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3 December 1984

JUVENILE PLUMAGE AND PLUMAGE VARIATION IN THE BROWN FALCON *FALCO BERIGORA*

The Brown Falcon *Falco berigora* is Australia's most widespread bird (Blakers *et al.* 1984), and one of its most abundant birds of prey. It is widely distributed throughout the continent and Tasmania, and extends to New Guinea. Its taxonomic position is unclear; initially it was placed in the genus *Hieracidea* and two species were recognised (North 1901). Cade (1982, p 180) considered it "an aberrant falcon, probably not closely related to any other species in the genus *Falco*", while Brown & Amadon (1968) thought of it as possibly a primitive or "degenerate" hobby. All authors reported many colour morphs in both juvenile and adult birds. Morris (1973) recorded no less than twenty-five plumage types.

Despite its importance in the study of taxonomy and geographical variation, no accurate juvenile plumage has been described. Condon (1951) listed the main juvenile characters as incomplete barring of rectrices, the presence of a buff or buffy-white nuchal collar, and dark underparts, with several subsequent subadult stages before the achievement of fully adult plumage. Cade (1982) however, repeated Brown & Amadon

(1968) and described the first year birds as similar to adults in both pale and melanistic plumages.

METHODS

During 1982 and 1983, we visited forty-seven nests of Brown Falcons when the young were about to fledge and recorded their plumages. Where possible, details of the plumage of the parent birds were noted as well. The majority of nests (62%) visited were on the Melbourne and Metropolitan Board of Works Farm near Werribee (38°S, 144°35'E) in coastal Victoria, and at Pirlta (34°20'S, 141°55'E) in arid north-western Victoria.

Two nests were visited in central Australia. Additional observations from central Australia were received from D. Hollands.

Injured Brown Falcons of known age from Victoria and Tasmania were retained in captivity for up to six years to document yearly changes in plumage.

Skins of 432 Brown Falcons from areas throughout Australia and New Guinea were examined for geographical variation and comparison with field work. Plumages were examined for any variation that we could not explain as due to age.



Plate 1. Juvenile Plumage and Plumage Variation in *Falco berigora*

Normal adult male, Mitiamo, Victoria (upper left).

Adult male, "red" variant, Rabbit Island, King George's Sound, Western Australia (upper right).

Normal juvenile, Loxton, South Australia (centre).

"Black" morph, South Alligator River, Arnhem Land, Northern Territory (lower left).

Normal adult female, Yunta, South Australia (lower right).

RESULTS

Live birds

Nestlings. All 124 Brown Falcon nestlings hatched with a deep honey-coloured down, which was replaced, beginning on about day five, by a dull pale grey down. At all nests the young fledged in a similar plumage, regardless of the colour phase of the parent birds. Of 42 adult pairs observed in detail, in 40 both birds were pale, whereas the females of two pairs were dark, though the males were pale.

Juveniles. The juvenile plumage was as follows: Crown, deep brown, each feather with a dark central strip and edged with pale russet. Forehead and superciliary stripe, pale buff. Nape patterned with a buff spot on each side, bounded by dark brown and leading into a broad buff nuchal collar. Upper back and rump, dark chocolate brown with pale russet edges to each feather, and blotches or bars of russet on secondaries. Primaries very dark brown tipped pale buff, and with regular rufous blotches on inner and some outer webs. Upper wing coverts dark chocolate brown, broadly edged rufous buff; under wing coverts pale ochre marked with dark brown. Tail, dark grey brown lightly barred in central area of feather with rufous, the marks usually extending about two thirds of the way or more down the feather. Face, buff with dark moustachial stripe, the top of which extends back beneath the eye to join with a broad dark patch on the rear of the ear coverts. Entire ventral surface from chin to under tail coverts buff, irregularly blotched and streaked on the breast and belly, and with dark chocolate faintly tipped rufous on flanks and thighs. Iris, deep brown, bill pale grey with dark grey tip; cere, orbit and feet greyish blue, claws dark grey.

The buff colouring of the unfledged juvenile is prone to extreme fading, and soon becomes a pale yellow ochre. This yellowness on the entire ventral surface, and the dark, unspotted flank feathers are the two most reliable guides to birds in their first year.

We have observed that in some years up to 20% of fledgling Brown Falcons from Tasmania are attacked by feather parasites while still in the nest. This leads to deterioration in the breast feathers, flank feathers and some scapulars and underwing coverts, revealing the whiter, downy under-feathers. This gives a false impression of whiteness, particularly on the breast. Usually these individuals are low in weight and in poor condition.

Captive birds. As Condon (1951) reported we observed that the juvenile plumage was followed by a series of progressive changes in subadult plumage over four years, after which adult plumage was achieved.

After the first post-nuptial moult, pale blotches appeared on either side of the shaft of the flank feathers, although these may be hidden by the feather overlap, particularly in generally dark birds. Flank mottling in all captive birds was complete after two moults and thereafter it is only hidden in the darkest morphs. The yellowness on the ventral surface began to be replaced by white. This started on the crissum, moving anteriorly with progressive moults. It was accompanied by a lessening of the density of brown markings on the breast. Both the paling of the ventral feathers to whiteness and the loss of breast patterning was swifter and more complete in male birds. Some adult females retained a yellow, speckled breast with cream abdomen and white crissum, but with age the tendency to whiten continued. Females were darker than males of equivalent age and morph, usually in the case of juveniles and always in adults. Also, after the first post-nuptial moult, the dorsal surface assumes a copper tinge, especially on the scapulars and covert edges. In the adults, the tendency to have rufous spots on the feathers of the dorsal surface may be so complete as to give the effect of being barred with rufous.

The tendency to become paler continues over the lifetime of both sexes and may occasionally include fading of iris colour from the near black of the juvenile to a paler hazel. Change of colour of soft parts from blue grey to yellow occurs in only about 10% of mature males and in very few females in Tasmania, and possibly as few as 1% on the Australian mainland, and is normally linked with a hazel iris, indicating that it probably only happens with advanced age.

(b) Study Skins

The study skins from south-eastern Australia and Tasmania exhibited little geographical variation in their plumages. However, further inland in Australia and in New Guinea there were several different morphs, including a very dark one (*melvillensis* — Condon 1951) that is reminiscent of the Black Falcon *Falco subniger*. In this dark plumage, even where the entire ventral surface is black, concealed russet spots occur on the bases of the flank feathers in more mature birds, presumably appearing after the first moult. The nuchal collar is absent in such birds, but there is nonetheless a tendency for the tail to be more completely barred, and for the under-tail coverts to be either dark or barred. This "black" morph is more common in the coastal north of Australia from the Kimberleys across to Brisbane, (16% of skins as opposed to 9% in the south). It may be a pedomorphic form because birds that are evidently adults and juveniles are so alike in tone and pattern.

A second, distinctive plumage was found amongst specimens from central and western Australia and might

be termed a "red" morph. Constant features in skins of this type were the barred under-tail coverts, the absence of nuchal collar, the very faint spotting on the flank feathers and the fact that spotting on the outer vane of the primaries started, as in the "black" morph, on or about the sixth primary. In nearly all other Australian Brown Falcons, spotting of primaries starts on the third or fourth primary (Amadon 1941). The obscure spotting of the flank feathers reflects mainly the similarity between the normal colour of the spots and general background colour, but they also tend to be near the base of the feathers as in the very dark birds. The absence of a nuchal collar, the barring of the under tail-coverts, and the tendency for the rectrices to be nearly completely barred, indicate that this morph may well be a reddish variation of the dark plumage. Birds without traces of spots on the flanks had yellow under tail-coverts, whereas birds with faint spotting of flank feathers had white under tail-coverts. It would seem therefore, that in the fledging plumage of this morph, the chocolate brown coloration may be replaced by russet (e.g. Western Australian Museum skin No. A10428).

The New Guinean birds and some occurring on Melville Island and the northern coastal areas of Australia have a distinctive appearance, with a dark head, russet ventral surface and brown back. Fledging juveniles in these areas had the same plumage as those in south-eastern Australia, and the process of "aging" seemed to follow the same stages. The normally immaculate outer webs of the first five primaries did not appear to change with age, although one juvenile had spots starting on its third primary. This point needs to be clarified by a much larger sample. We examined only four skins from Papua New Guinea.

In some female Brown Falcons the adult plumage can be particularly dark, whatever the region (e.g. AM No. 023845). Characteristic of it is a ventral colour and toning of flank spots that is not white but brown, giving the effect of a dark brown feather spotted with mid brown. This, not the black morph, is a phaeo-melanistic plumage.

CONCLUSIONS

Throughout its range and irrespective of parental morph, the Brown Falcon fledges in a uniform, rather dark juvenile plumage, or in rare instances a rufous variant of it. Juveniles have no spotting on their flank feathers and the pale areas on their ventral surfaces are

buff or yellow, not white. The subsequent stages of increased spotting on the flank feathers and gradual whitening of the ventral surfaces, commencing at the under tail-coverts and progressing anteriorly, enables birds to be aged with considerable accuracy up to adulthood, especially in Tasmania where almost no other variation in plumage occurs. These characters appear to be the most reliable guides to age in the species. While the presence of a nuchal collar in particular, and degree of tail barring tend to follow trends associated with age, there is sufficient individual variation between birds to render them unreliable as indicators of age. The nature of the juvenile plumage in Brown Falcons, and its changes, also seems to provide some clue as to the relationships between this species and other members of the genus *Falco*. The similarity of the juvenile plumage to that of the Australian Hobby *Falco longipennis*, with the same transition from plain to spotted flank feathers in adult plumage, would seem to support Brown & Amadon's (1968) suggestion that the Brown Falcon is indeed close to the hobbies.

ACKNOWLEDGEMENTS

We are indebted to the management of the Melbourne and Metropolitan Board of Works for allowing us unrestricted access to the Werribee study area and to the Directors and Curators of Ornithology of the Australian Museum, Sydney; the Australian National Collection, Canberra; the South Australian Museum; the Western Australian Museum; The Queensland Museum; the Tasmanian Museum; the Queen Victoria Museum, Launceston; the National Museum, Port Moresby and the Museum of Victoria, for allowing us to examine their collections of *Falco berigora*. Miss Belinda Gillies, Museum of Victoria, Melbourne, assisted in assembling these skins at one venue. Dr Richard Schodde criticised the original draft of the manuscript.

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