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Molt patterns and age and sex determination of selected southeastern Cuban landbirds

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ABSTRACT. Data from a banding station at Guantanamo Bay and the examination of 830 specimens were used to study molt patterns and criteria for determination of age and sex in 15 resident species of Cuban landbirds. All 15 species undergo their prebasic molt in August to November, with a few species commencing as early as May and/or completing as late as December. This timing corresponded with that of related taxa found in North America. With few exceptions, the extent of the first prebasic molts was also comparable to those of related taxa found at northern latitudes, being partial to incomplete in all nine passerines and four of six nonpasserines. Three species showed evidence of eccentric primary molt patterns during the first prebasic molt, to be expected in birds residing in scrubby or exposed environments such as those found at Guantanamo Bay. Determination of age is possible in most Cuban landbirds based on molt limits and the shape and condition of the primary coverts and rectrices, criteria very similar to those found in North American species of related taxa.

SINOPSIS. **Patrones de muda y criterios para determinar la edad y sexo de un grupo selecto de aves terrestres de la parte sureste de Cuba**

Datos obtenidos de una estación de anillaje en Guantanamo, Cuba y el examen de 830 individuos, fueron utilizaron para determinar los patrones de muda y establecer criterios para determinar la edad y sexo de 15 especies terrestres residentes. Todas las especies llevaron a cabo su muda prebásica de agosto a noviembre, con algunas especies comenzando tan temprano como el mes de mayo y terminando tarde en diciembre. Este patrón corresponde al mismo que llevan a cabo otras especies en Norte América. Con pocas excepciones, la extensión del periodo prebásico de muda resultó comparable con especies relacionadas encontradas en latitudes mas al norte, resultando de parcial a incompleta en nueve de los paserinos y cuatro de otras seis especies de no son paserinos. Tres especies mostraron evidencia de muda primaria eccéntrica, durante la primera muda prebásica, lo que era de esperarse en especies que residen en matorrales o ambientes expuestos como el que hay en la Bahía de Guantánamo. Es posible determinar la edad de la mayoría de las aves terrestres de Cuba, basándose en los límites de la muda y la forma y condición de las primarias y las rectrices. Criterios similares son utilizados con especies relacionadas o encontradas en Norte América.

Key words: age determination, Cuba, landbird, molt, sex determination

Despite recent advances in our understanding of molt and plumage development in North American landbirds (e.g., Pyle 1997), almost nothing is known about these subjects in neotropical resident species. Because the timing and extent of molts are often constrained by breeding and migration regimes (Voelker and Rohwer 1998), we might expect molting patterns to differ in the Neotropics, where food resources may be continuous, breeding seasons may be prolonged or year-round, and where resident species do not undertake extensive migrations (Stutchbury and Morton 2001). A few preliminary surveys of molting patterns in neotropical landbirds have been undertaken (Miller 1961; Snow and Snow 1964; Wolf 1969; Diamond 1974; Foster 1975; Prys-Jones 1982), but more information is needed to investigate neotropical molt strategies at the taxonomic or bioregional level.

There is developing interest in the population dynamics of neotropical landbirds as related to their conservation (Donovan et al. 2002). Recently, mark-recapture studies on overwinter survival of neotropical migrants (e.g., Sillet et al. 2000) have been conducted, and similar studies are proposed for tropical resident species. For example, the Institute for Bird Populations (IBP) has initiated a program for the establishment of Monitoring Avian Productivity and Survival (MAPS; DeSante et al. 2002) and MoSI (Moniterio de Sobrevivencia Invernal) stations to collect primary productivity and sur-

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vival data on both migrant and resident species in Middle America, including the West Indies. Such programs rely on the accurate determination of age and sex in captured individuals, but such criteria are virtually unknown for resident species not occurring at higher latitudes.

In 1998 a pilot banding station was established to monitor year-round survivorship on the U.S. Naval Station Guantanamo Bay, Cuba (Siegel and DeSante 2000). Raffaele et al. (1998) and Garrido and Kirkconnell (2000) provided some preliminary information on plumage variation in landbird species captured at Guantanamo Bay, but we could locate little other published information on molt patterns, aging, or sexing for these species. Here we provide information on molts and establish preliminary criteria based on plumage, skull condition, eye color, and wing chord data for the determination of age and sex for 15 resident landbird species commonly encountered at Guantanamo Bay.

METHODS

The study site is located along the southern coast near the eastern end of Cuba in xerophytic thorn scrub, cactus, and mangrove habitats that characterize that region (Borhidi 1991). The climate is hot and relatively dry, with only moderate seasonal variation in temperatures (averaging warmer in the summer) and a small peak in precipitation associated with the tropical storm season in the late summer and fall.

In 1998, IBP established a year-round banding program at Guantanamo Bay to monitor productivity and survivorship of both migrant and resident birds found at the naval station (Siegel and DeSante 2000). Each of six stations consisted of 15–20 12-mm mist nets operated two or three consecutive days per month from November 1998 through April 2002. During this period a minimum of 2949 individuals of the 15 resident species treated here were captured 5333 times. Standard measurements and data on skull condition and eye color were recorded. Attempts were made to determine age and sex according to criteria for related North American taxa (Pyle 1997) and preliminary information on plumages provided by Raffaele et al. (1998) and Garrido and Kirkconnell (2000). As appropriate, notes on plumages were recorded, and detailed molt sheets were computed for birds in active molt or showing molt limits indicating that the previous molt had been incomplete. Age determinations were repeatedly assessed on recaptured individuals, many of which were originally banded as juveniles and thus were of known age.

Preliminary information gathered at the stations on aging and sexing birds was confirmed and supplemented by examination of 830 Cuban specimens by Pyle at the U.S. National Museum (USNM), Washington D.C. From 36 to 90 specimens of each species were examined, although collecting biases often resulted in few specimens at critical time periods (e.g., when most of the species were molting in late summer and fall). Age determinations on specimens were made by carefully tracing plumage and molt sequences from juvenal through definitive plumages.

Molt and age terminology, including standard abbreviations, follow those of Pyle (1997). Primaries (pp) and primary coverts (p covs) are numbered from the innermost (p1) to the outermost (p9 or p10), secondaries (ss) are numbered from the outermost (s1) to the innermost (tertials), and rectrices (rects) are numbered from the central pair (r1) to the outermost pair (r5 or r6). For molt extent, "partial" indicates that no flight feathers (primaries, primary coverts, secondaries, or rectrices) were replaced (except the tertials or central rectrices in a proportion of birds) and "incomplete" indicates that some but not all flight feathers were replaced. Age codes include HY (hatching year), indicating a bird in the calendar year of its hatching; SY (second year), indicating a bird in its second calendar year (thus, HY/SY indicates a bird in its first year, being HY until 31 December and SY after 1 January); TY (third year), indicating a bird in its third calendar year; AHY (after-hatching year), indicating a bird in at least its second calendar year; ASY (after-second year), indicating a bird in at least its third calendar year; ATY (after-third year), indicating a bird in at least its fourth calendar year; and U (unknown), indicating a bird that may or may not be in the calendar year of birth. Month ranges in parentheses indicate the timing in which ages can be identified; e.g., "HY/SY (October–September)" indicates that a bird with indicative criteria can be aged HY from September to December and SY from January to October. Wing chord data were obtained by measuring the unflattened wing length of known-sex specimens collected in Cuba at USNM. Definitions for other commonly used abbreviations can be found in the account for Great Lizard Cuckoo, below.

SPECIES ACCOUNTS

The following accounts summarize our findings on molt, aging, and sexing of resident breeding landbirds commonly captured at the Guantanamo Bay banding station. The three sample sizes given after the species name indicate the number of individuals captured, the number of captures, and the number of specimens examined for each species. For pygmy-owls and hummingbirds, the number of individuals captured is minimal since these birds were not banded during the first year of the study.

***Saurothera merlini* (Great Lizard-Cuckoo; *N* = 16 individuals, 27 captures, 51 specimens).** Molting occurs primarily during July to November, completing as early as September and as late as December in some individuals. The first prebasic molt (1st PB) appears to be incomplete in many individuals but is almost certainly complete in some and may be partial (no flight feathers replaced; e.g., USNM 453622 on 15 November with juvenal flight feathers) in a few individuals. Following an incomplete 1st PB, up to five secondaries among s1–s5 (often just s2), two rectrices on each side (among r3–r5), and two outer primaries, p1–p2 and corresponding primary coverts (p covs), can be retained. The definitive PB appears complete in most or all birds; none of 13 banded birds or 27 specimens in definitive plumage at USNM had retained definitive ss or rects, as occurs occasionally in North American cuckoos (Pyle 1997:54–58). There was no evidence that prealternate molts (PAs) occur in this species. Juveniles (April–November) have duller plumage, yellow eyes and orbital skin (vs. brown eyes and red skin in adults), pale tips to gr covs, ss, and inner pp, and juvenal rects (see below). HY/SYs (October–September) can be identified by the retention of some or all juvenal rects, which are narrow, tapered, and buff tipped with indistinct dusky subterminal bands, essentially symmetrical on both webs; 1–5 ss (among s1–s5, often just s2), which are narrow with pale tips, contrasting with broader replaced ss; and sometimes 1–2 outer pp and p covs which are contrastingly worn. Birds with uniform definitive rects (broad, squared, and white-tipped with distinct black subterminal bands, more extensive on the inner than the outer web), ss, pp, and p covs should be aged AHY from January–October (November–December if still replacing old definitive rects) or U in November–December (if molt completed). Pyle (1997:54–58) provides examples of rect shape in cuckoos, and Raffaele et al. (1998:119) and Garrido and Kirkconnell (2000:27) illustrate of definitive and juvenal rects in Great Lizard Cuckoos. Occasional birds may be found with retained definitive rects or ss (Pyle 1997:54–58) that can be aged AHY/ASY in October–September. The plumage of males and females are similar, but wing chord appears to be useful for sexing many birds: males (*N* = 18), 147–173 mm, females (*N* = 19), 159–192 mm, with those of HYs falling in the lower halves of each range.

***Glaucidium siju* (Cuban Pygmy-Owl; *N* = 48 individuals, 127 captures, 41 specimens).** The PB occurs during June–September and is partial in HYs and complete in AHYs, as in other species of pygmy-owls (Pyle 1997:82–84). No PAs appear to occur. Juveniles have downy plumage with unmarked backs, streaked underparts, and indistinct crown spots. These can be aged HY in February–August. Birds in active wing molt in June–September or later can be aged AHY. Birds without juvenal body plumage and not in active wing molt cannot be reliably aged. These should be designated U in September–December and AHY in January–August. Eye color (bright yellow in adults vs. duller in HYs?) may be of additional use in aging, and look for molt limits (Pyle 1997:206–209) among the med and gr covs of HY/SYs, an area in need of further study among small owls. Females have wing chords of 95–101 mm and reddish brown plumage whereas males have wing chords of 84–94 mm and grayish-brown plumage, tinged reddish in a proportion of males (possibly HY/SYs?). Brood patches (BPs, mostly in February–May) are reliable for sexing females as well. Cloacal protuberances (CPs) apparently do not develop.

***Chlorostilbon ricardii* (Cuban Emerald; *N* = 360 individuals, 520 captures, 88**

specimens). PBs occur during May–October and appear to be complete in both AHYs (May–September?) and HY/SYs (June–October?). No PAs appear to occur. The only juvenile specimens at USNM were collected in May–September, and no specimens were present showing transitional male plumage. However, juveniles have been encountered year-round at the banding station, with many in the late fall. Juveniles are similar to definitive-plumaged females, but are duller and have pale grayish edging to the back feathers and >25% bill corrugation (Pyle 1997:121). These can be aged HY/SY in March–February. Birds in transitional male plumage (presumably encountered mostly in June–August) are either HYs or SYs and perhaps should be aged primarily based on bill corrugations: HY if >25% corrugations and SY if <25% corrugations. Birds with <10% corrugations should be aged AHY in January–August and U in September–December. Females in molt and both sexes in non-juvenile plumages should be aged solely on the basis of bill corrugations. Birds with >10% corrugations can be aged HY/SY through at least January. Males molting from worn definitive plumage to fresh definitive plumage in June–November can also be aged AHY. A small proportion of specimens (in all plumages) had pale tips to the outer rectrices, generally an indication of immaturity (Pyle 1997:134–136); more information is needed on the correlation between this and age. Sexes of all but juveniles are easily distinguished by plumage coloration, females having whitish underparts and notched, dusky greenish tails and males having green underparts and forked, steely black tails. The lower mandibles of adult males are orange whereas those of adult females are black. Juvenile males are similar to females in plumage, although juvenal-plumaged birds with green feathers on the underparts or orange coloration to the lower mandible are males. Measurements, particularly tail-fork length (Pyle 1997; Fig. 102) and bill length may be useful for sexing juveniles but more study is needed.

Todus multicolor **(Cuban Tody; *N* = 323 individuals, 730 captures, 67 specimens).** None of 67 specimens at USNM (collected primarily in December–June) was in flight feather molt, but wear patterns on specimens and banding data indicate that the prebasic molt takes place during July–early December. The PB is complete in AHYs and partial in HYs. The 1st PB includes the body feathers and gr covs and sometimes the greater alula but no flight feathers (including p covs). The definitive molt may involve irregular flight-feather replacement sequence (from two or more centers) but most evidence suggests normal sequence (p1 to p10, and s1 to s6 preceded by the tertials). No PAs appear to occur. Juveniles have dull gray-horn legs and lack red in the throat, although red throat feathers may be molted in very early, perhaps when birds are still in the nest. These can be aged HY in April–September. HY/SYs can be aged in September–August by retained juvenal feathers. The rectrices and p covs are narrow, pointed, and relatively worn, faded brown with narrow or no yellowish-green edging. The greater alula is often brown and dull with green edging (although a proportion individuals may replace this feather during the first PB). The outer pp are narrow and brown. Leg color is dull brownish turning to orange, probably within the first year. AHY/ASYs in September–August have relatively fresh and uniform feathers. The rectrices and p covs are broad, truncate, and relatively fresh, dusky with broad green or bluish-green edging. The greater alula is full and dusky with bluish or greenish-blue edging. The outer pp are narrow and brown. Leg color is dull to bright orange. Males and females are similar in plumage. Few to no birds have been observed at the banding station with CPs so these may not develop well in this species, as in kingfishers (Pyle 1997). BPs are found in April–August but may occur in both sexes. Variation in the fullness and color (red vs. tinged orange) of the throat patch and amount and brightness of the yellow in the lores and forehead seems to vary slightly by sex, with females duller on average, but this would be difficult to use in sexing, except perhaps with mated pairs. Wing chord also appears unhelpful: males (*N* = 15), 39–45 mm, females (*N* = 15), 40–44 mm. After review of all banding records, there is still a question concerning eye color in this species. Birds recaptured two or more times over a year and a half showed retention of blue, brown, or grayish iris color over long periods of time. In a proportion birds, iris color changed from grayish to browner as plumage changed from juvenal to definitive, indicating a possible relationship between eye color and age, but a proportion birds retained grayish eyes during breeding. It is possible that both eye and leg color may also vary by sex but more study is needed to determine this.

Melanerpes superciliaris **(West Indian Woodpecker; *N* = 38 individuals, 69 captures, 42 specimens).** Molting occurs during June–December with possible extension into February in a proportion of TYs (e.g., USNM 453882). The PB appears to be incomplete in HYs (including the pp but few if any ss or p covs), incomplete to complete in SYs (a proportion of birds not molting all p covs but most replacing all ss), and complete in most ASYs. The strategy of North American woodpeckers (Pyle 1997:163–166) generally seems to be followed, except that few SY/TYs retain ss and few ASY/ATYs retain ss or p covs. No PAs appear to occur. Juveniles have blackish crowns (through the lores) with red suffusion and brown irises. (Definitive-plumaged females have a black band through the hindcrown but no red suffusion between the nape and the lores.) Birds in juvenal plumage can be aged HY in April–October. Otherwise, aging by molt limits in the ss and p covs to SY/TY and ASY/ATY follows the complex criteria outlined by Pyle and Howell (1995) and Pyle (1997: 163–166). More feathers appear to be replaced per cycle (on average) in this species than in North American species. For example, there may be very few birds of any age group with retained ss and few ASY/ATYs with retained definitive p covs. Also, separation of fresh HYs from ASYs in fall can be difficult; molt limits among the gr and med covs indicate HYs, and a proportion of SYs retain brown or reddish-brown irises through spring, indicating that iris color should be helpful in distinguishing birds in the fall. Juvenile males appear to have more red suffusion extending forward of the eyes whereas females appear to have more restricted red suffusion, as in many North American woodpeckers (Pyle 1997: Fig. 130), but there were only three juveniles at USNM, so birds in juvenile plumage should be sexed U until further study has been performed. Sexes in non-juveniles are easily separated by crown plumage: males have red crowns whereas females have red restricted to the lores and nape, separated by tan and black bands. The illustrations in Raffaele et al. (1998:135) are misleading concerning Cuban birds: Fig. 2c represents definitive-plumaged females in Cuba (birds that look like Fig. 2b may occur in females of other Caribbean subspecies). The figures shown by Garrido and Kirkconnell (2000:32) are accurate for sexing.

Xiphidiopicus percussus **(Cuban Green Woodpecker; *N* = 59 individuals, 119 captures, 52 specimens).** Molting occurs primarily during July–November but as late as February in a proportion of individuals, with strategies similar to those of the West Indian Woodpecker. Juveniles have red hindnapes, blackish crowns (through the lores, as in definitive-plumaged females) suffused red, dense black streaking on the upper breast, and brown irises. The illustration in Garrido and Kirkconnell (2000:32) appears accurate although too much red suffusion may be depicted. Definitive-plumaged females have a black forecrown but no red suffusion between the hindcrown and the lores. Juveniles can be aged HY in April–October. Otherwise, aging to SY/TY or ASY/ATY by molt limits in the ss and p covs and eye color follows Pyle and Howell (1995) and Pyle (1997:163–166), as in the West Indian Woodpecker. In contrast to the West Indian Woodpecker, juvenal and definitive p covs are easily distinguished, with juvenal feathers being thinner and browner, and having a thin straight greenish edge as opposed to an irregular green edge forming notches into the dusky centers on definitive p covs. Juvenile males appear to have more red suffusion, as in the West Indian Woodpecker, but there were only four specimens of juveniles at USNM so birds in juvenile plumage should be sexed U until further study has been performed. Sexes in non-juveniles are easily separated by crown plumage: males have red forecrowns (forward of the eyes) whereas females have red restricted to the hindcrown and black forecrowns forward of the eyes. Raffaele et al. (1998:135 and 199) and Garrido and Kirkconnell (2000:32) illustrate these sex-specific plumages.

Contopus caribaeus **(Cuban Pewee; *N* = 18 individuals, 24 captures, 58 specimens).** The definitive PB is complete and occurs during July–October. The first PB is partial and occurs in August–November. The first PB includes 8–10 inner gr covs, 0–3 terts, and possibly the central rects in occasional birds but no other flight feathers. The terts appear to be replaced in <25% of HYs, and molt limits among the gr covs also appear to occur in

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<25% of birds. No PAs appear to occur. Juveniles (May–September) have buffy tipping to most upperpart feathers including lesser and p covs and have wide buffy wing bars. Juveniles may also have paler lower mandibles than adults but more study is needed. HY/SYs (August–July) are best distinguished by the narrow and brown p covs, with buffy tips when fresh, contrasting with the fresher replaced gr covs, and by the tapered and worn outer rects. A small proportion of individuals will show molt limits in the gr covs, and a small proportion of (different) individuals will show molt limits in the terts (see above). AHY/ASYs (August–July) are distinguished by the broad and dusky p covs, with olive edging, uniform in wear and luster with the gr covs, and by the broad, truncated, and relatively fresh outer rects. The gr covs and terts will not show molt limits. Pyle (1997: Figs. 138 and 139) illustrates these differences. Females and males are similar in plumage. CP and BP appear to be reliable for sexing birds in March–July, although male flycatchers in general show reduced CPs (Pyle 1997). Wing chords may be useful for a proportion of birds: males (N = 15), 68–77 mm, females (N = 15), 64–74 mm, with HY/SYs usually falling in the lower half of the ranges and AHY/ASYs in the upper half.

***Myiarchus sagrae* (La Sagra's Flycatcher; N = 225 individuals, 439 captures, 43 specimens).** The PBs occur during August–December in AHYs and August–January in HYs. The definitive PB is complete and the first PB includes all feathers except some or all p covs. A small proportion of HYs (<25%) can replace the outer 1–3 p covs during the first PB. We found no evidence of PAs but look for 1–2 terts and some body feathers to be replaced on a proportion of birds, as in other neotropical species of *Myiarchus* (Lanyon 1975; Pyle 1997). Juveniles (May–September) have cinnamon or rufous edging to the upperpart feathers and broader rufous edging to the rects than adults (Pyle 1997: Fig. 156). HY/SYs have brown and worn p covs, contrasting with the darker gr covs, pp, and ss, whereas AHY/ASYs have darker and fresher p covs, similar in color or darker than the gr covs, pp, and ss. Criteria for aging this species by worn and pale (HY/SY) vs. fresh and dark (AHY/ASY) outer p covs is very similar to those for the Dusky-capped Flycatcher (*M. tuberculifer*; Pyle 1997:243–245). Occasional HY/SYs may also show retained middle ss (among s2–s5), as in North American *Myiarchus*. Females and males are similar in plumage. CP and BP can be used for sexing in January–August, although CPs may be poorly developed and reduced BPs may occur in both sexes, as in North American *Myiarchus* (Pyle 1997). Wing chord is largely unhelpful for sexing: males (N = 15), 77–84 mm, females (N = 15), 75–81 mm, with HY/SYs usually falling in the lower half of the ranges and AHY/ASYs in the upper half of the ranges.

***Vireo gundlachii* (Cuban Vireo; N = 48 individuals, 129 captures, 31 specimens).** The definitive PB is complete and occurs during August–December. The first PB is partial, occurs during August–October, and includes 8–10 gr covs, 0–3 terts, and the central rects in occasional birds but no other flight feathers. Terts and/or rects appear to be replaced in <10% of HYs and molt limits among the gr covs also appear to occur in <10% of birds. No PAs appear to occur. Juveniles (to be expected in May–September) probably resemble adults but have looser-textured feathers and buffier wing bars. HY/SYs (August–July) are best distinguished by the narrow and brown p covs with thin yellowish-green edging and buffy tips, contrasting with the fresher replaced gr covs, and by the tapered and worn outer rects. Occasional birds will show molt limits in the gr covs or tertials and/or rects (see above). AHY/ASYs (August–July) are distinguished by the broad and dusky p covs, with green edging, uniform in wear and luster with the gr covs, and by the broad, truncated, and relatively fresh outer rects. The gr covs and terts will not show molt limits. Pyle (1997: Figs. 138 and 139) illustrates these differences. Males and females are similar in plumage. CP and BP appear to be reliable for sexing birds in March–August, although there is a possibility of a partial PB in breeding males. The wing chord may be useful for a proportion of birds: males (N = 15), 53–59 mm, females (N = 14), 50–56 mm, with HY/SYs usually falling in the lower half of the ranges and AHY/ASYs in the upper half.

***Polioptila lembeyei* (Cuban Gnatcatcher; N = 23 individuals, 25 captures, 49 specimens).** The definitive PB occurs during September–December and is complete. The definitive PA occurs during January–March and includes only the body feathers. The first PB occurs in July–December and is partial to incomplete; 2–3 outer gr covs can be retained (<25% of birds) and 1–3 terts can be replaced (>75% of birds). Central and other rects possibly may also be replaced at this molt. In one specimen (USNM 454140) s6 had been replaced during the first PB and another (USNM 454132) showed evidence of an "eccentric" molt pattern (Pyle 1997:208–209), with p8–p10 and s5–s6 replaced. The first PA occurs in February–May and is partial, as in ASYs. Juveniles (April–September) lack the black auricular stripe of later plumages and have brown-washed backs and fluffy body feathers. HY/SYs in first basic plumage (July–March) have pale gray backs and can be aged by the shape and condition of the p covs (narrow, brown, with thin pale gray edging) contrasting with some or all replaced gr covs. Most also have 1–3 terts replaced which are contrastingly fresher than the middle ss. The rects are narrower and are relatively tattered although rect tip shape is unhelpful. There may be a proportion of birds with molt limits in eccentric pattern (Pyle 1997: Fig. 136A). SYs in first alternate plumage (March–September) can be identified by the molt limit criteria as in HY/SYs. AHY/ASYs can be aged by the p covs (broad, dusky, with relatively broad blue or gray edging, depending on sex) that do not contrast in luster with the gr covs. The terts and middle ss are uniform (if anything the terts show more wear than the middle ss), and the outer rects are relatively broad and fresh. The sexes are probably not separable in juvenal or first-basic plumage (first-basic males average bluer backs than first-basic females), although birds beginning the PA in February can be distinguished by the color of the incoming back feathers. In alternate-plumaged SYs and all AHY/ASYs males and females can be separated by back color: blue in males and pale to medium-dark gray in females (sometimes with a bluish tinge in AHY/ASYs). CP and BP appear to be reliable for sexing birds in March–August. Wing chord may also be helpful for HYs and AHYs if back color is ambiguous: males (N = 15), 38–44 mm, females (N = 15), 35–41 mm, with HY/SYs usually falling in the lower half of the ranges and AHY/ASYs in the upper half. Pyle (1997:378–384) and Pyle and Unitt (1998) provide more information on aging and sexing gnatcatchers.

Turdus plumbeus **(Red-legged Thrush; N = 176 individuals, 398 captures, 90 specimens).** The definitive PB occurs during August–October and is complete. The 1st PB occurs during August–November and is partial to incomplete, varying from 8 gr covs and no flight feathers replaced to all 10 gr covs, all terts, most or all ss, and all rects replaced. One specimen (USNM 172861) and one captured bird showed evidence that the outer two p covs and some outer pp had been replaced, in an eccentric pattern (Pyle 1997:Fig. 136A) during the first PB. Fewer than 10% of birds retain juvenal gr covs, almost all birds replace at least one tert or retain at least one juvenal s, and <25% of birds replace all rects. No PA appears to occur. Juveniles (May–September) have spotted plumage with buffy-tipped wing coverts. HY/SYs are readily distinguished in May (HYs)–2 September (SYs) by the p covs (narrow, dusky, with thin pale blue edge) contrasting in luster with most or all gr covs, the narrower outer rect shape in most individuals (that do not replace these during the first PB), and the molt limits among the terts and ss of most individuals. Molt limits among the ss show varying patterns, but all birds that we examined show at least one tert replaced or at least one of s2–s4 retained. Outer pp and p covs may also be replaced in occasional birds. AHY/ASYs (October–September) have no molt limits, the p covs being broad and black with broad blue edging, not contrasting in luster with the gr covs. They also have uniform rects with broad and truncate outer rects (Pyle 1997: Figs. 138 and 139). Eye color may also be helpful in aging, varying from brown in juveniles to reddish brown in adults. Females and males are similar in plumage. The CP and BP are reliable indicators of sex in January–August, although females can sometimes develop small CPs. Wing chord length appears to be quite useful for sexing *T. p. schistaceus*: males (N = 28), 119–131 mm, females (N = 12), 110–122 mm, with HY/SYs usually falling in the lower half of the ranges and AHY/ASYs in the upper half. *T. p. rubripes* (with red vents) of western Cuba average smaller, sex for sex.

Teretistris fornsi **(Oriente Warbler; N = 219 individuals, 432 captures, 35 specimens).** The definitive PB is complete and occurs during August–November. The first PB is partial, occurs during August–December or January, and includes 8–10 gr covs, 0–3 terts, and the central rects in occasional birds. One specimen (USNM 454536) and one captured HY showed molt limits following an eccentric molt (Pyle 1997: Fig. 136A), with the outer 5–6 pp and three terts but no other ss and no p covs replaced. Terts and/or rects appear to be replaced in <10% of HYs and molt limits among the gr covs also appear to occur in <10% of birds. Banding data indicate that a limited PA may occur during March–May; more study is needed. No specimens in juvenal plumage were found at USNM. Juveniles (May–September) possibly resemble adults but have looser textured feathers, a brown wash to the back, and indistinct buffy wing bars. HY/SYs (August–July) are best distinguished by the narrow and brown p covs with thin or no grayish edging and buffy tips when fresh, contrasting in luster with the fresher replaced gr covs, and by the tapered and worn outer rects and pp. Fewer than 10% of birds will show molt limits within the gr covs, tertials, rects, or (rarely) primaries in an eccentric pattern (see above). AHY/ASYs (August–July) are distinguished by the broad and dusky p covs, with bluish-gray edging, uniform in wear and luster with the gr covs, and by the broad, truncated, and relatively fresh outer rects and pp. The gr covs, terts, and pp will not show molt limits. The differences in the p covs can be subtle. Females are similar to males in plumage. The CP and BP appear to be reliable for sexing birds in March–September. Wing chord may be useful for sexing many birds: males (*N* = 15), 53–59 mm, females (*N* = 14), 48–55 mm, with HY/SYs usually falling in the lower half of the ranges and AHY/ASYs in the upper half.

Tiaris canora **(Cuban Grassquit; *N* = 1153 individuals, 1941 captures, 45 specimens).** Molt patterns are complicated by extended or double breeding seasons and the occurrence of a prealternate molt. The PB occurs during August–December and is complete in AHYs. It may also be complete in HYs from early (January–March) breeding; however, more study is needed. The 1st PB appears to be partial in most individuals, including all gr covs but with terts and central rects being replaced in just a small proportion of birds. The PAs appear to occur primarily during February–May and include some body feathers and terts and central rects in a small proportion of birds. The extent of the PA appears to be similar in SYs and ASYs. Juveniles (March–September) have rufous faces and resemble definitive-plumaged females (see below). HY/SYs (March–2 August) are best distinguished by the narrow and brown p covs with thin or no pale greenish edging and buffy tips when fresh, contrasting in luster with the fresher replaced gr covs, and by the tapered and worn outer rects and pp. Occasional HY/SYs will show molt limits in the gr covs, tertials and/or rects in September–March (see above); those showing limits in April–August can be SYs or ASYs. Fresher birds without contrasts in terts or rects (and reduced black breast patches in males?) are HYs, and birds in very worn plumage, often with contrastingly fresh terts and rects (and full black in males?), are SYs. Birds showing broad and dusky p covs, with broad green edging, uniform in wear and luster with the gr covs, broad, truncated, and relatively fresh outer rects and pp, and no molt limits in the gr covs and terts, can be aged AHY/U (September–August). It is possible that birds in this group can be aged AHY/ASY (September–August), but early-hatching HYs (January–March) may potentially have a complete molt in July–September and afterwards be indistinguishable from AHYs. Juveniles cannot be sexed, although males are distinguished after black feathering appears in the lores or breast, soon after fledging. In subsequent plumages males are easily distinguished by the black lores and breast vs. the rufous lores and gray breast of females (Raffaele et al. 1998: 187; Garrido and Kirkconnell 2000:46). Juveniles and females are very similar; individuals with loose plumage should not be sexed female. The CP can be used to sex males (although these should be obvious based on plumage). The BP cannot be used to sex this species but can likely be used for aging U/AHYs (see above; no HYs with BPs were recorded at the banding station).

Tiaris olivacea **(Yellow-faced Grassquit; *N* = 233 individuals, 334 captures, 62 specimens).** Molt strategies appear to be similar to those of the Cuban Grassquit, being complicated by extended or double breeding seasons and the occurrence of a prealternate molt. Juveniles (March–September) look very much like definitive-plumaged females (see below). Subsequent aging criteria involving p covs, rects, and attainment of definitive plumage in males (see below) are similar to those found in the Cuban Grassquit. Juveniles cannot be sexed although males can be distinguished after black feathering appears in the face or breast, soon after fledging. In subsequent plumages, males are easily distinguished by the black lores, malar stripe, and breast and yellow throat vs. the greenish face, throat (sometimes with slight yellow wash), and breast of females (Raffaele et al. 1998:187; Garrido and Kirkconnell 2000:46). Juveniles and females are very similar. Criteria involving BP and CP are similar to those of the Cuban Grassquit.

Icterus dominicensis **(Greater Antillean Oriole; *N* = 10 individuals, 19 captures, 76 specimens).** The definitive PB is complete and occurs during July–October. The 1st PB appears to be protracted, occurring during August–March or later. The 1st PB is partial to incomplete, including up to 8 gr covs, 2–3 terts, and 2–4 rects. It is possible that a 1st PA occurs (feathers replaced twice before the 2nd PB), but more likely a protracted PB includes feathers replaced just once. Juvenile/HY/SY (April–2 September) plumage is olive to dull yellow (Raffaele et al. 1998:179; Garrido and Kirkconnell 2000:51) with a dusky or blackish throat, gr covs, terts, and rects coming in during the 1st PB (the later in winter/spring the blacker the incoming feathers). The pp and rects are yellowish to brownish. In April–September HYs are primarily green and SYs are molting into definitive plumage but can be aged by the juvenal rects through September. Birds in full definitive black-and-yellow plumage (Raffaele et al. 1998:179; Garrido and Kirkconnell 2000:51) should be aged AHY/ASY (September–August). A proportion has greenish-washed feathers and apparent molt limits in the gr covs and elsewhere; it is possible that these can be aged SY/TY but more study needed. Scott's Oriole (*I. parisorum*) shows similar plumage variation (Pyle 1997:660–661). Females and males are similar in plumage. The BP and CP are reliable for sexing in February–August. Almost all adults after the 2nd PB (with black primaries only) can be sexed by wing chord: males (*N* = 15), 94–101 mm, females (*N* = 15), 83–94 mm.

DISCUSSION

Specimen examination and banding data indicate that most Cuban species follow a north temperate molting cycle, as has been found in Jamaica (Diamond 1974) and Trinidad (Snow and Snow 1964). All 15 Cuban species treated here undergo their prebasic molt in August to November, with a few species commencing as early as May and/or completing as late as December. A few species showed evidence of prolonged or year-round breeding but maintained a predominant molting season in the late summer and fall. This phenomenon was also noted by Snow and Snow (1964) and Diamond (1974).

Results of this study indicate that, with few exceptions, the extent of the first prebasic molts were also comparable to those of related taxa found at northern latitudes, being partial to incomplete in all nine passerines and four of six nonpasserines. The first prebasic molt of the Red-legged Thrush, which included up to six of nine secondaries and three outer primaries, could be more extensive than that of *Turdus grayi* and *T. migratorius* or any other species of thrush found in North America (Pyle 1997). A small proportion of Cuban Gnatcatchers also showed evidence of an eccentric primary molt, which has not been documented in North American species (Pyle 1997). Eccentric molt patterns, found during this study in the Oriente Warbler, occur most frequently in birds that live in scrubby or exposed environments (Pyle 1998) and thus are not unexpected in species that reside at Guantanamo Bay. Similarly, the presence (three species) or lack (12 species) of prealternate molts coincided with the occurrence of these molts in related North American taxa.

Determination of age to SY/ASY (and in some cases ASY/ATY) is thus possible in most Cuban landbirds based on molt limits and the shape and condition of the primary coverts and rectrices, criteria that are similar to those found in North American species of related taxa with partial or incomplete first prebasic molts (Pyle 1997). The general concordance of molting patterns between North American and Caribbean taxa as far south in latitude as Trinidad (10–11°N; Snow and Snow 1964) may indicate that the age of landbirds throughout the Neotropics can be successfully determined through these criteria. We hope to assemble similar information for species throughout tropical America and that this will eventually lead to a fuller understanding of molt patterns in neotropical birds.

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LITERATURE CITED

BORHIDI, A. 1991. Phylogeography and vegetation ecology of Cuba. Akademiai Kiado, Budapest.

DESANTE, D. F., K. M. BURTON, P. VELEZ, AND D. FROEHLICH. 2002. *MAPS manual.* Institute for Bird Populations, Point Reyes Station, CA.

DIAMOND, A. W. 1974. Annual cycles in Jamaican forest birds. Journal of Zoology (London) 173: 277–301.

DONOVAN, T. M., C. J. BEARDMORE, D. N. BONTER, J. D. BRAWN, R. J. COOPER, J. A. FITZGERALD, R. FORD, S. A. GAUTHREAUX, T. L. GEORGE, W. C. HUNTER, T. E. MARTIN, J. PRICE, K. V. ROSENBERG, P. D. VICKERY, AND T. B. WIGLEY. 2002. Priority research needs for the conservation of Neotroical migrant landbirds. Journal of Field Ornithology 73: 329–339.

FOSTER, M. 1975. The overlap of molting and breeding in some tropical birds. Condor 77: 304–314.

GARRIDO, O. H., AND A. KIRKCONNELL. 2000. A field guide to the birds of Cuba. Cornell University Press, Ithaca, NY.

LANYON, W. E. 1975. Evidence of an incomplete prealterate molt in some South American *Myiarchus* flycatchers. Condor 77: 511.

MILLER, A. H. 1961. Molt cycles in equatorial Andean Sparrows. Condor 63: 143–161.

PRYS-JONES, R. P. 1982. Molt and weight of some landbirds on Dominica, West Indies. Journal of Field Ornithology 53: 352–362.

PYLE, P. 1997. Identification guide to North American birds, part 1. Slate Creek Press, Bolinas, CA.

———. 1998. Eccentric first-year molt patterns in certain tyrannid flycatchers. Western Birds 29: 29–35.

———, AND S. N. G. HOWELL. 1995. Flight-feather molt patterns and age in North American woodpeckers. Journal of Field Ornithology 66: 564–581.

———, AND P. UNITT. 1998. Molt and plumage variation by age and sex in the California and Black-tailed gnatcatchers. Western Birds 29: 280–289.

RAFFAELE, H., J. WILEY, O. GARRIDO, A. KEITH, AND J. RAFFAELE. 1998. A guide to the birds of the West Indies. Princeton University Press, Princeton, NJ.

SIEGEL, R. B. AND D. F. DESANTE. 2000. Survival rates and productivity of landbirds on U.S. Naval Station Guantanamo Bay, Cuba: first annual progress report. Institute for Bird Populations, Point Reyes Station, CA.

SILLETT, T. S., R. T. HOLMES, AND T. W. SHERRY. 2000. Impacts of a global climate cycle on population dynamics of a migratory songbird. Science 288: 2040–2042.

SNOW, D. W., AND B. K. SNOW. 1964. Breeding seasons and annual cycles of Trinidad land-birds. Zoologica 49: 1–39.

STUTCHBURY, B. J. M., AND E. S. MORTON. 2001. Behavioral ecology of tropical birds. Academic Press, San Diego, CA.

VOELKER, G., AND S. ROHWER. 1998. Contrasts in the scheduling of molt and migration in eastern and western Warbling Vireos. Auk 115: 142–155.

WOLF, L. L. 1969. Breeding and molting periods in a Costa Rican population of the Andean Sparrow. Condor 71: 212–219.