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MOLT PATTERNS AND SEX AND AGE CRITERIA FOR SELECTED LANDBIRDS OF SOUTHWEST COLOMBIA

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Resumen. – Patrones de muda y criterios de determinación de edad y sexo para algunas aves terrestres del suroccidente Colombiano. – Se presentan los patrones de muda y criterios para determinar la edad y sexo de cinco especies de aves terrestres residentes en la zona andina de Colombia. La información presentada fue colectada durante 12 meses de trabajo de campo en la Reserva Forestal Protectora Regional de Bitaco, y visitas al Museo de Ornitología de la Universidad del Valle, Colombia. Mudas preformativas parcial a incompleta, y muda prebásica completa fue lo encontrado para las cinco especies, similar a lo que ocurre en especies relacionadas de las zonas templadas. La muda prealterna sólo fue evidente en una especie (*Tangara vitriolina*), mientras que las mudas presuplementales no fueron detectadas. No se observaron diferencias morfológicas entre machos y hembras en las diferentes especies, por lo cual su uso no se recomienda para el sexado de estas aves. Es posible determinar la edad en estas especies gracias a la presencia o ausencia de diferencias en calidad, forma y desgaste entre plumas juveniles y formativas, resultantes de mudas preformativas parciales o incompletas, similar a los métodos utilizados en las latitudes templadas.

Abstract. – Molt patterns and sex and age criteria for five resident landbird species from the Colombian Andean zone are presented. This information was gathered throughout 12 months of field work in the Reserva Forestal Protectora Regional de Bitaco, and visits to Museo de Ornitologia of Universidad del Valle, Colombia. Partial to incomplete preformative molts, and complete prebasic molts were found for all species, similar to related taxa in temperate zones. Prealternate molts were detected for one species (*Tangara vitriolina*), while presupplemental molts remained undetected. Morphological differences between sexes were not observed, therefore its use is not recommended when sexing these birds. Age determination is possible thanks to the presence or absence of differences in quality, shape, and wear between juvenal and formative feathers, produced by partial or incomplete preformative molts; similar to the system used in temperate latitudes. *Accepted 31 May 2012.*

Key words: Andean Solitaire, *Myadestes ralloides*, Black-billed Thrush, *Turdus ignobilis,* Scrub Tanager, *Tangara vitriolina*, Golden Tanager, *Tangara arthus*, Orange-bellied Euphonia, *Euphonia xanthogaster*, molt, age determination, sex determination, landbirds, Colombia.

INTRODUCTION

Examining demographic trends are a critical facet of monitoring bird populations through time. However, to gain a detailed understanding of avian demographics it is necessary to first establish accurate criteria to categorize individuals into sex and age classes. Molt strategies of landbirds from temperate zones are well known (Jenni & Winkler 1994, Pyle 1997), and information derived from them has been widely used in long-term

monitoring programs (e.g., Saracco *et al.* 2009). Unfortunately, this is not the case for resident tropical birds (Ryder & Wolfe 2009).

Because of the critical nature of molt in the life histories of birds, and the utilitarian value of molt ecology in the understanding of population structure and demographic trends, many studies have focused on describing molt patterns of landbirds from around the world. In temperate latitudes this information has been summarized by Jenni & Wrinkler (1994) and Pyle (1997), while in the Neotropics only a few attempts have been made in the recent past (Pyle *et al.* 2004, Wolfe *et al.* 2009a, 2009b, 2010); establishing molt, and aging and sexing criteria for species of selected avifaunas, and calling for additional work in other Neotropical areas.

Given the pervasive loss of natural habitats in the Neotropics and that the majority of avian diversity resides in this region, it is necessary to increase our understanding of Neotropical molt patterns. Here I summarize my findings on molt, plumages, and morphological data for the age and sex determination of five resident landbird species commonly encountered in Colombia, Ecuador, Peru, Bolivia, Venezuela and Brazil.

METHODS

The study site is located in the western mountain range of Colombia, inside the Reserva Forestal Protectora Regional de Bitaco (4°35'5"N, 77°04'5"W), at 1850 m a.s.l.. Birds were captured between February 2011 and January 2012, completing 19 visits (= 1370 net/hours) in total. Standard measurements, molt, reproductive activity, molt limits, skull condition, and eye color were recorded for each individual captured. Important notes on plumages were recorded, molt sheets were completed, and photographs of open wings were taken for individuals showing active molt or molt limits as a result of previous incomplete or partial molts.

For molt extent, "partial" indicates that no flight feathers were replaced (except the tertials or central rectrices in some cases). "Limited" that some, but not all body feathers and no flight feathers were replaced, and "complete" that all body and flight feathers were replaced (Pyle 1997). Molt terminology follows Howell *et al.* (2003); in particular, the first molt out of juvenal plumage, often partial or incomplete, is referred to as the preformative molt, additional inserted molts are referred to as prealternate molts, and the complete molt of one-year-old and older birds is the prebasic molt. Definitive plumage in most passerines refers to second and later basic plumages, when appearance no longer changes with age. Rectrices, primaries, secondaries, and their coverts are referred as "inner" and "outer" depending on their position in relation to the body of the bird. Sex of birds were determined by the presence/absence of external reproductive signals (brood patch, cloacal protuberance), and in sexually dimorphic species, by plumage coloration. Age was inferred, when possible, according to criteria provided by Pyle (1997), Pyle *et al.* (2004), Ryder & Wolfe (2009), and Wolfe *et al.* (2009a, 2009b). These criteria are based on presence or absence of differences in quality, shape, and wear between juvenal and formative feathers produced by partial or incomplete preformative molts. Age classification followed the system proposed by Wolfe *et al.* (2010) were molt cycles are used instead of the calendar-year system, which is commonly used in temperate zones, to more accurately distinguish cohorts in tropical latitudes.

Data from field work were augmented and complemented by museum data. Visits to the Museo de Ornitología of Universidad del Valle were made parallel to field visits. All specimens examined were collected in

TABLE 1. Morphological measurements from specimens for five species of resident landbirds commonly found in the Andean zone of Colombia, South America. Numbers in parentheses indicate sample sizes.

Species	Wing chord		Tail	
	Male	Female	Male	Female
Andean Solitaire	83–89 (13)	81–87 (19)	71–79 (12)	68–76 (18)
Black-billed Thrush	106–116 (19)	106–113 (15)	79–88 (18)	79–87 (15)
Scrub Tanager	71–82 (30)	72–75 (9)	49–59 (29)	50–56 (7)
Golden Tanager	72–79 (9)	71–77 (8)	46–53 (9)	46–49 (8)
Orange-bellied Euphonia	55–64 (31)	55–61 (16)	29–36 (31)	28–34 (16)

Colombia, in the Valle del Cauca Bioregion. Wing chord and tail length data reported were obtained from museum specimens of known sex. Measurements were taken following Pyle (1997), and were recorded in mm.

RESULTS

Molt patterns and sex and age criteria for five common resident species in the Reserva Forestal Protectora Regional de Bitaco are summarized below. Sample sizes and morphological measurements are presented in Table 1. No sex-specific dimorphism relative to wing chord and tail length was found for any of the species. Molt patterns are summarized in Table 2.

Andean Solitaire (Myadestes ralloides). Sexes are similar in all plumages. The preformative molt is variable, with zero to eight inner greater coverts, and all median and lesser coverts replaced. Alula, primary coverts, tertials, and rectrices are retained during this molt. Juveniles have heavily buff-spotted upper and under parts, body washed reddish-brown above and gray underneath, with buff-tipped wing coverts (Fig. 1).

Formative birds retain primary coverts and a variable number of outer greater coverts. Molt limits occur among the greater coverts; the retained outer greater coverts being shorter, worn, paler, and with buff tips when fresh, which contrast with the longer, fresher, darker replaced inner coverts, usually without buff tips. Primary coverts are narrow, tapered, relatively abraded, and brownish with indistinct and relatively thin or no pale brownish edging. Rectrices are tapered and relatively abraded. Formative body plumage resembles that of adult individuals.

Definitive individuals have uniform rufous-brown upperparts, and gray head and underparts; wing coverts are uniform in wear. The amount of white in the outer rectrices does not seem to vary between age or sex classes.

Black-billed Thrush (Turdus ignobilis). Sexes are similar in all plumages. The preformative molt is variable, with none to all greater coverts, some to all median and lesser coverts, zero to three tertials, and sometimes the central pair of rectrices replaced. The alula might be replaced during the preformative molt as well. Juveniles have spotted breasts and buff tips on wing coverts (Fig. 2).

Formative individuals typically have retained outer greater coverts which are shorter, paler, and buff-tipped when fresh. When retained, lesser and median coverts are also relatively shorter, paler, and buff-tipped when fresh. Retained rectrices are narrow and relatively abraded. Molt limits between secondaries and tertials, when present, are easy to see and helpful when ageing this species.

TABLE 2. Molt patterns and sample sizes for five species of resident landbirds commonly found in the Andean zone of Colombia, South America.

Species	Sample size (n)		Molt pattern		
	Field captures	Museum specimens	Preformative molt	Definitive prebasic molt	Prealternate molt
Andean Solitaire	12	36	partial	complete	absent
Black-billed Thrush	42	58	partial	complete	absent
Scrub Tanager	8	59	partial-incomplete	complete	limited-partial
Golden Tanager	25	19	partial	complete	absent
Orange-bellied Euphonia	20	47	incomplete	complete	absent

Definitive individuals have uniform wing coverts and secondaries, with no buffy tips. Definitive rectrices and remiges are broad and truncate.

Scrub Tanager (Tangara vitriolina). Sexes are similar in all plumages, although females average duller and greener than males (not as blue-green). The preformative molt is variable, with three to ten inner greater coverts and two to three tertials replaced. Sometimes the alula, secondaries 5–6, and some to all rectrices are replaced, too. Juveniles have pale orange crown, pale green upperparts, and whitish-buff underparts, with a greenish tinge; coverts are dull with indistinct pale green edging.

Formative birds retain primary coverts which appear narrow, tapered, relatively abraded, and grayish with little pale blue-green edging, contrasting with the fresher, duskier, and blue-green edged replaced greater coverts (Fig. 3A). Replaced tertials and rectrices are dusky, and prominently edged blue-green.

Museum specimens suggest that a limited to partial prealternate molt occurs in all age and sex classes, although it appears to be more extensive in definitive males than in other age/sex groups. This molt includes none to all greater coverts, zero to three tertials, and sometimes one to two rectrices. The replaced feathers appear fresher and brighter than the retained ones, and the contrast between juvenal and alternate feathers in first cycle alternate (FCA) individuals is easy to see (Fig. 3B).

Definitive birds show no contrast between uniform blue-green edged primary and greater coverts. Remiges are dusky with distinct blue-green outer margins.

Golden Tanager (Tangara arthus). Sexes are similar in all plumages. The preformative molt is partial, including all greater coverts and two to three tertials, but no rectrices. Juveniles have fine black spotting on the head. Streaking on the back is present, but is duller and not as conspicuous as in definitive birds. Overall color is duller than that on definitive birds as well.

Formative birds retain primary coverts and alula, which contrast in wear and quality with the replaced coverts. The same contrast can be observed between replaced tertials and inner secondaries. Retained rectrices are narrow and often worn, but their relative shape is hard to differentiate between age classes, therefore its use is not recommended.

Definitive individuals have uniform coverts and remiges that do not contrast in wear or quality (Fig 4).

FIG. 1. Juvenal-plumaged Andean Solitaire (*Myadestes ralloides)* showing buff-spotted juvenal body plumage, and buff-tipped wing coverts (photo: A. M. Cuervo).

Orange-bellied Euphonia (Euphonia xanthogaster). The preformative molt is incomplete and includes most or all greater coverts, 2-3 tertials, and usually all rectrices. Juveniles are dull olive-green above, washed with gray on the nape, and dull yellow on the crown and forehead. Underparts are buff with a tinge of olive-yellow on the flanks. Loosely texture coverts, tertials, and rectrices have indistinct olive edging (Fig. 5A).

Formative females have olive upperparts and throat, with olive-yellow forecrown. The mid-crown is olive, which distinctly contrasts with the gray nape. Primary coverts are narrow, tapered, relatively abraded, and brownish with indistinct, narrow dull olive edging, contrasting with the fresher, duskier, olive-edged greater coverts. Replaced tertials are broad and truncate, with gray centers and distinct olive edging that contrast with retained brownish inner secondaries. Rectrices are as tertials, with little to no white on the outer rectrix (r6). Formative males have retained primary coverts and alula edged olive or blue-olive, and definitive male-like body plumage and rectrices. Remiges are brownish, with indistinct blue-olive edges. Sometimes two or three outer greater coverts and one tertial (ss7) are retained.

Definitive females have dusky gray primary coverts with distinct olive edging, not contrasting in wear or color with other coverts. Definitive males have uniform deep-blue edged coverts and remiges (Fig. 5B). The amount of white in the primaries below the primary coverts seems to vary by age class, with less white in formative males (FCF) and more in definitive males (DCB) (Figs 5A and 5B, respectively), but confirmation is needed.

DISCUSSION

My results agree with the findings from previous studies in the Neotropics, the Caribbean, and temperate zones (Pyle 1997, Pyle *et al.* 2004, Ryder & Wolfe 2009; Wolfe *et al.* 2009a, 2009b), where partial to incomplete preformative molts and complete prebasic molts have been found in related taxa. They also suggest phylogenetic conservation of molt patterns through widespread genera of birds with similar habitat preferences (forest edges) which, in some cases, has been observed to be more influential in the molt strategy than the relative phylogenetic closeness of related species (Ryder & Wolfe 2009). Information on these species will serve as a framework and will lead to a better understanding of their natural history and conservation in the future.

The presence of a partial or incomplete preformative molt in all five species will allow

FIG. 2. Juvenal-plumaged Black-billed Thrush (*Turdus ignobilis*) showing buff-tipped wing coverts (photo: A. Hernández).

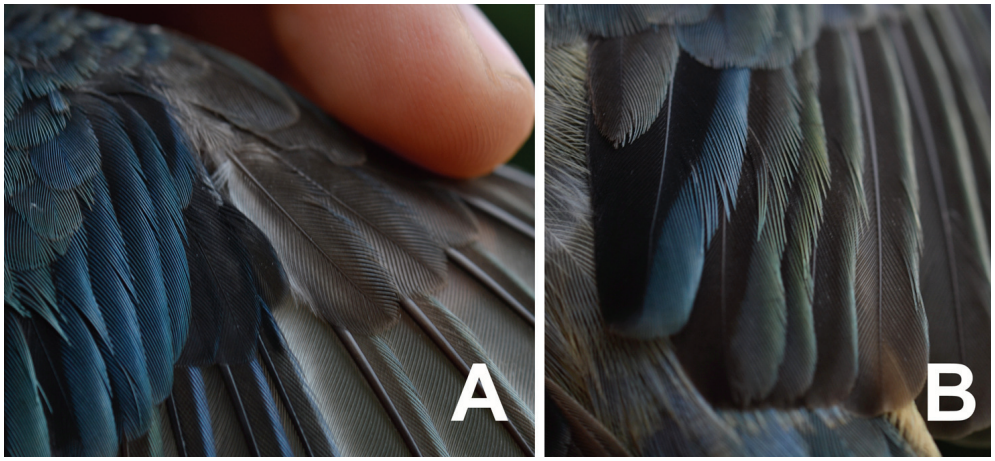

FIG. 3. First cycle alternate (FCA) Scrub Tanager (*Tangara vitriolina*) undergoing the first prebasic molt. A - Alternate greater coverts, basic inner primary coverts, and juvenal outer primary coverts and alula. B - Contrast among alternate secondary 8, formative secondaries 7 and 9, and juvenal inner secondaries (photo: A. Hernández).

FIG. 4. Definitive-plumaged Golden Tanager (*Tangara arthus*) showing uniform wing coverts (photo: A. Hernández).

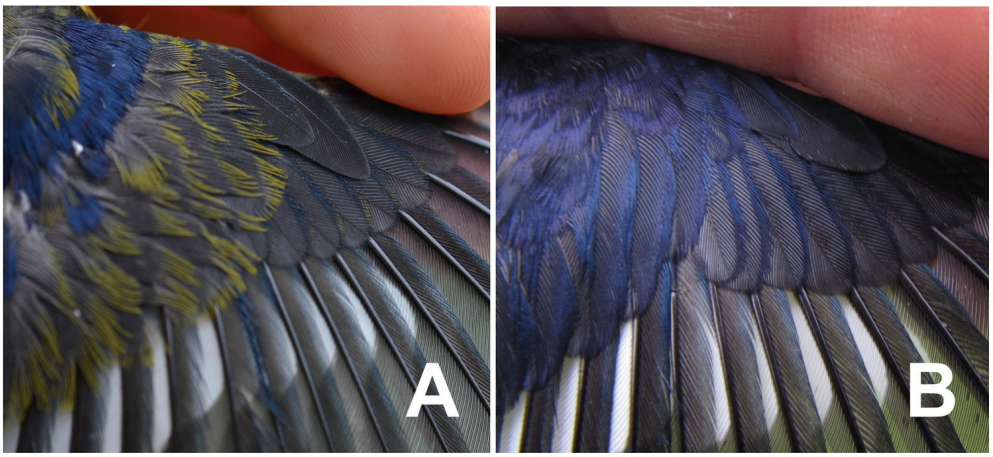

FIG. 5. Orange-bellied Euphonia (*Euphonia xanthogaster*). A - Young male undergoing the preformative molt, transitioning from juvenal to formative plumage. B - Definitive male showing uniform wing coverts (photo: A. Hernández).

ornithologists to accurately identify and classify individuals into age classes. The presence of a prealternate molt in the Scrub Tanager, but not in other tanagers described here, confirms the variable nature of this molt in tropical resident birds, as stated by Ryder & Wolfe (2009); it also increases our knowledge related to this underdeveloped subject. However more information is needed in order to reliably accept or deny the presence or absence of prealternate molts in other Neotropical species. Presupplemental molts were not detected. Other important features that could potentially aid sex and age determination such as iris, bill and mouth lining coloration were not found for the species treated here.

It is important to note that although males averaged slightly larger than females, none of these species showed any sex-specific dimorphism that can be precisely used to determine their gender. Therefore only external reproductive signals such as brood patch and cloacal protuberance, when present, and plumage coloration in the Orange-bellied Euphonia are recommended as sexing criteria for this group of species.

Despite the importance of accurate molt and plumage criteria for age classification, there are still significant gaps pertaining to the subject in Neotropical residents. In contrast, other attributes of avian life history are more often studied and, as a result, better represented in the contemporary ornithological literature (Ryder & Wolfe 2009). Gathering molt data during any banding effort while other data are being collected is easy, and the information resulting from them is highly valuable.

Data presented here in combination with previous efforts in other Neotropical zones create a framework for some species. However given the unparallel bird diversity in the Neotropics, especially in Colombia, larger efforts are needed to determine if molt patterns presented here are exportable to other species. Further related studies will enhance our understanding of the natural history of Neotropical birds and therefore increase our ability to manage and preserve their populations.

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