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A NOTE ON THE BREEDING OF THE LITTLE EAGLE *Hieraeetus morphnoides* AND OTHER RAPTORS IN THE MT MUGGA AREA, ACT

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In 1980, two nesting pairs of Little Eagles *Hieraeetus morphnoides* were found in the Mt Mugga area, ACT. They were located again in 1981 and the date of laying noted by climbing to the nest every day or so around the estimated time of laying; this was repeated for some nests in 1982, 1984 and 1985. Starting in June 1982 and finishing in January 1986, a count was made of all birds, mammals and reptiles seen during a monthly two-hour morning walk (for details of the birds, see Olsen *et al.* 1990). In addition a search was made for all raptors nesting in the approximately 10 square km study area.

Mt Mugga adjoins suburban Canberra and is a small mountain, with gently sloping sides, 812 m above sea level. Partly cleared paddocks cover the foothills while woodland predominates near the summit. The climate is temperate; 1981 and 1985 were years of average rainfall (651 mm of rain on 109 days and 604 mm/101 d, respectively; longterm average 624 mm/105 d), 1980 and 1982 were drought years (476 mm/88 d, 262 mm/66 d, respectively), and 1983 and 1984 were wet (757 mm/113 d, 800 mm/118 d, respectively).

Both pairs of Little Eagle laid each year, except in 1985 when only one pair laid. They used a number of nests in different trees over the period; one pair used two nests in four years and the other pair four nests in five years. Each pair used one nest for two consecutive years before using another, regardless of their success at breeding. During the study they either built a new nest or refurbished one of their old nests; however, in 1986 they refurbished an old nest of a Wedge-tailed Eagle *Aquila audax*.

Extensions brought the suburbs closer to the nesting eagles each year; the shortest distance between an active eagle's nest and houses was about 0.75 km. The longest distance between nests used by what were assumed to be the same pair of Little Eagles was 1.5 km (Fig. 1). In the two

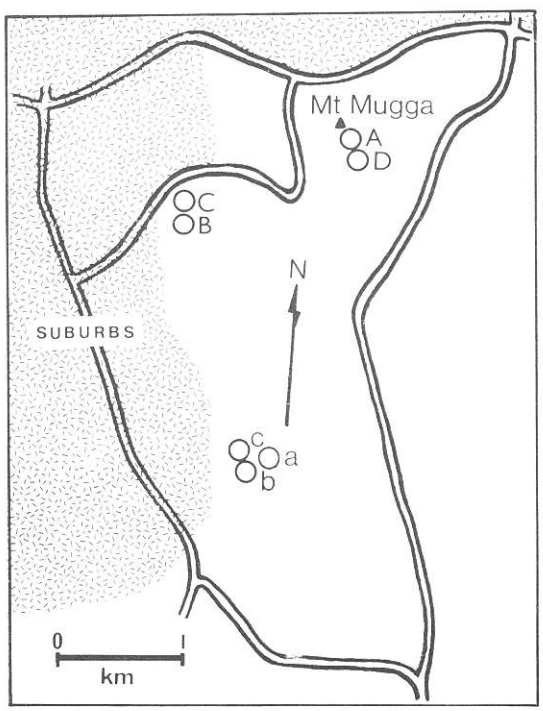

Figure 1. *Map of Mt Mugga study area showing location of nests of Little Eagles. Pair 1: A—1980, 1981, 1982; B—1983; C—1984; D—1985. Pair 2: a—1980; b—1982, 1983; c—1981, 1984.*

wet years (1983, 1984) those eagles moved from a tree near the peak of Mt Mugga to lower on the hillside, possibly a less exposed position. The closest that the two eagle pairs nested to each other was 2 km. Other raptors nested as close to the Little Eagles as 0.25 km (Brown Falcon *Falco berigora*), 0.33 km (Brown Goshawk *Accipiter fasciatus*), 0.33 km (Australian Hobby *F. longipennis*), and 1.0 km (Australian Kestrel *F. cenchroides*).

The remains of food found in or under the nests included Australian Raven *Corvus coronoides*, Common Starling *Sturnus vulgaris*, young Rabbit (about 300–400 g) *Orytolagus cuniculus*, Cunningham's Skink *Egernia cunninghami* and insect fragments. Other studies (Debus 1984; Baker-Gabb 1984) have found a predominance of rabbit in the diet of Little Eagles, as well as a variety of birds and reptiles.

Although numbers were small some interesting trends were evident. The Little Eagles' eggs hatched on 11 and 16 October in 1981, 9 October in 1982, 11 October in 1984 and 7 October in 1985. Laying was therefore in the first week of September. For 1982-85, when rabbits were counted, a significant relationship was found between the number of rabbits seen in September and the date that the eagles laid (assuming an incubation period of about 37 days). The greater the number of rabbits, the earlier the eagles laid,

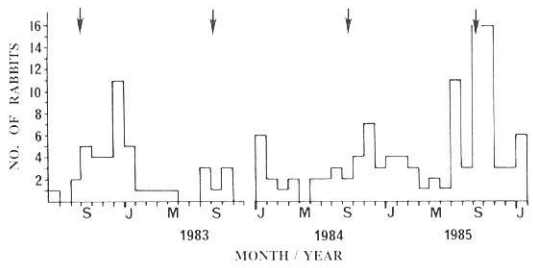

Figure 2. *Numbers of rabbits seen each month during monthly transects of the study area. Arrows indicate month of laying for Little Eagles. No count was made for December 1983.*

as reflected by the date of hatching; the relationship can be expressed by the equation: day of hatching (day of year) = 246.98 −0.26 (number of rabbits in September), $r = -0.95$, d.f. 2, $P < 0.05$. In general, the eagles laid when rabbit numbers were relatively high and during months when rabbits were most consistently seen during the monthly surveys (Fig. 2, Table 2, rabbits seen in 15 of 16 surveys during the months August, September, October and November). Aumann (1986) noted that hatching of Brown Goshawks roughly corresponded with peak rabbit and bird numbers in his Victorian study area. We could find no correlation with bird numbers although the number of bird species was at its highest about the time of laying (September, Table 1).

TABLE 1

Number of young fledged by all raptors found on Mt Mugga 1980–85. Numbers indicate the number of young per nest, e.g., 1,1 indicates that one chick fledged from each of two nests. Little Eagle pair 1 is listed before pair 2.

Year	Little Eagle	Brown Goshawk	Australian Hobby	Brown Falcon	Australian Kestrel	Rainfall
1980	1,2	3	2	—	—	dry
1981	1,1	3,3	—	1,3	—	average
1982	1,1	4,3	—	1	—	dry
1983	1,1	—	—	1	—	wet
1984	1,0*	—	—	4	3	wet
1985	1,–	2,3	—	—	—	average

*2 eggs, both hatched and the chicks died in the first day or two.

Newton (1986) found that the timing of laying for European Sparrowhawks *Accipiter nisus* was related to temperature and raindays in the month before egglaying. The relationship between weather (mean maximum temperature, mean temperature, rainfall and number of raindays for each month from August to October) and timing in the Mt Mugga study was investigated, and only the relationship between date of hatching and September rainfall approached significance. Rabbit numbers were not related to rainfall in September, so that the relationship between date of laying and rain was independent of weather.

The number of raptors seen during the bird counts was small (Table 1) and was not related to rabbit numbers. However, raptors were seen most often in spring when rabbit numbers and numbers of bird species were at their greatest (Fig. 1). When the data for each year were pooled according to season (e.g., number of birds per month for July + August + September = number of birds per month for winter) the number of raptor species seen was correlated with the number of species of resident birds seen [number of raptor sp./mo. each season = $-1.3 + 0.13$ (number of res. bird sp./mo. each season), $r = 0.65$, d.f. 14, $P < 0.01$] and with the total number of birds per month for each season [number of raptor sp./mo. each season = $2.05 - 0.01$ (number of birds/mo. each season), $r = -0.63$, $P < 0.01$].

Little Eagles bred each year of the study regardless of rabbit or bird numbers. The reason for the failure of one nest in 1984 was not apparent. In 1985 the rabbit warrens were ripped in October, during the early nestling period, but this had no obvious effect on the eagles. Kestrels bred in the study area in 1984, the only year when the House Mouse *Mus domesticus* was recorded in the monthly transects during the breeding season. Brown Goshawks bred in the two years with high rabbit numbers (1982, 1985), not in the two (wet) intervening years. In general, both the number of raptors breeding and the number of chicks successfully fledged were lower in wet years than in average or dry years (Table 2).

TABLE 2

Species seen during monthly surveys of the Mt Mugga area, June 1982–January 1986. The number of individuals per month, to the nearest whole number, are shown. Final columns show the total number of individuals (ind.) seen over the survey period, total months that species was seen, and the percentage of monthly surveys (%ms) during which that species was seen.

	Month												Total		
	J	F	M	A	M	J	J	A	S	O	N	D	ind.	months	%ms
No. monthly surveys	4	3	3	2	3	4	4	4	4	4	4	3	—	42	—
Lizards*	<1	1	1	0	0	0	0	0	0	0	2	0	7	6	14
House Mouse	0	0	1	0	0	0	<1	0	0	0	0	0	3	2	5
Rabbit	5	2	2	4	1	1	3	3	6	7	4	4	149	37	88
Brown Hare**	<1	1	0	0	0	0	1	0	<1	<1	<1	0	8	7	17
Brown Goshawk	<1	0	0	0	0	0	1	0	1	1	1	1	14	13	31
Wedge-tailed Eagle	0	0	0	0	0	0	0	<1	0	0	0	0	1	1	2
Little Eagle	1	1	1	1	0	0	1	1	1	0	1	1	25	13	31
Peregrine Falcon†	0	0	0	0	0	<1	1	0	0	0	0	<1	4	3	7
Australian Hobby	0	0	0	0	0	0	<1	<1	<1	0	0	0	3	3	7
Brown Falcon	0	2	<1	1	0	0	1	1	<1	<1	1	1	19	15	36
Australian Kestrel	0	<1	0	2	0	<1	<1	<1	<1	<1	1	2	17	10	24
Total birds/month	162	129	201	168	155	136	125	118	137	103	116	103	5686	—	—
Total bird species	36	21	24	25	32	37	37	36	46	42	41	39	—	77	—

*Cunningham's Skink, Blue-tongue Skink and Bearded Dragon.
**_Lepus capensis_
†_F. peregrinus_

Breeding success was similar to that found in other studies. The Little Eagles fledged two chicks from one of ten successful nests; Debus (1984) found one in six in the RAOU's Nest Record Scheme, but no broods of two in his Armidale study. Ten of 11 attempts at breeding succeeded to give 1.0 young/pair and 1.1 young/successful pair (brood size). Debus (1984) found 0.5 young/pair at Armidale and Baker-Gabb (1984) found 0.8 in north-western Victoria, fewer than Mt Mugga. Both those authors reported an average brood size of 1.1, the same as Mt Mugga. The Brown Goshawks had a brood size of three; Aumann (1986) found 2.4 in his Victorian study area and Baker-Gabb (1984) 2.2. At Mt Mugga Brown Falcons fledged an average of 1.8 young; Baker-Gabb (1984) reported 2.4.

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METHODS FOR ATTACHING PATAGIAL TAGS, AND A DESCRIPTION OF A NEW METHOD

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Patagial tags have been used for field identification of individual birds since at least 1953 (Koskimes and Routamo cited by Anderson 1963). To judge by the ornithological literature, their use is increasingly widespread as the technique becomes more widely known and better developed.

Three decisions follow on the initial decision to use patagial tags: (a) what material to use for the tag; (b) how to attach the tag; and (c) how to pierce the patagium. This last stage is crucial both for the welfare of the bird and for the continuing successful attachment of the tag, yet it has received little attention in the literature.

In general, the material used to attach the tag to the wing is used to pierce the patagium. Thus, where steel pins are used (Koskimes and Routamo 1953; Anderson 1963; Blackman 1973; Cowling 1973; Hart 1987), they are made sharp so as to pierce the tissues. Similarly, nylon rods can be cut to a point for this purpose (Picozzi 1971; Reimer, pers.comm.).

Where stainless steel or other wire is used (Brereton and Pidgeon 1967), it will either be fine enough to pierce the patagium or can be cut to a point for this purpose. Where nylon fishing line has been used a hole has first been punched with a leather punch (Maddock 1989). Others (Hester 1963, 1963a; Parry 1967) have used aluminium poultry wing bands to hold tags in place. These bands were placed through slits in the patagium which were presumably first cut with a blade. Recently Cummings (1987) has pioneered the use of a commercial fastening gun (a Buttoneer II), which uses a nylon fastener inserted through the patagium with a heavy duty needle.