Mortality in Pardalotes in Melbourne, 1960 to 1980

J. C. Z. WOINARSKI and A. R. McEVEY

Forty-six museum specimens of pardalotes were found dead in the Melbourne area between 1960 and 1980. An additional 47 birds were reported dead in that period, but left uncollected. An analysis of the dates of these mortality records indicated that deaths occurred non-randomly over months and years, with two years (1974 and 1977) and four months (May-August) accounting for the bulk of deaths. The three taxa of pardalotes represented (*Pardalotus punctatus* and *Pardalotus striatus* morphs 'striatus' and 'ornatus') had correlated mortality dates, although *punctatus* deaths tended to be more evenly spaced. There was no significant correlation of deaths with three weather variables examined. There was little evidence that starvation or epidemic were the cause of the deaths. It is suggested that the pattern of deaths reflects a major variation in actual density and aggregation of pardalotes in this area during this period.

Little is known about mortality in Australian birds. This is particularly so for small, forest and commercially insignificant species. Information that is available is mainly anecdotal or, at best, fragmentary.

Stimulated by an apparent massive mortality of pardalotes in Melbourne in the winter of 1974, we attempted systematically to analyse reported mortality in the two small insectivorous species the Spotted Pardalote *Pardalotus punctatus* and Striated Pardalote *P. striatus*. Our aim was to determine the extent of mortality, and the reasons for it, and to investigate any temporal pattern of death.

Methods

The survey was restricted to birds found within the Melbourne suburban area in the period 1960-1980. Collections of the National Museum of Victoria, The Australian Museum, Fisheries and Wildlife Division, Monash, Melbourne and La Trobe Universities were examined. From all pardalotes that had been reported as found dead we recorded date of discovery (presumably close to date of death), age, species (or phenotype for the morphologically variable *P. striatus*) and, where possible, sex.

Information was also sought from various local sources — *The Bird Observer, Geelong Naturalist, Victorian Naturalist* and *The Australian Bird Watcher*, the Royal Zoological Gardens, the Melbourne *Herald* (G. Pizzey), the Bird Observers' Club (E. McCulloch and D. Robertson) and the Gould League (A. Reid).

Records of weather conditions in Melbourne in this period were obtained from the Bureau of Meteorology. Absolute minimum temperature, precipitation and number of rain-days were recorded in weekly, monthly and yearly intervals.

Following a large number of pardalotes sent to the N.M.V. in winter 1974, one of us (ARMcE) sought further information from local groups and individual observers. Data from responses are included in some analyses here.

Results

Specimens

A total of 18 *P. punctatus* and 28 *P. striatus* were found dead in the Melbourne area in this period (in collections of the N.M.V., F. and W.L. Div., and Monash University). No additional records were located from either the journals consulted or from correspondence.

Replies to 'Project Pardalotus' added a further 14 *punctatus*, 28 *striatus* and 5 unidentified pardalotes for the period May to July 1974.

Distribution of records

The monthly and annual distribution of birds found dead is given in Tables 1 and 2. These results exclude the 47 birds recorded from 'Project Pardalotus' correspondents, because that survey probably biased the intensity of search for, and the reporting of, dead pardalotes.

When all taxa are combined, both the monthly and annual distribution of records are non-random; the high value of variance to mean implies a marked degree of aggregation (Kershaw 1966; Southwood 1978). Following Southwood (1978) the index $I_D = \frac{S^2(n-1)}{\bar{x}}$ was used to approximate X^2. Both monthly and yearly distributions were significantly non-random ($p < 0.001$). The two years, 1974 and 1977, and the 'winter' months, May to August, were markedly over-represented in the mortality totals compared with other years and months. There was no indication of any cyclical or other regular pattern in yearly mortality records.

The mortality records for all taxa were significantly correlated. This was particularly so for the two morphs 'striatus' and 'ornatus' of *P. striatus*, with correlation coefficients of 0.88 ($p < 0.001$) for monthly mortality totals and 0.73 ($p < 0.001$) for yearly totals for those taxa. Death records for the two species *P. punctatus* and *P. striatus* were also significantly correlated, with $r = 0.59$ ($p < 0.05$) for monthly totals and 0.58 ($p < 0.01$) for yearly totals. The actual co-occurrence of deaths (i.e. in the same month of the same year) for pairs of taxa was also higher than expected. Of 252 months in the period three months had both *punctatus* and *striatus* found dead (c.f. expected of 1.8), and three had both 'ornatus' and 'striatus' morphs (c.f. expected of 0.7). Association indices Yule's co-efficient $= \frac{ad - bc}{ab + bc}$ (Pielou 1977) were also positive (0.72 for 'striatus'/'ornatus', and 0.31 for *striatus/punctatus*) implying a level of coincidence.

Although this indicates a degree of synchrony in deaths, there are differences between the taxa in the pattern of observed mortalities. *P. punctatus* had deaths more equitably spread between months and years than did *striatus* (ratio of variance to means given in Table 3), and the morph 'ornatus' had deaths more spread than 'striatus'.

There was no significant difference in the distribution nor proportions of male and female pardalotes. Juveniles and immatures were uncomon in the sample, only four of the 46 birds examined being subadult (Disney 1974).

Locations

All the pardalotes reported dead were found in Melbourne's eastern suburbs. Three public gardens with abundant native trees (Maranoa Gardens, Blackburn Lake Reserve and Wattle Park) accounted for 30 of the 93 birds reported dead. Most others were found in suburbs with considerable garden and uncleared areas (e.g. Caulfield, Hiedelberg, Sandringham and Eltham).

TABLE 1

Monthly totals of pardalotes found dead, 1960-1980.

Month	*P. punctatus*	*P. striatus* 'striatus'	*P. striatus* 'ornatus'	Total
January	0	0	0	0
February	1	0	1	2
March	0	0	0	0
April	1	0	0	1
May	1	3	2	6
June	7	5	5	17
July	0	5	3	8
August	4	2	0	6
September	1	0	0	1
October	1	0	0	1
November	1	0	1	2
December	0	0	0	0

Mean = 3.7
Variance = 22.9
$S^2/\bar{x} = 6.2$
$I_D = 68.6$; d.f. = 11; $p < 0.001$

TABLE 2

Yearly totals of pardalotes found dead, 1960 to 1980.

Year	*P. punctatus*	*P. striatus* 'striatus'	*P. striatus* 'ornatus'	Total
1960	1	0	0	1
61	2	0	0	2
62	0	0	0	0
63	0	0	0	0
64	0	0	0	0
65	0	0	1	1
66	0	0	1	1
67	0	0	0	0
68	1	0	0	1
69	2	0	0	2
1970	1	0	0	1
71	1	1	1	3
72	2	0	0	2
73	0	0	1	1
74	5	7	6	18
75	1	0	0	1
76	0	0	1	1
77	0	7	1	8
78	1	0	1	2
79	0	0	0	0
1980	1	0	0	1

Mean = 2.1
Variance = 14.7
$S^2/\bar{x} = 6.9$
$I_D = 138$; d.f. = 20; $p < 0.001$

TABLE 3

Randomness of mortality figures for taxa considered separately.

Taxa	Ratio variance: mean	
	Monthly	Yearly
P. punctatus	2.8*	1.6*
P. striatus	5.4*	7.7*
'ornatus'	2.3*	2.9*
'striatus'	2.9*	5.9*

* $p < 0.001$ of random distribution based on approximation to X^2.

Weather

Small birds may be particularly affected by unusually cold or wet conditions (e.g. Kricher 1975, Perrins 1979). We compared annual total rainfall and number of rainy days for each of the years 1960 to 1980 with the number of pardalotes found dead in each of those years. More pardalotes were found dead in wet years, but this was not significant ($r = 0.245$ for rainfall and $r = 0.182$ for number of rainy days). A more refined analysis, using the weather and mortality data for each of the 252 months in this period, resulted in the correlation coefficients dropping to 0.029 and 0.038 respectively. A multiple linear regression using these two variables explained only 0.16% of the mortality variation. In a more sensitive analysis of weather data, the 21-year period was divided into 1 096 weekly intervals and these were categorised into weeks of mortality (when dead pardalotes were found) and of non-mortality. Weekly rainfall, weekly number of rain-days and absolute minimum weekly temperature were compared, using a t-test, between weeks of mortality and the same number of weeks of non-mortality (chosen randomly from equivalent weeks in other years). Differences between weeks of mortality and non-mortality were negligible for rain-days and minimum temperature (Table 4). Weeks of mortality averaged higher rainfall than those of non-mortality, but this was not significant ($0.05 < p < 0.1$).

Health

Seven birds found dead in 1974 were examined. All birds were in good nutritional condition and had no gross lesions. One bird may have died from trauma with associated haemorrhage within the bones of the skull and a small depressed fracture, otherwise cause of death was unclear. One more bird, found dead in June 1981, had large fat deposits and a full stomach including lerps of psyllids, a small spider and beetle (examined by JCZW).

TABLE 4

Comparison of weather variables between weeks of mortality and non-mortality.

		$\bar{x}$	s.d.	t(d.f. = 80)
Min. temp. (°C)	mortality	5.61	2.85	0.06 ns
	non-mortality	5.57	3.31	
Rainfall (mm)	mortality	20.6	28.6	1.74 ns
	non-mortality	12.4	10.1	
Rain-days	mortality	3.57	2.03	0.81 ns
	non-mortality	3.24	1.75	

One of us (ARMcE) happened to observe an instance of a pardalote dying. He noted while standing under a eucalypt in a Blackbourn South garden a plop at his feet that revealed a Striated Pardalote that had at that instant simply fallen from the tree above. On being picked up still warm, the bird had the appearance and feel of a bird in perfect condition, but it had obviously been dead by the time it had hit the ground.

One other record (E. Adamson in litt. 11.3.81) was of a Spotted Pardalote found dead along with many dead and paralysed bees, with the suggestion that death was caused by spraying of poisons.

Most birds were found singly, but one 'Project Pardalotus' report was of five dead pardalotes together under a 'diseased' Bangalay *Eucalyptus botryoides*.

How many die?

Presumably most dead pardalotes escape notice, and of those noticed, few are reported or handed to museums. 'Project Pardalotus' provides an estimate of this ratio of birds seen dead to those handed to museums. During the period of that survey (May to July 1974), 17 birds were sent to museums; in comparison, 47 dead birds were reported in 'Project Pardalotus'. Hence museum collections may represent only about one quarter of the dead birds found by interested observers. Considering the large proportion of dead birds not found, or dead birds seen by uninterested people, the birds reaching museums must represent a very small proportion of the total mortality. Therefore the 64 dead pardalotes collected or recorded between May and July 1974 suggest that very many deaths occurred at that time.

Discussion

The pattern of mortality around Melbourne is unclear. Most deaths occur in the 'winter' months, May to August. This does not appear to be closely related to either the coldness or the wetness of those months. Spread of deaths over years is very irregular, with occasional years having abnormally high mortality records. This again appears unconnected with the weather variables examined.

Food shortage and starvation may be an alternative cause of death. Green (1980) found a decrease in invertebrate abundance on trees in Melbourne suburbs during winter. She also found that exotic plant species had fewer invertebrates than did native plants. This may imply a shortage of food for insectivorous birds in winter, particularly where remnants of native vegetation are very patchily distributed. Time spent locating and travelling to suitable areas and a possible high density of birds in those areas could make the location of sufficient food items impossible. Gibb (1957) suggested that small insectivores must seek and capture food almost continuously in cold weather. However, all eight corpses examined were in good nutritional condition.

Epidemics are occasionally reported in wild birds (Thomson 1964). It is possible that the high mortalities of 1974 and 1977 result from such an epidemic, or that birds were more susceptible to illness in those peak periods. The sociable nature of pardalotes would facilitate the spread of epidemics. The corpses examined did not show any clear sign of disease, which is unhelpful.

Pesticide, and other chemical, poisoning has been implicated in the deaths of small birds in Melbourne suburbs (Salter 1969). Some pardalote deaths may be due to this cause (notably that reported by Adamson). However, most deaths occured in winter, when spraying is least common. Also, in some periods, pardalotes died more or less synchronously across extensive areas, suggesting some cause other than pesticide spraying (which tends to be localised in suburbs).

Another possibility is that the mortality rate has been roughly constant during these two decades; it is, instead, the density of pardalotes in the Melbourne area that has varied. This suggestion has some support. The morph 'striatus' of *P. striatus* is known to have a breeding range almost restricted to Tasmania and to migrate to the mainland following breeding (Hindwood and Mayr 1946, Mees 1965). It is thus unsurprising that deaths of this taxon are restricted to the May-August period. *P. punctatus* is also known to move long distances — for example an adult bird banded in South Australia has been recovered in Melbourne (Anon. 1980). Most flocking movements occur in the non-breeding season (McGill 1976; Sedgwick 1971); these flocks may be very large (Chandler 1910; Lane 1967; Lenz 1981; Morris 1967; Rogers 1977; Sedgwick 1971; Woinarski in prep.), and many contain several pardalote taxa (Ipsen 1965; Marchant 1973; Waterman and Condon 1965; Woinarski *et al.* 1979).

These may be irregular in both time and place (Chandler 1910; Salomensen 1961; Sedgwick 1977; Storr 1973), and massive irruptions of pardalotes have been recorded (Howe 1928; Sedgwick 1952). Sedgwick (1952) reported that dead pardalotes were found relatively commonly during such an irruption. It seems likely that changes in observed mortality around Melbourne reflect major changes in population density of pardalotes between months and years; that spotted and, particularly, striated pardalotes are 'boom bust' species, reaching extremely high population levels under favourable environmental conditions and then crashing when food resources to support such numbers cannot be located.

Acknowledgements

We are grateful to J. M. Cullen, D. F. Dorward and H. Ford for their helpful criticisms of drafts of this paper, to the curators of bird collections in The Australian Museum (W. E. Boles), Monash University (M. Davey) and Fisheries and Wildlife Division (D. Deerson), and to Dr K. E. Harrigan for his diagnosis of several pardalote corpses.

This study was very dependent on information sent to us from the public and we acknowledge the assistance of E. Adamson, G. Pizzey, P. Veerman, E. McCulloch, J. Wheeler, I. Leith, E. Leamon, H. Tarr, M. Thornton, M. O'Brien, D. Plant, B. Salter, M. Craig, J. Watson, F. Smith, R. Buckingham, P. Reilly and N. Whittaker. Reports of no dead pardalotes were sent in from an additional 32 observers, and we are grateful for their interest and co-operation.

References

Anon. (1980), 'Recovery Round-up', *Corella* 4: 61-63.

Chandler, L. G. (1910), 'Notes on pardalotes', *Emu* 10: 113.

Disney, H. J. De S. (1974), *In* Lane, S. G. (ed.) Bird in the Hand. Bird-banders Assoc. of Aust., Sydney.

Gibb, J. A. (1957), 'Food requirements and other observations on captive tits', *Bird Study* 4: 207-215.

Green, R. J. (1980), Ecology of native and exotic birds in the suburban habitat. Unpublished Ph.D thesis, Dept. of Zoology, Monash University.

Hindwood, K. A. and E. Mayr (1946), 'A revision of the striped-crowned pardalotes', *Emu* 46: 49-67.

Howe, F. E. (1928), 'Notes on some Victorian birds', *Emu* 27: 264.

Ipsen, J. C. (1965), 'A note on the yellow-tipped pardalote', *Aust. Bird Bander* 3: 34.

Kershaw, K. A. (1966), Quantitative and dynamic plant ecology, Edward Arnold, London.

Kricher, J. C. (1975), 'Diversity in two wintering bird communities; possible weather effects', *Auk* 92: 766-777.

Lane, S. G. (1967), 'Habits of spotted pardalotes', *Aust. Bird Bander* 5: 27-29.

Lenz, M. (1981), 'Bird report. 1 July 1979 to 30 June 1980', *Canberra Bird Notes* 6: 3-42.

Marchant, S. (1973), 'Birds of the Caswell Drive area', *Canberra Bird Notes* 2(5): 2-16.

McGill, A. R. (1976), Review: 'Interim List of Australian Songbirds — Passerines', *Aust. Bird Bander* 14: 80-82.

Mees, G. F. (1965), 'The status of *Pardalotus ornatus* Temminck', *Emu* 65: 97-102.

Morris, A. K. (1967), 'Spotted Pardalote notes', *Aust. Bird-Bander* 5: 61.

Perrins, C. (1979), British Tits, Collins, London.

Pielou, E. G. (1977), Mathematical Ecology, Wiley, New York.

Rogers, A. E. F. (1977), 'N.S.W.) Bird Report for 1976', *Aust. Birds* 11: 81-103.

Salomensen, F. (1961), 'Notes on flowerpeckers (Aves, Dicaeidae). 6. The superspecies *Pardalotus striatus*', *Am. Mus. Novitt.* 2068.

Salter, B. (1969), Australian Native Gardens and Birds, Jacaranda Press, Brisbane.

Sedgwick, E. H. (1952), 'Bird life at Leonara, W.A.', *Emu* 52: 285-296.

Sedgwick, E. H. (1971), 'Movements of *Pardalotus substriatus*, Red-tipped Pardalote in Western Australia', *West. Aust. Nat.* 12: 1-4.

Sedgwick, E. H. (1977), 'Movements of the spotted pardalote', *West. Aust. Nat.* 13: 176.

Southwood, T. R. E. (1978), Ecological methods, with particular reference to the study of insect populations, 2nd (revised) edition. Chapman and Hall, London.

Storr, G. M. (1973), List of Queensland Birds, West. Aust. Museum. Spec. Publ. No. 5.

Thomson, A., Landsborough (Ed.) (1964), A New Dictionary of Birds, Nelson, London.

Waterman, M. H. and Condon, H. T. (1965), 'Banding of the yellow-tipped pardalote in South Australia', *Emu* 64: 298-301.

Woinarski, J. C. Z., C. W. Meredith and H. Parnaby, (1979), 'A mallee record of the spotted pardalote', *Aust. Bird Watcher* 8: 133.

J. C. Z. Woinarski,
Zoology Department, Monash University,
Clayton, Victoria 3168.

A. R. McEvey,
National Museum of Victoria,
Melbourne, Victoria 3000.

A Modified Penguin Stomach Tube

A. N. COWAN

Emison (1968) in his major study of the food of the Adelie Penguin *Pygoscelis adeliae* described his stomach tube for obtaining partial stomach contents samples in the living bird. Both he and later Paulin (1975) used this technique in the Ross Sea area. My own ornithological work at Casey, Antarctica (Cowan 1979a, 1979b, 1981) included a study of the food of the Adelie Penguin at the Windmill Islands as it seemed desirable to do a similar study in a different part of Antarctica, in order to compare food taken.

Methods

My familiarity with human endoscopic instruments suggested some modifications to Emison's design and these were incorporated into the instrument which was fabricated at the station by Egon Wehrle and which is shown in Figure 1.

The outer tube, instead of being rigid as in Emison's design, is of nylon-reinforced polythene tubing (Dunlop CS ¾" (20 mm) 250 PSI W.P.) which has an internal diameter of 19 mm and an external diameter of 26.5 mm. The introduced end is bevelled. A brass bullet-shaped obturator protrudes from the tip of the tube during introduction, making the operation easier and safer, and a rubber O ring sits in a groove in this obturator to form a good seal. The stainless steel handle wire (approximately 5 mm diameter) is attached to a threaded and knurled aluminium bolt by means of its hammered end and the aluminium bolt screws into the brass