

A case of plumage aberration in the Pin-tailed Manakin *Ilicura militaris*

Marina Anciães, André Nemésio and Fabiane Sebaio

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O tangarazinho *Ilicura militaris* é endêmico da Mata Atlântica, onde ocorre da Bahia a Santa Catarina. Apresentamos um indivíduo com plumagem aberrante, com a coloração vermelha típica do dorso e fronte substituídas por amarelo, coletado em um fragmento florestal em Minas Gerais. A deposição de pigmentos carotenóides, principais responsáveis pela coloração de penas amarelas e vermelhas, pode ser afetada por alterações de dieta ou metabolismo. Enquanto alterações na dieta geram variações graduais entre indivíduos, mudanças metabólicas podem produzir a diferença observada no tangarazinho aberrante. Alterações similares não são incomuns entre as aves, e sugerem que o presente indivíduo expressa uma mutação em genes que regulam a conversão metabólica de pigmentos carotenóides adquiridos da dieta. A ocorrência de mutantes em fragmentos da Mata Atlântica merece investigação.

Pin-tailed Manakin *Ilicura militaris* is a frugivorous passerine endemic to the Atlantic Forest of Brazil, where it occurs in the Serra do Mar, Mantiqueira and Espinhaço ranges, from Santa Catarina to Minas Gerais and Espírito Santo²⁹, and locally in southern Bahia¹¹. Around Belo Horizonte (Minas Gerais), Pin-tailed Manakin

is common in forest fragments (M. Anciães & M. Â. Marini unpubl.) in the ecotone between Atlantic Forest and Cerrado. The species occupies a monotypic genus and, like most Pipridae, is characterised by sexual dichromatism, polygyny and elaborate courtship behaviour^{27,28,31}.

Males with definitive plumage have a black back and primary remiges, grey head-sides, a white belly and green secondaries. They have red patches on the forehead and rump (rump Scarlet 14 and forehead Geranium 12³⁰). Irides are orange and tarsi pink to brownish in both sexes. Males in pre-definitive plumage and females are mostly green, with grey on the breast and head-sides, and white on the belly. The central rectrices are longer in males with definitive plumage than in green individuals³², and are on average longer in green-plumaged males than in females (Anciães unpubl.).

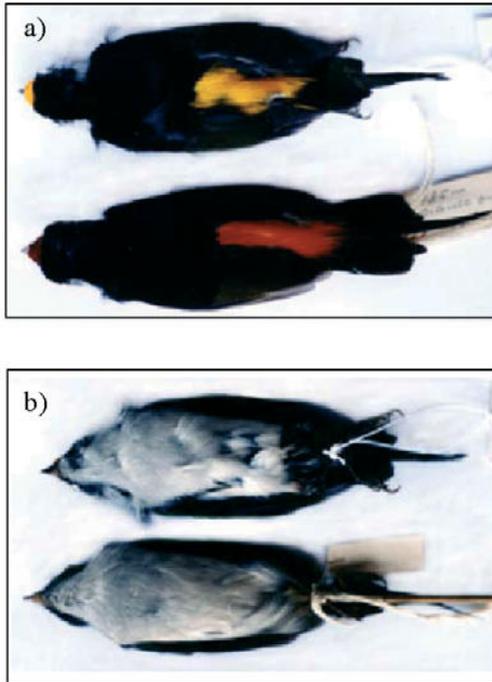


Figure 1. Dorsal (a) and ventral (b) views of the Pin-tailed Manakin *Ilicura militaris* with aberrant plumage, and a normal individual, with red plumage (Marina Anciães)

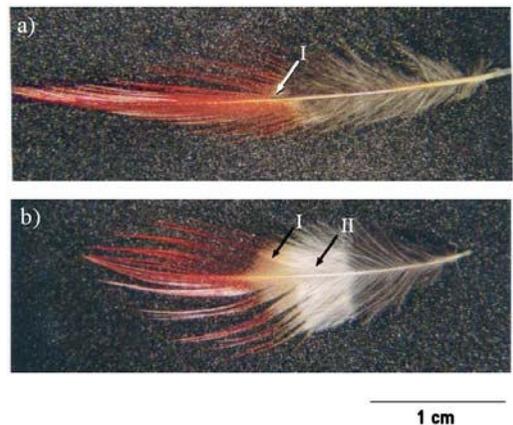


Figure 2. Feathers from the rump of a Pin-tailed Manakin *Ilicura militaris* with normal (red) plumage. Both feather types—short (a) and long (b)—have yellow basal stripes (I). The short feather also has a white stripe (II) following the yellow one (Marina Anciães)

The sequence of plumage maturation is undescribed but histological data (Anciães unpubl.) indicate that males delay plumage maturation, which has been previously reported for other manakins^{7,21,23}.

Aberrant bird

On 13 May 1999, during a study of the lekking behaviour of Pin-tailed Manakin in Barreiro reserve (20°00'S 44°00'W; c.850 m), Minas Gerais, MA and FS collected an individual with the characteristic adult male plumage, except that the rump and forehead patches were yellow (Orange Yellow 18⁹⁰) rather than red (Fig. 1). The specimen was deposited in the ornithological collection of the Department of Zoology of the Universidade Federal de Minas Gerais (DZUFMG 2560). Morphological characteristics including the colour of the irides (orange) and tarsi (pink to brownish) are typical of the species (Table 1). The rump feathers of normal adult males have yellow or yellow-and-white basal stripes (Fig. 2), whereas the aberrant specimen has white basal stripes only in the shortest feathers.

Study area

The study area includes three fragments of secondary forest, separated from other forests by c.2 km of open Cerrado vegetation, on the western slopes of the Espinhaço range. In this transition zone, between Atlantic Forest and Cerrado, the avifauna is represented by Atlantic Forest species, with a strong Cerrado element (e.g. Helmeted Manakin *Antilophia galeata* in gallery forest, and White-banded Tanager *Neothraupis fasciata* in Cerrado patches). Details of the vegetation are in CETEC⁶.

Discussion

We suggest that the plumage aberration could be the result of 1) hybridisation, 2) a previously unrecognised transitional plumage, 3) a nutritional deficiency or 4) a genetic mutation. Mensural data, as well as iris and tarsus colour, are typical; therefore it is unlikely that the specimen is a hybrid. That this individual is in pre-definitive plumage can also be rejected. In the same study area, we caught pre-definitive males that were sexed by molecular techniques², with red feathers on the forehead and rump. These data suggest that red feathers are present in the early stage of plumage maturation. The more likely hypotheses are either numbers 3 or 4.

Nutritional deficiency

The hypothesis that the yellow plumage is due to a nutritional deficiency is weakly supported. Food items containing carotenoids are usually abundant in nature and should not represent limiting resources for birds^{9,10}, particularly in second-

growth forests where small berries of the families Melastomataceae and Rubiaceae, which are important in the diet of manakins²², are abundant. Therefore, it appears unlikely that foraging ability explains these variations. Instead, given the metabolic inter-conversion of carotenoids in birds, the control of colour production from ingested carotenoids might depend on individual health^{15,17}. There is evidence that colour variation in carotenoid-based ornaments reflects physiological condition rather than food availability^{12,34,35}, and the hypothesis that the aberrant plumage reflects a rare physiological disorder cannot be rejected.

It is particularly unlikely, however, that the present case reflects differential physiological ability because such variations are gradual and observed in substantially higher proportion in a population^{14,19}. Since 1995, 141 Pin-tailed Manakins have been mist-netted in the study area, of which 49 were males in definitive plumage. The yellow Pin-tailed Manakin was the first individual with rump or forehead coloration different from the usual red (M. Â. Marini pers. comm.). Among 80 males in definitive plumage studied in collections, there was also no gradual variation. Despite colour alterations that might occur in skins due to preservation conditions, no significant deviation from the normal pattern was detected.

Genetic mutation

The most plausible hypothesis is that the yellow pigmentation resulted from a genetic mutation. Enzymes controlled by hormonal mechanisms mediate the deposition and endogenous modification of carotenoids in birds³. Although a single gene may control the enzymatic process, studies which link pigment chemistry, genetics and natural history are lacking^{4,16}, and thus any explanation regarding the possible mutation and its expression would be speculative.

Nevertheless, the substitution of red for yellow pigmentation is not uncommon in manakins. Populations of *Chiroxiphia pareola* south of the Amazon (*C. p. regina* and *C. p. alicei*), and of *Machaeropterus regulus* from Roraima (*M. r. aureopectus*) and Peru (undescribed subspecies¹) present yellow plumage, replacing the red tracts characteristic throughout the remainder of their ranges (Appendix 1). In the *P. erythrocephala* superspecies, Hudon *et al.*¹⁸ found that red ketocarotenoids represent primitive colour characters, and that the change from red pigments to yellow xanthophylls is an autapomorphy of *P. erythrocephala*. Chromatographic studies verified that yellow feathers also contained trace amounts of red carotenoids, and the authors suggested that the difference was promoted by a regulatory change in the timing of conversion of yellow pigment to red.

Table 1. Body mass (g) and character length (mm) of Pin-tailed Manakins *Ilicura militaris* from (a) the studied population and (b) museum collections. Values are mean \pm 1 SD, and sample sizes are given in parenthesis.

Sample	Individuals	Body mass	Wing	Tail	Central rectrices	Tarsus	Nostril
a	Aberrant	13	61.7	38.9	57.6	18.7	5
	All males	12.55 \pm 1.74 (53)	59.87 \pm 2.25 (47)	38.75 \pm 2.61 (29)	56.24 \pm 9.34 (50)	19.94 \pm 6.39 (47)	4.97 \pm 2.11 (47)
	Adult males	12.62 \pm 1.90 (41)	60.47 \pm 2.10 (36)	39.96 \pm 2.31 (18)	61.02 \pm 3.59 (38)	20.29 \pm 7.29 (36)	4.97 \pm 2.37 (36)
b	All males	-	61.06 \pm 1.80 (91)	38.47 \pm 2.98 (105)	55.41 \pm 9.00 (106)	18.13 \pm 0.91 (87)	6.11 \pm 1.03 (85)
	Adult males	-	61.63 \pm 1.54 (67)	39.04 \pm 3.10 (79)	59.67 \pm 4.90 (79)	18.15 \pm 0.83 (64)	6.05 \pm 1.02 (63)

The red feathers of Pin-tailed Manakins exhibit a regulatory mechanism of pigment deposition (Fig. 2), suggesting that the substitution of red by yellow in the aberrant bird might have occurred similarly. Chromatographic analysis of feather pigments from the aberrant and normal Pin-tailed Manakins will permit the description of the metabolic changes between red and yellow carotenoids that occurred in the yellow bird (Hudon *et al.* unpubl.). Likewise, a comparison of the carotenoids present in the yellow feathers of the aberrant Pin-tailed Manakin and on the crown of its close relative, Golden-winged Manakin *Masius chrysopterus*, may reveal the nature of colour trait change between species.

Occurrence in other taxa

Substitutions of red to yellow feather pigmentation are well documented in other birds (e.g. Northern Cardinal *Cardinalis cardinalis*²⁴) and not restricted to carotenoid-based pigmentation (e.g. parrots³³). In several species, two homologue alleles control the synthesis of red and yellow pigments, and some species, e.g. Gouldian Finch *Erythrura gouldiae*, are polymorphic for the expression of this gene^{5,8}. In parrots, at least one case is known where polymorphism exists involving red and yellow. In Dusky Lory *Pseudeos fuscata* there are two morphs in the wild²⁰.

Conservation

Few data on patterns of inheritance are available, but it is noticeable that yellow mutants of wild-type red species are common, but the reciprocal has never been reported. Moreover, the few available data on inheritance reveal that yellow mutants are produced by an autosomal recessive allele of the gene for red colour (e.g. psittacines^{13,25}, Gouldian Finch^{5,8}). If this hypothesis holds for Pin-tailed Manakin, we may assume that the frequency of the allele is sufficient to be expressed in a homozygous individual, implying that the population in the study area is subject to increased combined effects of genetic drift and inbreeding. Nemésio²⁶ also found colour aberration in another taxon (orchid bees, Hymenoptera) in forest fragments within the same region that the yellow Pin-tailed Manakin

was collected, and discussed whether the finding reflects bias in past sampling effort or if it occurs more frequently in small fragments than in continuous forest. The incidence of mutants in the fragmented Atlantic Forest deserves further study.

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References

- Alverson, W. S., Rodriguez, L. O. & Moskovits, D. K. (2001) *Perú: Biabo Cordillera Azul. Rapid Biological Inventories Report 2*. Chicago: The Field Museum.
- Anciães, M. & del Lama, S. N. (2002) Sex identification of Pin-tailed Manakins (*Ilicura militaris*: Pipridae) using Polymerase Chain Reaction and its applications to behavioral studies. *Orn. Neotrop.* 13: 159–165.
- Brush, A. H. (1967) Pigmentation in the scarlet tanager, *Piranga olivacea*. *Condor* 69: 549–559.
- Brush, A. H. (1978) Avian pigmentation. In: Brush, A. H. (ed.) *Chemical zoology*, 10. New York: Academic Press.
- Brush, A. H. & Siegfried, H. (1968) Pigmentation and feather structure in genetic variants of the Gouldian Finch, *Poephila gouldiae*. *Auk* 85: 416–430.
- CETEC (1996) *Desenvolvimento de tecnologia para o manejo de espécies nativas e recuperação de áreas degradadas de proteção das captções da Copasa Mutuca e Barreiro*. Relatório Técnico Final. Belo Horizonte: Fundação Centro Tecnológico de Minas Gerais.
- Foster, M. S. (1987) Delayed maturation neoteny and social system differences in two manakins of the genus *Chiroxiphia*. *Evolution* 41: 547–558.

8. Franklin, D. C. & Dostine, P. L. (2000) A note on the frequency and genetics of head colour morphs in the Gouldian Finch. *Emu* 100: 236–239.
9. Goldwin, T. W. (1980) *The biochemistry of the carotenoids*, 1. Second edn. New York: Chapman & Hall.
10. Goldwin, T. W. (1984) *The biochemistry of the carotenoids*, 2. Second edn. New York: Chapman & Hall.
11. Gonzaga, L. P., Pacheco, J. F., Bauer, C. & Castiglioni, G. D. A. (1995) An avifaunal survey of the vanishing montane Atlantic Forest of southern Bahia, Brazil. *Bird Conserv. Intern.* 5: 279–290.
12. Hamilton, W. D. & Zuk, M. (1982) Heritable true fitness and bright birds: a role for parasites? *Science* 218: 384–387.
13. Hayward, J. (1992) *The manual of colour breeding: parakeets, lovebirds, cockatiels and other parrots*. Oxford: Aviculturists' Publications.
14. Hill, G. E. (1992) The proximate basis of variation in carotenoids plumage pigmentation of house finches. *Biol. J. Linn. Soc.* 49: 63–86.
15. Hill, G. E. & Montgomerie, R. (1994) Plumage colour signals nutritional condition in the house finch. *Proc. Roy. Soc. Lond., Ser. B* 258: 47–52.
16. Hudon, J. (1991) Unusual carotenoid use by the Western Tanager (*Piranga ludoviciana*) and its evolutionary implications. *Can. J. Zool.* 69: 2311–2320.
17. Hudon, J. (1994) Showiness, carotenoids, and captivity: a comment on Hill (1992). *Auk* 111: 218–221.
18. Hudon, J., Capparella, A. P. & Brush, A. H. (1989) Plumage pigment differences in manakins of the *Pipra erythrocephala* superspecies. *Auk* 106: 34–41.
19. Inouye, C. Y., Hill, G. E., Stradi, R. D. & Montgomerie, R. (2001) Carotenoid pigments in male house finch plumage in relation to age, subspecies, and ornamental coloration. *Auk* 118: 900–915.
20. Juniper, T. & Parr, M. (1998) *Parrots: a guide to parrots of the world*. New Haven: Yale University Press.
21. Marini, M. Á. (1992) Notes on the breeding and reproductive biology of Helmeted Manakins. *Wilson Bull.* 104: 173–178.
22. Marini, M. Á. (1992) Foraging behavior and diet of the Helmet Manakin. *Condor* 94: 151–158.
23. McDonald, D. B. (1993) Delayed plumage maturation and orderly queues for status: a manakin mannequin experiment. *Ethology* 94: 31–45.
24. McGraw, K. J., Hill, G. E. & Parker, R. S. (2002) Carotenoid pigments in a mutant cardinal: implications for the genetic and enzymatic control mechanisms of carotenoid metabolism in birds. *Condor* 105: 587–592.
25. Nemésio, A. (2001) Colour production and evolution in parrots. *Intern. J. Orn.* 4: 75–102.
26. Nemésio, A. (2002) Notes on the occurrence of an aberrant coloration in *Eulaema nigrita* (Hymenoptera: Apidae: Euglossina) in forest fragments in southeastern Brazil. *Lundiana* 3: 75–77.
27. Prum, R. O. (1990) Phylogenetic analysis of the evolution of display behavior in the Neotropical manakins (Aves: Pipridae). *Ethology* 84: 202–231.
28. Sick, H. (1967) Courtship behavior in manakins (Pipridae): a review. *Living Bird* 6: 5–22.
29. Sick, H. (1997) *Ornitologia brasileira*. Rio de Janeiro: Ed. Nova Fronteira.
30. Smithe, F. B. (1975) *Naturalist's color guide*. New York: American Museum of Natural History.
31. Snow, D. W. (1963) The evolution of manakin courtship display. *Proc. XVI Intern. Orn. Congr.* 12: 553–561.
32. Snow, B. K. & Snow, D. W. (1985) Display and related behavior of male Pin-tailed manakins. *Wilson Bull.* 97: 273–282.
33. Stradi, R., Pini, E. & Celentano, G. (2001) The chemical structure of the pigments in *Ara macao* plumage. *Comp. Biochem. Physiol. Ser. B* 130: 57–63.
34. Thompson, C. W., Hillgarth, N., Leu, M. & McClure, H. E. (1997) High parasite load in house finches (*Carpodacus mexicanus*) is correlated with reduced expression of a sexually selected trait. *Amer. Nat.* 149: 270–294.
35. Zuk, M., Thornhill, R. & Ligon, J. D. (1990) Parasites and mate choice in red jungle fowls. *Amer. Zool.* 30: 235–244.

Marina Anciães

Natural History Museum and Biodiversity Research Center, 1345 Jayhawk Boulevard, University of Kansas, Lawrence, KS 66045-7561, USA. E-mail: marina.anciaes@yale.edu. Current address: Department of Ecology and Evolutionary Biology, Yale University, 165 Prospect St. New Haven CT 06520-8106, USA.

André Nemésio

Departamento de Zoologia, Universidade Federal de Minas Gerais-ICB, Caixa Postal 486 Belo Horizonte, MG 30123-970, Brazil. E-mail: nemesio@ornitologia.com.br

Fabiane Sebaio

Departamento de Biologia Geral, Universidade Federal de Minas Gerais-ICB, Caixa Postal 486 Belo Horizonte, MG 30123-970, Brazil, and Fundação Biodiversitas, Rua Ludgero Dolabela, 1021 - 7º andar, Gutierrez, Belo Horizonte, MG 30430-130, Brazil.

Appendix I. Specimens studied in museum collections.

Brazil: MNRJ—Museu Nacional da Universidade Federal do Rio de Janeiro, Rio de Janeiro; MUZUSP—Museu de Zoologia da Universidade Estadual de São Paulo, São Paulo; DZUFMG—Coleção Ornitológica do Departamento de Zoologia da Universidade Federal de Minas Gerais, Belo Horizonte. USA: AMNH—American Museum of Natural History, New York; ANSP—Academy of Natural Sciences of Philadelphia, Philadelphia; LSUMZ—Louisiana State University Museum of Zoology, Baton Rouge; and NMNH—Smithsonian Institution National Museum of Natural History, Washington.

Ilicura militaris: AMNH 5029, 5030, 14086, 42016, 147034, 147035, 315489, 493351, 493352, 493353, 493354, 493358, 493359, 493360, 493361, 493362. ANSP 8519, 8520, 8522. DZUFMG 1275, 1277, 1278, 1279, 1280, 1281, 1282, 1285, 1289, 1290, 1292. LSUMZ 53037, 53038, 63383, 71413. MNRJ 8832, 8833, 8834, 8835, 11035, 11040, 11041, 11043, 11044, 11045, 19759, 19760, 19761, 19762, 22740, 22741, 22743, 22744, 26076, 27285, 28051, 30125, 30126, 34235, 35557, 37430, 38311, 38558, 43141, 43241, 43562, 43563, 43564. MUZUSP 2960, 4798, 5413, 5414, 5472, 10082, 11395, 11821, 24040, 24041, 24043, 24122, 24123, 26313, 31322, 33504, 33505, 34826, 35354, 36356, 36453, 36972, 48154, 50123, 50124, 50129, 53483, 53957, 57009, 62728, 69614, 69615, 69618, 69619. NMNH 15010, 84069, 115146, 147578. *Chiroxiphia pareola regina*: AMNH 232350, 493203, 493200, 493206, 309521, 278162, 238458. LSUMZ 115820, 133240, 133231. *Chiroxiphia pareola alicae*: AMNH 311130, 434955.

Machaeropterus regulus (undescribed subspecies) LSUMZ 161893, 161894, 161895, 161896, 161897, 161898, 161899. *Machaeropterus regulus aureopectus* FMNH 344154, 344155.