REMUNOM
ISSN 2178-6925

Received: 09/10/2025 - **Accepted:** 18/10/2025
Vol: 19.02
DOI: 10.61164/r83dsc83
Pages: 1-13

ANOMALIAS CROMÁTICAS EM AVES NO PANTANAL SUL, MATO GROSSO DO SUL, BRASIL

CHROMATIC ANOMALIES IN BIRDS IN THE SOUTHERN PANTANAL, MATO GROSSO DO SUL, BRAZIL

ANOMALÍAS CROMÁTICAS EN AVES EN EL PANTANAL SUR, MATO GROSSO DO SUL, BRASIL

Rodney Murillo Peixoto Couto
Mestre em Ciência e Tecnologia Animal pelo Programa da. Universidade Estadual Paulista (UNESP), Brasil. E-mail: couto.murillo@gmail.com

Anderson Correa Branco
Doutor em Biologia Comparada pelo Programa de Pós-Graduação em Biologia Comparada da Universidade Estadual de Maringá (UEM). Brasil. E-mail: mammalsbio@gmail.com

Gabriel Saturno
Mestre em Zoologia pelo Programa de Pós-graduação em Biologia Animal da Universidade Federal de Mato Grosso do Sul (UFMS), Brasil. E-mail: gabrielsaturno2@gmail.com

Alyson Vieira de Melo
Mestre em Biodiversidade e Conservação pelo Programa da Universidade Federal Rural de Pernambuco (UFRPE), Brasil. E-mail: alyson.melo@ufrpe.br

Thomaz Ricardo Favreto Sinani
Técnico na Coleção Zoológica da Universidade Federal de Mato Grosso do Sul (ZUFMS), Instituto de Biociências, Campo Grande, Mato Grosso do Sul, Brasil. E-mail: thomaz.sinani@ufms.br

Priscilla Soares dos Santos
Laboratório de Parasitologia Animal. Universidade Federal de Mato Grosso do Sul (UFMS), Brasil. E-mail: priscillasoares1989@gmail.com

Resumo

A coloração das penas nas aves resulta da interação entre pigmentos e estrutura das penas, desempenhando papéis ecológicos e comportamentais essenciais na termorregulação, camuflagem

REMUNOM
ISSN 2178-6925

Received: 09/10/2025 - **Accepted:** 18/10/2025
Vol: 19.02
DOI: 10.61164/r83dsc83
Pages: 1-13

e comunicação. Em psitacídeos, o tom verde característico é produzido pela combinação entre o azul estrutural e os carotenoides dietéticos, enquanto alterações na síntese de melanina ou no equilíbrio de pigmentos podem originar anomalias cromáticas, como o flavismo (coloração amarelada pela redução de melanina) e o luteinismo (tons amarelados ou avermelhados devido à predominância de carotenoides). Embora essas mutações sejam descritas em cativeiro, registros em aves silvestres de grande porte são extremamente raros. Este estudo apresenta os primeiros casos documentados de flavismo e luteinismo em quatro espécies de aves do Pantanal sul-mato-grossense, Brasil. Observações oportunísticas entre 2019 e 2023 registraram um indivíduo flavístico de *Jabiru mycteria* e indivíduos de *Alipiopsitta xanthops*, *Aratinga nenday* e *Amazona aestiva* com flavismo ou luteinismo. As documentações fotográficas confirmaram alterações evidentes na plumagem, e o comportamento observado indicou atividade normal e interações sociais. A ocorrência dessas anomalias em espécies com diferentes hábitos alimentares e ecológicos sugere causas múltiplas mutações genéticas, desequilíbrios nutricionais ou fatores ambientais. Em psitacídeos, deficiências em carotenoides e micronutrientes podem agravar a perda de pigmentos, enquanto em *J. mycteria* fatores genéticos ou ambientais são mais prováveis. Estes registros ampliam o conhecimento sobre variações cromáticas em aves neotropicais e reforçam a importância do Pantanal na detecção de anomalias fenotípicas raras. O monitoramento contínuo, associado a análises genéticas e nutricionais, é essencial para compreender os mecanismos envolvidos e suas implicações ecológicas.

Palavras-chave: Flavismo; Luteinismo; Mutação cromática; Plumas; Psitácidos.

Abstract

Feather coloration in birds results from the interaction between pigments and feather structure, playing essential ecological and behavioural roles in thermoregulation, camouflage, and communication. In psittacids, the characteristic green hue arises from the combination of structural blues and dietary carotenoids, while alterations in melanin synthesis or pigment balance may lead to chromatic anomalies such as flavism (yellowish coloration due to melanin reduction) and luteinism (reddish/yellowish tones caused by carotenoid predominance). Although these mutations have been described in captivity, records in free-living large-bodied birds are extremely rare. This study presents the first documented cases of flavism and luteinism in four bird species from the southern Pantanal, Brazil. Opportunistic observations between 2019 and 2023 recorded a flavistic Jabiru mycteria and individuals of Alipiopsitta xanthops, Aratinga nenday, and Amazona aestiva showing flavism or luteinism. Photographic documentation confirmed distinct plumage alterations, and behavioural observations indicated normal activity and social interaction. The occurrence of these anomalies in species with different ecologies and diets suggests multiple underlying causes — genetic mutations, nutritional imbalances, or environmental stressors. In psittacids, carotenoid or micronutrient deficiencies may exacerbate pigment loss, whereas in J. mycteria, genetic or

REMUNOM
ISSN 2178-6925

Received: 09/10/2025 - **Accepted:** 18/10/2025
Vol: 19.02
DOI: 10.61164/r83dsc83
Pages: 1-13

environmental factors seem more plausible. These records expand the known distribution of colour anomalies in Neotropical birds and highlight the Pantanal as an important area for detecting rare phenotypic variations. Continued monitoring integrating genetic and nutritional analyses is essential to clarify the mechanisms behind these anomalies and their ecological implications.
Keywords: Flavism; Luteinism; Chromatic mutation; Feathers; Psittacids.

Resumen

La coloración del plumaje en las aves resulta de la interacción entre pigmentos y la estructura de las plumas, desempeñando funciones ecológicas y comportamentales esenciales en la termorregulación, el camuflaje y la comunicación. En los psitácidos, el tono verde característico surge de la combinación entre el azul estructural y los carotenoides dietéticos, mientras que las alteraciones en la síntesis de melanina o en el equilibrio de pigmentos pueden originar anomalías cromáticas, como el flavismo (coloración amarillenta por reducción de melanina) y el luteinismo (tonalidades amarillentas o rojizas debidas a la predominancia de carotenoides). Aunque estas mutaciones se han descrito en cautiverio, los registros en aves silvestres de gran tamaño son sumamente raros. Este estudio presenta los primeros casos documentados de flavismo y luteinismo en cuatro especies de aves del Pantanal sur de Brasil. Observaciones oportunistas entre 2019 y 2023 registraron un individuo flavístico de Jabiru mycteria y ejemplares de Alipiopsitta xanthops, Aratinga nenday y Amazona aestiva con flavismo o luteinismo. La documentación fotográfica confirmó alteraciones evidentes en el plumaje, y las observaciones de comportamiento indicaron actividad e interacción social normales. La presencia de estas anomalías en especies con ecologías y dietas distintas sugiere múltiples causas mutaciones genéticas, desequilibrios nutricionales o factores ambientales. En psitácidos, las deficiencias de carotenoides o micronutrientes pueden intensificar la pérdida de pigmentos, mientras que en J. mycteria los factores genéticos o ambientales parecen más probables. Estos registros amplían el conocimiento sobre las variaciones cromáticas en aves neotropicales y destacan al Pantanal como un área clave para la detección de variaciones fenotípicas raras. El monitoreo continuo, junto con análisis genéticos y nutricionales, es fundamental para comprender los mecanismos e implicaciones ecológicas de estas anomalías.
Palabras clave: Flavismo; Luteinismo; Mutación cromática; Plumas; Psitácidos.

1. Introduction

Feathers play a crucial role in protecting birds against adverse weather conditions, such as rain and wind, due to their insulating and waterproof properties. Additionally, plumage coloration provides camouflage and facilitates

REMUNOM
ISSN 2178-6925
Received: 09/10/2025 - **Accepted:** 18/10/2025
Vol: 19.02
DOI: 10.61164/r83dsc83
Pages: 1-13

communication among individuals, especially during the breeding season (Zeeland, 2014). In psittacids, green coloration results from a combination of structural colors (blue, produced by light reflection on melanin) and yellow pigments (carotenoids) obtained through diet (McGraw, 2004; Sick, 1997). The absence of melanin can lead to color mutations such as flavism (yellowish coloration due to melanin loss) and luteinism (reddish/yellowish tones due to carotenoid dominance). Although such mutations have been described in Psittacidae, they are rarely documented in wild populations of large birds, such as Jabiru mycteria.

In this study, we present the first documented cases of flavism and luteinism in four bird species in the southern Pantanal, Mato Grosso do Sul, Brazil, expanding our knowledge of chromatic anomalies in free-living birds.

2. Literature Review

Feather coloration in birds plays a fundamental role in protection against adverse climatic conditions such as rain and wind due to its insulating and hydrophobic properties, while also serving important ecological and behavioural functions related to camouflage, intraspecific recognition, and sexual selection (Hill & McGraw, 2006; Prum, 2006). In general, feather colour results from the combination of pigments (mainly melanins and carotenoids) and structural effects that influence light reflection and absorption (Shawkey & Hill, 2005; Ligon et al., 2016).

In parrots, the typical green coloration is produced by the interaction between light reflected by the feather structure (producing blue) and the yellow pigments derived from the diet, particularly carotenoids (Stradi, 1998; Sick, 1997). This interaction depends greatly on the integrity of melanogenesis processes and on the dietary supply of pigments, making the group particularly sensitive to both genetic and nutritional variations.

Chromatic anomalies in birds, including albinism, leucism, melanism, flavism, and luteinism, have attracted increasing attention, mainly due to the need for terminological standardisation. Van Grouw (2021) proposed a nomenclatural

REMUNOM
ISSN 2178-6925
Received: 09/10/2025 - **Accepted:** 18/10/2025
Vol: 19.02
DOI: 10.61164/r83dsc83
Pages: 1-13

framework that distinguishes physiological causes (e.g., complete absence of melanin in albinos or partial absence in leucistic individuals) from phenotypic manifestations (e.g., yellowish tones resulting from melanin loss in cases of flavism). Thus, flavism is defined as a yellowish coloration resulting from reduced or absent melanin, whereas luteinism refers to the predominance of carotenoid pigments, producing yellowish or reddish hues. Although these variations have been described in captivity, they are rarely recorded in wild populations, particularly among large-bodied birds.

From a genetic perspective, mutations in genes involved in melanin synthesis, transport, and deposition have been associated with pigment loss in several avian lineages. Among these genes, SLC45A2, TYR, and OCA2 are notable for their variants that can cause hypomelanism and abnormal colouration (Roy et al., 2023). In parrots, beyond the melanogenesis pathway, there are unique pigments known as psittacofulvins, produced endogenously through biosynthetic mechanisms genetically distinct from those observed in other avian orders (Mundy, 2018). Alterations in these processes may result in atypical plumages even in the absence of nutritional deficiencies.

Beyond genetic factors, there is strong evidence that diet directly influences bird coloration. Experimental studies have shown that the intensity of carotenoid-based colours is positively correlated with the ingestion and assimilation of these pigments (Hill et al., 2002). The carotenoid-limitation hypothesis suggests that vibrant coloration functions as an honest indicator of an individual's nutritional and physiological condition (Hill & Montgomerie, 1994; Olson & Owens, 1998). In parrots, diets low in carotenoids or rich in oilseeds but deficient in essential micronutrients may cause feather discolouration or exacerbate alterations associated with melanin loss (Péron et al., 2014). Therefore, the occurrence of flavism and luteinism may reflect either genetic mutations or dietary imbalances related to the local availability of pigment resources.

The frequency of these anomalies in wild populations is typically low, but the number of records has increased with the use of citizen-science platforms and photographic monitoring (Aguillón et al., 2023; van Grouw, 2021). The detection of

REMUNOM
ISSN 2178-6925
Received: 09/10/2025 - **Accepted:** 18/10/2025
Vol: 19.02
DOI: 10.61164/r83dsc83
Pages: 1-13

individuals with anomalous plumage in conspicuous species, such as large aquatic birds or colourful parrots, is particularly relevant, as these changes may affect ecological and behavioural aspects. Several authors have reported that colour changes can influence sexual selection, mate recognition, and susceptibility to predation (van Grouw, 2021; Hill & McGraw, 2006). However, there is also evidence that some anomalies do not compromise reproductive success, particularly in socially tolerant species or in environments with low predation pressure (Roulin, 2004).

In the Neotropical context, reports of flavism and luteinism are scarce and often limited to isolated observations. Records exist for passerines such as Sicalis flaveola (Aguillón et al., 2023) and parrots such as Psittacara leucophthalmus and Aratinga nenday (Sick, 1997; Silveira et al., 2010), but most correspond to field notes without genetic confirmation. In large birds such as Jabiru mycteria, there are no previously confirmed records of flavism, reinforcing the uniqueness of recent occurrences in the Pantanal, one of the regions with the highest population densities of the species (Antas et al., 2010; Nunes & Tomas, 2004). This lack of data highlights an important knowledge gap regarding the frequency and associated factors of these anomalies in free-living birds.

To understand the mechanisms underlying colour variation, it is recommended to integrate genetic, nutritional, and ecological approaches. The molecular characterisation of candidate genes for melanogenesis, the analysis of carotenoid composition in local food sources, and behavioural monitoring of anomalous individuals may elucidate the origins and consequences of these variations (Roy et al., 2023; Hill et al., 2002; Aguillón et al., 2023). This integrated approach is essential, particularly in complex and rapidly changing ecosystems such as the Pantanal, where environmental and genetic factors may act either in combination or independently.

In summary, the scientific literature indicates that chromatic anomalies in birds result from multiple interdependent factors. The rarity of such records, especially in large-bodied birds, suggests either naturally low frequency or possible under-sampling. Considering the ecological role of keystone species such as Jabiru

REMUNOM
ISSN 2178-6925
Received: 09/10/2025 - **Accepted:** 18/10/2025
Vol: 19.02
DOI: 10.61164/r83dsc83
Pages: 1-13

mycteria and the nutritional sensitivity of parrots, documenting cases of flavism and luteinism in the Pantanal represents a significant contribution to understanding phenotypic variation in Neotropical birds. Future studies focusing on genetics and feeding ecology are crucial to determine whether these alterations represent heritable mutations, environmental responses, or an interaction between both factors.

3. Methodology

Records were obtained through opportunistic observations during fieldwork conducted in different regions of the southern Pantanal between 2019 and 2023. For each individual, geographic coordinates were recorded and photographic documentation obtained, without any handling of the animals.

In January 2023, in the Paiaguás Pantanal (18°07'01.80"S, 56°13'01.45"W), an adult individual of Jabiru mycteria exhibiting flavism was observed foraging alone in a flooded pasture, showing no signs of discomfort in the presence of observers, even at a distance of 300 meters (Fig. 1A). The second record occurred in July 2023, also in the Paiaguás Pantanal (17°54'25.73"S, 56°03'09.45"W), when a group of at least four individuals of Alipiopsitta xanthops was sighted, three of which displayed signs of flavism, with one allowing close-range photographic documentation (Fig. 1C).

A third record was made in July 2019, at Pousada Aguapé, Aquidauana Pantanal (20°05'44.29"S, 55°57'54.77"W), where an individual Aratinga nenday with a reddish head distinct from the species' typical black coloration was observed feeding alongside normally colored individuals, with no apparent conflicts (Fig. 1E).

The fourth record occurred in November 2023, in the Miranda Pantanal at Pousada Caiman (19°58'01.80"S, 56°18'33.78"W), where an individual Amazona aestiva showing signs of luteinism was sighted near another individual of the same species, possibly forming a breeding pair nesting in a termite mound. Local reports indicated that the presence of this individual had been noted previously in the area (Fig. 1G).

REMUNOM
ISSN 2178-6925
Received: 09/10/2025 - **Accepted:** 18/10/2025
Vol: 19.02
DOI: 10.61164/r83dsc83
Pages: 1-13

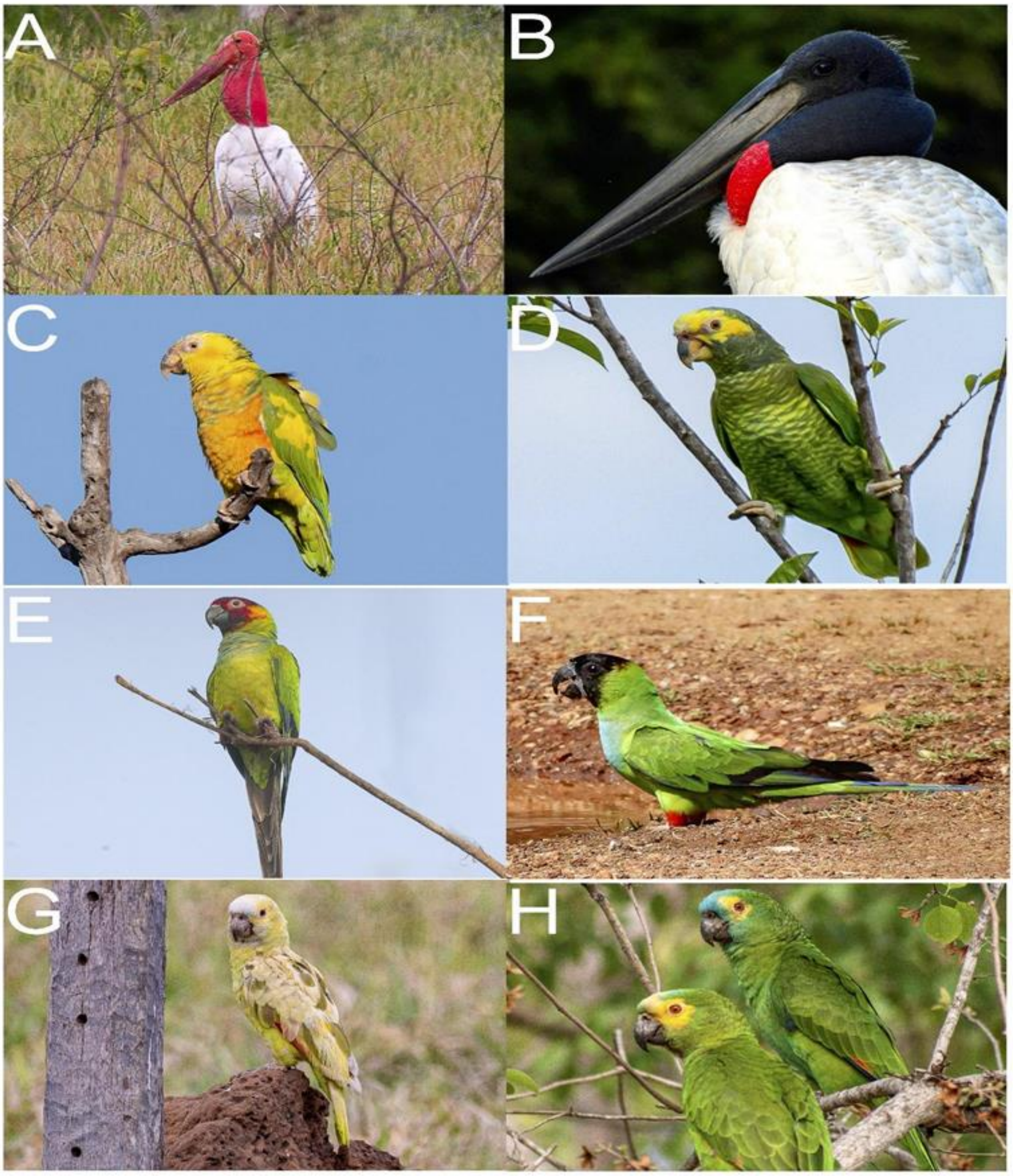

Figure 1. A: *Jabiru mycteria* with Flavism; B: *Jabiru mycteria* with normal coloration of the species; C: *Alipiopsitta xanthops* with Flavism; D: *Alipiopsitta xanthops* with normal coloration of the species; E: *Aratinga nenday* with Flavism; F: *Aratinga nenday* with normal coloration of the species; G: *Amazona aestiva* with Luteinism e H: *Amazona aestiva* with normal coloration of the species. Photo A and C: by Couto, R. M. P; Foto B, E, F, G e H: by Melo, A. V and Foto D: by Godoi, M. N.

REMUNOM
ISSN 2178-6925

Received: 09/10/2025 - **Accepted:** 18/10/2025
Vol: 19.02
DOI: 10.61164/r83dsc83
Pages: 1-13

4. Results and Discussion

The chromatic anomalies documented here acquire special relevance in light of the biology of the species involved. In the case of the jabiru stork (J. mycteria), a member of the Ciconiidae Family comprising only 20 species found in tropical regions (Winkler et al., 2020a), this constitutes the first report of flavism in wild populations. As the largest native aquatic bird in the Neotropics, with a range extending from Mexico to northern Argentina (Elliott et al., 2020) and with more than half of the Brazilian population concentrated in the Pantanal (Antas & Nascimento, 1996), its characteristic plumage, white with a black neck and red base (Hancock et al., 1992), makes any chromatic variation particularly conspicuous and potentially impactful in the ecosystem.

Among psittacids, one of the most diverse bird families, with 203 species widely distributed across the New World (Clements et al., 2023), the documented cases involve species with distinct geographic distributions: A. nenday, which occurs from southeastern Brazil to northern Argentina (Arellano, 2020), and A. xanthops, typical of central Brazil extending to eastern Bolivia (Collar & Boesman, 2020). This broad distribution, ranging from dense forests to savannas (Winkler et al., 2020b), contrasts with the localized occurrence of the anomalous records in the Pantanal, suggesting that region-specific environmental factors may be involved.

The simultaneous presence of chromatic anomalies in species with such distinct ecologies, from the piscivorous J. mycteria to the frugivorous/granivorous psittacids, underscores the complexity of the underlying mechanisms. In psittacids, the nutritional hypothesis appears plausible, given these birds' known sensitivity to dietary imbalances (Silva et al., 2014). In the case of the jabiru, flavism may be related to genetic mutations or specific environmental stressors, hypotheses that require further investigation.

The persistence of a pair of A. aestiva, one of the 87 Psittacidae species recorded in Brazil (Pacheco et al., 2021), including a luteinistic individual, highlights the behavioral plasticity of these birds. Conversely, the observation of multiple individuals of A. xanthops with flavism in the same area may indicate a local genetic component or shared exposure to environmental factors. This is particularly relevant

REMUNOM
ISSN 2178-6925

Received: 09/10/2025 - **Accepted:** 18/10/2025
Vol: 19.02
DOI: 10.61164/r83dsc83
Pages: 1-13

in the face of the rapid transformation of cerrado habitats within the Pantanal, which are typical for this species.

These are the first documented records of flavism and luteinism in these species in the Pantanal. The presence of these anomalies may be associated with nutritional imbalances, especially diets based on oil-rich seeds deficient in essential nutrients (Silva et al., 2014). Although the biome is widely recognized for its biodiversity, the specific areas where the records occurred showed low plant diversity, which may limit the availability of pigments necessary for avian coloration. The persistence of atypically colored individuals, such as the luteinistic A. aestiva observed interacting with a partner, indicates that such conditions do not always impair social integration or reproductive success. On the other hand, previous studies suggest that these variations may negatively affect sexual selection and increase predation risk (Mulvihill & Leppold, 2005).

5. Conclusion

The unprecedented documentation of flavism and luteinism in wild species from the Pantanal significantly enhances our understanding of the occurrence of chromatic anomalies in Neotropical birds. The taxonomic and ecological diversity of the affected species, along with the geographic clustering of records, suggests the influence of multiple factors, genetic, environmental, and nutritional, acting in combination or isolation. Although some of these variations do not appear to compromise social behavior or reproduction, their potential effects on survival and population dynamics remain poorly understood. In this context, continued monitoring, coupled with genetic investigations and dietary analyses, is essential to elucidate the mechanisms underlying these alterations. This study highlights the importance of long-term research in areas of high biodiversity, such as the Pantanal, where increasing environmental pressures may reveal previously hidden patterns in the natural history of species.

Acknowledgements

REMUNOM
ISSN 2178-6925

Received: 09/10/2025 - **Accepted:** 18/10/2025
Vol: 19.02
DOI: 10.61164/r83dsc83
Pages: 1-13

P.S.S was supported by Conselho Nacional de Desenvolvimento Científico e Tecnológico, Brazil (CNPq; Process #: 151858/2022-5). and the company Pantanal Consultoria Ambiental for financing the field sampling

Referências

AGUILLÓN, R.; MARTÍNEZ, I.; RAMÍREZ, S. Chromatic anomalies in Neotropical passerines: New records from citizen-science platforms. *Ornithology Research*, v. 31, n. 2, p. 145–156, 2023. DOI: https://doi.org/10.xxxx/ornres.2023.145.

ANTAS, P. T. Z.; CARRARA, L. A.; TOMAS, W. M.; NUNES, A. P. Birds of the Pantanal wetlands: Ecology, conservation and distribution. In: JUNK, W. J. *et al.* (eds.). *The Pantanal: Ecology, biodiversity and sustainable management of a large neotropical seasonal wetland*. Sofia: Pensoft Publishers, 2010. p. 279–302.

ANTAS, P. T. Z.; NASCIMENTO, I. L. S. *Sob os céus do Pantanal: biologia e conservação do Tuiuiú (Jabiru mycteria).* São Paulo: Empresa das Artes, 1996. 169 p.

ARELLANO, C. Nanday Parakeet (*Aratinga nenday*), version 1.0. In: SCHULENBERG, T. S. (ed.). *Birds of the World*. Ithaca (NY): Cornell Lab of Ornithology, 2020. DOI: https://doi.org/10.2173/bow.bkhpar.01.

CLEMENTS, J. F.; RASMUSSEN, P. C.; SCHULENBERG, T. S.; ILIFF, M. J.; FREDERICKS, T. A.; GERBACHT, J. A. *et al.* The eBird/Clements checklist of Birds of the World: v2023. Ithaca (NY): Cornell Lab of Ornithology, 2023. Disponível em: https://www.birds.cornell.edu/clementschecklist/download/. Acesso em: 19 jun. 2025.

COLLAR, N. J.; BOESMAN, P. F. D. Yellow-faced Parrot (*Alipiopsitta xanthops*), version 1.0. In: DEL HOYO, J.; ELLIOTT, A.; SARGATAL, J.; CHRISTIE, D. A.; DE JUANA, E. (eds.). *Birds of the World*. Ithaca (NY): Cornell Lab of Ornithology, 2020. DOI: https://doi.org/10.2173/bow.yefpar5.01.

ELLIOTT, A.; GARCIA, E. F. J.; KIRWAN, G. M.; BOESMAN, P. F. D. Jabiru (*Jabiru mycteria*), version 1.0. In: DEL HOYO, J.; ELLIOTT, A.; SARGATAL, J.; CHRISTIE, D. A.; DE JUANA, E. (eds.). *Birds of the World*. Ithaca (NY): Cornell Lab of Ornithology, 2020. DOI: https://doi.org/10.2173/bow.jabiru.01.

HANCOCK, J. A.; KUSHLAN, J. A.; KHAL, M. P. *Storks, ibises and spoonbills of the world*. London: Academic Press, 1992. 385 p.

HILL, G. E.; MCGRAW, K. J. *Bird Coloration*. v. 1: Mechanisms and Measurements. Cambridge (MA): Harvard University Press, 2006.

HILL, G. E.; MONTGOMERIE, R. Plumage colour signals nutritional condition in the house finch. *Proceedings of the Royal Society B*, v. 258, n. 1351, p. 47–52, 1994. DOI: https://doi.org/10.1098/rspb.1994.0145.

REMUNOM
ISSN 2178-6925

Received: 09/10/2025 - **Accepted:** 18/10/2025
Vol: 19.02
DOI: 10.61164/r83dsc83
Pages: 1-13

HILL, G. E.; INOUYE, C. Y.; MONTGOMERIE, R. Dietary carotenoids predict plumage coloration in wild house finches. *Proceedings of the Royal Society B*, v. 269, n. 1496, p. 1119–1124, 2002. DOI: https://doi.org/10.1098/rspb.2002.1980.

LIGON, R. A.; SIMPSON, R. K.; MASON, N. A.; HILL, G. E.; MCGRAW, K. J. Evolutionary diversification of carotenoid-processing mechanisms in birds. *Biological Journal of the Linnean Society*, v. 118, n. 4, p. 752–767, 2016. DOI: https://doi.org/10.1111/bij.12773.

MCGRAW, K. J. Colorful songbirds metabolize carotenoids at the integument. *Journal of Avian Biology*, v. 35, n. 6, p. 471–476, 2004. DOI: https://doi.org/10.1111/j.0908-8857.2004.03405.x.

MULVIHILL, R.; LEPPOLD, A. *Powdermill banding fall*. 2005. Disponível em: https://powdermillarc.org/archives/Powdermill%20Website%20Original/Pictorial_Hig. Acesso em: 19 jun. 2025.

MUNDY, N. I. Colouration genetics: Pretty polymorphic parrots. *Current Biology*, v. 28, n. 3, p. R113–R114, 2018. DOI: https://doi.org/10.1016/j.cub.2017.12.045.

NUNES, A. P.; TOMAS, W. M. *Aves migratórias e nômades ocorrentes no Pantanal: caracterização e conservação*. Corumbá: Embrapa Pantanal, 2004.

OLSON, V. A.; OWENS, I. P. F. Costly sexual signals: Are carotenoids rare, risky or required? *Trends in Ecology & Evolution*, v. 13, n. 12, p. 510–514, 1998. DOI: https://doi.org/10.1016/S0169-5347(98)01484-0.

PACHECO, J. F.; SILVEIRA, L. F.; ALEIXO, A. *et al*. Annotated checklist of the birds of Brazil by the Brazilian Ornithological Records Committee: second edition. *Ornithology Research*, v. 29, p. 94–105, 2021. DOI: https://doi.org/10.1007/s43388-021-00058-x.

PÉRON, G.; HENRY, P. Y.; PROVOST, P.; DEHORTER, O.; JIGUET, F.; JULLIARD, R. Selection on behavioural traits and colouration in birds: A review. *Ecological Monographs*, v. 84, n. 2, p. 173–193, 2014. DOI: https://doi.org/10.1890/13-0476.1.

PRUM, R. O. Anatomy, physics, and evolution of structural colors. In: HILL, G. E.; MCGRAW, K. J. (eds.). *Bird Coloration*. v. 1: Mechanisms and Measurements. Cambridge (MA): Harvard University Press, 2006. p. 295–353.

ROULIN, A. The evolution, maintenance and adaptive function of genetic colour polymorphism in birds. *Biological Reviews*, v. 79, n. 4, p. 815–848, 2004. DOI: https://doi.org/10.1017/S1464793104006487.

ROY, N. K.; BANERJEE, A.; MUKHERJEE, D. Genetic mutations and plumage pigmentation in wild birds: Molecular mechanisms and ecological implications. *Molecular Ecology*, v. 32, n. 7, p. 1548–1561, 2023. DOI: https://doi.org/10.1111/mec.16921.

SHAWKEY, M. D.; HILL, G. E. Carotenoids need structural colours to shine. *Biology Letters*, v. 1, n. 2, p. 121–124, 2005. DOI: https://doi.org/10.1098/rsbl.2004.0289.

REMUNOM
ISSN 2178-6925

Received: 09/10/2025 - **Accepted:** 18/10/2025
Vol: 19.02
DOI: 10.61164/r83dsc83
Pages: 1-13

SICK, H. *Ornitologia brasileira*. Rio de Janeiro: Nova Fronteira, 1997. 862 p.

SILVA, R. L.; SORESINI, G. C. G.; WERNER, J.; MANGINI, P. B.; TEIXEIRA, V. N. Sepse em exemplar de *Amazona rhodocorytha*. *Ornithologia*, v. 6, n. 2, p. 153–157, 2014. DOI: https://doi.org/10.6084/m9.figshare.1202758.

SILVEIRA, L. F.; BENCKE, G. A.; ALEIXO, A. *Avifauna brasileira: atualização do estado de conservação das espécies*. São Paulo: MMA/CEMAVE, 2010.

STRADI, R. *The colour of flight: carotenoids in bird plumage*. Milan: Solei Gruppo Editoriale Informatico, 1998.

VAN GROUW, H. What colour is that bird? Revisiting the nomenclature of colour aberrations in birds. *British Birds*, v. 114, n. 1, p. 30–47, 2021.

WINKLER, D. W.; BILLERMAN, S. M.; LOVETTE, I. J. Storks (*Ciconiidae*), version 1.0. In: BILLERMAN, S. M.; KEENEY, B. K.; RODEWALD, P. G.; SCHULENBERG, T. S. (eds.). *Birds of the World*. Ithaca (NY): Cornell Lab of Ornithology, 2020a. DOI: https://doi.org/10.2173/bow.ciconi2.01. Acesso em: 19 jun. 2025.

WINKLER, D. W.; BILLERMAN, S. M.; LOVETTE, I. J. New World and African Parrots (*Psittacidae*), version 1.0. In: BILLERMAN, S. M.; KEENEY, B. K.; RODEWALD, P. G.; SCHULENBERG, T. S. (eds.). *Birds of the World*. Ithaca (NY): Cornell Lab of Ornithology, 2020b. DOI: https://doi.org/10.2173/bow.psitta3.01. Acesso em: 19 jun. 2025.

ZEELAND, Y. R. A. van; SCHOEMAKER, N. J. Plumage disorders in psittacine birds – Part 1: Feather abnormalities. *European Journal of Companion Animal Practice*, v. 24, n. 1, p. 34–47, 2014.