

Fluorescence in some Australo-Papuan birds

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Abstract. Three groups of fluorescing pigments in the plumage of birds of Australo-Papua and elsewhere have been known for a while, all restricted to certain groups of non-passerines. Recently, fluorescing plumage in several species of birds-of-paradise (Paradisaeidae) and other passerines has been reported, the first evidence of this in this group of birds. This raises the question of the nature of this unidentified pigment and its possible distribution elsewhere in the Passeriformes.

Introduction

Several groups of pigments contribute to the coloration of avian plumage and other structures (Hill & McGraw 2006). Two are by far the most predominant: melanins (blacks, greys) and carotenoids (yellows, oranges, reds). These are widespread throughout birds, one or both occurring in all avian orders. Three less-common pigment groups are much more restricted in their distribution: porphyrins, psittacofulvins and pterins. These have been reported in only certain groups of non-passerines. In some instances of these three groups they also have the striking property of fluorescing under ultraviolet (UV) light, a phenomenon not known for either melanins or carotenoid feather pigments. (There are many carotenoid pigments in nature and some of these do fluoresce, but this has not been reported for any avian pigmentation.) Fluorescence in plumage involves the feather pigment absorbing the UV or even violet and blue light (high-energy wavelengths) and re-emitting them in the visible spectrum as yellow or greenish yellow (lower-energy wavelengths). This is different from UV reflection, in which the light reflected off the plumage is in the UV range, invisible to humans but visible to many birds (e.g. Eaton & Lanyon 2003). This is known for some Australo-Papuan birds.

In the Australo-Papuan region, there are some examples of birds with fluorescing plumage pigments, although groups of birds exhibiting this are not restricted to this part of the globe, being found worldwide.

Porphyrins, sometimes in combination with melanins, contribute to a range of colours – pink, brown, grey – in a variety of bird species, notably in owls, nightjars, bustards, pigeons and landfowl. Two porphyrin pigments (turacoverdin and turacin) are restricted to the African turacos (Musophagidae) and produce bright reds and greens in normal light and do not fluoresce. In some groups of birds, the porphyrins fluoresce bright pink (Figure 1). Because this disappears over time with exposure to light, they are useful in studying moult patterns of live owls and nightjars (Weidensaul *et al.* 2011; Blythman *et al.* 2016). In bustards, the plumulaceous barbs glow pink or even deep red (Figure 2). The Tawny Frogmouth *Podargus strigoides* shows a pink colour, similar to that of owls (Gershwin 2022, 2023), and some pigeons, such as the Brown Cuckoo-Dove *Macropygia phasianella*, show reddish purple on the plumulaceous section of the feather (WEB unpubl. data).

Psittacofulvins are known only in parrots. The yellows, yellow-greens, oranges and reds play the same role as carotenoids (not found in parrots). Some yellow and yellow-green pigments fluoresce strongly (e.g. Boles 1991; Arnold *et al.* 2002; Berg & Bennett 2010). This occurs in Neotropical and Old World parrots, but is particularly pronounced among several groups of Australo-Papuan taxa (Figures 3–6), including rosellas *Platycercus* (Figure 4) and related genera and cockatoos (but not lorikeets). Plumage areas that are particularly prominent in reacting to UV include crowns/crests, wing-patches and



Figure 1. Porphyrin fluorescence. Powerful Owl *Ninox strenua*, underwing. Left, normal light; right, UV light. Photo: Carl Bento, Australian Museum Photography Department



Figure 2. Porphyrin fluorescence. White-bellied Bustard *Eupodotis senegalensis*, dorsal surface. Left, normal light; right, UV light. Red colour appears on exposed plumulaceous feathers under contour feathers, indicated by arrow in normal light view. Photo: Carl Bento, Australian Museum Photography Department

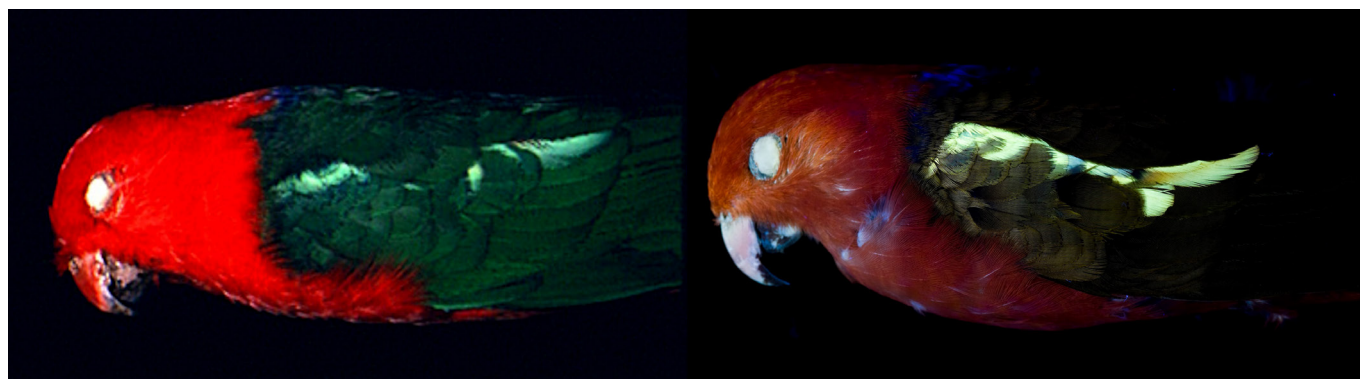


Figure 3. Psittacofulvin fluorescence. Male Australian King-Parrot *Alisterus scapularis*, lateral view. Left, normal light; right, UV light. Photo: Carl Bento, Australian Museum Photography Department

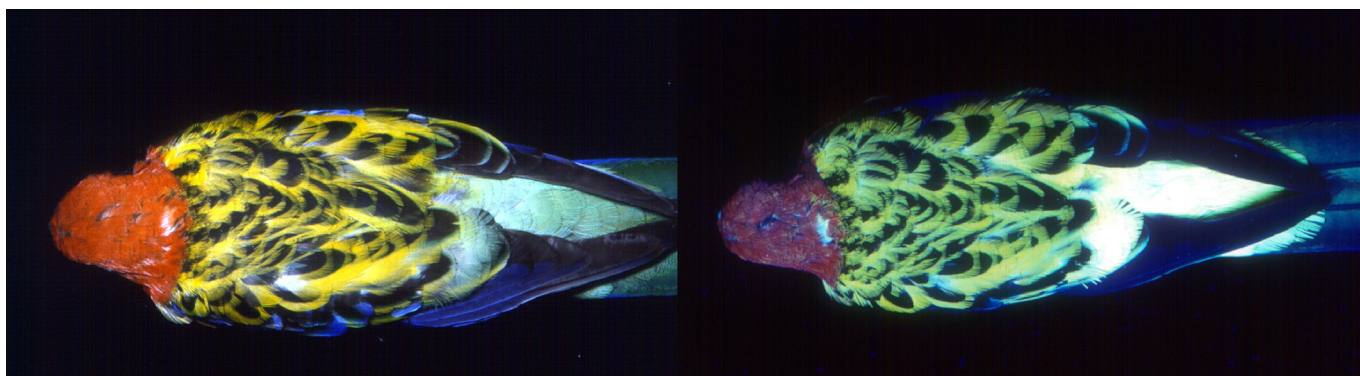


Figure 4. Psittacofulvin fluorescence. Eastern Rosella *Platycercus eximius*, dorsal view. Left, normal light; right, UV light. Photo: Carl Bento, Australian Museum Photography Department

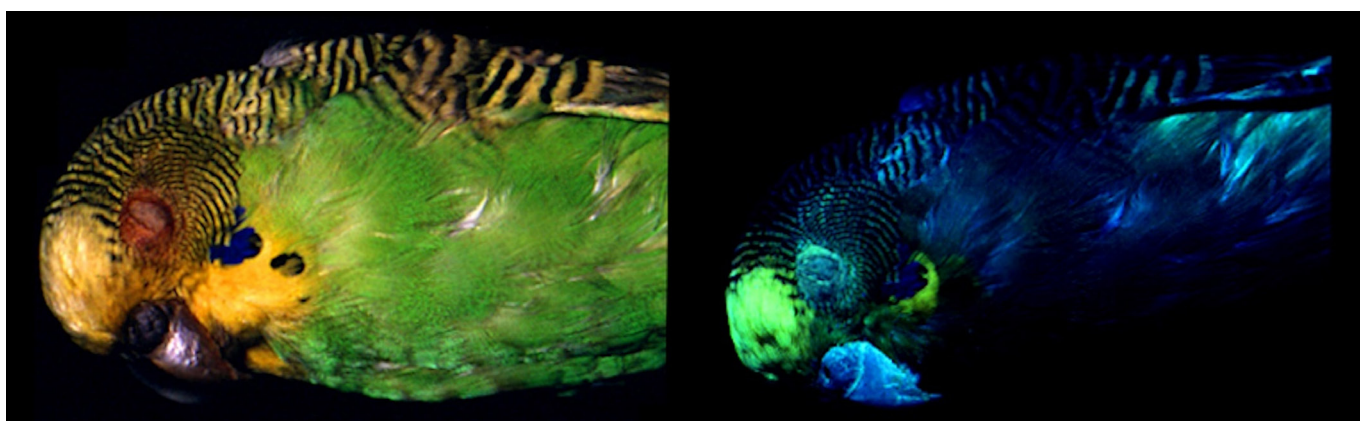


Figure 5. Psittacofulvin fluorescence. Wild-type Budgerigar *Melopsittacus undulatus*, latero-ventral view. Left, normal light; right, UV light. Photo: Carl Bento, Australian Museum Photography Department

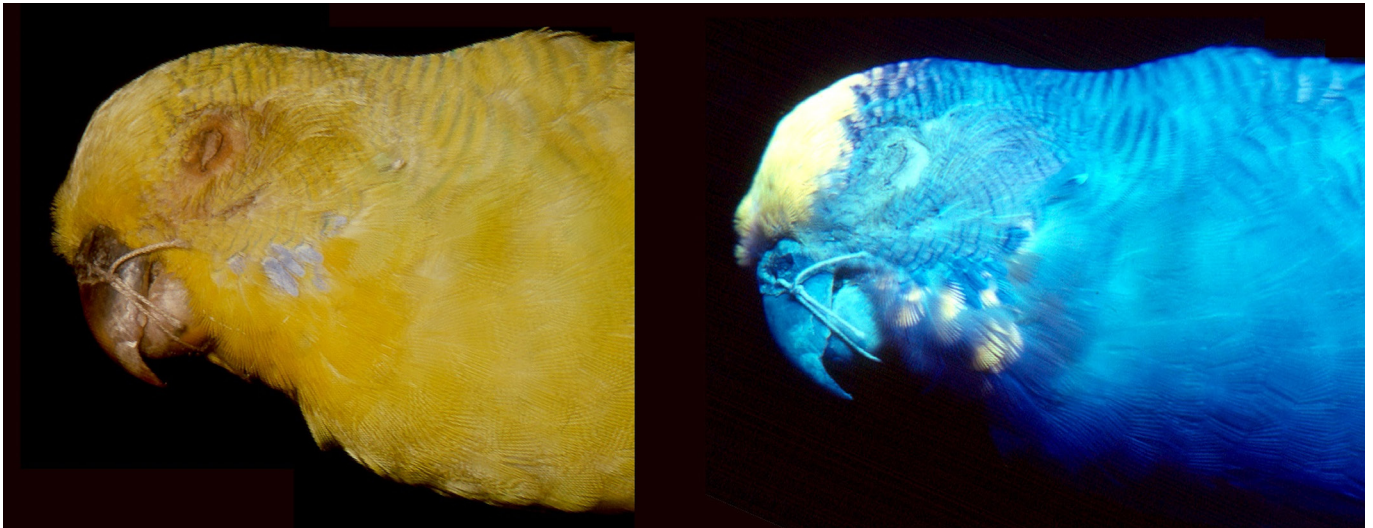


Figure 6. Psittacofulvin fluorescence. Yellow-mutation Budgerigar, latero-ventral view. Left, normal light; right, UV light. Photo: Carl Bento, Australian Museum Photography Department

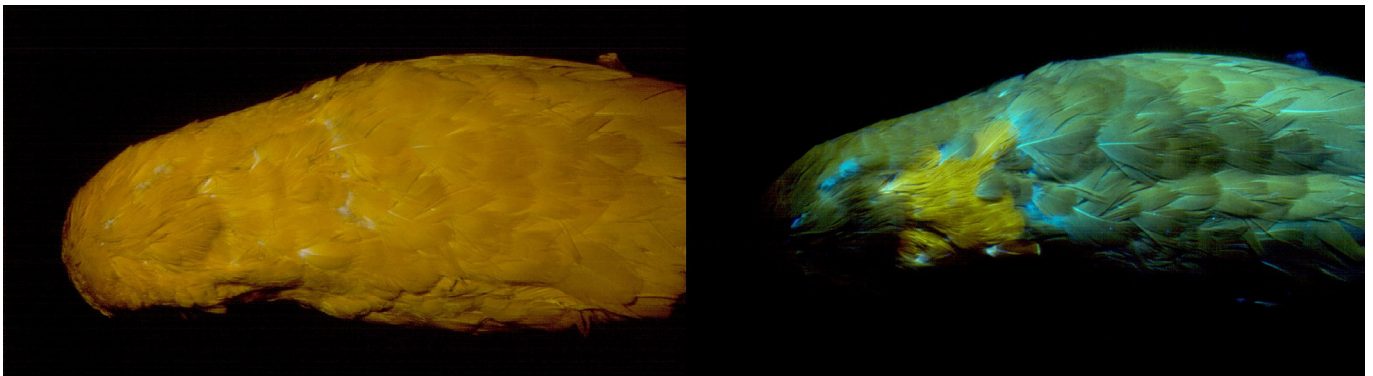


Figure 7. Psittacofulvin fluorescence. Golden Conure *Guaruba guarouba*, dorsal view. Left, normal light; right, UV light. Although entire head and back are yellow, only a patch on the nape fluoresces. Photo: Carl Bento, Australian Museum Photography Department

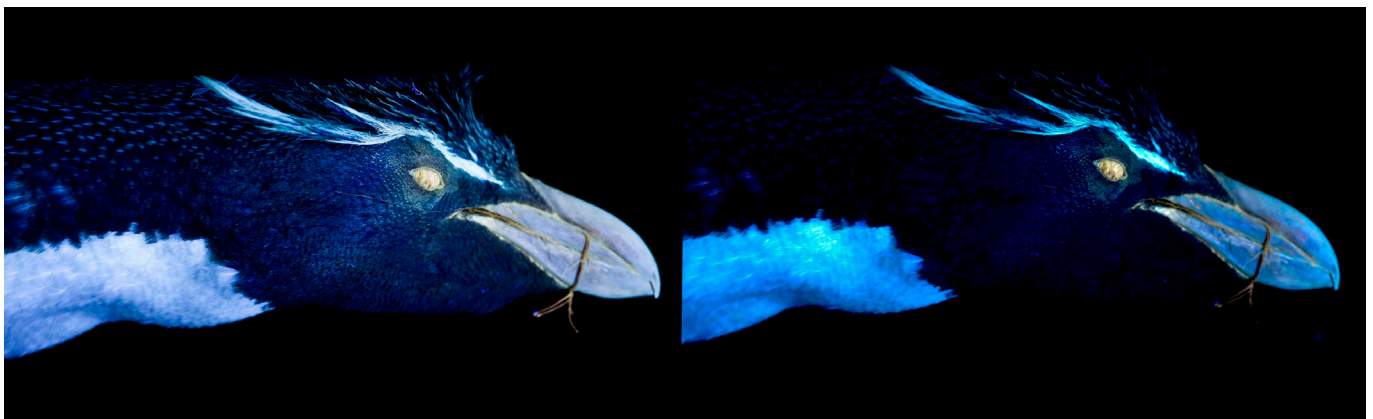


Figure 8. Pterin fluorescence. Southern Rockhopper Penguin *Eudyptes chrysocome*, head, lateral view. Left, normal light; right, UV light. Photo: Carl Bento, Australian Museum Photography Department

rumps. There are both fluorescing and non-fluorescing yellow forms of psittacofulvins. This is demonstrated by a colour mutation of the Budgerigar *Melopsittacus undulatus*. In the wild-type green coloration, the yellow forehead and cheek-stripe fluoresce (Figure 5). In the yellow mutant (where no blue colour is produced, leaving just the yellow pigmentation), the fluorescing yellow forehead and cheek-stripe are still evident; but the other yellow plumage does not fluoresce (Figure 6). Another example is the Golden

Conure *Guaruba guarouba* of South America: its head and back are yellow, but only a patch on the nape fluoresces (Figure 7).

Pterins are common contributors to coloration of the iris in many birds, but in plumage these, or a pterin-like substance, are much more restricted. Their presence was reported in crested penguins (*Eudyptes*), in which they occur in the yellow superciliary stripe (McGraw *et al.* 2007) (Figure 8).

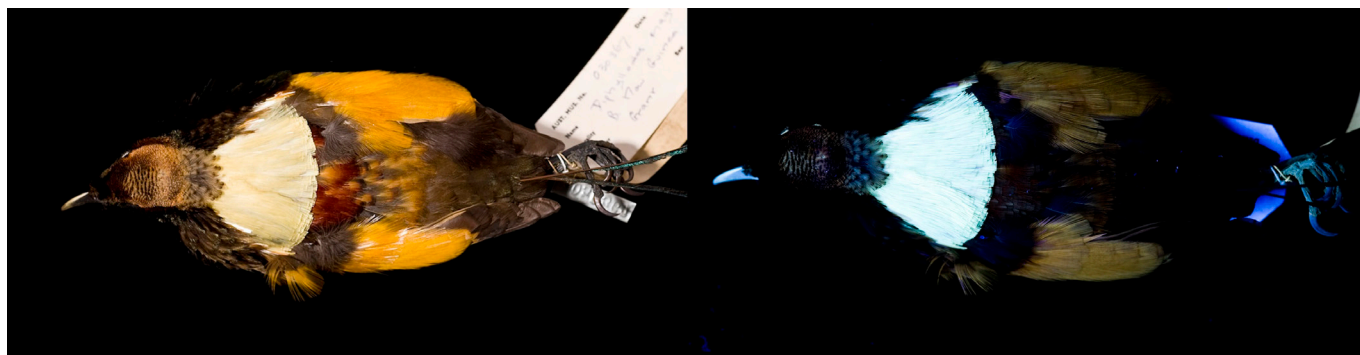


Figure 9. Unknown pigment fluorescence. Male Magnificent Bird-of-Paradise *Diphyllodes magnificus*, dorsal surface. Left, normal light; right, UV light. Photo: Carl Bento, Australian Museum Photography Department

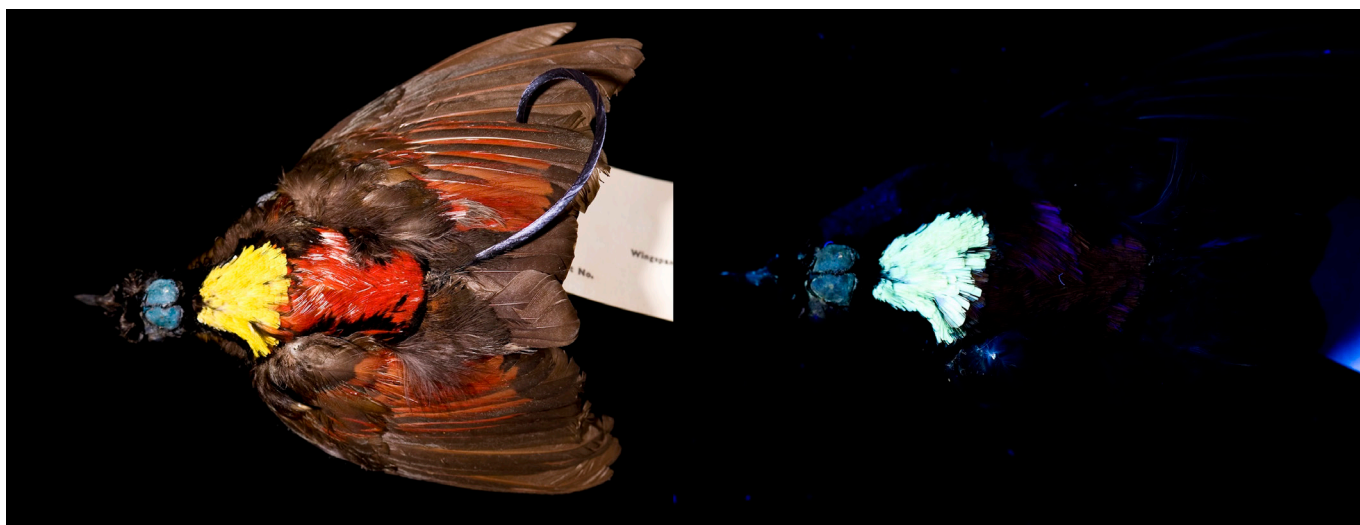


Figure 10. Unknown pigment fluorescence. Male Wilson's Bird-of-Paradise *Diphyllodes respublica*, dorsal surface. Left, normal light; right, UV light. Photo: Carl Bento, Australian Museum Photography Department

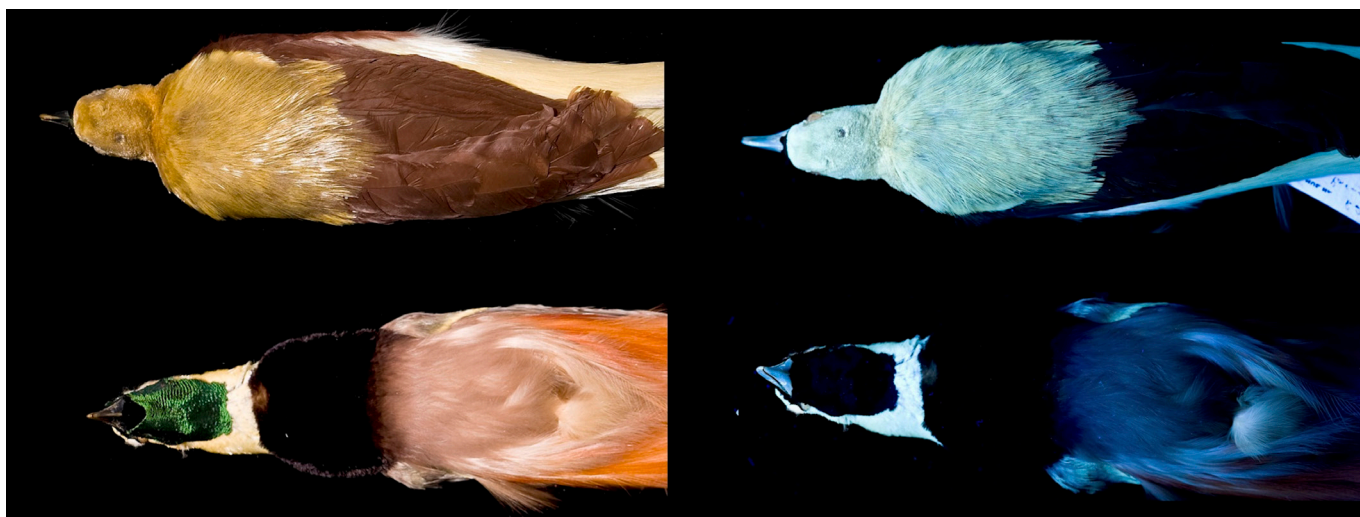


Figure 11. Unknown pigment fluorescence. Upper, male Lesser Bird-of-Paradise *Paradisaea minor*, dorsal surface. Left, normal light; right, UV light. Lower, male Raggiana Bird-of-Paradise *P. raggiana*, ventral surface. Left, normal light; right, UV light. Photo: Carl Bento, Australian Museum Photography Department

Some instances of fluorescence have been reported for which the pigments responsible have not been identified. Fluorescence of components of the bill has been reported in several species of Northern Hemisphere auks and puffins (Alcidae) (e.g. Wails *et al.* 2017; Wilkinson *et al.* 2019). The pigment involved is possibly a pterin or pterin-like substance. Gershwin (2023, Plate 12) found fluorescence in the cere of the Cape Barren Goose

Cereopsis novaehollandiae and around the flippers of the Little Penguin *Eudyptula minor*.

Fluorescing pigments were not known in the Passeriformes until reported by Seeholzer & Moser (2009) for the Magnificent Bird-of-Paradise *Diphyllodes magnificus* and Wilson's Bird-of-Paradise *D. respublica* (Paradisaeidae). This was described in a poster paper



Figure 12. Likely unknown pigment fluorescence. MacGregor's Honeyeater *Macgregoria pulchra*, facial wattle. Left, normal light; right, UV light. Photo: Emily Cave, Ornithology Section, Australian Museum

and accompanying abstract at a conference and does not appear to have been published in detail subsequently. Gershwin (2023) reported fluorescence in the wattles of the Yellow Wattlebird *Anthochaera paradoxa*.

Observations and discussion

Initially, intrigued by a brief mention by Welty (1975, p. 44) of “an unanalysed fluorescent yellow pigment in some parrots” (subsequently identified as a psittacofulvin: Stradi *et al.* 2001), I examined several parrot species using opportunistic access to a UV light source (Boles 1991). I subsequently observed a range of taxa over a prolonged period in no systematic manner, but primarily looking at representatives from groups known to fluoresce, often in response to recent information in the literature, and brightly coloured species. The exercise was merely to ascertain whether the plumage of various birds would fluoresce under UV light. A standard commercial UV fluorescent tube was used, with the photographs taken in a darkened room, with no note taken of the specifications of the UV source or its output.

I revisited the observations of Seeholzer & Moser (2009) and examined a few other species of birds-of-paradise. As reported by those authors, the yellow nape shields (‘cape’) of the Magnificent and Wilson’s Birds-of-Paradise glow brightly under UV light (Figures 9–10). I also examined specimens of several species of *Paradisaea*. Fluorescence was observed on the crown, upper back, sides of the face and throat-band of Lesser *P. minor*, Raggiana *P. raggiana* (Figure 11) and Greater Birds-of-Paradise *P. apoda*.

Martin *et al.* (2025) used detailed spectrometry, imaging and analysis of response to UV light in all species of birds-of-paradise. Their study also included the Blue-capped Ifrit *Ifrita kowaldi* (Ifritidae) of New Guinea, the presumed sister-group to the Paradisaeidae. The UV fluorescence had emission peaks around 520 nm and 560 nm. Although plumage was involved for most species, in some there were also reactions from the bill, legs, inside of the mouth or wattles. Because these areas also feature prominently in behavioural displays, Martin *et al.* (2025) proposed that the fluorescence enhanced already conspicuous patches of colour. A similar interaction has also been considered for fluorescing plumage areas in parrots (Arnold *et al.* 2002).

The findings of these studies document the presence of a fluorescing pigment in the plumage and some soft parts of passerine birds, specifically the birds-of-paradise, but also in the Ifrit.

A major question to follow up is whether this pigment is found in other passerine groups.

Bright-yellow plumage is not by itself indicative of its presence – the Regent Bowerbird *Sericulus chrycephalus*, for example, does not fluoresce. Investigations should not be limited to the plumage. Martin *et al.* (2025) reported fluorescence in the bill of the Blue Bird-of-Paradise *Paradisornis rudophi* and the facial wattles of two species of paradigallas *Paradigalla*. My casual observations suggest that the yellow face wattle of MacGregor’s Honeyeater *Macgregoria pulchra*, previously considered to be a bird-of-paradise, fluoresces in UV light (Figure 12).

Perhaps most importantly, what is the chemical nature of fluorescing pigment in birds-of-paradise, the first known example for the Passeriformes? The chemical is quite stable, surviving at least superficially unchanged in specimens kept in normal storage for well over 100–150 years. This is unlike porphyrins, which lose their ability to fluoresce in a relatively short time (hence their utility in studies on moult). Because some non-avian carotenoids fluoresce, it is possible that fluorescent carotenoids may occur in birds, specifically passerines, although none is currently known.

Recent molecular studies confirm that parrots are the sister-group of passerines among living taxa (summarised by Sangster *et al.* 2022 and references therein). This relationship is further supported by several fossil groups that structurally connect parrots and passerines, including the Zygodactylidae, which combined a passerine-like skeletal morphology with parrot-like zygodactyl feet (Mayr 2022). This suggests that perhaps the yellow pigment in birds-of-paradise is also psittacofulvin, with its shared possession another character uniting the two orders.

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