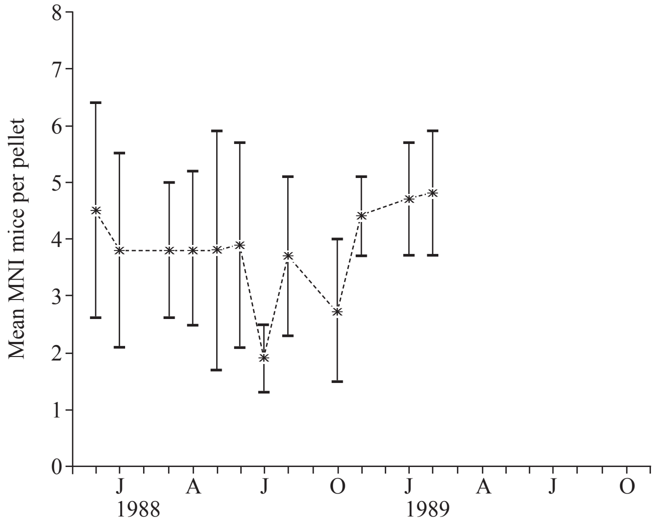

Figure 2. *Variation in the minimum number of House Mice per Barn Owl pellet over the study period. Vertical bars indicate standard deviations.*

The numerical response shown by Barn Owls was strongly correlated with mouse density over the whole study period (r = 0.70, P<0.01, n = 13), indicating that Barn Owls tracked changes in mouse density (also Fig. 1). However, the number of owls was not correlated with mouse density during either the mouse peak (r = 0.27, P>0.05, n = 6) or mouse crash (r = –0.16, P>0.05, n = 7).

Functional response of Barn Owls

The functional response was indicated by the number of mice recorded per pellet. Despite a pronounced low in mice per pellet coincident with the House Mouse crash during July 1988 (Table 3, Fig. 2), this response was independent of mouse density over the study period ($r = 0.32$, $P > 0.05$, $n = 13$). The functional response during the peak also was not correlated with mouse density ($r = 0.27$, $P > 0.05$, $n = 8$), although there was a significantly greater number of mice per pellet in June 1988 than in July 1988 (two-sample *t*-test: $t = 5.0$, $P < 0.01$, d.f. = 33; Fig. 2). During the mouse low, the number of mice per pellet increased with mouse density. Although this result did not reach significance, the trends in the data were strong ($r = 0.67$, $P < 0.10$, $n = 5$; Fig. 2).

The number of pellets comprising each monthly pellet assemblage was strongly correlated with the number of owls recorded on the study site ($r = 0.76$, $P < 0.01$, $n = 12$), suggesting that number of pellets collected may also provide an index of the numerical response. The number of pellets produced per owl present did not differ significantly between mouse population phases (Mann-Whitney *U*-test: $U = 13.5$, $P > 0.05$), suggesting that Barn Owls did not functionally respond to continued low mouse densities by producing more or fewer pellets. However, this suggestion does not take into account pellets deposited away from the roost site.

Following the mouse population crash in July 1988, Barn Owls that remained on the study site continued to prey on House Mice despite the low densities (below the sensitivity of the trapping program [Table 3]). Some evidence indicated that Barn Owls supplemented their diet with prey other than House Mice immediately after the crash (Table 1), although the overall contribution of this prey was minor. The main departure from the usual high (>90%) proportion of mice was in August 1988, following the mouse crash, when 27% of the diet was beetles and 3% frogs by number, and 70% mice (Table 1), although mice would still likely have contributed ~90% by biomass. Barn Owls at the study site were apparently unable or unwilling to switch to alternative prey as a major dietary component.

Total Barn Owl response

The product of the number of owls recorded on the study site and the mean minimum number of House Mice per pellet gives an index of the total Barn Owl response (Table 3). This response was strongly correlated with mouse density over the study period ($r = 0.72$, $P < 0.01$, $n = 13$), indicating that, collectively, Barn Owls ate more mice at high mouse densities than they did at low densities. Total response was not correlated with mouse density during either the peak ($r = 0.20$, $P > 0.05$, $n = 6$) or the low ($r = 0.06$, $P > 0.05$, $n = 7$).

Total Barn Owl response divided by the index of mouse density provides an index of the proportion of mice taken by Barn Owls at different mouse densities (Table 3). The impact of Barn Owls over the whole of the study period was not correlated with mouse density ($r = -0.14$, $P > 0.05$, $n = 11$), indicating that the overall proportional predation of Barn Owls on House Mice was density-independent. Similarly, the mortality imposed by Barn Owls during the low was independent of mouse density ($r = 0.23$, $P > 0.05$, $n = 5$), although the number of data points is small. In contrast, however, the proportional mortality imposed by Barn Owls during the peak was strongly negatively correlated with mouse density ($r = -0.89$, $P < 0.02$, $n = 6$), indicating that Barn Owl predation on House Mouse populations was directly inversely density-dependent. That is, Barn Owls took proportionally fewer mice at high mouse densities than they did during low densities. Because regulation of prey populations occurs when predators have a direct density-dependent effect, during the peak Barn Owls were not regulating House Mouse populations.

DISCUSSION

Despite only a single mouse population cycle (high to low density) over two years of Barn Owl counts, this study was able to infer an effect of changing mouse density on Barn Owl feeding ecology and local population trend. Multiple investigation techniques, including live-trapping of mice, owl dietary analysis and the number of mice per owl pellet, enabled inferences on the proportion of the mouse population taken by owls at differing mouse densities, and thus insight into the Barn Owl's ability to regulate the mouse population.

Diet

House Mice comprised the bulk of prey taken by Barn Owls, consistent with other Australian studies in the temperate agricultural belt where few other small mammals are available (e.g. Baker-Gabb 1984, Debus and Rose 2004, Debus and Tsang 2023, Fitzsimons *et al.* 2008, Fleay 1968, Hutton and Brickhill 1985, Morton 1975, Rose 1996). Although specialising on small mammals, especially rodents, Barn Owls take various other prey including birds, reptiles, amphibians and invertebrates (e.g. del Hoyo *et al.* 1999, Higgins 1999, König and Weick 2008, Roulin 2020, Taylor 1994). Usually, these alternative or non-preferred prey are taken in minor proportions during shortages of small terrestrial mammals (e.g. Morton and Martin 1979, Taylor 1994; but see McDowell and Medlin 2009 for reptiles). Barn Owls rarely breed on diets not composed primarily of small mammals (Bunn *et al.* 1982; but see Olsen *et al.* 2020).

Functional and numerical response

Barn Owl functional response over the study period was independent of mouse density, suggesting that individual satiation levels were achieved at low prey densities. At low prey densities, however, Barn Owls showed a functional trend toward increased consumption of mice. As a specialist predator the Barn Owl may respond to increasing mouse abundance at low prey densities by increasing the quantity or proportion of mice in the diet. There may also have been an increase in food intake during cold weather (winter) to maintain energy balance.

At high House Mouse densities Barn Owls ate essentially only mice, whereas dietary diversity, though always restricted, was greatest in the two months following the major prey decline. Despite some expansion of diet breadth after the mouse crash, Barn Owls eventually disappeared from the study site (emigrated or died), indicating that they were unable or unwilling to switch to other prey (e.g. Jaksić *et al.* 1992, Morton and Martin 1979). Opportunities for prey-switching by Barn Owls were limited because no other mammals of suitable size (adult mass <500 g) occur at the Walpeup study site (although the owls can, where available, switch to dasyurids, bats or even lizards: Debus *et al.* 2008, 2010, Heywood and Pavey 2002, McDowell and Medlin 2009). The alternative strategy is to undertake apparently nomadic movements in search of suitable prey. However, failure to find adequate prey during such dispersal may be responsible for large-scale deaths occasionally observed in Barn Owls (e.g. Baker-Gabb 1984, Fleay 1968, Higgins 1999, Hutton and Brickhill 1985).

Over the study period the number of Barn Owls on the study site was strongly correlated with prey density, indicating that Barn Owls tracked changes in mouse densities. Therefore, the primary response shown by Barn Owls was numerical, as is typical for Barn Owls elsewhere (e.g. Jaksić *et al.* 1992). In Australia, Barn Owls show positive numerical responses, sometimes reaching high densities, to outbreaks of House Mice and native rodents, and negative responses to their decline (e.g. Baker-Gabb 1984, Fleay 1968, Hollands 2008, Hutton and Brickhill 1985, Morton and Martin 1979, Rees *et al.* 2019). The greatest component of Barn Owl numerical response during this study was breeding and subsequent emigration of young owls (McLaughlin and Debus 2025b).

Potential impact of Barn Owl predation on House Mice

The ability of a predator to influence the population dynamics of its prey depends on a combination of factors, including degree of food specialisation, mobility, reproductive potential and time-lags between population fluctuations of predators and their prey. Ultimately it depends on whether the impact of predation on the prey population is density-dependent (Sinclair *et al.* 1990). The proportional impact of Barn Owl predation on mouse populations during high densities was inversely density-dependent, and therefore non-regulatory, but it was unclear whether Barn Owls had a regulatory influence over mouse populations at low mouse densities, with a suggestion of density-independent predation at low prey densities. At low prey densities, Barn Owls were better at catching mice than were the traps used to assess mouse abundance, thus emphasising the effectiveness of owls in the capture of small mammals (e.g. Charley *et al.* 2025, Heisler *et al.* 2016, Kutt *et al.* 2021, Schoenefuss *et al.* 2024).

Further study is required to establish the regulatory role of Barn Owl predation. However, given the ecological and behavioural similarity of this species to other nomadic rodent specialists such as the Black-shouldered Kite *Elanus axillaris* (Sinclair *et al.* 1990), Barn Owls may potentially assist in regulating House Mouse populations (e.g. Fleay 1968, Olsen 1989). Current methods of controlling House Mouse populations primarily involve the use of rodenticides, which may affect non-target species through secondary poisoning, especially the more dangerous second-generation anticoagulants (e.g. Lohr and Davis 2018, Low *et al.* 2024, Mooney 2017). The most effective methods of controlling pest rodent populations may be through coumatetralyl, zinc phosphide and/or cholecalciferol (vitamin D3) baits, and the provision of enhanced habitat for rodent predators such as the Barn Owl (e.g. artificial hunting perches or nest and roost hollows: Kay *et al.* 1994, McLaughlin and Debus 2025c, Meaney *et al.* 2021). In the monsoonal tropics where oil-palm and cocoa plantations or rice fields are saturated with nest boxes at one box per 10 to 25 hectares, Eastern Barn Owls (somewhat larger subspecies *javanica*) can control pest rodents without the need for rodenticides, and reduce rat damage to acceptable levels of <5%, or by a factor of 2-7 (Hafidzi and Na'im 2003, Hafidzi and Saayon 2001, Lee 2010, Mohd Noor *et al.* 2024, Zainal Abidin *et al.* 2022). This outcome suggests that, with sufficient saturation of croplands with nest boxes of ideal design (Meaney *et al.* 2021), Barn Owls may be able to control mice in grain crops in the build-up phase, and perhaps truncate the population peak.

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