

SHORT COMMUNICATIONS

DISTRIBUTION, STATUS, MOVEMENTS AND BREEDING OF THE GREY FALCON *FALCO HYPOLEUCOS*

Little is known of the elusive Grey Falcon *Falco hypoleucos*. It is the rarest of Australia's six falcons and has always been considered so (North 1912). Sighting of the falcon is a notable event and the finding of a nesting pair exceptional. No detailed studies have been done although there are two recent reports of observations made at three nest sites (Cupper & Cupper 1981; Hollands 1984). Other anecdotes are scattered throughout the literature but many have recently been gathered together by Debus & Czechura (1985).

This paper summarizes and interprets the information contained in the literature, the RAOU's Field Atlas and Nest Record Schemes, skin and egg collections in museums and private collections, our own unpublished information and that solicited from colleagues. Only those records thought beyond reasonable doubt to be genuine are included in the study.

RESULTS AND DISCUSSION

Distribution

Grey Falcons have been sighted over much of mainland Australia (Fig. 1). Cape York is the only major area where they have not been reported. They have seldom been seen on the Nullarbor Plain and in the Great Victoria, Gibson and Great Sandy Deserts. Recently, they were recorded for the first time in New Guinea, at two localities, both arid plains (Finch 1981; Stronoch 1981).

Most sightings (Fig. 1; Table 1a) and breeding record (Fig. 2) of Grey Falcon have been made within the 500 mm rainfall zone, essentially corresponding to the Australian arid zone (as defined by Gibbs 1969; Gentilli 1971) and Eyrean faunistic zone (Schodde 1982). Their distribution is centred on the inland's lightly timbered lowlands, particularly *Acacia* shrubland, and along the inland drainage systems. They also frequent spinifex and tussock grassland. Occasionally, they are seen outside of this climatic — faunistic boundary, but even then are usually found in drier, low altitude, open woodland or grassland.

Many of the rare coastal sightings of Grey Falcons, especially the more southerly ones, have been made in drought years. Similarly, most of the more coastal nestings (eight out of nine) were recorded in drought years or in the season immediately following a drought.

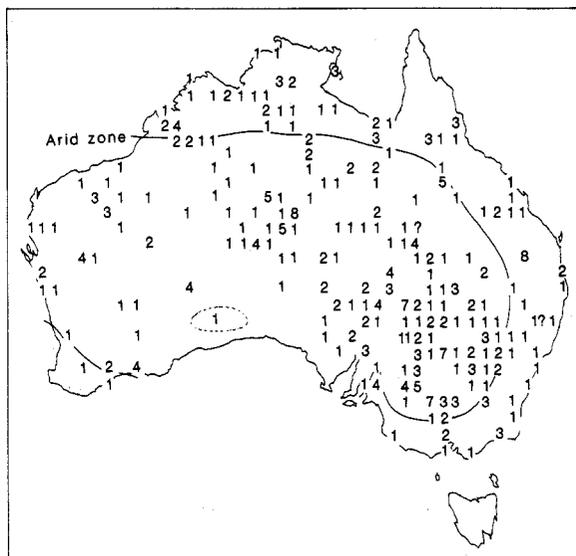


Figure 1. Sightings of Grey Falcons from various sources (see text) — historical to 1984. Numerals are the number of sightings in each 1° latitude-longitude and block.

TABLE I

*Numbers of sightings of Grey Falcons by two-monthly periods according to a. mean annual precipitation (mm) and b. latitude (degrees south). Significance of difference between areas, and months: *P > .05, **P > .005, ***P > .001.*

a.	DJ	FM	AM	JJ	AS	ON	χ d.f.
<150	6	1	10	3	9	5	10.46
150-250	10	4	14	21	39	17	43.67 ***
250-500	10	3	23	14	22	10	21.75 ***
>500	10	1	11	29	22	16	32.56 ***
χ^2 d.f.	3	1.33	3.00	7.24	21.78	19.74	7.83
				***	***	*	
b.	DJ	FM	AM	JJ	AS	ON	χ d.f.
≥ 35	7	2	9	4	4	3	7.21
32-<35	5	3	14	9	15	10	12.15 *
26-<32	12	2	19	20	33	19	29.80 ***
20-<26	8	3	12	14	24	9	21.71 ***
<20	4	0	4	23	13	5	43.43 ***
χ^2 d.f.	4	5.39	1.00	10.63	17.29	27.28	16.61
			*	***	***	***	

Grey Falcons have been recorded breeding on Dunk Island (Banfield 1906) and Green Island, off the

Queensland coast. The Dunk Island record may be a misidentification of the Grey Goshawk *Accipiter novaehollandiae* (Tarr 1948) and the size of the eggs collected and the location indicate that the Queensland record was most likely a Peregrine Falcon *Falco peregrinus*.

The distribution of breeding records indicates that the Grey Falcon's breeding range has shrunk in recent years (since the 1950's, Fig. 2). Breeding is now more or less confined to the more arid parts of the Falcon's range, within the 250 mm annual rainfall zone.

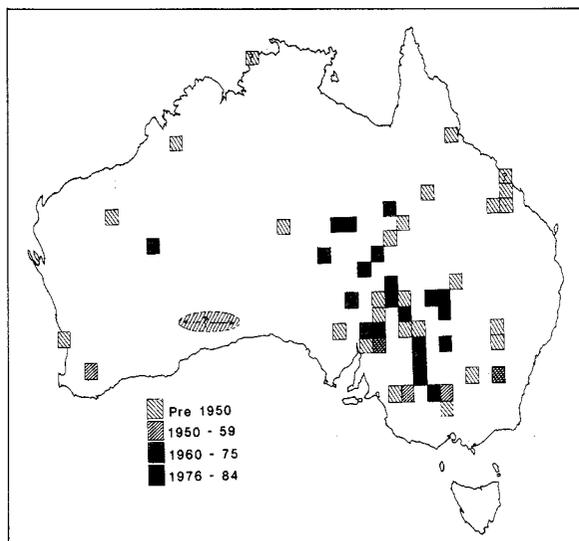


Figure 2. Breeding records (82 in all) of Grey Falcon (nests with eggs or chicks) in each of four time periods: before 1950, 1950-59, 1960-75, 1976-84. There are multiple records in latitude-longitude and blocks $24^{\circ} \times 132^{\circ}$ (n = 2), $25^{\circ} \times 122^{\circ}$ (2), $26^{\circ} \times 139^{\circ}$ (2), $28^{\circ} \times 140^{\circ}$ (3), $29^{\circ} \times 139^{\circ}$ (2), $29^{\circ} \times 143^{\circ}$ (3), $29^{\circ} \times 144^{\circ}$ (2), $31^{\circ} \times 144^{\circ}$ (3), $31^{\circ} \times 148^{\circ}$ (5), $32^{\circ} \times 139^{\circ}$ (2), $34^{\circ} \times 142^{\circ}$ (3), $35^{\circ} \times 143^{\circ}$ (3), $34^{\circ} \times 146^{\circ}$ (2) and $34^{\circ} \times 148^{\circ}$ (2).

Status

In the past the Grey Falcon was considered '...nowhere common' (North 1912) but early ornithologists recorded it as fairly numerous at Lake Frome (McGilp 1923), near Winton (Jackson 1919), on the rivers of the Gulf of Carpentaria (MacGillivray 1914), and the western Macdonnell and Levi Ranges (North 1912). Today it is still seen more often than the Peregrine Falcon in some areas, for example, Buronga/Ivanhoe (Hobbs pers. comm.) and the gibber plains of mid-western Queensland. However, the Grey Falcon is now less numerous than it was before the 1950's around Mildura

(Favaloro pers. comm.), Broken Hill (Barrier Homing Society) and perhaps the south-west of Western Australia where several of the early specimens of this species were collected (e.g. Gould 1865). In general, Grey Falcons occur and breed less often than in the past in areas where there has been extensive clearing of trees and where the intensity of land use is moderate to high (according to the classification of Nix 1981).

Movements

In the south some pairs of adult Grey Falcons appear to be present in their home range all year round. However, the distribution of sightings indicates that there are seasonal movements by at least part of the population (Table I). In the spring the Falcons breed within the 150 or 250 mm rainfall isohyet at middle latitudes (Fig. 2). There may be some dispersal in summer radiating out from the inland towards the coast, into the 250 to 500 mm rainfall zone but avoiding the far north during the rainy season. In autumn there is a strong movement towards far northern latitudes where some Grey Falcons spend the winter during the northern 'dry'. Much of this movement is by young birds, or at least single, unattached birds, although some pairs are involved, particularly in the autumn northward movement.

Throughout the year Grey Falcons are often seen in pairs or what are assumed to be family groups of an adult pair and usually one, but up to four, first year birds. During severe drought an unprecedented number of groups of up to six have been seen in the general area of the junction of the Murray and Darling rivers (Winter 1967, Hobbs *in litt.*). Presumably they move into this other refuge areas during periods of exceptional aridity. Other likely refugia to which the Falcons may withdraw, and which provide foci for recolonization when conditions improve, are the lowlands around the Central Ranges, the central drainage system of Lake Eyre, the ranges of the Western Australian Pilbara, the Flinders Ranges of South Australia and the Selwyn Ranges of Queensland. Outside the arid zone, most of the rare coastal sightings have been the result of dispersion during drought.

Food

Grey Falcons have been reported as pursuing, catching or eating prey during a surprisingly high number of the random observations made of them. This may be a because of their habit of often eating on the ground in the open, of hunting around inland bores and other places that observers are likely to visit, and, perhaps, of flying (fast) over a wide, open area.

These observations (Table II), and the Grey Falcon's relatively long middle toe, typical of a bird-catcher, in-

dicates that their main prey is birds (88% of observations). Insects (1%), reptiles (5%) and small mammals (6%) are also taken. Worms are listed as the only stomach contents in one report (Lea & Grey 1935).

Grey Falcons usually prey on birds that feed on the ground and form flocks, both characteristics typical of birds of the arid zone (Schodde 1982). Bird prey was mostly granivorous parrots and pigeons (Table II).

The majority of species taken were members of the autochthonous Eyrean avifauna, reflecting the Grey Falcons centre of distribution. Most species taken weigh between about 50 and 200 g. Heavier birds taken included Galahs (340 g) and a Feral Pigeon (460 g), the former approximately the same weight as a male Grey Falcon, the latter about 75% of the weight of a female Falcon.

TABLE II

List of bird species taken as prey by Grey Falcons, based on sightings of Falcons catching or eating the particular species. Number of observations in brackets. An asterisk indicates a member of the autochthonous Eyrean avifauna according to Schodde 1982.

Feral Chicken <i>Gallus domesticus</i> (2)
Red-capped Plover <i>Charadrius ruficapillus</i> (1)
Feral Pigeon <i>Columba livia</i> (3)
Peaceful Dove <i>Geopelia striata</i> (1)
Flock Bronzewing <i>Phaps histrionica</i> (1) *
Common Bronzewing <i>Phaps chalcoptera</i> (1)
Crested Pigeon <i>Geophaps = Ocyphaps lophotes</i> (9) *
Spinifex Pigeon <i>Petrophassa plumifera</i> (1) *
Galah <i>Cacatua roseicapilla</i> (8) *
Regent Parrot <i>Polytelis anthopeplus</i> (1)
Cockatiel <i>Nymphicus hollandicus</i> (2)
Red-winged Parrot <i>Aprosmictus erythropterus</i> (1)
Budgerigar <i>Melopsittacus undulatus</i> (3) *
Eastern Rosella <i>Platyercus eximius</i> (1)
Mallee Ringneck <i>Barnardius barnardi</i> (2) *
Port Lincoln Ringneck <i>Barnardius zonarius</i> (2) *
Red-rumped Parrot <i>Psephotus haematonotus</i> (5)
Mulga Parrot <i>Psephotus varius</i> (3) *
Blue Bonnet <i>Norhiella haematogaster</i> (6) *
Rainbow Bee-eater <i>Merops ornatus</i> (1)
Fairy Martin <i>Cecropis ariel</i> (1)
Richard's Pipit <i>Anthus novaeseelandiae</i> (3)
Willie Wagtail <i>Rhipidura leucophrys</i> (1)
Rufous Songlark <i>Cinclorhamphus mathewsi</i> (1)
Yellow-throated Miner <i>Manorina flavigula</i> (1) *
White-plumed Honeyeater <i>Lichenostomus penicillatus</i> (2) *
Red-browed Pardalote <i>Pardalotus rubricatus</i> (1) *
Zebra Finch <i>Peophila guttata</i> (2) *
Apostle Bird <i>Struthidea cinerea</i> (1)
Australian Magpie-lark <i>Grallina cyanoleuca</i> (1)
Total species 30, total individuals 68
Parrots 34 individuals (50%) of 11 species (37%)
Pigeons 16 individuals (24%) of 6 species (20%)
Members of Eyrean avifauna 41 individuals (60%) of 13 species (43%)

Grey Falcon pellets, found at a Lake Frome bore in spring, contained feathers from Galah, Mallee Ringneck, Blue-bonnet, Singing Bushlark *Mirafra javanica*, and White-browed Woodswallow *Artamus superciliosus*.

One Grey Falcon was shot with a Mallee Ringneck skull clamped, by the beak, to its middle toe. The remaining skin on the skull was shrivelled indicating that the falcon had carried the skull around for some time (North 1912). A pair of Falcons pursued and ate a duck wounded by a shooter (Cameron 1932). Falcons have also been seen 'attacking' Yellow-rumped Thornbill *Ancanthiza chrysorrhoa* (Czechura 1981), Black-tailed Native-hen *Gallinula ventralis* (Hobbs 1973), corvids (Australian Raven *Corvus coronoides*, Czechura 1981), Black-fronted Plover *Charadrius melanops* (Bristowe *et al.* 1971) and a Masked Lapwing *Vanellus miles*.

Locusts are taken by Grey falcons, at least during outbreaks (Hobbs *pers. comm.*). Although birds were the only prey brought to nests (Cupper 1981; Hollands 1984), snakes (North 1912) and lizards are taken, particularly in the northern part of their range. Lizards taken included a large dragon *Lophognathus* sp. or pygmy monitor *Varanus* sp. (Czechura 1981) and a 20 cm long *Amphibolurus* sp.

Mammal prey includes the House Mouse *Mus musculus* (one observation), Rabbit kittens *Oryctolagus cuniculus* (2 observations), unspecified 'rats' and 'jerboa' (North 1912), the latter presumably the Kultari *Antechinomys laniger*. One Grey Falcon was seen pursuing a bat (White 1923), another was seen perched on a lamb carcass.

Breeding season

Eggs have been found in nests between 9 July and the end of October. One heavily incubated clutch collected on 18 July must have been laid about mid-June, another clutch collected on 1 November may have been a second (replacement) clutch. The average date when clutches were seen in nests was 7 September (day of year $251 \pm$ s.d. 30, $n = 52$). The estimated average date of laying was 23 August (236 ± 55 , range 170 - 300, $n = 42$). No correlation was found between laying date and latitude. The estimated average date of hatching was 20 September (263 ± 28 , $n = 7$).

Many Grey Falcons may fail to breed during severe drought. During the inland drought of 1911 MacGillivray found only one pair of Grey Falcons nesting in an area where, two years before, he had located at least four nesting pairs (North 1912).

Clutch size is usually two or three averages 2.7 ± 0.7 (range 2 - 4, $n = 53$). No correlation was found

between clutch size and latitude. Brood size is usually 2 (mean 2 ± 0.6 , range 1 - 4, $n = 12$) and the average number of nestlings, based on 18 groups, is 1.7 ± 1 (range 1 - 4).

Nests

Although Grey Falcons are often associated with vegetation dominated by acacia, their nests are usually in the slender, sloping, topmost branches of one of the taller eucalypts in the area. They are usually situated near water, often on a tree-lined watercourse, albeit sometimes dry, occasionally over water.

Nests have been found in Baobab trees *Andansonia gregoryii* (Slater 1978), native pine *Callitris* sp. (Chisholm 1938, Iron Bark *Eucalyptus sideroxylon*, 'mallee tree' (Howe & Burgess 1942), 'white wood', Black Box *E. largiflorens* (Hobbs *in litt.*; Giles pers. comm.), River Red Gum *E. camaldulensis* (Brandon 1938), Coolibah *E. microtheca* (Jackson 1919; Cupper & Cupper 1981; Hollands 1984), Port Jackson Fig *Ficus rubiginosa* (Bourke *in litt.*) and Leopard Tree *Flindersia maculata* (North 1912).

The nests are constructed by other species and may be used by Grey Falcons for several years. They include the nests of corvids (9 cases), Whistling Kite *Haliastur sphenurus* (3), Wedge-tailed Eagle *Aguila audax* (1) and, perhaps, Little Eagle *Hieraetus morphnoides* (1). The nests are made of sticks and twigs, sometimes unlined but usually lined by the previous occupants with wool, bark, leaves or rat fur.

One nest was 0.5 m in diameter (MacGillivray 1910) and another had an egg cavity measuring about 20 cm across and 15 cm deep (Jackson 1919). Reported height from the ground ranged from 6 m (Hobbs *in litt.*) to over 25 m (North 1912), but was usually about 10 m.

Grey Falcons have nested in a Letter-winged Kite *Elanus scriptus* colony, in a tree with an active Letter-winged Kite's nest in the opposite side (Jackson 1919). They also have been found nesting near to the following nesting pairs of raptors: within a few metres of Australian Kestrel *Falco cenchroides*, 200 m from Australian Hobby *F. longipennis*, 20 m from Brown Falcon *F. berigora* and Swamp Harrier *Circus approximans*, 'nearby' Black Kite *Milvus migrans* and Little Eagle, 150 m from Black-breasted Buzzard *Hamirostra melanosternon*, and less than 2 km from Black Falcon *F. subniger*. They occur largely where the Peregrine Falcon is scarce or absent. One pair nested in the same tree as a pair of Sulphur-crested Cockatoo *Cacatua galerita* (North 1912).

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CROP AND GIZZARD CONTENTS OF TWO MALLEE FOWL

During a study on several aspects of Mallee fowl *Leipoa ocellata* biology in triodia — mallee shrubland, 10 km west of Renmark South Australia, two adult Mallee fowl were accidentally killed providing an opportunity to examine their crop and gizzard contents.

The first bird, a male, was found dead on 6 January 1983. His crop was virtually empty (contents: one bee, one seed of *Cassythia melantha*, and folage of *Arthropodium strictum*), but the gizzard contained two species of seed (Table I). The second bird, a female, was killed by a fox after being scared from her roost on 17 November 1984. When her carcass was found (approximately one hour after death) the entire alimentary canal below the crop had been eaten, but the crop was full of food items (Table II). Crop samples from both birds contained litter material (old eucalypt leaf and twig

fragments), and the male's crop also contained egg shell fragments (Tables I and II). Presumably this material was picked up incidentally while feeding. The sand found in the gizzard of the male (Table I) probably aids the mechanical break down of food items. In both birds, plant material, chiefly seeds, was by far the most important food type in terms of both number of items, and bulk, accounting for 99% and 93.5% of food on a dry weight basis (Table I and II). The sample from the male bird may be biased because the gizzard is primarily a site of mechanical break down of food stuffs and the relatively soft bodies of animals would have a short processing time compared to the relatively hard-coated seeds. *Cassythia melantha* seeds are surrounded by a fleshy pulp when ripe; because there was no sign of this pulp in either the crop or gizzard of the male it may be assumed that the seeds had been in the alimentary

TABLE I

Crop and gizzard contents of a male Mallee Fowl collected on 6 January 1983.

Item	Species	Number	Dry wt (mg)	% of total _a contents
Detritus	Litter material		34	
	Mallee fowl egg shell		80	
	Sand		5 320	
Plant material seeds	<i>Cassythia melantha</i>	41	2 617	99.0
	unidentified sp. A	84	904	24.5
Foliage	<i>Zygothallum</i> sp. (empty seed pods)		18	0.5
	<i>Arthropodium strictum</i> (seed pods and stems)		117	3.2
Animal material			35	1.0
Insects				
Hymenoptera	<i>Apis mellifera</i>	1	35	1.0

^aFood items only considered in calculations. Calculations expressed on the basis of dry wt.