

S24-4 Identification and occurrence of a biannual complete molt

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Abstract A complete molt twice a year is rare in birds. I used the following criteria to identify double molt from museum collections: (1) seasonal pattern of occurrence of primary molt, (2) seasonality of fresh and worn breeding and non-breeding plumages, and (3) percent active primary molt in the total sample. In species with well-synchronized seasonal cycles, all three criteria reveal a clear simple annual molt pattern. In tropical taxa, however, they indicated pattern in only a fraction of molting birds: >25% of species showed a possible double molt and <15% a single molt. Out of 21 *Prinia* species, 11 appear to have a double molt.

Key words Double molt, Cisticolidae, *Prinia*, Africa, Specimen sampling

1 Introduction

Two complete molts per year are generally called a “biannual molt”, a term that is nevertheless ambiguous because it also means “every second year”. “Semi-annual” is an alternative, but suggests six-monthly intervals which is also inaccurate. Accordingly, “double molt” will be used in this paper to categorize this phenomenon; and, except when otherwise stated, molt refers to complete replacement of plumage.

Replacement of all feathers twice a year is rare in birds. In a review, Prys-Jones (1991) found sufficient evidence for it in only seven passerines in six families. Subsequently, Herremans (1999) identified it in the black-chested prinia *Prinia flavicans*, the first record for a resident African species. There are several other reports of a complete double molt (e.g., Verheyen, 1953; Ali and Ripley, 1983; Baker, 1997). Some are of individual cases (Prys-Jones, 1991); others are misinterpretations (Prys-Jones, 1991; Hobson et al., 2000); and some are inadequately documented. Proving double molt is difficult and laborious, because it requires information at both population and individual level.

This paper presents simple methods for screening museum collections for candidate species, and illustrates them with examples from the Cisticolidae.

2 Materials and methods

I studied primary molt in museum specimens by scoring the primary bases and classifying them into the following stages: (1) no molt, (2) start of primary molt, i.e. replacement of inner three primaries, (3) mid stage of molt, i.e. molt focus between primaries 4 and 6, and (4) end of molt, i.e. molt of primaries 7–10. For birds not in active molt, plumage condition at the time of collection was further classified as: (1) fresh, i.e. recently molted, (2) intermediate, and (3) worn,

i.e. close to being replaced again. Based on these classifications, the following parameters were used to assess molt: (1) seasonal occurrence of primary molt, (2) seasonality of fresh and worn breeding and non-breeding plumages, and (3) percent birds in the total sample in active primary molt. Only adult birds were used in the analyses.

Data from different subspecies or populations (e.g., north and south of the equator) were only pooled when patterns and seasonality were the same. Information on the seasonality of breeding was obtained from literature.

3 Results

3.1 Reference pattern for double molt

I re-analyzed data for the black-chested prinia (*Prinia flavicans*) from Herremans (1999) using the above plumage classifications. The resulting information presented in Fig. 1 provides a reference for species with a double molt. This subtropical African species shows a clear but complex seasonality, breeding during the moist austral summer

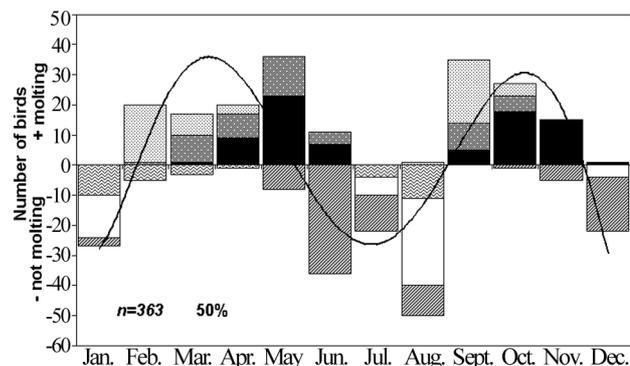


Fig. 1 Seasonality of breeding, primary molt and plumages in the black-chested prinia, *Prinia flavicans*
For legend, see Fig. 2; breeding recorded October–May.

(October–May) and recuperating during the dry winter months (June–September). It undergoes two periods of primary molt, overlapping the beginning and ending of breeding. Moderate to high proportions of museum samples are in active molt (>20%–25%).

3.2 Reference pattern for single molt

The southeast Asian hill prinia (*Prinia atrogularis*) shows a more traditional annual cycle (Fig. 2). It breeds in May–August, and undergoes a single molt in October–January. Plumage becomes increasingly worn over the boreal summer. The overall proportion of molting birds in collections is small (7%).

3.3 Equatorial populations

The tawny-flanked prinia (*Prinia subflava graueri*) from southern equatorial Africa does not show seasonality at population level (Fig. 3). Breeding and molting occur throughout the year, and birds in worn and fresh plumage are found in all months. The high overall percentage of birds in active molt suggests a double molt, at least.

3.4 Taxa with irregular annual cycles

Seasonal cycles in many arid zone birds are opportunistic, resulting in irregular breeding and molting. Small-scale random sampling over many years, as in museum collections, produces complex population patterns. The rufous-eared warbler (*Malcorus pectoralis*) of southern African deserts may breed or molt in nearly any month, with a tendency to breed more in early summer, September–December (Berruti, 1997), and to molt more in late summer and autumn, January–June (Fig. 4). Because of this and the fact that some birds molt faster than others, it is difficult to judge the overall plumage stage in many birds. An intermediate percent of the total sample was in active molt. The breeding-molt pattern in the pale prinia (*Prinia somalica*) appears to be similar (15 % molting).

3.5 Summary for Cisticolidae

I examined 5 513 adults of 21 prinia species (76 taxa), and 1 845 adults of 5 cisticola species (12 taxa), the details

of which will be presented elsewhere.

Most prinia species (11) appear to have a double molt (*Prinia flavicans*, *P. subflava*, *P. inornata*, *P. hypoxantha*, *P. bairdii*, *P. sylvatica*, *P. rufescens*, *P. hodgsonii*, *P. buchanani*, *Schistolais leucopogon* and *Heliolais erythropus*). Over >20% (mostly >25%) in the overall sample were in active molt. Six taxa (the four subspecies of *Prinia socialis*, *P. inornata extensicauda*, and *P. (inornata) insularis*) undergo an extensive pre-breeding molt of the contour plumage, which occasionally also includes the primaries: 13%–16% are in primary molt. Seven species undergo a single molt: *P. maculosa*, *P. gracilis*, *P. polychroa*, *P. atrogularis*, *P. burnesii*, *P. criniger* and *P. flaviventris*. Up to 10% in the overall sample were in active molt. When the core ranges of taxa are classified according to climate, a tendency emerges for a double molt to prevail in species from wet, tropical areas, and a single molt in temperate or arid climates.

I found molt patterns more difficult to interpret in cisticolas. Four species (*Cisticola ruficeps*, *C. natalensis*, *C. galactotes* and nominate *C. t. tinniens*) showed an extensive partial pre-breeding molt, including tail feathers, tertials and, in a minority of birds, primaries and secondaries. An intermediate percentage (15%–20%) of the overall sample in all five species was in active primary molt. Most of the birds undergoing a complete pre-breeding molt were young of the previous year.

4 Discussion

A study of museum specimens can at best provide circumstantial evidence at population level for the existence of a double molt. Data from museum skins may give a clear indication of candidate species, but confirmatory field studies with marked birds remain necessary. Proof at the individual level, however, is rarely obtained and “circumstantial evidence” still dominates the issue. Even in the willow warbler (*Phylloscopus trochilus*), one of the best studied double molters (Underhill et al., 1992), I am not aware of a single case of a bird ringed while molting at breeding grounds being recaptured while molting on nonbreeding

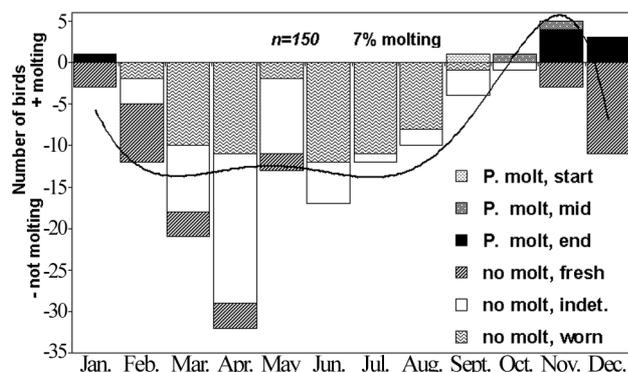


Fig. 2 Seasonality of breeding, primary molt and plumages in the hill prinia, *Prinia atrogularis* (6 ssp) Breeding recorded October–August.

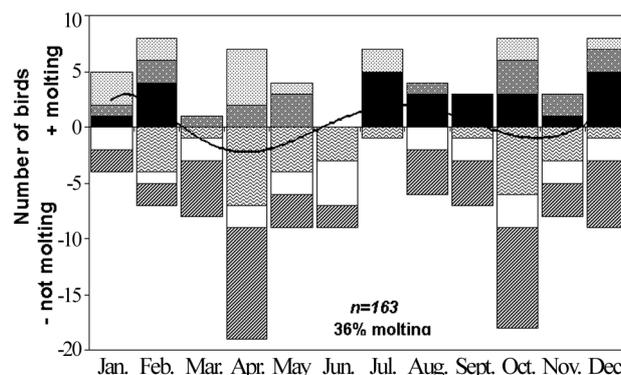


Fig. 3 Seasonality of breeding, primary molt and plumages in the equatorial tawny-flanked prinia, *Prinia subflava graueri* For legend, see Fig. 2; breeding recorded throughout the year.

grounds, and *vice versa*.

In species with clear, well-synchronized seasonal cycles, the identification of a single or double molt is straightforward (Figs. 1–2). All three criteria (molt sequence, plumage sequence and fraction in active molt) reveal the same pattern. In populations without a synchronized annual cycle, e.g. many equatorial birds (Fig. 3) or erratic breeders (Fig. 4), the information on molt and plumage sequences becomes uninformative.

The total fraction of molting birds is then the only remaining criterion, but it is nevertheless sensitive to several sampling biases. When data from living birds are used (e.g., data contributed by ringers), there may be a bias to report only molting birds. If birds hide during molt, sample sizes may become unrepresentatively small, resulting in an underestimation of the overall proportion in molt.

Molt speed is another factor that can affect the fraction of molt in samples. Opportunistic desert species may molt fast in a year with good rains, but protract or even suspend molt during drought. Such strategies cannot be described by a single parameter, and therefore, the fraction of birds in molt is most meaningful in populations with a rather similar molt speed. In any case, small passerines with >25% in active primary molt across a year may be double molters, while populations with <15% in molt are more likely

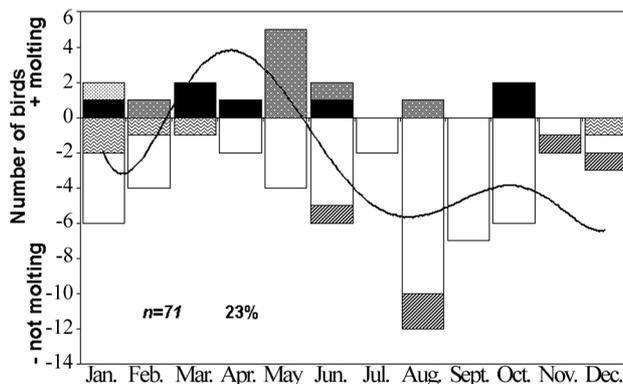


Fig. 4 Seasonality of breeding, primary molt and plumages in the rufous-eared warbler, *Malcorus pectoralis*. For legend, see Fig. 2; breeding recorded throughout the year.

to be single molters.

If juveniles undergo a complete molt at different times than adults, this may create a confusing bimodal pattern. When juvenile and adult plumages differ, this is rather easily resolved, except that young birds finishing molt are often difficult to distinguish from adults.

The present scan of museum specimens in the Cisticolidae increases to 18 the number of species suspected to have a double molt. Many more probably remain to be discovered, and these would constitute interesting comparative models for many studies. Unfortunately, because of the lack of well-marked seasonality in the wet tropics, the most promising species are also the most difficult to elucidate.

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