SILVEREYES Zosterops lateralis ON KANGAROO ISLAND, SOUTH AUSTRALIA

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A 13 year study of Silvereye populations on Kangaroo Island provides an insight into the dispersal patterns of Silvereyes in the S.A. region. Only nine confirmed movements of birds between Kangaroo Island and the mainland of S.A. were recorded even though retrap data clearly indicates a movement of birds away from the banding site in winter and spring. The Silvereyes that were resident on Kangaroo Island are not distinguishable from the S.A. mainland birds in terms of morphometrics or plumage. Only two "Tasmanian" plumage birds were captured on Kangaroo Island during the course of the study.

INTRODUCTION

A study of a population of the Silvereye Zosterops lateralis was carried out at a banding station at Antechamber Bay, Kangaroo Island, South Australia, where 4 189 birds were banded* over a period of 13 years from 1 July 1965 to 30 June 1978.

Objects of the study were to assess the migration of the species between the mainland and Kangaroo Island (which necessitates a sea crossing of about 12 km at the closest point), and to determine whether these movements could be correlated with plumage colour variations within the changing population.

The Silvereye is a common species throughout Kangaroo Island, particularly during summer and autumn when orchard fruits are in season; therefore the homestead garden offered great promise as a banding station. The actual trapping area, comprising approximately 0.133 hectares, included 30 fruit trees, with stone fruits predominating, plus fig, mulberry, quince, apples, pears and a few grape vines. There are also flowering shrubs and vegetables but few, if any, other garden flowers. The area is sheltered to some extent on three sides but open to the east. There is a considerable area, probably in excess of 100 hectares of rough stony uncleared hills, gullies and creeks within 1 km. This area is covered principally with various eucalypts, Eucalyptus cneorifolia predominating, but including E. leucoxylon and E. fusciculosa and acacias, Acacia *armata* predominating on the better soils. Yacca trees Xanthorrhoea tateana and Broombush Melaleuca uncinata predominate on the higher stony and rocky hillsides. The whole area is understoried with a wide assortment of shrubbery which includes Native Fuchsia Correa reflexa, Common Heath *Epacris impressa* and Cranberry Bush Acrotriche sp. Grasses, principally native species, including hard and soft Brome, clothe the creek flats on which the larger eucalypts are found. The homestead garden banding station is situated approximately 2 km inland overlooking Lashmar's Lagoon and Antechamber Bay and is approximately 11 km south-east from the closest point across Backstair's Passage to the mainland (Figure 1).

^{*}Bands used were provided by the Australian Birdbanding Scheme (ABBS), Division of Wildlife and Rangelands Research, CS1RO, Canberra.



Figure 1. Map of Kangaroo Island and adjacent mainland showing Silvereye movement across Backstairs Passage, South Australia.

> 1 Waitpinga Lagoon; 2 Scott Conservation Park; 3 Kuttpo Forest; 4 Bluett Springs; 5 Beaumont (Adelaide suburb); 6 Parndana, Kangaroo Island; 7 Homestead Garden Banding Station; 8 Backstairs Passage.

METHODS

Trapping

Initially all birds were caught using one 18 m standard (32 mm mesh) mist net. This proved so successful that three more nets were purchased. These were sited around and amongst the fruit trees and shrubbery which included tree fuchsias, trellised passion fruits Lauristinus sp., banksia sp., honeysuckle sp., hakea sp. and Tempeltonia retusa and were quite satisfactory for catching new birds. Nets were frequently resited to catch the many birds which apparently became net-shy. Banding was earried out most weekends when the weather was suitable for netting. In 1969 the secretary of the then Australian Bird Banding Scheme, Mr David Purchase, persuaded me to use traps as well as nets and sent me construction details of a maze trap as used by Ms Narella Swanson in N.S.W., (Purchase, Pers. comm.). A trap with dimensions 30x30x40 cm was constructed and this gave an immediate increase in retrap numbers. Two more traps were constructed, one similar and the other with twice the capacity of the first and all three have remained in fixed positions for the last 9 years. The traps were kept baited at all times with fruits in season, pears being the most attractive, or with sheep kidney-fat or caul fat if fruit was scarce. The capture effort expended was fairly uniform

throughout the duration of the study. Greater numbers were handled in the autumn due to greater concentrations of birds at that time.

Recording of Recovery and Plumage Data

Initially records were kept on individual record cards but it was soon evident that this method would become unmanageable and records were transferred to record sheets. These sheets, which each accommodated up to 72 birds for about 90 days, were supplemented with monthly summary sheets so as to simplify the extraction of data.

Plumage colour intensity for three positions on each bird was recorded. Colour was noted for base of undertail, chin and flanks and recorded using a code devised by Mrs Joan Paton. This code consists of numbers denoting depth of colours; for undertail and chin: 1=grcy or white; 1+=grey or white with trace of yellow; 2=yellow, less than grey or white; 3=yellow, equal to grey or white; 4=yellow, no grey or white; and for the flanks: 1=grey; 1+=grey with trace of tawny; 2=soft tawny (powdered nutmeg); 3=bright tawny; 4=light cinnamon (brighter than 2 or 3); 5=bright tan. Plumage colour intensity was recorded for each bird every day it was trapped so that any changes might be detected.

The presence of down and a soft fleshy gape were recorded as a clear indication of juvenile characteristics.

RESULTS

Recovery Data

During the period of the study nine birds made the sea crossing between Kangaroo Island and the mainland (Table 1; see also Figure 1). I recovered five birds which had been banded on the mainland, one over 8 years earlier. Three of my birds were recovered on the mainland. One of these was recovered within 5 weeks of banding and the other two, banded 2 days apart, were recovered on the same day and at the same place approximately 4 months after banding. Four other birds caught initially at the banding station were recovered dead up to 77 km west on Kangaroo Island, the elapsed time for one of them being 16 months. The greatest distance between the points of banding and recovery was 145 km.

Retrap Data

Using mist nets, retraps were less than I would have expected, possibly because the birds became

Band Number	Date Banded	Where Banded	Bander	Where Recovered	Date Recovered	Distance (km)	Elapsed Time (months)	Recovered By	Status
010-43934	11 Mar. 62	BS	VJW	KI	26 Mar. 70	86 SW	96	AFL	Alive
020-53373	7 Sept. 63	WL	MHW	KI	11 Jan. 68	45 SW	52	AFL	
011-10071	5 June 64	BS	MHW	KI	26 Feb. 66	86 SW	20	AFL	15
011-38165	26 June 65	BS	MHW	KL	18 Mar. 66	85 SW	9	AFL	13
012-13243	12 Jan. 68	KI	AFL	В	11 May 68	109 NNE	-4	JBP	**
012-13274	14 Jan. 68	KI	AFL	В	11 May 68	109 NNE	4	JBP	**
012-13484	10 Feb. 68	KI	AFL	KF	17 Mar. 68	80 NE	1	JBP	
012-21400	16 June 68	BS	CRJ	Р	15 Aug. 72	145 WSW	50	NFJ	Dead
012-78502	20 May 75	SC	JBP	KI	9 Oct. 76	75 S W	16	AFL	**

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B – Beaumont, S.A.BS – BluettSprings, S.A.

KF - Kuitpo Forrest, S.A.

KI - Kangaroo Island, S.A.

P – Pardana, Kangaroo Island, S.A.

SC - Scott ConservationPark.S.A.

WL - Waitpinga Lagoon, S.A.

AFL – A.F. Lashmar CRJ – C.R. Jenkins JBP - J. B. Paton MHW - M. H. Waterman NFJ - N.F. Jenner VJW - V. J. Wood

BANDERS:

TABLE 2

The number of days three individual Silvereyes were retrapped in each month of the study.

Band Number 012-29328						012-29376							012-37677							_			
Yea	ar	1969	197()	1971	1972	2 1973	1974	1975	1969	197() 1971	1972	1973	1974	1975	1971	1972	1973	3 1974	1975	1976	1977	1978
M	Jan. Feb			1	2	1	1	3			1	2	2	23	3 1	В			3	1			1
	Mar.		3	i		2	1			1	1	1		1			1		1				1
0	Apr.	BI	2	1	2	2	1	6		2	1	1	1	1	3		4		4	5	1	4	51
	May		1	1		2	3	1	В	2	2			4	1		1	5	2	2	2	5	1
	June		2	1		5		2		1			5		1		2	4		2	6	3	
N	July		1									1					2	1			2	2	
	Aug.	2	1		2	3		1	1			2	1		1		2					1	
	Sept.	1	1	3	1	3	2	1	1	1	2		3		1		1	1	-1	1	3		
Т	Oct	1	1	3	1	3			1	2	5	4	2			2	2	3	1		3		
	Nov.	2	1	1	2	5		1	1	5	1	3	6					3					
Н	Dec.	4	1	6	4	3	2		1	1	8	4	6	1			2		1				

B denotes month of banding.

net-shy. With the introduction of maze traps during 1969 the number of retrapped birds using mist-nets only was 27.5 per cent whilst that for traps only was 30.7 per cent. This increase is probably not significant as by 1969 there was a larger base of banded birds. Birds entered the traps readily and repeatedly, often bringing their young to the traps for feeding. Occasionally a count was kept of the number of times individual birds were retrapped during any 1 day; Silvereye 012-47311 was recorded eight times.

Four Silvereyes were retrapped in every month of the year when examined over a number of years: 012-29328 on 111 different days (in 7 years); 012-29376 on 109 days (in 7 years); 012-37677 on 96 days (in 8 years); and 012-29527 on 77 days (in 5 years). Two birds were re-

Band M	Number	011-91748									012-29051					012-47566			
Year	1966	1967	1968	1969	1970	1971	1972	1973	1974	1968	1969	1970	1971	1974	1975	1976	1977	1978	
М	Jan. Feh.			1								1		1					1
0	Mar. Apr.	B2 1				23						1	3	1			2	1	1
Ν	May June					3	23	6	2					1			23	1	
Т	July Aug.			1										а ,					
Н	Sept. Oct Nov.			1							B3	1	1 2	324	D				

 TABLE 3

 The seasonal recovery patterns of three individual Silvereves.

B denotes month of banding.

trapped during 11 months of the year (012-37713 on 27 days in 5 years and 012-47014 on 49 days in 2 years) and a further two during 10 months (012-29088 on 40 days in 3 years and 012-37743 on 39 days in 4 years). Seven others were each retrapped on 30 to 49 different days over periods of from 1 to almost 9 years. Table 2 shows the history of the three Silvereyes retrapped most often. Table 3 shows the history of three other Silvereyes which appeared in certain seasons only.

Table 4 depicts monthly and seasonal retrap data. The highest retrap rate for birds banded in each season was autumn. Retraps decreased greatly into winter and remained low in spring, with an increased rate again in summer.

Table 5 indicates that juvenile Silvereyes were caught only during the months of September to February. Of the 1973 Silvereyes banded during these months from 1967 to 1977, only 225 (11.4%) were juveniles and no juveniles were noted outside this timespan. By March juveniles were not distinguishable from adults, when down, fleshy gape and plumage colour were taken into account. Of the 225 juveniles banded only 27 birds were retrapped more than twice during the duration of the study and these were seven birds each three times, seven birds each four times, two birds each five times and one bird each 8, 10, 13, 14, 15, 16, 18, 21, 23, 32 and 77 times. Most of those retrapped only once or twice were usually retrapped in the month during which they were banded or, in the following month.

Although no Silvereye of any great age emerged from this study, there were two birds of modorate age recorded. Table 6 lists the details of seven older birds (see also Figure 2). Another bird (012-46797) was retrapped after 76 months and two others (012-29539 and 012-29552), both juveniles at banding, were retrapped at 75 months.

in May 1977, towards the end of the banding period, two Silvereyes, unusual for this area, were trapped together and banded. One of them (013-73243) was retrapped three times during the next 14 days, while the other was not seen again. The total length of one of these birds was measured and was found to be significantly larger (125 mm) than 35 individuals considered to be local types and trapped on that same day ($\overline{\mathbf{x}} =$ $107.5 \text{ mm} \pm \text{S.D.} 4.1 \text{ mm}$). These two birds (one slightly brighter than the other), were also more richly coloured than all of the other birds that were handled during the study. Their plumage pattern was outside of the code used and more readily relates to that of Walker (1962) and Lane (1966). I quote a brief description taken at the time: 'Upper throat (chin) green-yellow; throat light smoky-grey, almost to the extent of being a collar: flanks rich cinnamon; belly white; base of undertail light yellow; bill very dark, almost black; legs very dark grey; iris pale brown (hazel); green on back more yellowish-quite noticeable; more obvious white orbital ring.'

		Summe	r		Autumn	1		Winter			Spring	
	D	Juliante	F 1		A			T I		0	opring O i	
Numbers banded	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	NOV
Banded summer (1699)	52	77	145	168	184	124	78	19	.37	48	46	25
Retraped Monthly %	3.1	4.5	8.5	9.9	10.8	7.3	4.6	1.1	2.2	2.8	2.7	1.5
Seasonal %		16.1			28.0			7.9			7.0	
Banded Autumn (2 002)	26	24	31	76	211	1 67	103	22	22	31	24	17
Retrapped Monthly %	1.3	1.2	1.5	3.8	10.5	8.3	5.1	1.1	1.4	1.5	1.2	0.8
Seasonal %		4.0			22.7			7.3			3.6	
Banded Winter (214)	13	4	4	17	17	18	13	5	9	13	8	3
Retraped Monthly %	6.1	1.9	1.9	7.9	7.9	8.4	6.1	2.3	4.2	6.1	3.7	1.4
Seasonal %		9.8			24.3			12.6			11.2	
Banded Spring (247)	38	24	22	41	46	35	20	3	6	18	27	15
Retrapped Monthly %	13.9	8.8	8.0	14.9	16.8	12.8	7.3	1.1	2.2	6.6	9.9	5.5
Seasonal %		30.7			44.5			10.6			21.9	

TABLE 4

Numbers of Silvereyes retrapped at Banding Site on Kangaroo Island by Season. Retrap numbers have been converted to a percentage of total number banded.

Retrapped Silvereyes counted once per month only.

Th	e perce	ntage c	of juveni	ile Silve	reyes n	oted in	the pop	ulation	from 19	67 to 19	77.	
Month	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.
Fotal Banded	112	100	62	2.52	714	7.33	1076	739	187	108	31	75
Juveniles	3	5	13	83	103	18	0	0	0	0	0	0
Percentage of juveniles	2.7	5.0	20.9	32.9	14.4	2.5	0	()	0	0	()	()

TABLE 5

Plumage Changes

At times I recorded what seemed to be further intermediate stages of colour to those devised by Mrs Paton. The system is not ideal as I found that changes of available light, from one day to another or bright conditions to dull, during bird handling, varied my perception of colour by as much as one point. The extent of colour change in any one individual was much less than anticipated, with only 10 birds showing variation greater than $1\frac{1}{2}$ points. There were four birds at 2 points, one at $2\frac{1}{2}$, four at 3 and one at $3\frac{1}{2}$ points of colour change. One of the 3 point changes (012-29093), took place within the space of 2 months after banding as a juvenile. The ages of the other birds were unknown. June, 1987

DISCUSSION

Recovery Data

Silvereyes move both ways between Kangaroo Island and the mainland of South Australia but only nine crossings were confirmed in 13 years. This paper may be regarded as a sample which highlights the necessity to band large numbers of birds in order to elucidate the fine details of long distance movement. Evidence of crossings of Backstair's Passage, as revealed by this research, was insufficient to determine whether the migration was seasonal or irregular, but the numbers involved would tend to indicate that the crossings were deliberate and not just accidental. Two birds migrated (apparently together) from Kangaroo Island to Beaumont and mainland banded birds were found on Kangaroo Island in 5 of the 13 years of the study. Nevertheless, some birds had been trapped on Kangaroo Island in every month of the year by the end of the study and these were presumed to have been permanent residents of Kangaroo Island. Although four birds were retrapped every month of the year, when considered over a number of years, there were periods when they were not noted for several months at a time. Neither of these four birds was retrapped in every month of any one year, nor in any consecutive 12 month period (Table 2). Swanson (1968) however found birds in N.S.W. with coatinuous residency. Whilst Table 2 shows birds with probable continuous residency Table 3 depicts the seasonal patterns of others. Of the birds listed in these two tables none was ever recovered again and it is assumed that they either died or left the area.

The variation in retrap numbers in different seasons tends to indicate that some Silvereyes disperse more widely than others. Silvereyes banded in spring and summer, with a high retrap rate in summer and autumn, would seem to be partly resident during those seasons as evidenced by the retrap data. The high retrap rate in summer and autumn appears to be associated with a temporary flush in food supply in the form of orchard fruits, plus freely available food in the baited traps which help to offset the autumn shortages. The earliest appearance of juvenile birds was September and numbers built up to a maximum in January. By Autumn the juveniles, banded earlier, had mostly disappeared and so were not responsible for the high retrap rate. Liddy (1966) found that in April and May Silvereyes were migrating northwards and many birds

passed through his area at that time. Battam (Lane and Battam 1971) records similar events. This study also found that autumn banded birds seemed to be largely birds of passage or migrants. These birds were retrapped mainly during autumn when recovery figures rose sharply from 3.6 to 22.7 per cent of the autumn banded birds (Table 4). Like Liddy (1966), who found little or no compensating data for the return southwards of the migrants, I also found no upsurge in numbers at other seasons which might balance the autumn data. Possibly the autumn birds returned through the banding area over a longer period, so lessening the concentration of numbers and disguising the movement. Could it be that Silvereye movements follow a circular pattern, therefore no 'return' flight takes place?

Silvereyes banded in the winter months produced a more even recovery rate throughout the year and were thus probably largely the resident birds of the area.

The recording of plumage patterns was not wholly successful because of the relatively poor repeatability of the recording. I feel, therefore, that some form of standardised colour reference is necessary for reliable and uniform recording by all persons examining colour changes. In the past other banders have also found the need for a standard chart of colours (Lane 1966, Robertson 1971, 1972). The 'Naturalist's Colour Guide' by F. B. Smithe, which became available since the fieldwork for this study was completed, may very well fill that need. What changes were detected were probably attributable to moult and age, especially in one clear case where a juvenile bird underwent a 3 point change within 2 months. Two 'Tasmanian' type birds have been described and were the only indication that another race of birds could occasionally be found in the area. The birds' plumage pattern was identical to the 'Tasmanian' type photographed by Lane (Robertson 1971). Walker (1962) gained the impression that 'Tasmanian' types 'are heavier and bigger in appearance than all other Silvereyes', although weighing (Walker 1964) disclosed 'an apparent difference in body weight of only ten per cent'. McKean (1965) also found that 'Tasmanian' (type) Silvereyes were heavier than Canberra or Sydney Silvereyes. Unfortunately I had no equipment for such weight analysis. Nonetheless, this record of 'Tasmanian' type birds on Kangaroo Island presumably extends the previously known winter range of Zosterops lateralis lateralis, the

	Details of older Silvereyes.											
Band Number	Date Banded	Date last Retrapped	Number of days Retrapped	Elapsed Time (Years) (Months)								
011-91748	11 Mar. 66	15 Dec. 74	33	8 - 9								
012-12620	10 Oct. 67	16 Apr. 77	5	9 - 6								
012-12650	23 Nov. 67	13 Apr. 75	11	7 - 5								
012-29003	14 Sept. 68	9 Apr. 76	3	7 - 7								
012-29328	6 Apr. 69	29 Nov. 75	11!	6 - 7								
012-37677	27 Jan. 71	20 May, 78	96	7 - 4								
012-379-18	12 Apr. 71	26 Mar. 78	5	6 - 11								

TABLE 6

nominate race (Mees 1974), beyond Adelaide. It is assumed that the 'Tasmanian' type birds may have made the crossing from the mainland. Much has been written in the past regarding the northward or southward coastal movement of Silvereyes between Tasmania and south-east Queensland (Liddy 1966, Lane and Battam 1971, Robertson 1971, Lane 1972b, Mees 1974), but I find few records of a westward movement (Hitchcock 1966, Mees 1974). Lane (1972b) records the arrival of 'Tasmanian' type Silvereyes in the Sydney district in the month of May and this is consistent with my record. Both Kangaroo Island and Sydney are approximately equidistant from the assumed landfall of birds arriving on the mainland from Tasmania. Could the 'Tasmanian' type Silvereye have a very set migration pattern which might explain why it is seldom, if ever, noted in some areas? Lane (1972b) recorded 63 per cent 'Tasmanian' type Silvereyes at Lane Cove in the winter of 1965 while at Five Dock, only 5 km distant, Swanson (Lane 1972b) found only 1.6 per cent 'Tasmanian' type birds for the same period.

The mainland banded birds that I handled did not appear to be distinguishable from other birds frequenting Kangaroo Island. Thus there would not appear to be a 'Kangaroo Island' type Silvereye distinguishable by colour or size, from a 'Mainland' type bird, unlike the situation in eastern Australia, where several well defined geographical types regularly appear (Walker 1962, 1964). While some birds appear to be, in all probability, permanent residents (Table 2), other groups (Table 3) take up residence only in certain seasons and then move on, reappearing during the same seasons in subsequent years. Lane (1972a) and Swanson and Bradley (Lane 1972a), experienced a similar activity in populations of Silvereyes in New South Wales.

Table 4 denotes the retrap numbers for any season, of Silvereyes banded in that or any other season. Given the dearth of numbers of birds at the banding station in winter and spring, it would seem that most Silvereyes disperse from the area or even perhaps from Kangaroo Island, during those seasons and so are no longer available for trapping.

Some upper limits of lifespan that may be expected within a Silvereye population are indicated in Table 6. Many years of continual effort are required to recapture the large numbers of birds needed (Figure 2) to detect the long lived individuals, some of which may make up the sedentary



Figure 2. Silvereye longevity, as indicated by last recoveries of birds.

June, 1987

population. I found, as did Lane (1972b), that the numbers of Silvereyes present tended to vary considerably from year to year. In particular large numbers were present during 1970 to 1972.

I found trapping to be much more effective than mist-netting. Birds rapidly become net shy and avoid nets, whereas they enter traps readily and repeatedly and give a more accurate indication of birds present in the area.

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THE DIET OF WEDGE-TAILED EAGLES Aquilla audax

In Cindy Hull's recent article (Hull 1986) on this subject, based on a study of pellets and other prey remains at nest sites and roosting trees, I noted a list of species not previously recorded in the Wedge-tailed Eagles' diet. These species included the Sacred Ibis Threskiornis aethiopica. The following observations, as recorded in my diary, may therefore be of interest.

On 6 April 1980, I was motoring near Yuckandandah, Victoria, when I saw two Wedge-tailed Eagles on the ground, one standing on a struggling Sacred Ibis while the other looked on. When disturbed, the attacking eagle backed-off and the ibis got to its feet and staggered to the shelter of some nearby rushes. The eagles then flew up into a tall adjacent eucalypt, where a number of ravens had gathered. We then left the scene.

Arthur Gwynn, 40 Golfers Parade, Pymble, NS.W. 2073

Hull, C. (1986). The diet of the Wedge-tailed Eagle, Aquila audax, breeding near Melbourne. Corella 10: 21-24.