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# SEASONAL CHANGES IN RAPTOR NUMBERS AT ARMIDALE, NEW SOUTH WALES

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Transect counts and other observations in 1980 and 1984-1985 revealed a winter low and summer peak in raptor numbers and species diversity at Armidale (N.S.W.). Most of the common species were more numerous in summer than in winter; literature data indicate that these species are correspondingly more numerous in winter than in summer in some climatically less extreme areas in eastern and south-eastern Australia. Some species at Armidale appear to conform to Newton's (1979) movement categories: (a) breeding adults sedentary, surplus birds dispersive (Wedge-tailed Eagle *Aquila audax*, Little Eagle *Hieraaetus morphnoides*, some Brown Falcons *Falco berigora* and Australian Kestrels *Falco cenchroides*); (b) local movements (some Collared Sparrowhawks *Accipiter cirrhocephalus*, Peregrine Falcons *Falco peregrinus* and Brown Falcons ; (c) migrants (breeding: some Brown Goshawks *Accipiter fasciatus* and Australian Kestrels; wintering: Marsh Harrier *Circus aeruginosus*); (d) nomadic or irruptive (Black-shouldered Kite *Elanus notatus*, Black Kite *Milvus migrans*).

Published information on the seasonal movements of common Australian raptors is still fragmentary. Evidence (reviewed by Blakers *et al.* 1984) on the movements of some species has come from band returns, recorded fluctuations in numbers, visible passage at a given place, and the presence of southern forms in northern Australia and islands to the north during their non-breeding season.

Baker-Gabb (1984a,b) undertook regular transect counts to detect seasonal changes in raptor number in Victoria. A similar approach was used at Armidale (30° 30'S., 151° 40'E.) on the Northern Tablelands of New South Wales during 1980. This was a drought year; only 68% of the mean annual rainfall was recorded. The drought broke in 1983, and transect counts were resumed in mid 1984.

## METHODS

In 1980, a seasonal index of raptor numbers was obtained by regular road counts on five closed routes radiating from Armidale. All raptors seen with the unaided eye, or first heard or detected by the reactions of other birds, were noted and stops were made only to identify birds where necessary. Additional counts were made during regular train travel between Armidale and Woolbrook 68 km to the south-west. The same distance and routes were travelled according to a standard pattern each season. Table 1 details the distribution of counts through the year and the mode of travel. Where a car was used instead of a bicycle, there was usually at least one additional observer Car speed was not more than 60 km per hour and was not more than 40 km per hour on the few occasions (late in

TABLE 1

Monthly distribution of raptor transect counts at Armidale, 1980-1981. Travel was by bicycle unless otherwise indicated: c = car, t = train.

| Route | Distance (km) | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec. | Jan | Total per season |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 24 | — | 2 | 2 | — | 2 | 2 | 1 | 2 | 1 | — | 4(2c) | 4 |
| 2 | 21* | — | 2 | 2 | — | 2 | 2 | 1 | 2 | 1 | — | 4(2c) | 4 |
| 3 | 31** | — | 2 | 2 | — | 2 | 2 | 1c | 2 | 1 | — | 4(2c) | 4 |
| 4 | 34 | — | 2 | 2 | — | 2 | 2 | 1c | 2 | 1 | — | 4(3c) | 4 |
| 5 | 74 | 1 | 1c | 1c | 1c | 1c | 1c | 1c | 1c | 1c | 2c | 1c | 3 |
| 6t | 68 | — | 3 | 3 | — | 2 | 4 | 1 | 3 | 2 | 3 | 3 | 6 |

* includes 8 km within Armidale city
**includes 11 km within Armidale city

the year) when no additional observers were present. Counts were equally distributed between morning and afternoon on routes 1-4 (starting two hours after sunrise or finishing within the hour before sunset), and were done in the morning on routes 5 and 6. Counts were opportunistic, so weather conditions were variable and counts were not precisely spaced, however rainy weather was avoided.

Armidale is located on an outlier of the south-eastern highlands, a region characterised by marked seasonality and low winter temperatures (*cf.* Nix 1976).

The general study area has been described by Genelly (1978), Kikkawa (1980) and Ford and Bell (1981). Suffice it to say here that the winters are quite severe, with occasional snowfalls. Routes were selected to maximise the habitat types traversed, and each route had some unique features although all passed through undulating, partly cleared grazing land with remnant patches of *Eucalyptus* dominated open forest and woodland.

**Route 1:** passed adjacent to a water reservoir (*c.* 20 ha of open water).

**Route 2:** passed adjacent to the Armidale sewage treatment works (several hectares of marshy ground and settling ponds) and a 107 ha *Pinus radiata* plantation.

**Route 3:** flatter and more open than the other routes; trees more severely cleared or affected by dieback.

**Route 4:** more diverse than other routes; passed some cultivation paddocks (orchards and sorghum).

**Route 5:** climbed to *c.* 300 m higher elevation at the mid-point (Black Mountain 20 km north of Armidale).

**Route 6:** passed through several kilometres of flat, almost treeless terrain; also passed a large (*c.* 65 ha), shallow fresh-water swamp.

In 1984, approximately monthly road counts were resumed on a closed route that incorporated parts of the previous routes 1, 3, 4 and 5. This 50 km survey is being conducted according to the guidelines of Baker-Gabb (1981), with two observers in a car travelling at not more than 50 km per hour. This is part of a long-term study, but preliminary data are presented here to supplement the 1980 results.

## RESULTS

Transect counts (Tables 2 and 3) revealed seasonal fluctuations in numbers of all the common species in 1980. The trend for most species was one of decline through the year to a low in winter or spring, then an increase in summer. This trend also applied to species diversity (Tables 2 and 3). The Armidale urban area supported the poorest tally, followed by route 3 (especially in the breeding season). Route 5 showed greater fluctuations in numbers and diversity than the other routes. The raw data

TABLE 2

Seasonal count of raptors at Armidale March, 1980 to January, 1981, routes 1-5. Figures in parentheses are the totals including route 6. All species except the Black Falcon bred in the area in 1980.

| Species | Autumn | Winter | Spring | Summer | Significance ($X^2$) |
|---|---|---|---|---|---|
| Black-shouldered Kite | 12 (14) | 8 (9) | 5 (6) | 10 (11) | n.s. |
| Whistling Kite | 11 (17) | 3 (4) | 3 (7) | 11 (24) | $p<0.05$[a] |
| Brown Goshawk | 2 (3) | — | 7 (8) | 8 (16) | $p<0.05$[a] |
| Wedge-tailed Eagle | 11 (12) | 7 (7) | 4 (4) | 2 (2) | n.s.[b] |
| Little Eagle | 24 (25) | 7 (7) | 7 (8) | 13 (18) | $p<0.01$ |
| Black Falcon | — (2) | — | — | — | — |
| Australian Hobby | 2 (2) | — | 1 (1) | 1 (1) | — |
| Brown Falcon | 33 (54) | 14 (25) | 11 (20) | 9 (34) | $p<0.001$ |
| Australian Kestrel | 59 (94) | 38 (43) | 40 (60) | 61 (122) | $p<0.05$[a] |
| Total | 154 (223) | 77 (95) | 78 (114) | 115 (228) | $p<0.001$ |
| No. species | 9 | 6 | 8 | 8 | |

[a] for routes 1-5 only; $p<0.001$ for routes 1-6.

[b] for routes 1-5; $p<0.05$ for routes 1-6 (but note summer only records in Table 4)

TABLE 3

Raptor diversity on routes 1-5, Armidale March, 1980 to January, 1981. Figures are no individuals/no. species)

| Route | Distance (km) | Counts/ season | Distance/ season (km) | Raptor diversity | | | |
|---|---|---|---|---|---|---|---|
| | | | | Autumn | Winter | Spring | Summer |
| 1 | 24 | 4 | 96 | 17/6 | 9/4 | 22/7 | 16/5 |
| 2 | 13 | 4 | 52 | 13/5 | 5/4 | 8/3 | 15/4 |
| 3 | 20 | 4 | 80 | 21/4 | 11/5 | 5/2 | 10/4 |
| 4 | 34 | 4 | 136 | 38/6 | 25/5 | 20/5 | 30/6 |
| 5 | 74 | 3 | 222 | 60/8 | 21/2 | 20/3 | 35/6 |
| City* | 19 | 4 | 76 | 5/3 | 8/3 | 2/2 | 9/3 |
| All routes: | | | 662 | 154/8 | 77/6 | 78/8 | 115/8 |

*those sections of routes 2 and 3 traversing the Armidale urban area are shown separately.

for Tables 2 and 3 are to be published separately as an accessory publication (Debus 1985).

Data for 1984-1985 (Table 4) also show a winter low and a summer peak in raptor numbers and diversity at Armidale.

TABLE 4

Monthly count of raptors along a 50 km transect at Armidale, May, 1984 to September, 1985. Species as in Table 2.

| Species | M | J | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Black-shouldered Kite | — | — | — | — | — | — | — | — | — | 1 | 3 | 3 | 3 | 6 | 2 | 1 | 2 | 1 | — |
| Black Kite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — |
| Whistling Kite | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Brown Boshawk | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | 1 | 3 |
| Wedge-tailed Eagle | — | — | — | — | — | — | — | — | 2 | 2 | — | — | — | — | — | — | — | — | — |
| Little Eagle | — | — | — | — | — | — | — | — | 1 | — | 1 | 1 | — | — | — | — | — | — | — |
| Black Falcon | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Peregrine Falcon | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | 1 | — |
| Australian Hobby | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | 2 | — | — | 2 | — |
| Brown Falcon | — | — | 2 | 2 | — | 3 | 5 | — | 1 | 1 | 8 | 1 | — | 2 | 1 | — | 2 | — | 1 |
| Australian Kestrel | 2 | 5 | 1 | 1 | 9 | 8 | 7 | 7 | 7 | 8 | 3 | 3 | 4 | 3 | 4 | 3 | 3 | 10 | 7 |
| No. species: | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 1 | 4 | 5 | 4 | 4 | 2 | 3 | 4 | 2 | 3 | 6 | 3 |
| | | | | 2 | | | 4 | | 6 | | | 4 | | | 4 | | | 7 | |
| No. individuals: | 2 | 4 | 3 | 3 | 10 | 11 | 13 | 7 | 11 | 13 | 15 | 8 | 7 | 11 | 9 | 4 | 7 | 16 | 11 |
| | | | | 10 | | | 34 | | 31 | | | 30 | | | 24 | | | 34 | |

## SYSTEMATIC LIST

**Black-shouldered Kite** *Elanus notatus*
Easily seen when flying and hovering, and when perched on poles and wires along roads and railway lines (to which it is attracted) and on dead trees. Fluctuations in numbers in 1980 were not significant (Table 2). In 1983-1984 there was a mouse plague on the slopes and plains west of Armidale; during this time the Kites were seldom seen at Armidale. Following the decline of the mouse plague, Kites in adult plumage appeared at Armidale (Table 4), often in pairs, and defended territories. This suggests that this species is periodically resident, rather than adhering to a regular seasonal pattern, at least over the period of the survey.

**Black Kite** *Milvus migrans*
Not detected on 1980 transects. A single individual occasionally seen at other times in 1980 near the swamp on route 6. An irruption occurred in 1978 (pers. obs.); according to local residents the kites bred during this or a previous irruption. Recorded once on later transects, when conspicuous in flight over a road.

**Whistling Kite** *Haliastur sphenurus*
Easily seen in flight, also readily detected by its call, but may be overlooked when perched in leafy trees. Rumoured to be declining locally. Hunt (1977) recorded one active nest per 1.6 km of river in past years at Inverell (100 km north-west of Armidale); in 1980 two active nests in this study area were 15 km apart and two others reported as roughly between these were apparently no longer in use. A nest in dry agricultural land (nest 1, see Debus 1983) has since been deserted, and the species has not been recorded on recent road counts (Table 4). Perhaps the abundance of lamb carrion in the drought year of 1980 permitted temporary breeding away from water bodies. Sightings in 1983-1985 have been confined to the vicinity of water.

**Brown Goshawk** *Accipiter fasciatus*
A skulking species, difficult to detect on transects. Seen when flying or soaring near roads, but easily overlooked when perched. Appears to leave the Armidale district for the winter; becomes noisy and conspicuous in display in spring. Occasional adults and immatures are observed in the Armidale urban area in autumn and winter, and numbers increase at New England National Park 70 km east of Armidale in autumn and winter (McFarland 1984). Active nests at Armidale in 1980 were about 1 km apart where the habitat permitted.

**Collared Sparrowhawk** *Accipiter cirrhocephalus*
Not seen on transects as it is small and skulking; occasionally seen at other times, particularly in forested country to the east of Armidale. Adults are occasionally observed within Armidale city during the winter months (pers. obs., P. Jarman pers. comm.); a spring sighting of an immature in the city coincided with the fledging of Common Starlings *Sturnus vulgaris*.

**Wedge-tailed Eagle** *Aquila audax*
Large and conspicuous, readily seen when perched and flying, to greater distances from the observer than the other species. Immatures and surplus adults (as evidenced by territorial evictions) present in the autumn to spring of 1980 (but not route 5 in winter); preoccupation with nesting probably accounts for the low spring to summer tally (nests were well away from transect routes). Several active nests averaged *c.* 5-6 km apart in the study area, suggesting a breeding density of about 3 000 ha per pair. Birds recorded in January, 1985 (Table 4) were immature: Tables 2 and 4 in combination suggest that seasonal fluctuations are not significant.

**Little Eagle** *Hieraaetus morphnoides*
Inconspicuous except when flying at close range, and when displaying; sometimes detected first by call. Often perches in leafy trees rather than on exposed perches. Some apparently left the area for the winter in 1980 (Table 2), but most of the ten known pairs studied at the nest were present all year. Breeding density at Armidale was about 1 600 ha per pair (Debus 1984).

**Spotted Harrier** *Circus assimilis*
Not seen on transects. Single records in 1982: route 6 in November and Armidale in December, possibly drought-related.

**Marsh Harrier** *Circus aeruginosus*
Not seen on transects; several on a large lagoon 50 km north of Armidale in winter 1980 and one at the swamp on route 6 in autumn 1984 and winter 1985.

**Black Falcon** *Falco subniger*
Chance sighting of a pair from the train in March 1980, otherwise not seen on transects. Other sightings of 'a' single birds in the area 1979-1984 in January, March, April (once each), September (three times) and November (twice), which suggests that this species is a scarce but regular visitor in the warmer months.

**Peregrine Falcon** *Falco peregrinus*
Not seen on transects in 1980; 'one' seen in 1984-85 in flight near a road, when reasonably conspicuous. Seen away from known breeding sites in the cooler months: family parties and single adults and immatures occasionally in the outer Armidale urban area and surrounding country.

**Australian Hobby** *Falco longipennis*
Difficult to detect on transects, as it is small and inconspicuous. Seen on exposed perches and in flight at close range. Transect counts and other observations suggest that the species is present all year but records are too few to detect any seasonal fluctuations.

**Brown Falcon** *Falco berigora*
Detection as for Black-shouldered Kite, perhaps more conspicuous because of its larger size and loud calling. There was an indication of a peak in numbers in autumn before the winter decline in 1980; other observers remarked that there were many Brown Falcons around at this time. The summer increase was largely confined to route 6, especially the flat, open terrain. There was an apparent movement pulse through the area in March 1985 (Table 4): five birds, some obviously juveniles, were seen together. Some adults in distinct and recognisable plumage can be seen regularly in predictable places in winter, suggesting that they hold winter territories in areas where they do not breed (e.g. on the outskirts of the city).

**Australian Kestrel** *Falco cenchroides*
Detection as for Black-shouldered Kite. The trend in numbers in autumn 1980 followed that found by Genelly (1978), however some adults as well as juveniles appeared to leave, perhaps because of drier conditions than in 1975. Other observers remarked that Kestrel numbers seemed lower than usual in 1980. Genelly's study did not extend beyond autumn, so he did not detect any winter decline. Trends in 1984-1985 were similar to 1980; a marked spring influx was evident (Table 4).

## DISCUSSION

In 1980 some general trends in raptor numbers could be discerned. However the value of the value of the study is limited because it lasted for one year only (a drought year) and results may have been a typical. Baker-Gabb (1984a) found marked differences in results for some species in consecutive years. Except for the Black-shouldered Kite, which showed irregular fluctuations as in many other areas (Blakers *et al.* 1984, Baker-Gabb 1984a,b), trends in 1984-1985 parallelled those in 1980. It appears that raptor numbers and diversity experience a regular winter decline as might be expected from the seasonal climatic extremes (*cf.* Nix 1976). The data support Nix's predictive models that birds breeding in the south-eastern highlands are likely to move elsewhere for the winter, and that seasonal fluctuations in bird numbers are marked where seasonality is pronounced.

Mortality could account for some of the winter decline in raptor numbers at Armidale, but this is unsubstantiated. However the subsequent increase in numbers has preceded the fledging of local juveniles of several species (Brown Goshawk, Little Eagle, Australian Kestrel), and in fact fledglings of these species were rarely seen on summer road counts. This suggests that there is a genuine departure and arrival of some individuals of the more common species.

The question remaining is the birds' winter destination .Numbers of some of these species increase in autumn to winter in more temperate coastal or inland localities: Whistling Kite on the coast (N.S.W.: Debus 1982; Vic.: Baker-Gabb 1984b); Brown Goshawk on the coast (N.S.W.: Bennett 1973, Debus 1982; Vic.: Baker-Gabb 1984b); Little Eagle on the coast (Qld: Longmore 1978; N.S.W.: Debus 1982; Vic.: Baker-Gabb 1984b) and possibly inland (Vic.: Calaby 1951); Brown Falcon and Australian Kestrel on the coast (N.S.W.: Debus 1982) and inland (N.S.W.: Blakers *et al.* 1984; Qld: Storr 1973, pers. obs.). "Leapfrogging", in which birds from higher latitudes migrate beyond resident birds at lower latitudes, is common in Northern Hemisphere raptors (Newton 1979). There are indications in the literature (e.g. Storr 1973; Reader's Digest 1976) that this may be occurring in Australia (from cooler regions to the tropics) in the Brown Goshawk, Australian Hobby, Brown Falcon and Australian Kestrel at least,

and probably others. Further banding studies may confirm that birds wintering in northern Queensland originate in south-eastern Australia. However, it appears that for many of the species in this study seasonal movements are not on a large scale (Blakers *et al.* 1984), certainly not on the scale of Northern Hemisphere migrations although passage is visible at points such as Bass Strait (Thomas 1969). The above literature data support Nix's (1976) predictive models on the winter destinations of birds originating in south-eastern Australia.

Raptor density and diversity are inversely related to the intensity of human use of the land (Newton 1979). The results for the city and route 3 (intensively grazed) agree with Newton's finding that the value of the landscape as raptor habitat increases in the order: urban, cultivation, improved pasture, rough grazing, natural vegetation cover. The extreme fluctuations on route 5 were probably a result of the more severe winter at higher altitude, and the effect this has on prey availability. However it should be remembered that in drawing these conclusions the author is aware that relative abundance and not density was measured in this survey.

Morris *et al.* (1981) gave status and movements data on New South Wales raptors, but much of this seems based on subjective opinion. They considered adults only, and their blanket term "partial nomad" incorporated post-breeding dispersal and altitudinal migration. This term obscures what is probably a more complex situation involving regular wintering areas, at least for some of the species in this study. "Partial nomad" is also an inappropriate term for the Wedge-tailed Eagle, which is sedentary as a breeding adult in temperate regions (Leopold and Wolfe 1970, Reader's Digest 1976). Until more banding data are forthcoming, "resident" may be a premature label for species such as the Collared Sparrowhawk and Australian Hobby, since small species are more apt to make seasonal movements than larger species (Brown 1976). Different strategies may operate in different climatic zones, according to the birds' food supply.

Newton (1979) has identified five categories of residence status for raptors, but data are insufficient to place more than a few Australian species firmly in any category. At Armidale it appears that some of the raptors can be categorised in the following way:

(a) Breeding adults sedentary, surplus birds dispersive (Wedge-tailed Eagle, Little Eagle, some Brown Falcons and Australian Kestrels)

(b) Local movements to winter territories (some Collared Sparrowhawks and Brown Falcons), or expanded home ranges in winter (some Peregrine Falcons)

(c) Breeding migrants (some Brown Goshawks, and Australian Kestrels) or winter (non-breeding) migrants (Marsh Harrier)

(d) Nomadic or irruptive (Black-shouldered Kite, Black Kite).

Further banding studies, transect counts and individual marking of birds are needed in this and other areas to provide more data on raptor movements, possible routes and concentration areas and wintering areas, and on age and sex differences in movements. There is scope for much more work on even the common Australian species; transect guidelines suggested by Baker-Gabb (1981) deserve wide adoption because they offer a standardised approach.

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