



FIRST RECORD OF A CYANISTIC (BLUE) PLUMAGE ABNORMALITY IN ORANGE-FRONTED PARAKEETS *EUPSITTULA CANICULARIS* IN MEXICO

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Abstract · Pigmentary coloration in bird plumage involves several pigment types. In addition, Psittacidae species (parrots and allied) synthesize their own yellow pigment, psittacin (psittacofulvin), which is normally present in green feathers. The inability to synthesize psittacin, due to a gene mutation, results in a cyanistic —or blue— plumage phenotype. We present the first record of a cyanistic (blue) abnormality in the plumage of the Orange-fronted Parakeet *Eupsittula canicularis* in Mexico. Two young blue parakeets were removed from their nest in 2023 and kept as pets. Both birds lacked the typical green coloration and displayed extensive blue plumage on the entire body. The frequency of psittacin mutations in wild Psittacidae populations is unknown, but the alleles involved must be quite rare. Further studies are needed to understand the biology and ecology of the species in relation to possible population declines that could potentially increase the homozygous frequency for the recessive blue allele.

Resumen · Primer registro de una anomalía cianótica del plumaje en el perico de frente naranja *Eupsittula canicularis* de México

La coloración pigmentaria del plumaje de las aves implica varios tipos de pigmentos. Las especies de Psittacidae (loros y afines) sintetizan su propio pigmento amarillo, la psitacina (psitacofulvina), normalmente presente en las plumas verdes. La incapacidad para sintetizar psitacina, debido a una mutación genética, da como resultado un fenotipo de plumaje cianístico o azul. Aquí presentamos el primer registro de una anomalía cianística (azul) en el plumaje del perico frente naranja *Eupsittula canicularis* en México. Dos jóvenes periquitos fueron sacados de su nido en 2023 y mantenidos como mascotas. Ambas aves carecían de su típica coloración verde y mostraban un extenso plumaje azul en todo el cuerpo. Se desconoce la frecuencia de las mutaciones de psitacina en poblaciones silvestres de Psittacidae, pero el alelo involucrado debe ser bastante raro. Se necesitan más estudios para comprender la biología y ecología de la especie en relación con posibles disminuciones poblacionales que podrían aumentar potencialmente la frecuencia homocigótica del alelo azul recesivo.

Key words: Bird coloration · plumage aberration · Psittacidae · psittacin · psittacofulvin.

The Orange-fronted Parakeet *Eupsittula canicularis*, locally known as “periquito atolero” in Oaxaca, is one of the 22 species of Psittacidae recorded in Mexico (Cantú-Guzmán & Sánchez-Saldaña 2018). This parakeet is distributed along the Pacific slope, from southern Sinaloa, Mexico, to northern Costa Rica (Forshaw 1989, Howell & Webb 1995, Collar et al. 2000), where it inhabits humid and subhumid deciduous forests, riparian forests, and agricultural areas (Ridgely et al. 1981, Stotz et al. 1996, Collar et al. 2000). It has an unmistakable wide orange-red band in the forecrown that extends to the lores, a noticeable bare yellow eye ring, and a conspicuous blue crown (Figure 1; Forshaw 1989, Howell & Webb 1995). The rest of the body shows a gradient from pale green to olive green, and the primary feathers are blue (Forshaw 1989, Howell & Webb 1995).

Plumage coloration in birds is determined by both, the presence of pigments and microstructural arrangement of feathers (Tickell 2003, Hill & McGraw 2006, Roulin & Ducrest 2013). Pigmentary coloration in general involves three types of pigments: melanins, carotenoids, and porphyrins (Hill & McGraw 2006, Bostwick 2016). However, psittacids produce a unique pigment called psittacin (psittacofulvin), which is responsible for the expression of a range of colorations from yellow to red (Martin 2002, Pérez-Rodríguez 2011). Thus, the green coloration of psittacids results from the yellow psittacine pigment on top of eumelanin granules in the deeper cells of feather barbs, which distorts the light as it passes through, making the feathers appear blue (Auber 1941, Dyck 1971, Martin 2002, Hume & van Grouw 2014). The distribution of psittacin in the cortex and the outermost

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Figure 1. Typical coloration of the Orange-fronted Parakeets *Eupsittula canicularis* in Mexico (Photo: Jesús García Grajales).

layer of a feather barb, combined with the structural blue coloration, creates the bright shades of green characteristic of most parrot species (Martin 2002).

Cyanistic -or blue- phenotypes result from the inability, due to a gene mutation, to synthesize yellow pigment (psittacine) normally present in green feathers (Nemésio 2001, Martin 2002). Psittacins are of endogenous origin, and their synthesis occurs in feather follicles (Pérez-Rodríguez 2011); therefore, in the absence of yellow pigments, the blue structural color is exposed (Nemésio 2001, Martin 2002, D'Alba et al. 2012). Although pigmentary abnormalities are frequently recorded in many bird species (McCardle 2012), mutations that affect carotenoid or psittacine pigmentation are rare in the wild (van Grouw 2006, Mahabal et al. 2016, Rosas-Espinoza et al. 2020).

Cyanistic and blue are synonyms describing the blue coloration of Psittacidae species. The term blue is used more frequently among bird breeders (Martin 2002), whereas the term cyanistic was proposed by Texeira (1985), who based it on the Greek word *Kyanos* (blue). Both terms have been used indiscriminately in the scientific literature to describe the blue coloration of wild psittacids (Pagotto et al. 2019, Rosas-Espinoza et al. 2020, Ramos et al. 2023). Within this context, we present the first record of a cyanistic (blue) abnormality in the Orange-fronted Parakeet in Mexico. To avoid controversy, we use both terms (cyanistic and blue) to describe the blue coloring of the plumage.

On June 14, 2023, a resident of the San Vicente community, municipality of Villa de Tututepec, Oaxaca, showed us a couple of caged young parakeets that were completely blue in color. Both parakeets were captured in a nest built in a termitarium during the nesting season of April 2023. The termitarium was built on a cuajilote tree, *Parmentiera aculeata* (Bignoniaceae), which grows in the Sierra Madre del Sur Mountain range. Both individuals lacked green coloration, the typical wide band of orange-red forecrown, and the bare yellow eye-ring. They presented a wide white band in the fore-

crown (Fig. 2a) and a bare white eye-ring (Fig. 2b). Instead of the normal green ventral plumage, they had blue on their throat, and their upper chest faded to nearly white on the belly (Fig. 2c). The dorsal region of the birds displayed an intense blue color (Fig. 2d).

This is the first record of a cyanistic mutation in the Orange-fronted Parakeet. Blue plumage mutations or cyanism in Psittacidae are rare, and few reports exist in the Neotropics. Pagotto et al. (2019) documented this abnormality in a wild Blue-winged Parrotlet *Forpus xanthopterygius* in Brazil, and Rosas-Espinoza et al. (2020) reported a wild Mexican Parrotlet *Forpus cyanopygius* in Jalisco, Mexico. Recently, Ramos et al. (2023) reported a wild blue mutation in an Orange-chinned Parakeet *Brotogeris jugularis* from Colombia.

To date, the frequency of psittacin mutations in wild Psittacidae populations is unknown, but the allele involved must be quite rare (Rosas-Espinoza et al. 2020). As a result of different threats confronted by parrots and parakeets in Mexico, some of their populations tend to be small and isolated (Bensch et al. 2000). Consequently, the probability of homozygous individuals with recessive alleles coding for color abnormalities is expected to increase (Sage 1962, Bensch et al. 2000, Rosas-Espinoza et al. 2020).

The blue mutation reported here is the most frequent color mutation in parrots and parakeets within Psittacidae (Nemésio 2001), and this is the first documented record of a cyanistic plumage abnormality in *E. canicularis*. Further studies in the wild are needed to understand the biology and ecology of the species in relation to possible population decline, which could potentially increase the frequency of homozygous recessive blue alleles in this species.

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Figure 2. Orange-fronted Parakeet *Eupsittula canicularis* showing cyanistic anomalies: a) wide band of white feathers in forecrown; b) white eye-ring; c) fading of blue to white from throat to belly; d) dorsal view of the intense blue color (Photos: Jesús García Grajales).

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