

the moult pattern as an aid to determine age. In this district birds with profuse body moult and complete remiges in late autumn, and birds moulting remiges in spring will be first year birds. This was confirmed by using skull ossification checks in the autumn of 1968. In adult birds the pre-nuptial moult is a replacement mainly of head feathers giving a bright new appearance to the bird. This is a partial moult and not profuse for adult birds.

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## Silvereye Movement in Eastern Australia

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Numerous recoveries have indicated the extent of movement by Eastern Silvereyes *Zosterops lateralis* but little has been recorded of the manner of such movement. Observations on this latter aspect are set out, and for comparison, some instances of movement by small passerines overseas are discussed.

The recovery in Tasmania of an Eastern Silvereye which had been banded seven months earlier in Sydney, New South Wales (Lane 1962) was the first proof of long-distance movement by this species. There is yet no conclusive evidence to indicate the flight speed of or the time taken by these birds between their breeding and wintering areas.

#### Flight Speed

Two European Swallows *Hirundo rustica* banded in South Africa were captured at the nest in U.S.S.R. 34 days later, having covered a minimum distance of 7,500 miles (Rowan 1968). This represents an average of over 200 miles a day but the daily maximum movement was probably greater as the figures would include resting periods.

Graber (1968) estimated distances that could be travelled on a clear night by migrants, mostly

small passerines, that were tracked by radar from central Illinois, U.S.A. His estimates relied on the migrants continuing on the same track as when under radar surveillance. For flight speeds in the vicinity of 30 knots (about 34 mph), a full night's migration could be 400 miles. Graber's estimates were made for typical clear spring and autumn nights, with about 12 hours of darkness. A similar period of darkness prevails in southern Australia at the time of the main silvereye movement.

On a few occasions one of us (SGL) has had the opportunity to check the speed of silvereye flight by automobile speedometer and found it to be in the region of 30 to 35 miles per hour. Probably silvereyes migrate at such speeds for up to 12 hours of darkness and future evidence may confirm daily or nightly movements of over 200 miles for these and other small passerines in Australia.

### Nocturnal Movement

There are few published records of nocturnal silvereye movement. Stidolph (1937) reported night movement in New Zealand in 1923. Gilbert (1935) reported hearing silvereyes calling on numerous occasions at night, particularly in the early morning (before dawn) and premised that "a proportion of silvereyes migrates northwards". He did not state where these observations occurred but almost certainly they refer to the Sydney region.

Since the inception of the Co-operative Silver-eye Banding Project in 1958, numerous aural records of nocturnal silvereye movement have been made at various locations on the east coast. In the Sydney region, night movement was first reported at Cronulla (by Battam) one night in April 1963. Between 19:00 and 19:30 he heard continuous calling from large numbers which were flying in a northerly direction. In the following month, L. C. Haines reported hearing silvereyes calling as they passed over Haberfield in bright moonlight at 01:30 on 9 May; again a northerly movement was indicated. Two nights later J. J. McKean reported a similar occurrence at 03:00 over Burwood. Subsequently nocturnal silvereye movement has often been recorded aurally at Lane Cove, Engadine and other suburbs.

Near Nerriga, some 35 miles south-west of Nowra, N.S.W. the late K. A. Hindwood reported hearing numerous silvereyes calling as they passed overhead at 02:00 on 26 April 1967. About two years earlier Liddy (1966a) stated that at Hastings Point on the north coast of N.S.W. at 05:45 on 22 May 1965 "a flock of several thousand (to judge by the volume of calls) of birds passed over, moving northwards in the moonlight . . . The only calls recognised were those of silvereyes of which there appeared to be several hundred."

At Mario, on the south coast of Victoria, at 19:30 on 6 May 1967, C. Hodge (pers. comm.) reported a flock of silvereyes which "came from seaward and went inland in a northerly direction. It would be difficult to say how many as they passed overhead, but I would say 500 (plus)." Also in Victoria a southerly movement was reported from Dandenong at 04:00 on 13 September (year not given).

Another southerly movement was reported from Sydney by Trevor Lane; at 21:15 on 22 September 1967 he heard silvereyes calling as

they flew in a southerly direction over Longueville.

In the Brisbane *Courier-Mail* on 20 June 1970, Ian Gall recorded an interesting observation made at sea by two fishermen a week earlier. Off the south coast of Queensland, some 3½ miles north-north-east of Cape Moreton at the north end of Moreton Island, they heard silvereyes calling as they flew overhead for more than an hour from about 03:00. No flight direction was given.

### Study Area Observations

On a plateau west of Mount Keira, N.S.W. at an altitude of about 1,500 feet a study area is established in a sandstone scrubland environment. The vegetation includes a predominance of *Banksia ericifolia*, a shrub which flowers profusely in autumn and winter, providing food for migrating silvereyes and honeyeaters. This area is visited by banders (Battam and others) usually weekly from late February to September and less frequently at other times. Records were kept of silvereye movements during the years 1966-1968.

Nocturnal movement was aurally recorded in the one to two hours preceding dawn while mist nets were being erected. The following pattern was noted: Night movement was in a northerly direction from late February until mid July when it ceased. Southerly movement was recorded twice only—on 20 October 1966 and 19 August 1967.

From late February to early April, nocturnal silvereye movement dwindled to zero by dawn and during the day silvereyes were not seen or heard in the area. Banksias are not in flower at that time of the year and movement apparently continues to areas where food is available, possibly rainforest and domestic gardens some three or four miles to the east. From early April until July the migration does not cease at dawn but seems to continue during the day in a different manner. At daylight, migrating silvereyes move through the areas of flowering banksias and many are caught in mist nets during this period. Of the silvereyes caught, less than two per cent are retrapped in the area more than a week later. This low retrap rate indicates that the birds are continually moving through the area. For instance, on 6 May 1967, a total of 714 silvereyes was banded. The following

morning some 220 were caught including only 24 which had been banded the previous day, most of them in the late afternoon.

Nocturnal silvereye movement still proceeds in poor weather conditions and the birds appear to be correctly orientated. On 24 June 1967, the sky was completely overcast with cloud only a few hundred feet above the terrain. A strong south-easterly wind was blowing and light rain fell continuously. During the two hours preceding dawn, silvereyes in small flocks, apparently calling from a low altitude, were continuously moving north. As daylight approached, the flocks came lower and could be seen moving above the vegetation. By daybreak the flocks had dropped into the vegetation and overhead movement ceased.

### Discussion

From the limited data available, it seems that silvereye migration may occur at virtually any hour of darkness and under varying weather conditions. More precise information such as the numbers migrating in any particular period, the altitude or altitudes at which the birds migrate, the effects of moonlight, cloud density and height, wind speed and direction and visibility etc. is difficult to obtain.

In central Illinois, counts of nocturnally migrating birds were obtained using both radar and aural observation (Graber p. 39). Radar missed migration below 1,500 feet, while overcast skies caused migrants to call more often, resulting in a considerable variation in counts using aural methods; each method revealed limitations and failed to give an accurate count.

Radar studies in the same area (Bellrose 1967) showed that comparable numbers of birds can be aloft and correctly orientated under overcast skies as under clear skies, provided winds are favourable. Also migrants were aloft for similar periods of up to 12 hours and probably covered similar distances under both conditions.

### Diurnal Movement

There have been few reports of diurnal silvereye migration possibly because it tends to be discontinuous; usually the birds move in small parties or groups, in a series of short hops, feeding in between. However some continuous daylight movement has been observed. McKean

(pers. comm.) recorded daylight movement of these birds in a northerly direction across Bass Strait while banding Short-tailed Shearwaters *Puffinus tenuirostris* at Cape Woolamai, Vic. on 25 and 26 March 1961. Flocks were observed coming in from the sea and passing over at about 150 feet altitude. The flocks comprised from 30 to 50 silvereyes. Several exhausted birds landed in the bushes on the side of the cliffs and were nearly captured by hand.

Liddy (1966a, 1966b) also observed flocks of some hundreds moving north with Yellow-faced Honeyeaters *Meliphaga chrysops* near Kingscliff on the north coast of N.S.W. in May. P. J. Spurge reported seeing a "continuous stream over 50 yards wide" flying southward from Tweed Heads on 7 November 1966. The movement was still in progress when he left the area after about five minutes.

### Conclusion

Large scale movement of silvereyes takes place in eastern Australia during autumn and winter; some northward movement commences in late summer and some southward movement is recorded in late spring or early summer. Most of the movement is nocturnal and extends from Tasmania to southern Queensland.

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