Iris coloration and a case of temporary heterochromia in the Red-bellied Grackle *(Hypopyrrhus pyrohypogaster)*

Coloración del iris y un caso de heterocromía temporal en el Cacique Candela *(Hypopyrrhus pyrohypogaster)*

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Abstract

We describe overlooked patterns and age-related variation in the iris coloration of the Red-bellied Grackle *(Hypopyrrhus pyrohypogaster),* a range-restricted threatened species of the Colombian Andes. Whereas adults exhibit a bicolored pale-yellow/scarlet red iris, juveniles show a dark iris, ranging from dark brown to grayish brown. In addition, we report the first case for a Neotropical species of temporary heterochromia iridis, an uncommon phenomenon in birds, from recaptures of a female Red-bellied Grackle in 2010. Our observations suggest that this case of heterochromia may be related to stress and changes in blood flow to the eye.

Key words: Antioquia, heterochromia iridis, *Hypopyrrhus pyrohypogaster*, iris coloration.

Resumen

Describimos patrones y variación relacionada con la edad en la coloración del iris del Cacique Candela *(Hypopyrrhus pyrohypogaster),* una especie amenazada con distribución restringida en los Andes Colombianos. Mientras los adultos presentan un iris bicolor con amarillo pálido y rojo escarlata, los juveniles muestran un iris oscuro que va desde café oscuro a café grisáceo. Adicionalmente, reportamos el primer caso para una especie Neotropical de heterocromía temporal en la coloración del iris, un fenómeno poco común en aves, a partir de una hembra de Cacique Candela recapturada en 2010. Sugerimos que este caso de heterocromía pudo estar relacionado con el estrés y cambios de flujo sanguíneo al ojo.

Palabras clave: Antioquia, coloración del iris, heterocromía iridis, *Hypopyrrhus pyrohypogaster*

Introduction

Among the external phenotypic traits of birds, iris coloration is perhaps the most mechanistically complex and one of the least understood (Prum 2006). Iris coloration can be produced by structural elements as well as pigments (Oehme 1969, Ferris & Bagnara 1972, Prum 2006), notably pteridines and purines in brightly colored irises (Oehme 1969, Oliphant 1987, Oliphant & Hudon 1993). Iris color can vary greatly within a population (Craig & Hulley 2004). In some species, this variation distinguishes the sexes and age classes (Hudon & Muir 1996), which implies individual color variation (Selander 1958, Hardy 1973, Scholten 1999). The histological basis of aging and the changes in iris color in an individual have been described in detail for few species (*e.g.,* Sweijd & Craig 1991). Rarely, an individual bird will have different iris colors in each eye. This condition of unequal pigmentation of the eyes in an individual, heterochromia iridis, is frequently associated with pathology, although Bond (1912) demonstrated that a significant proportion of cases are congeni-

tal and unassociated with any evidence of disease.

Occasionally individual birds are reported with abnormal eye coloration (Dias *et al.* 2009) with important implications for identification (Mckee & Jaramillo 1999, Boano & Janni 2008), but cases of individuals with heterochromia iridis are rarely reported in the literature (F. Hayes, pers. comm.).

The Red-bellied Grackle *(Hypopyrrhus pyrohypogaster)* is a threatened endemic icterid of the humid montane forests of the Colombian Andes (Cadena *et al.* 2004, Ocampo *et al.* 2012). Little is known about phenotypic variation and demography of this threatened bird. Here, we describe the iris coloration and report a case of temporary heterochromia iridis in the Red-bellied Grackle. Age classes can be distinguished in the field by plumage characteristics and iris coloration in this species, and adults can be sexed in the field due to conspicuous differences in size (Ocampo *et al.* 2012).

Methods

During two breeding seasons (2010-2011) we used mist-nets to capture Red-bellied Grackles as part of a long-term project on breeding biology initiated in 2006 (see Ocampo *et al.* 2012). The study area comprises second growth forest, pastures with isolated trees, semi-open areas at different stages of succession and forestry plantations, located at Alto San Miguel, Caldas, Antioquia, Colombia (06° 02' N, 75° 37' W; 1800-2100 m elevation).

We captured juveniles, adults and nestlings. All individuals were measured and marked with a combination of two plastic color bands to identify them and reproductive groups. We recorded iris color of both left and right eye, and all individuals were photographed. For recaptured individuals we only remeasured their weight. We captured 22 Red-bellied Grackles, consisting of 18 adults and 4 fledglings at least 8 weeks old. Additionally, we banded 23 nestlings in nine successful nests.

Results

All adults captured and observed at Alto San Miguel irrespective of sex exhibited bicolored irises, consisting of a pale yellow center surrounded by a sharp scarlet red margin (Fig. 1a,b,e). This pattern does not differ from other localities where we have observed or captured adults of this species (*e.g.,* Cuervo *et al.* 2008). The bicolored iris, and particularly the red outer margin, is conspicuous in live birds (Fig. 1a,b), but changes rapidly after death.

We have collected adult Red-bellied Grackles in previous studies (*e.g.*, Cadena *et al.* 2004) and have noticed a post-mortem change in the tone and extent of the red margin to a faint brownish color. The nestlings and fledglings of three months of age had a dark iris, ranging from dark brown to grayish brown (Fig. 1c,d), and we presume that the bicolored iris is acquired between 8 and 12 months of age.

On 28 April 2010, we captured an adult female with bicolored irises in both eyes, but whereas the tone of the yellow of her left eye looked typical, that in her right eye was abnormally intense (Fig. 2). The color difference between eyes remained while the bird was handled and released. One month later, on 27 May 2010, the bird was recaptured and had both irises with the typical coloration in both eyes (Fig. 1a). This individual, banded as a nestling on 7 May 2006, was four years old at the time of capture. The individual has been characterized as an active member in its reproductive group for four breeding seasons, helping to feed and take care of the nestlings and fledglings. This female had an otherwise typical morphology, and no other captured bird showed such abnormalities in eye color.

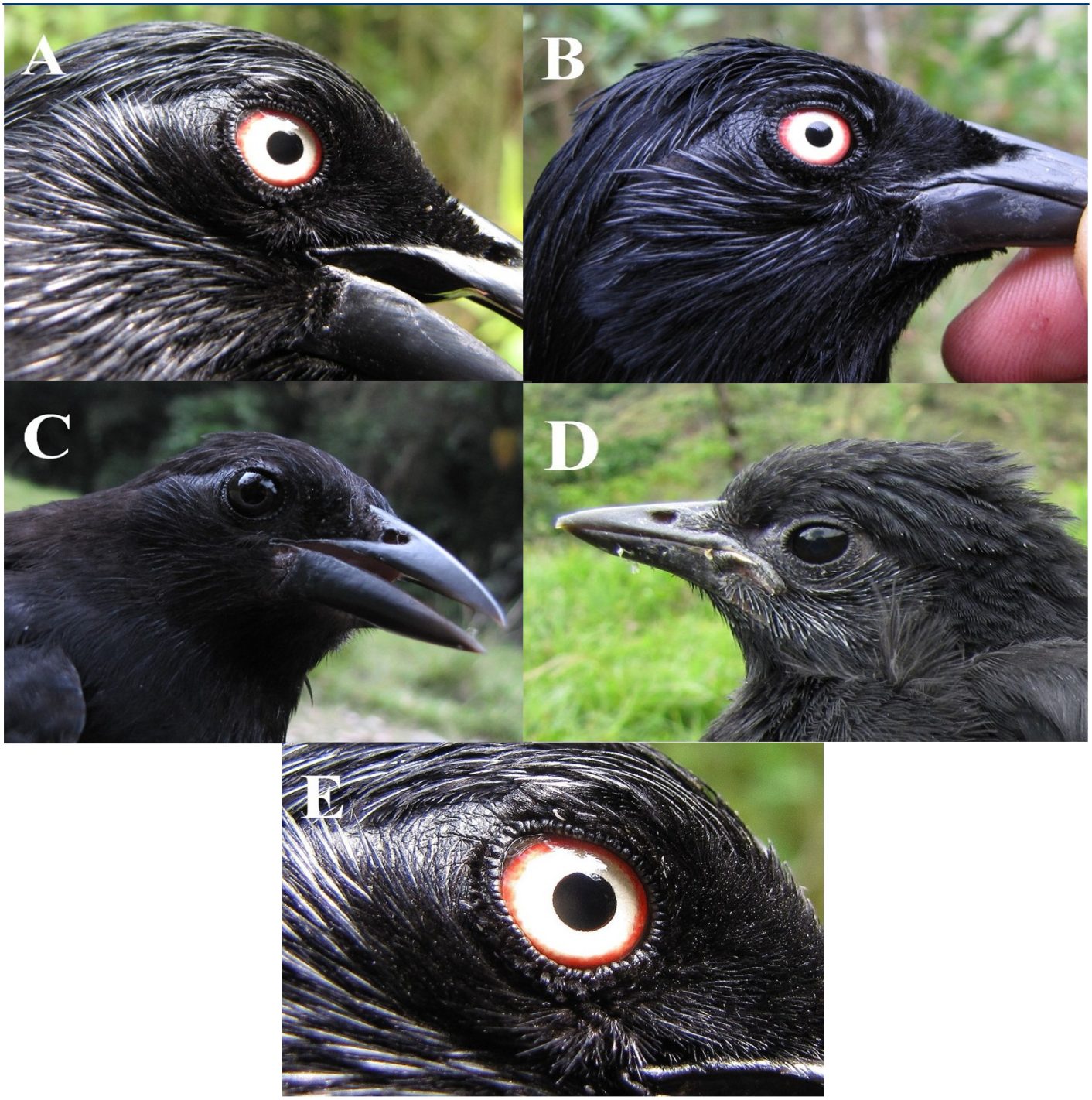

Figure 1. Typical iris coloration in the Red-bellied Grackle: **(A)** Adult female. **(B)** Adult male. **(C)** Fledgling over 8 weeks old. **(D)** Nestling. **(E)** Close-up of the bicolored iris (Photographs by S. David).

Discussion

The iris color of the Red-bellied Grackle is reported in the literature as "yellowish white" (Hilty & Brown 1986), "straw yellow" (Ridgely & Tudor 1989) or "pale yellow" (Fraga 2011). These inaccurate descriptions in the literature may have originated from old museum specimen tags since collectors could have easily overlooked this pattern if detailed soft part coloration was not promptly recorded, as it is customary in modern ornithology. It is possible that the red coloration of Red-bellied Grackles' eyes is hemoglobin-based (see below).

Heterochromia iridis is rarely observed in birds. In two gull species, Herring Gull *(Larus argentatus)*

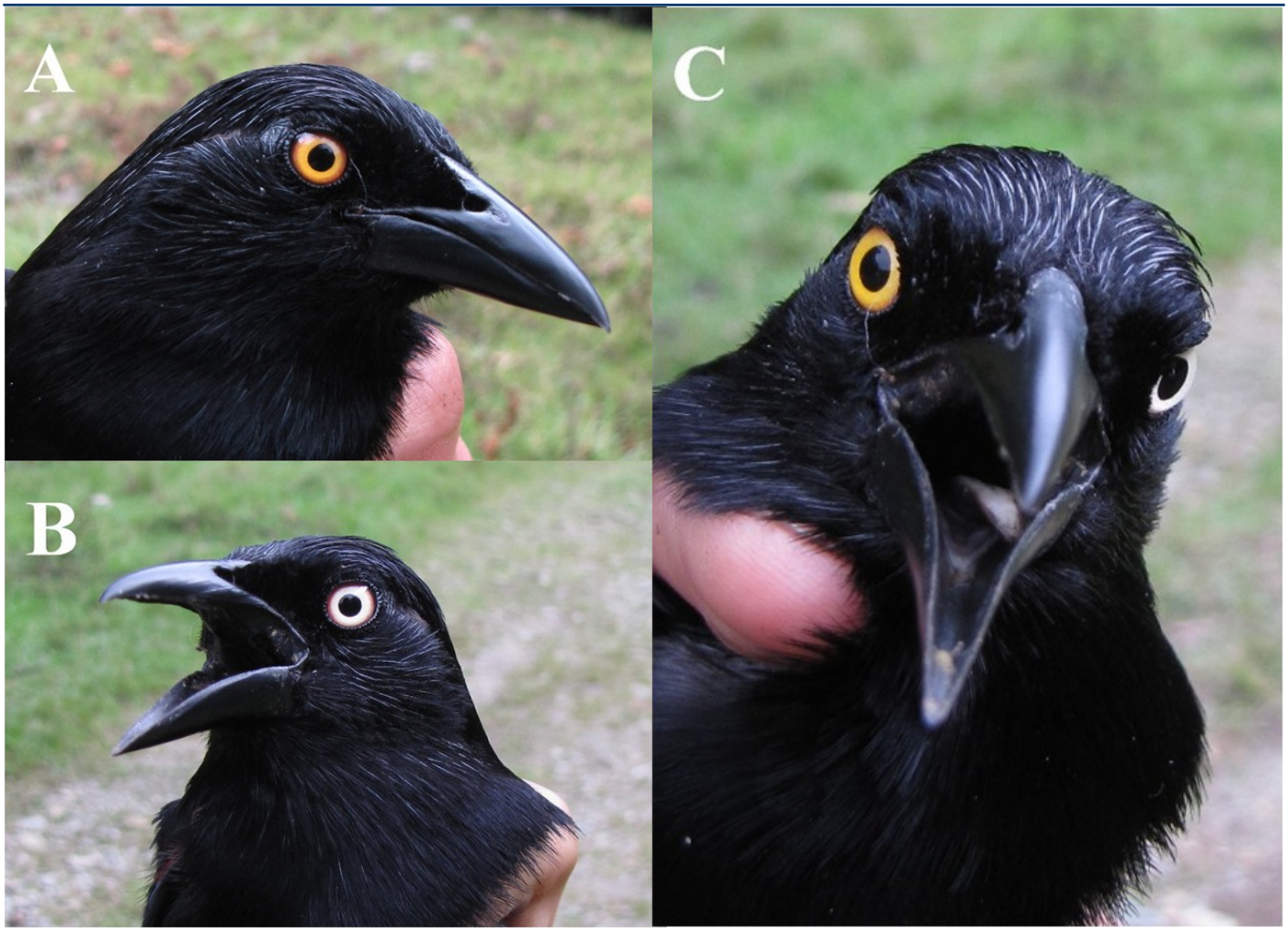

Figure 2. Adult female Red-bellied Grackle with temporary heterochromia iridis captured on 28 April 2010 in Caldas, Antioquia, Colombia. **(A)** Right eye. **(B)** Left eye. **(C)** Frontal view (Photographs by S. David).

(Poor 1946) and Thayer´s Gull *(Larus thayeri)* (Eckert 2002), anomalous individuals with one yellow iris and one brown iris have been described.

More interesting are cases where the eye color difference is temporary. For example, the eye color of individual Black-bellied Glossy Starling *(Lamprotornis corruscus)* changed from yellow to red when handled (McCulloch 1963). The eye color of 5-6% of Red-billed Oxpeckers *(Buphagus erythrorhynchus)* captured in South Africa also changed during handling (Raijmakers & Ellmer 2009): the birds initially had red eyes and changed one or both eyes to yellow or partially yellow. In both cases, this phenomenon was explained by stress and changes to the flow of blood to the iris. No case of temporary heterochromia has so far been reported in a Neotropical bird, and there is no obvious explanation for this phenomenon. One possibility is that, as in the aforementioned cases, the temporary difference in eye coloration of the Red-bellied Grackle female was related to changes in blood flow to the iris as a result of handling. The red iris in another icterid, the Bronzed Cowbird *(Molothrus aeneus),* is caused by hemoglobin in blood in large thin-walled venous sinuses overlaying abundant reflective pigment cells (Oliphant 1998). The iris loses its red color after death, as does the outer margin of the iris of Red-bellied Grackles. The yellow center of the Red-bellied Grackle iris may also be vascularized, albeit to a lesser extent, and sensitive to changes in blood flow. Another possibility is that the pigment make-up of pigment cells in the aberrant eye differed

slightly from that in the normal eye or that blood leaked in the anterior chamber of that eye (J. Hudon, pers. comm.). At present we are not able to conclusively rule out any of these explanations.

In the Red-bellied Grackle, little information about the variation in iris color with age has been published (Hilty & Brown 1986, Jaramillo & Burke 1999, Fraga 2011), although this is an important feature to distinguish between age classes (Fig. 1).

The iris of juvenile birds changes color from dark brown to gray and becomes bicolored pale yellow within the first year. In adults, this feature does not differ between sexes. This information can serve as a basis for understanding the age-related variation and the mechanisms involved in the iris coloration in this species and other icterids.

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