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Molt pattern in *Pyriglena leucoptera* with considerations about the study of molt

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RESUMO. **Padrão de muda em *Pyriglena leucoptera* com considerações sobre o estudo de muda.** Foi estudado o padrão de muda em 56 indivíduos de *Pyriglena leucoptera* dentre 119 indivíduos capturados numa área de Mata Atlântica no sudeste do Brasil. A muda foi registrada no período de dezembro a maio, sendo significativamente correlacionadas as mudas das penas do corpo e a das penas de vôo. A sequência de substituição das penas foi similar à de outros passeriformes, mas com assimetria bilateral na substituição das penas de vôo mais frequente nas retrizes do que nas primárias e secundárias. Alguns indivíduos foram encontrados com as secundárias e retrizes mudando após o fim da muda das primárias. Sugerimos que um índice de muda, obtido a partir de um escore geral, incluindo todas as penas de vôo do indivíduo, seja uma boa forma para descrever o estágio de muda. A atividade reprodutiva, estimada pela presença de placa de incubação, foi registrada de outubro a dezembro, sem nenhum indivíduo sendo encontrado em muda e com placa de incubação simultaneamente. Não foi encontrada mudança na massa corporal média entre os indivíduos em muda e sem muda.

PALAVRAS-CHAVE: massa corporal, muda, placa de incubação, plumagem, *Pyriglena leucoptera*, Thamnophilidae.
KEY WORDS: body mass, brood patch, molt, plumage, *Pyriglena leucoptera*, Thamnophilidae.

Molt cycle for single Neotropical species has been little investigated (Miller 1961, Davis 1971, Mallet-Rodrigues *et al*. 1995) and its relationships with breeding activity is still poorly understood (Snow 1976, Poulin *et al*. 1992).

Few informations have been obtained about the White-shouldered Fire-eye *Pyriglena leucoptera.* Euler (1900) described the nest and egg of *P. leucoptera*, having observed egg laying in October and December. Ihering (1900) showed data of egg measurements, comparing those with Euler's data. The species was found in molt mainly between November and April (Willis 1981).

This paper presents data of the pattern of molt of a population of *P. leucoptera* in an area of Atlantic forest in southeastern Brazil, considering intraspecific variation in the sequence of replacement of feathers as an important factor in the study of avian molt.

METHODS

Birds were studied in an area of Atlantic forest in the foothills of the Serra dos Órgãos (22° 31'24"S, 43°01' 04"W) in Guapimirim, Rio de Janeiro State, southeastern Brazil. The forest has a canopy reaching 25-30 m with a relatively dense understory.

Following Bernardes (1952) the climate at the study area is intermediate between the hot, wet climate and the mesotermic climate with mild summers. Mean annual rainfall is around 1700 mm, with no dry season, December to March being the wettest months and May to August the driest period. Mean annual temperatures are between 17 and 22 °C, with the highest temperatures from December to February and the coolest from June to August.

Birds were captured using mist-nets between July 1995 and June 1997, at a frequency four to five days a month. Each captured bird was marked with a numbered metal band, and weighed (Pesola 100 g balance with +1 g accuracy), and checked for the flight feather (primary, secondary, and rectrix) and body feather molt. Primaries were numbered from the innermost outward, while secondaries were numbered from the carpal region inwards. Retrices were numbered from the central pair outward. As previously used by Miller (1961) and Ashmole (1962), individual flight feather growth was scored from 0 (= old feather) to 5 (= fully grown new feather). A molt index (Underhill and Zucchini 1988) for each flight feather groups (primaries, secondaries and rectrices) was obtained summing the individual feather scores and dividing the result by the maximum potential score of the feather group. Thus, the molt index for each feather group ranges from 0 (not yet molted) to 1.0 (recently molted).

Body molt was determined through of the presence or absence of growing feathers.

Breeding season was determined by the presence of individuals with an brood patch (Bailey 1952).

Data from two years of study were combined to provide a mean monthly value of the molt and breeding cycles of the species.

To control the influence of possible body mass fluctuations during the day, were included, in the analysis of body mass change during molt, only birds captured in the mid-morning, when the body mass is more stable (Baldwin and Kendeigh 1938). A *t*-test was used to evaluate the difference in body mass between molting and non-molting birds.

RESULTS

Fifty-four molting birds were studied among 119 captured individuals of *P. leucoptera*. Of the birds captured in molt, 35 individuals (64.8%) were replacing all the plumage, 10 (18.5%) only the flight feathers, and 9 (16.6%) only the body feathers.

The majority (77.7%) of the flight feather molting birds was captured in the second half of the molt process (more than 50% of the flight feathers molted).

Molt was recorded from December to May, with the molt of flight and body feathers coinciding in time (figure 1).

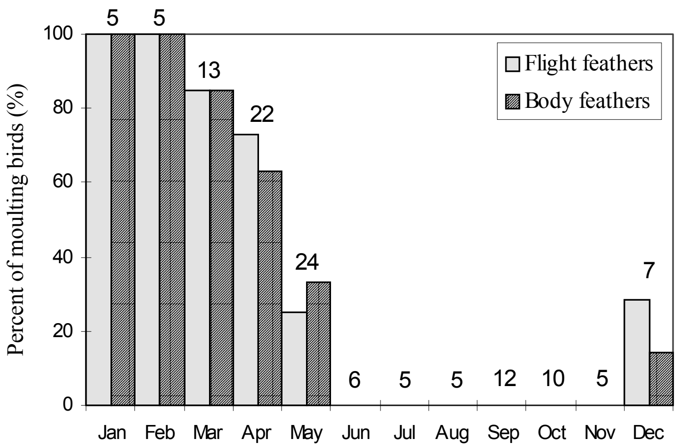

Figure 1. The molting season of *Pyriglena leucoptera* in Guapimirim. Data from the two year study period are lumped. Numbers represents the sample size of total captured birds in each month.

The sequence of primary replacement (N = 38) was centrifugal, from primary 1 (innermost) to primary 10 (outermost) (table 1). Alterations in the order of feather replacement involving two or three primaries occurred in one (2.6%) and both wings (5.2%).

Secondary molt (N = 36) progressed inward from both extremities, beginning in January after molt of the fifth primary. Birds concluded the secondary molt in April or May (table 1), replacing the secondary 6 (58.3%) or the secondary 5 (41.7%). Two birds (5.5%) showed alterations in the sequence of secondary replacement, with different abnormal sequences for each wing.

Table 1. Number of individuals of *Pyriglena leucoptera* found replacing each flight feather in relation to months of the molting season. Data from the two year study period are lumped.

Primaries	Dec.	Jan.	Feb.	Mar.	Apr.	May
1	1	-	-	-	-	-
2	-	-	-	-	-	-
3	-	-	-	-	-	-
4	-	2	-	-	-	-
5	1	3	2	1	-	-
6	-	-	3	-	1	-
7	-	-	-	-	-	-
8	-	-	-	3	-	-
9	-	-	-	2	1	-
10	-	-	-	4	12	2
Secondaries	Dec.	Jan.	Feb.	Mar.	Apr.	May
1	1	2	-	-	-	-
2	-	-	1	-	-	-
3	-	-	-	1	-	-
4	-	-	-	4	1	-
5	-	-	-		1	4
6	-	-	-	1	10	5
7	-	-	1	1	2	-
8	-	-	-	-	-	-
9	-	1	-	-	-	-
Rectrices	Dec.	Jan.	Feb.	Mar.	Apr.	May
1	1	-	-	-	-	-
2	-	1	-	-	-	-
3	-	1	1	2	-	-
4	-	-	-	1	1	-
5	-	-	-	3	1	-
6	-	-	-	2	8	2
Molting birds	3	5	5	11	18	12

Although there were several exceptions, sequence of rectrix molt (N = 24) was predominantly from the central pair (rectrices 1) outward (table 1). Five birds had different sequences of rectrix replacement (20.8%).

Flight feather molt was bilaterally symmetrical in most of the cases (78%, N = 41), while frequency of asymmetry differed among feather groups. Primaries (86%, N = 38) and secondaries (84%, N = 36) molts were more symmetric than rectrices (52%, N = 24) (figure 2).

Secondary molt began when a quarter of the primaries had molted (primary molt index between 0.2 and 0.4). Rectrix molt began in the middle of primary molt (primary

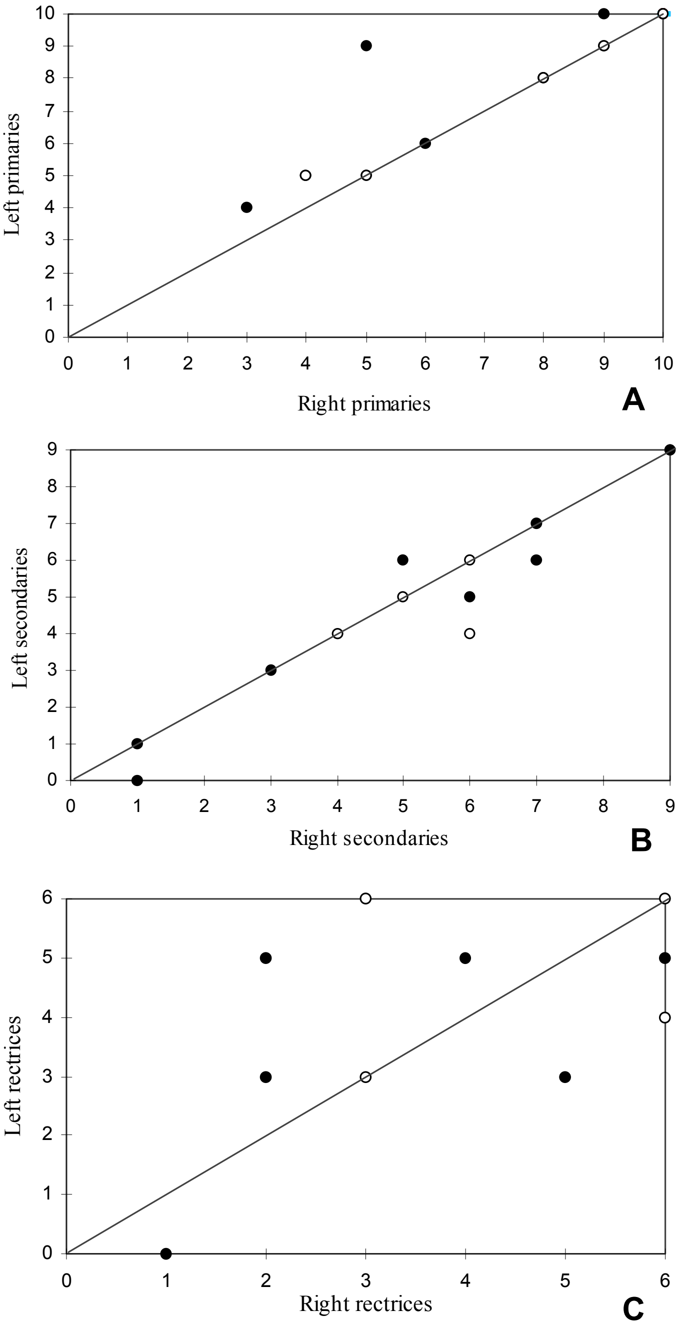

Figure 2. Bilateral asymmetry found in flight feather (A – primaries, B – secondaries and C – rectrices) molt in *Pyriglena leucoptera*. Each dot represents one individual and open circles represent more than one bird.

molt index between 0.3 and 0.6). The replacement of rectrices was faster than that of the secondaries. Five birds (10.2%, N = 49) were recorded with rectrix and secondary molt still in progress, although they had already completed primary molt, while six birds (19.3%, N = 31) had advanced primary molt (primary molt index above 0.5) and very low secondary and rectrix molt indices (< 0.5) (figure 3).

A significant correlation (r = 0.98, p < 0.01) was found between body molt and flight feather molt, in spite of some cases in which only body feathers or flight feathers were molted.

Active brood patch (N = 8) was recorded from October to December, being more common in this last month (57% of the captured birds in December). Most birds with brood patch were females (86.3%) and none of them had feathers in molt.

The mean body mass of molting birds (30.1 g; N = 46) was not significantly different from the body mass of non-molting birds (29.8 g; N = 60)(t = 0.31, p > 0.05). Body mass of the molting (N = 24) and no-molting (N = 29) males was the same value (31.2 g), while molting females (29.1 g; N = 22) were heavier than no-molting females (28.5 g; N = 31), but not significantly different (t = 0.33, p > 0.05).

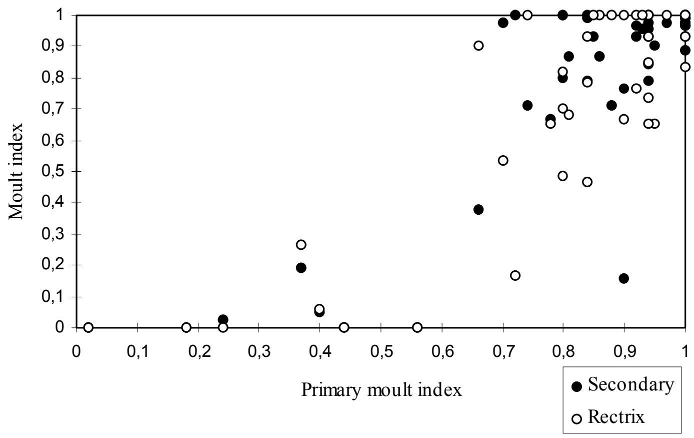

Figure 3. Relation between primary molt and secondary and rectrix molts in *Pyriglena leucoptera*.

DISCUSSION

Molt in *P. leucoptera* is similar to that of other passerines, with an annual cycle and one complete molt that occurs after the breeding season. All records of molting birds were made from December to May, a period of heavy rainfall in the study area. This result is similar to the molt period from November to April found by Willis (1981) for this species. Molt was completed by the end of the wet season, as also recorded in other tropical passerines (Poulin *et al*. 1992, Mallet-Rodrigues *et al*. 1995). The breeding season of *P. leucoptera* was during October-December, as stated by Euler (1900). Breeding/molt overlap was recorded in December, with birds captured either in molt or with brood patch, although no bird showed both conditions simultaneously. This overlap has been descibed for some species (Snow and Snow 1964, Poulin *et al*. 1992, Mallet-Rodrigues *et al*. 1995). However, since breeding activity was determined by presence of brood patch, molt seems not overlap with incubation or early brooding, but adults may be caring for fledged juveniles or older nestlings while molting. In contrast, the closely related Barred Antshrike *Thamnophilus doliatus* was found to molt in almost every month of the year in Trinidad, with molting and breeding seasons being more or less continuous (Snow and Snow 1964). This difference in molt-breeding patterns between *P. leucoptera* and *T. doliatus* may be related to that the almost continuous breeding activity in some birds of lower latitudes (as *T. doliatus* in Trinidad) occurs in the population, but it not occurs in individual birds (Sick 1997). Thus, distinct individuals of the same species show seasonally different breeding/molt cycles in the same area.

In *P. leucoptera*, the sequence of flight feather replacement was similar to that of most other passerines. However, in some birds the sequence of replacement of feathers (mainly rectrices) was altered. Irregularities in the sequence of the wing molt were also very common in *Thamnophilus doliatus* (Snow and Snow 1964). An irregular pattern in the sequence of rectrix molt was also found in other species (Miller 1961, Newton 1966, Ginn 1975, Mallet-Rodrigues *et al*. 1995). The descending symmetry levels found among primaries, secondaries and rectrices are probably related to the different degree of importance of each of these groups of feathers to flight efficiency.

The more accelerated process of rectrix molt compared to secondary molt was also found in *Ramphocelus bresilius* (Mallet-Rodrigues *et al*. 1995), but the opposite of other species of the temperate regions (Evans 1966, Newton 1966).

Primary molt has been taken as the basis for the study of molt in passerines, because it spans almost the entire period of feather replacement of the bird. Thus, the beginning of the process is determined when the first primary is lost and its end when the last primary is substituted (Snow and Snow 1964, Avery 1985). However, some birds were found with secondaries and rectrices molting although they had already completed primary molt. Thus, primary molt should not be considered a good indicator of the stage of individual molt. The molt index, as used by Underhill and Zucchini (1988), obtained from a general score (including primary, secondary and rectrix scores) is perhaps more accurate in indicating the stage of individual molt.

In spite of the highly significant correlation found between flight feather and body molts, many birds were found with only body molt or flight feather molt. Body molts of many species were of longer duration and could not be distinguished from the partial molt realized before breeding (Snow and Snow 1964). Even so *P. leucoptera* should not be included in these species, because no molting birds were recorded in the period immediately before the breeding season.

It has been noticed that fewer molting birds have been captured at the middle of molt than at the beginning and end, being possibly a consequence of a reduction of the bird's activity as strategy for conserving energy (Newton 1966), although this feature does not always occur (Ginn 1975). The high proportion of *P. leucoptera* individuals captured in the second half of the flight feather molt may suggest that the birds are less active at the beginning of molt, since captures are more frequent at the end of the molt process when they return to a normal level of activity. However, the largest number of birds captured at the end of molt may be related to postbreeding dispersal, because the final period of molt in the population corresponded with the period with the highest rates of capture of *P. leucoptera* in the study area (April and May).

Although the body mass has been shown to decrease (Fogden 1972, Akinpelu 1997) or increase (Evans 1966, Newton 1966, Craig and Manson 1979) in other bird species during the molt period, we found no evidence of body mass change in *P. leucoptera* as a result of molting.

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