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## **THE MOLT ISSUE: WHERE DO WE GO FROM NOW?**

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Molt is one of the most important processes of avian life history. All known species undergo at least one molt episode per year, yet basic aspects of molt remain unknown in the Neotropical region, even for widespread species. In North America, comprehensive molt descriptions were not finished until toward end of the last century (Pyle et al. 1987). At that time, these authors stated that molt knowledge in North American species was about two decades behind their European counterparts. However, three decades later, while our knowledge of molt in North America has advanced (e.g., Pyle 1997, 2008), that for Neotropical birds is still in their wake, most species still lacking any molt information at all (Ryder & Wolfe 2009, Wolfe & Pyle 2012, Johnson & Wolfe 2018).

In reviewing existing knowledge and understanding of molt in Neotropical birds over the last two decades, we performed a search in Scopus, using the terms “molt”/“moult” and “tropical”/“Neotropical,” or any of the 47 Latin American countries occupying this biogeographic realm. Additionally, we included non-indexed works cited in the publications that resulted from the initial search. We then identified the year of publication, country where the study was carried out, first author’s nationality, and assigned these papers to major subjects for further analysis.

This search resulted in a sample of 78 publications (see Supplementary material online). The amount of publications on the molt of Neotropical species greatly increased in the late 2000’s, averaging 6 papers per year. Since then, however, they seem to have reached a plateau. Furthermore, we found molt studies for only 19 of the 47 Latin American countries, with those from Brazil, Mexico, Argentina, and Ecuador comprising more than half of the publications. Fifteen papers included data from more than three countries and 38 studies were first-authored by North American ornithologists, followed by ornithologists from Brazil (14), Colombia (3), and Mexico (3).

Studies describing molt strategies dominated the literature (35), with eight papers covering more than 10 species, up to as many as 104 species (Stouffer et al. 2013). Studies on strategies were followed by those on molt-migration (11) and molt-breeding overlap (9). Most publications focused on passerines and closely related land-bird species. We noticed that there are families largely under-represented in the literature, such as the Furnariidae, Bucconidae, Ramphastidae, Cotingidae, and Tityridae. These families are typically associated with threatened tropical rainforest habitats, in which capture rates tend to be low due to canopy height and generally low population densities for many species.

Molt studies of Neotropical birds have been largely translated in literature reviews (Wolfe & Pyle 2012, Pyle 2018), molt pattern descriptions (Johnson & Wolfe 2014, Guallar et al. 2018), and articles pointing out gaps in our knowledge on this topic (Echeverry-Galvis and Córdoba-Córdoba 2008, Ryder & Wolfe 2009). In addition, regional field handbooks have provided a great deal of information on the molt cycles and patterns of dozens of Neotropical species (Guallar et al. 2009, Pyle et al. 2015, Lentino 2016, Torrez & Arendt 2016, Johnson & Wolfe 2018). These advances have instigated new studies, for example, those which deepen our understanding of population level-differences of molt biology (Jahn et al. 2017) or explore the evolution of molt patterns in relation to environmental and phylogenetic constraints (Guallar et al. 2016).

Despite recent developments of knowledge, there is still a huge gap to be covered regarding standardized description of molt patterns and strategies, molt timing and its relationship with population phenomena (e.g., reproduction, migration, dispersal) for most Neotropical species; particularly for those with limited distribution within understudied countries, and for non-passerines. Moreover, the relationship among the plasticity of molt

extent and environmental variables, such as habitat selection, food resources, nesting resources, predation, disturbance, etc., have been unexplored. It is noteworthy that most of the large studies are byproducts of long-term monitoring programs, which highlights the importance of these projects in the Neotropics (i.e., Johnson & Wolfe 2018). Additionally, given the general scarcity of such projects, the importance of scientific collections comes to the fore. They constitute an invaluable source of molt information on the molt of Neotropical birds, which can be used to complement field data (e.g. Pyle et al. 2004, 2015; Guallar et al 2009, Wolfe et al. 2009, Johnson & Wolfe 2018).

This issue presents information on species for which basic aspects of molt were unknown, such as the Blue-and-yellow Tanager (*Pipraeidea bonariensis*). It includes studies developed in Mexico, Ecuador, Brazil, Peru, and Venezuela, where molt research is scarce, particularly in Peru and Venezuela where only four other publications were found (Verea et al. 2009, Camacho & Torres 2015, Lentino 2016, Tavera et al. 2016). Moreover, this issue contains three papers on correlations of molt with breeding and a summary in which molt concepts are reviewed and definitions are clarified. The Guest Editorial Team hopes that this Special Issue raises awareness on the need to direct research effort to the subject of molt in Neotropical birds. A byproduct of this issue is to highlight some of the existing gaps in molt knowledge and to promote collaboration among ornithologists and bird enthusiasts across the Neotropics. Although much more research is still needed to achieve a solid understanding of molt for Neotropical birds, the available information is a potential baseline to explore deeper ecological relationships at different levels. For example, further studies at population level should explore molt timing, duration and extent in relation to local environmental conditions and broad-scale, long-term environmental change. Habitats needed for molting in the Neotropics are virtually unknown, and need to be identified to inform essential conservation management of Neotropical habitats.

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