Overturning more than a century of mistaken notions on the plumage of sub-adult Greater Racket-tailed Drongo *Dicrurus paradiseus*

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For almost 150 years, white speckling on the underwing and undertail coverts of Greater Racket-tailed Drongos *Dicrurus paradiseus* has been believed to be a diagnostic feature of sub-adult birds. Through a series of mist-netting sessions we discovered that this widely held assumption is incorrect. A recaptured individual known to be at least eight years old displayed white-speckled plumage. A thorough review of photographs from online databases revealed that this plumage feature is not uncommon among adults of the species. Moreover, it is not a seasonal trait. While the reasons and mechanisms behind the plumage trait remain unclear, it likely extends to congeners.

INTRODUCTION

The Greater Racket-tailed Drongo *Dicrurus paradiseus* is a widespread passerine ranging from India to the Greater Sundas. It is a common resident in wooded habitats and is easily detected due to its vocal nature (Wells 2007). Conspicuous throughout its range, the species is well known for its repertoire of vocalisations, especially its mimicry (Goodale & Kotagama 2006b, 2008, Ratnayake *et al*. 2010, Agnihotri *et al*. 2014). This drongo has been the focus of many behavioural studies and observations and is also recognised for its frequent participation in mixed-species flocks and mobbing activities (Nash & Nash 1985a,b, King & Rappole 2001, Styring & Ickes 2003, Goodale & Kotagama 2005, Satischandra *et al*. 2007, Oommen & Shanker 2010, Adimallaiah & Maranko 2013, Agnihotri & Kethegowda 2020). Even so, many aspects of the species remain unknown. We here share that one of the most fundamental pieces of knowledge of an avian species–its plumage–has hitherto been widely misunderstood.

METHODS

We conducted a mist-netting catch-and-release bird survey at Upper Seletar Reservoir, Singapore, on 2 and 3 February 2021 (National Parks Board Singapore, permit NP/RP13-019-7). To assess the seasonality of the presence of white speckles on Greater Racket-tailed Drongos, we systematically inspected all photographs of adult Greater Racket-tailed Drongos from Singapore and lowland Peninsular Malaysia south of 4°N on the online databases eBird and Oriental Bird Images. We evaluated the presence or absence of white-tipped feathers in all pictures of adult birds showing the breast, undertail or underwing clearly.

RESULTS

On 2 February 2021, we mist-netted a Greater Racket-tailed Drongo. Species identification was confirmed by the presence of rackets, which are absent in all other *Dicrurus* species that occur in Singapore. The captured individual exhibited a red iris, prominent greyish gape, white barring on the vent, white speckles on the underwing coverts and breast (Figures 1 & 2), as well as asymmetrical rackets and a nearly glossless plumage (individual 1). These plumage features led to our initial identification as a sub-adult (Wells 2007, Robson 2014, Eaton *et al*. 2016, Grimmett *et al*. 2014, Rocamora *et al*. 2020). However, the bird was a ringed re-capture and we later learnt that it was actually a full adult, first ringed at the same site on 10 July 2013–seven and a half years earlier. The next day, a second and new bird (individual 2; Figure 3) was caught at the same site, again showing similar white speckling, although with glossier plumage and without the prominent gape seen in the first individual. Assessment of online archival photographs revealed that birds with white-tipped coverts were not rare and can be seen throughout the year (Figure 4).

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Figure 1. Greater Racket-tailed Drongo *Dicrurus paradiseus* individual 1, recaptured after 7.5 years, with white speckling on underwing and undertail coverts, long thought to be sub-adult characteristics. Upper Seletar Reservoir, Singapore, 2 February 2021.

Figure 2. Individual 1: note the red iris, prominent greyish gape and dishevelled non-glossy plumage. Upper Seletar Reservoir, 2 February 2021.

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Figure 3. Individual 2: a second Greater Racket-tailed Drongo captured the next day had similar white speckling. Upper Seletar Reservoir, 3 February 2021.

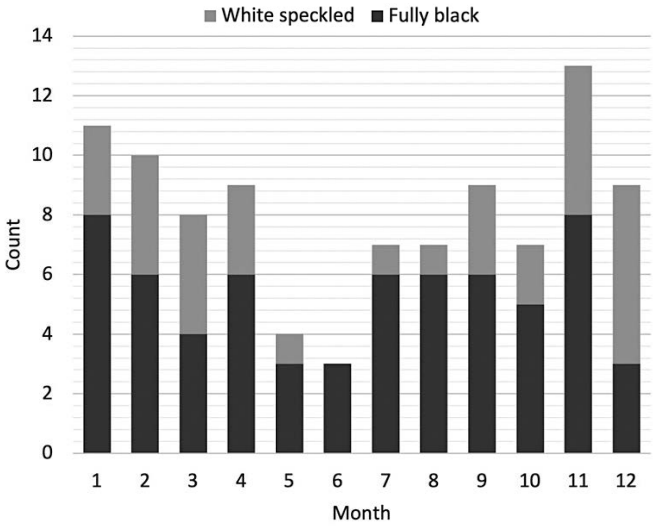

Figure 4. Proportions of Greater Racket-tailed Drongos observed in lowland south Peninsular Malaysia and Singapore with either fully black feathers or with white-speckling.

DISCUSSION

Misunderstood plumage features

Our observations cast doubt on previous notions of age-related plumage variation in the Greater Racket-tailed Drongo. A number of key modern field guides (Wells 2007, Robson 2014, Grimmett *et al*. 2014, Rocamora *et al*. 2020) describe sub-adults as being similar to full adults except for the presence of white-tipped axillaries, undertail coverts and underwing coverts, and a generally less glossy plumage. Within Sundaland, sexually mature Greater Racket-tailed Drongos have red irises (Wells 2007, Eaton *et al*. 2016). The presence of white feather tips on an individual known to be at least eight years old suggests that these features are not diagnostic sub-adult characteristics. In fact, juvenile (young birds up until first annual moult; Figure 5) and sub-adult (post-juvenile but not yet fully mature; Figure 6) Greater Racket-tailed Drongos do not have white speckling at all but are instead characterised by having matt dark grey underparts and brown eyes. This discordance between the white speckling and the age of a bird has been suggested by multiple authors in the past. In what may be the first description of this plumage characteristic in this species, Sharpe (1877) described sub-adults as having white marks. However, Kloss (1918) later noted the lack of congruence between eye colour and speckles in Greater Racket-tailed Drongos, with some individuals having red eyes and speckling. It is hence likely that eye colour is a more reliable feature to distinguish sub-adults from adult Greater Racket-tailed Drongos.

The discrepancy between the purported sub-adult plumage features and observations is not restricted to the Greater Racket-tailed Drongo; similar irregularities have been noted in the Hair-crested Drongo *D. hottentottus* complex and the Andaman Drongo *D. andamanensis*, where Vaurie (1949) noted that white-tipped coverts

Figure 5. Juvenile Greater Racket-tailed Drongos have matt dark grey underparts. Singapore, 15 April 2017.

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Figure 6. Young Greater Racket-tailed Drongo transitioning from juvenile to sub-adult plumage, showing matt grey underparts and brown iris. Note the lack of white speckling on the breast. Singapore, 6 August 2016.

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can be seen in the adults of both species. Likewise, sub-adults and females of the Crow-billed Drongo *D. annectans* were originally described to have white speckling (Hodgson 1836). With this Oates (1889) agreed, yet he also stated that these same marks could be retained into old age. Speckled plumages are common among many young birds (Ryder & Wolfe 2009) and it seems probable that these white feathers were incorrectly assumed to be sub-adult characteristics and this assumption was applied to the whole genus. Whilst it is currently difficult to determine conclusively how and why this white speckling is seen only on some individuals, seasonal plumage variation, feather wear, poor nutrition, ageing or genetic variation within the population all come to the fore as potential explanations. In the following, we discuss these hypotheses in sequence.

We initially speculated that seasonal plumage variation may account for why this trait is seen in some individuals but not others. However, results from the online database search (Figure 4) and our own mist-netting records (not shown) revealed that white-tipped feathers can be seen throughout the year. The breeding season for the Greater Racket-tailed Drongo lasts from late February to June in the region (Wells 2007; LMB unpubl. data). The lack of temporal correlation with the white speckles suggests that it is unlikely to be a seasonal trait.

It is possible that the white feather-tips wear away over time and are only visible on freshly moulted feathers. Melanin increases the strength of feather barbs (Barrowclough & Sibley 1980, Bonser 1995) and plumage colours of multiple species are known to change with feather wear (Tökölyi *et al*. 2008). In European Starlings *Sturnus vulgaris*, for example, feathers are black with white tips when freshly moulted. As the birds approach their breeding season, the white tips gradually wear away until eventually their feathers are entirely black (Jenni & Winkler 1994). However, although the drongos have a seemingly similar feather pattern, there are several reasons why this explanation is less likely in drongos. First, our individual 1 had flight and body feathers which were already quite worn and in a poor state. If white tips wore away with abrasive wear, then individuals with freshly moulted body feathers would be expected to have the most white speckling. Second, the white colour on the coverts extends upwards along the rachis, forming a diamond-like shape (Figure 3) rather than the V shape seen in starling plumage. If the tips of these feathers were to wear away they would either leave behind a visible white rachis or else lose a large part of the rachis in order to become completely black. This oddly-shaped white tip in the drongo is therefore unlikely to be produced by a 'moult-by-wear' mechanism similar to that observed in other species.

Among European Blackbirds *Turdus merula*, oxidative stress due to ageing or poor nutrition has in some cases been found to cause typically black feathers to become completely white (Sage 1962, Izquierdo *et al*. 2018). Our individual 1 was both quite old and in poor body condition. However, it is unlikely that the mechanism which causes white feathering in European Blackbirds is the same mechanism which creates the pattern seen here. In the case of European Blackbirds, entire feathers are rendered white in asymmetrical patches, while in drongos we see a distinct pattern of white speckles, with only the feather tips becoming white. Furthermore, our individual 2 (Figure 3) had white speckles and was in excellent body condition, with fresh glossy feathers. The correlation between the presence of white plumage and the age and wellbeing of a bird hence remains unclear. It is possible that the degree of speckling may vary over the lifetime of a single individual, changing gradually over multiple years.

It is also possible that the white speckling is seen in some individuals but not others due to standing genetic variation within the population. Certain individuals might maintain white-speckled feathers throughout their lives while other individuals are consistently black. This would be consistent with the pattern that Kloss (1918) observed, in which some sub-adult individuals had white speckling and others did not. While not sufficiently distinct to be considered a separate colour morph, there may be a distinct allele which codes for white speckling which is only present in a subset of the population. While it is possible that other factors, such as sexual differentiation, might play a role in the expression of this trait, the monomorphic plumage of this species (Wells 2007) means that there is little evidence to support an argument along those lines.

Longevity and dispersibility

The recaptured bird had attained an age of at least eight years, improving our knowledge of the longevity of this species. Our finding is consistent with observations of the congeneric Madagascar Drongo *D. forficatus* reaching an age of at least 10 years (Woog *et al*. 2018). Many species of equatorial forest birds of comparable size are known to have similar lifespans (Wells 1999, 2007). Such information not only improves our understanding of the species' life history but also of its behaviour–that the individual was mist-netted at precisely the same site eight years apart suggests that, despite being a seemingly strong flyer, the Greater Racket-tailed Drongo might have a rather restricted home range and high site fidelity. The species is reported to have a small territorial radius, below 750 m (Goodale & Kotagama 2006a), which is in line with what is known about low dispersal capability among insectivores (Moore *et al*. 2008, Cros *et al*. 2020).

CONCLUSION

Ornithology has greatly benefited from improved technology in recent years but there is still much that can be discovered from comparatively simple techniques such as mist-netting. It will be beneficial for researchers to take detailed notes of plumage features, especially in recaptured birds, to further our understanding of the birds in our region. Oftentimes plumage features which have been used for ageing do not necessarily transition from juvenile to adult in synchrony, and certain characteristics may be maintained for longer periods than others. As of 2021, ornithological knowledge in tropical Asia is still woefully underdeveloped and the combination of traditional techniques with more modern resources, such as online photo repositories, shows promise in bridging this gap.

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REFERENCES

Adimallaiah, D. & Maranko, M. (2013) Commensalism of Greater Racket-tailed Drongo *Dicrurus paradiseus* with Phayre's langur *Trachypithecus phayrei* in the Sepahijala Wildlife Sanctuary, Tripura, India. *Indian BIRDS* 8(3): 68–69.

Agnihotri, S. & Kethegowda, M. (2020) Do racket-tailed drongos make tree guards for their nest trees? *Behaviour* 157(14–15): 1239–1244.

Agnihotri, S., Sundeep, P., Seelamantula, C.S. & Balakrishnan, R. (2014) Quantifying vocal mimicry in the greater racket-tailed drongo: a comparison of automated methods and human assessment. *PloS ONE* 9(3): e89540.

Barrowclough, G.F. & Sibley, F.C. (1980) Feather pigmentation and abrasion: test of a hypothesis. *Auk* 97(4): 881–883.

Bonser, R.H. (1995) Melanin and the abrasion resistance of feathers. *Condor* 97(2): 590–591.

Cros, E., Ng, E.Y., Oh, R.R., Tang, Q., Benedick, S., Edwards, D.P., Tomassi, S., Irestedt, M., Ericson, P.G. & Rheindt, F.E. (2020) Fine-scale barriers to connectivity across a fragmented South-East Asian landscape in six songbird species. *Evol. Appl.* 13(5): 1026–1036.

Eaton, J.A., van Balen, S., Brickle, N.W. & Rheindt, F.E. (2016) *Birds of the Indonesian Archipelago: Greater Sundas and Wallacea*. Barcelona: Lynx Edicions.

Goodale, E. & Kotagama, S.W. (2005) Testing the roles of species in mixed-species bird flocks of a Sri Lankan rain forest. *J. Trop. Ecol.* 21: 669–676.

Goodale, E. & Kotagama, S.W. (2006a) Context-dependent vocal mimicry in a passerine bird. *Proc. R. Soc. B* 273: 875–880.

Goodale, E. & Kotagama, S.W. (2006b) Vocal mimicry by a passerine bird attracts other species involved in mixed-species flocks. *Anim. Behav.* 72(2): 471–477.

Goodale, E. & Kotagama, S.W. (2008) Response to conspecific and heterospecific alarm calls in mixed-species bird flocks of a Sri Lankan rainforest. *Behav. Ecol.* 19(4): 887–894.

Grimmett, R., Inskipp, C. & Inskipp, T. (2014) *Birds of the Indian Subcontinent: India, Pakistan, Sri Lanka, Nepal, Bhutan, Bangladesh and the Maldives*. (Digital edition.) London: Bloomsbury Publishing.

Hodgson, B.H. (1836) On some new species of the Edolian and Ceblepyrine subfamilies of the Laniidae of Nepal. *Indian Rev.* 1: 324–329.

Izquierdo, L., Thomson, R.L., Aguirre, J.I., Díez-Fernández, A., Faivre, B., Figuerola, J. & Ibáñez-Álamo, J.D. (2018) Factors associated with leucism in the common blackbird *Turdus merula*. *J. Avian Biol.* 49(9): e01778.

Jenni, L. & Winkler, R. (1994) *Moult and ageing of European passerines*. London: Bloomsbury Publishing.

King, D.I. & Rappole, J.H. (2001) Kleptoparasitism of laughingthrushes *Garrulax* by Greater Racket-tailed Drongos *Dicrurus paradiseus* in Myanmar. *Forktail* 17: 121–122.

Kloss, C.B. (1918) On birds recently collected in Siam, Part II. Passeres. *Ibis* 6(2): 189–234.

Moore, R.P., Robinson, W.D., Lovette, I.J. & Robinson, T.R. (2008) Experimental evidence for extreme dispersal limitation in tropical forest birds. *Ecol. Lett.* 11(9): 960–968.

Nash, A.D. & Nash, S.V. (1985a) An extreme example of aggression displayed by the Greater Racket-tailed Drongo. *Kukila* 2(1): 7.

Nash, A.D. & Nash, S.V. (1985b) Large Frogmouth *Batrachostomus auritus* mobbed by a Greater Racket-tailed Drongo *Dicrurus paradiseus*. *Kukila* 2(3): 67.

Oates, E.W. (1889) Birds – Volume 1. In W.T. Blanford, *The fauna of British India including Ceylon and Burma.* London: Taylor & Francis.

Oommen, M.A. & Shanker, K. (2010) Shrewd alliances: mixed foraging associations between treeshrews, greater racket-tailed drongos and sparrowhawks on Great Nicobar Island, India. *Biology Letters* 6(3): 304–307.

Ratnayake, C.P., Goodale, E. & Kotagama, S.W. (2010) Two sympatric species of passerine birds imitate the same raptor calls in alarm contexts. *Naturwissenschaften* 97(1): 103.

Robson, C. (2014) *Field guide to the birds of South-East Asia*. Second edition. London: Bloomsbury Publishing.

Rocamora, G., Yeatman-Berthelot, D. & de Juana, E. (2020) Greater Racket-tailed Drongo *Dicrurus paradiseus*, version 1.0. *Birds of the world*. Accessed at https://birdsoftheworld.org/bow/species/grtdro1/cur/introduction on 10/03/2021.

Ryder, T.B. & Wolfe, J. (2009) The current state of knowledge on molt and plumage sequences in selected tropical families: a review. *Ornitol. Neotrop.* 20: 1–18.

Sage, B.L. (1962) Albinism and melanism in birds. *British Birds* 55(6): 201–225.

Satischandra, S.H.K., Kudavidanage, E.P., Kotagama, S.W. & Goodale, E. (2007) The benefits of joining mixed-species flocks for Greater Racket-tailed Drongos *Dicrurus paradiseus*. *Forktail* 23: 145–148.

Sharpe, R.B. (1877) *A catalogue of the birds in the British Museum*: 3. London: Trustees of the British Museum (Natural History).

Styring, A.R. & Ickes, K. (2003) Woodpeckers (Picidae) at Pasoh: foraging ecology, flocking and the impacts of logging on abundance and diversity. In T. Okuda, N. Manokaran, Y. Matsumoto, K. Niiyama, S.C. Thomas & P.S. Ashton, P. S. (eds.) *Pasoh: ecology of a lowland rain forest in Southeast Asia*. Tokyo: Springer.

Tökölyi, J., Bokony, V. & Barta, Z. (2008) Seasonal colour change by moult or by the abrasion of feather tips: a comparative study. *Biol. J. Linn. Soc.* 94(4): 711–721.

Vaurie, C. (1949) A revision of the bird family Dicruridae. *B. Am. Mus. Nat. Hist.* 93: 199–342.

Wells, D.R. (1999) *The birds of the Thai-Malay Peninsula*. Volume 1. Non-passerines. London: Academic Press.

Wells, D.R. (2007) *The birds of the Thai-Malay Peninsula*. Volume 2. Passerines. London: Bloomsbury Publishing.

Woog, F., Ramanitra, N., Rasamison, A.S. & Tahiry, R.L. (2018) Longevity in some Malagasy rainforest passerines. *Ostrich* 89(3): 281–286.

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