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ECCENTRIC PREFORMATIVE MOLT IN A MUSEUM SPECIMEN OF THE BLUE-AND-YELLOW TANAGER (*PIPRAEIDEA BONARIENSIS DARWINII* BONAPARTE, 1983) (AVES: THRAUPIDAE)

MUDA PREFORMATIVA EXCÉNTRICA EN UN ESPÉCIMEN DE COLECCIÓN DE LA TANGARA AZUL Y AMARILLA (*PIPRAEIDEA BONARIENSIS DARWINII* BONAPARTE, 1983) (AVES: THRAUPIDAE)

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ABSTRACT

We document a unusual variation in the extent of preformative molt across 20 formative-plumaged Blue-and-yellow Tanager (*Pipraeidea bonariensis darwinii* Bonaparte, 1838) museum specimens from Peru. Our finding represents the first evidence of eccentric replacement of primaries and primary coverts during the preformative molt for this species.

Keywords: eccentric – museum specimen – preformative – Peru – *Pipraeidea bonariensis darwinii*

RESUMEN

Documentamos una variacion inusual en la extension de la muda preformativa en un espécimen de colección entre un total de 20 especímenes en plumaje formativo de la Tangara Azul y Amarilla (*Pipraeidea bonariensis darwinii* Bonaparte, 1838) colectados en Perú. Esto representa la primera evidencia de reemplazo excéntrico de primarias y cobertoras primarias durante la muda preformativa para esta especie.

Palabras clave: excéntrico – espécimen de museo – preformativa – Peru – *Pipraeidea bonariensis darwinii*

INTRODUCTION

The partial to incomplete nature of the extent of the preformative molt in most Neotropical resident landbird species can be used to facilitate an accurate and rapid technique for ageing birds in the hand (Pyle, 1997b; Pyle *et al.*, 2004; Hernández, 2012). To date, the preformative molt of species in the family Thraupidae in the Neotropics has been documented as partial, incomplete or complete (Ryder & Wolfe, 2009; Gómez *et al*., 2012; Hernández, 2012; Pyle *et al*., 2015; Johnson & Wolfe, 2018; Díaz *et al*., 2018) with possible variations among these molt extents within the same genera and even individuals of the same species (Ryder & Wolfe, 2009; Johnson & Wolfe, 2018). Evidence of eccentric flight feather replacement during the preformative have been documented in 20 species among 13 genera within the family (e.g. *Chlorophanes*, *Sicalis*, *Phrygilus*, *Diglossa*, *Volatinia*, *Eucometis*, *Ramphocelus*, *Cyanerpes*, *Sporophila*, *Saltator*, *Tiaris*, *Diuca*, and *Tangara*) (Pyle *et al*., 2004; Ryder & Wolfe, 2009; Wolfe *et al*., 2009; Gómez *et al.*, 2012; Pyle *et al*., 2015; Johnson & Wolfe, 2018, Díaz *et al*., 2018); but has not yet been reported for the Blue-and-yellow Tanager (Díaz *et al*., 2018). To survey how regular incomplete molts (*sensu* Pyle, 1997b) might be in the Blue-and-yellow Tanager (*Pipraeidea bonariensis darwinii* Bonaparte, 1838), we examined specimens collected in Peru from several national and international ornithological museums.

MATERIAL AND METHODS

Bird specimens of the Blue-and-yellow Tanager from Peru were examined at the "John O'Neill" Ornithological Collection at the Centro de Ornitología y Biodiversidad (CORBIDI), Museo de Historia Natural Javier Prado (MHNJP), Museo de Historia Natural de la Universidad Nacional de San Agustín de Arequipa (MUSA), Florida Museum of Natural History (FLMNH), and the Louisiana State University Museum of Natural Science (LSUMNS). Plumage terminology is based on Howell *et al*. (2003), and feather-tract terminology and abbreviations follow those of Pyle (1997b). Wing coverts and flight feathers of each specimen were carefully examined in both wings in order to avoid cases of adventitious replacement (Mulvihill, 1993; Pyle, 1997a; Burton, 2002; Wolfe & Frey, 2011). Moreover, since no individuals with unossified skulls were found undergoing the typical molt sequence (*sensu* Ginn & Melville, 1983) or having a definitive-basic plumage aspect, we discarded the presence of complete preformative molts among examined specimens and focus our attention on individuals possesing formative plumages as consequence of partial or incomplete molts. Age determination was based on the molt cycle-based aging system proposed by Wolfe *et al*. (2010) and refined by Johnson *et al*. (2011). Data of skull ossification gathered from specimen labels were also used to confirm age (Díaz *et al*., 2018), and sex of birds were established from museum labels and plumage differences. Ethical approval: The conducted research is not related with live animals use.

RESULTS

From a total of 178 examined Blue-and-yellow Tanagers, we focused on 20 formative-plumaged specimens (Table 1). These specimens were collected in Cajamarca, Cuzco Junin, La Libertad and Lima, between March to December since 1941 until 2012 (Table 2). Eighteen specimens exhibited

Table 1. Sample size of museum specimens of the Blue-and-yellow Tanager (*Pipraeidea bonariensis darwinii*) collected in Peru and deposited in five ornithological collections.

Museum	CORBIDI[a]	MHNJP[b]	MUSA[c]	LSUMNS[d]	FLMNH[e]
Sample Size	12	85	49	33	1

[a]Centro de Ornitología y Biodiversidad. [b]Museo de Historia Natural Javier Prado. [c]Museo de Historia Natural de la Universidad Nacional de San Agustín de Arequipa. [d]Florida Museum of Natural History. [e]Louisiana State University Museum of Natural Science .

a formative plumage as consequence of a partial replacement, and only one specimen (MUSM 4066) showed evidenced of a more extensive molt pattern. This last specimen showed a simetrically wing molt replacement that involved all secondary coverts (lesser, median and greater), carpal and alula coverts, lesser and greater alula, tertials (s7-9), and all rectrices. In addition, the specimen had replaced p9, s6 and two outer primary coverts. These replaced formative flight feathers contrasted with their retained juvenal ones, by being more lustrous, less worn, and evidencing a bluish coloration at the leading edge of each feather (Figure 1).

Table 2. List of Blue-and-yellow Tanager (*Pipraeidea bonariensis darwinii*) museum specimens in formative plumage. Date, location, sex, and specimen number associated with each specimen is provided.

Specimen Number[a]	Month	Year	Department	District	Altitude	Sex
MUSM 7190	November	1941	Junín	Huasahuasi	800	Male
MUSM 7193	December	1942	Junín	Palca	2700	Female
MUSM 7198	December	1953	Lima	San Bartolomé	2850	Unknown
MUSM 7201	October	1955	Lima	San Batolomé	2840	Female
MUSM 4066	October	1964	Lima	Chosica	700	Male
LSUMNS 34729	November	1964	Lima	San Bartolome	3050	Male
LSUMNS 93344	August	1971	La Libertad	Cochorco	1050	Male
LSUMNS 80859	August	1975	Cajamarca	Balsas	2011	Male
LSUMNS 85536	September	1977	Cajamarca	Cutervo	2545	Female
MUSM 7328	March	1980	Lima	San Bartolomé	2850	Female
MUSM 7324	April	1980	Lima	San Bartolomé	2850	Female
LSUMNS 127917	October	1984	Junin	Santo Domingo de Acobamba	3300	Male
MUSA 1222	December	2003	Arequipa	Yarabamba	2650	Female
MUSA 1260	October	2004	Arequipa	Quequeña	2600	Unknown
CORBIDI AV 011705	December	2006	Cuzco	Urubamba	3380	Male
CORBIDI AV 001426	September	2008	Junín	Satipo	3350	Male
CORBIDI AV 003040	November	2009	Cuzco	Marcapata	2240	Male
LSUMNS 190403	July	2010	La Libertad	Cospan	2700	Male
MUSA 4635	April	2011	Apurímac	Chalhuanca	3263	Female
MUSA 4513	March	2012	Junín	Chanchamayo	3284	Unknown

[a]Label Codes: Centro de Ornitología y Biodiversidad = CORBIDI AV, Museo de Historia Natural Javier Prado = MUSM, Museo de Historia Natural de la Universidad Nacional de San Agustín de Arequipa = MUSA, and the Louisiana State University Museum of Natural Science= LSUMNS.

DISCUSSION

Díaz *et al*. (2018) described the preformative molt in Blue-and-yellow Tanagers as partial in a tropical montane desert scrub intermixed with a mosaic of agroscapes (MINAM, 2012) in the highlands of Lima, Peru. Specifically, they reported the replacement of the body feathers (including all lesser and median coverts, and at least one to all greater coverts), and a variable number of tertials and rectrices, but not flight feathers (as secondaries, primaries, or primary coverts). Our closer examination of museum specimens corroborated these findings in relation to the extent and timing of molt (Table 3). However, we report evidence of an unusual eccentric (i.e., incomplete) molt pattern in a formative-plumaged bird specimen of this species. So far, we are aware of incomplete eccentric preformative molts reported in some species of thraupids (Pyle *et al*., 2004; Ryder & Wolfe, 2009; Wolfe *et al*., 2009; Gómez *et al*., 2012; Pyle *et al*., 2015; Johnson & Wolfe, 2018; Díaz *et al*., 2018); hence, it should not be unexpected to find eccentric molt limits in other species within this extensive family (Johnson, 2013). In addition, records of primary covert replacement during preformative molts has also been evidenced in other neotropical passerine taxa, as *Elaenia parvirostris* von Pelzeln 1868,

Figure 1. Museum specimen of the Blue-and-yellow Tanager (*Pipraeidea bonariensis*), collected at Chosica, dpto. Lima, Peru, October 1964 (MUSM 4066), showing formative ("F") outer primary (p9), inner secondaries (s6-s9) and two outer primary coverts as evidence of an eccentric incomplete molt (Photo: Alexis Díaz).

Tyrannus melancholicus melancholicus Vieillot 1819, and some others species which records remain unpublished (Johnson & Wolfe, 2018).

Because of our unique formative-plumage bird specimen exhibiting this unusual feather replacement pattern, it is difficult to hypothesize why this variation exists. Moreover, we cannot eliminate the possibility of this molt pattern being prevalent for other subspecies. Previous studies reporting more extensive molt patterns for other taxa suggest possible associations with age-sex groups (Pyle, 1997a, 1997b, 1998; Guallar *et al*., 2016; Díaz *et al*., 2018), fledge date (Elrod *et al*., 2011; Crates *et al*., 2015), latitude and migration (Pyle, 1997a, 1997b; Howell, 2010; Johnson, 2013; Morganti *et al*., 2013), and occupancy of open habitats and high levels of solar exposure for long-distance migrants (Pyle, 2008; Pyle & Kayhart, 2010). Molt patterns are among the most important tools used by bird banders to determinate the age of birds (Pyle 1997a, 1997b). Consequently, it is essential to continue to carefully document unusual molt patterns in any living bird or museum specimens to ensure that species are correctly identified in future work.

Table 3. Variation in the extent of the preformative molt by feather tract among 20 formative-plumaged Blue-and-yellow Tanager (*Pipraeidea bonariensis darwinii*) specimens collected in Peru and deposited in different ornithological collections. Carpal covert and alula tracts were not included in our analysis since they were difficult to examine for most specimens (Johnson *et al.,* 2013).

[a]Greater coverts	[a]Secondaries	[a]Rectrices	[a]Primaries	[a]Primary coverts	[a]Number of individuals
none	none	none	none	none	2
none	none	r1 (R) (asymmetrical)	none	none	1
2	none	r1-6	none	none	1
2	s9	none	none	none	1
3	none	none	none	none	2
3	none	r1	none	none	1
3	none	r1-6	none	none	1
4	none	none	none	none	1
4	none	r1-4	none	none	1
4	none	r1-6	none	none	1
4	s8-9	r3-4	none	none	1
5	none	r2-6	none	none	1
5	s8-s9	none	none	none	1
6	s9	none	none	none	1
6	s9	r1	none	none	1
8	s8-9	none	none	none	1
8	s7-9	none	none	none	1
all	s6-9	all	p9	2 outermost	1

[a]Data shows symmetrical replacements across the different tracts unless it expresses another replacement mode.

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