NOTES

AN ECCENTRIC PREFORMATIVE MOLT WITH INCOMPLETE REPLACEMENT OF PRIMARY COVERTS IN A DARK-EYED JUNCO

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ABSTRACT: Though the Dark-eyed Junco has not been reported to replace any juvenile primaries during its preformative molt, one first-cycle bird captured at Stanford, California, in November 2022 had replaced all its remiges but the three innermost primaries. Thus it followed the eccentric pattern more frequently seen in other sparrows, wrens, and some tyrant flycatchers. This novel pattern may be an adaptation to the urban habitats that the junco has recently colonized.

Attention to variation in patterns of molt within a species is increasing, broadening our understanding of molt and demonstrating substantial variation on which natural selection may act (e.g., Fettig and Hathcock 2015, Pyle and Carnes 2022, Tattoni et al. 2022). A molt pattern describes the sequence and extent of feather replacement during a molt (Pyle 1997). All passerines follow either a "complex basic" or "complex alternate" molt strategy, characterized by a molt—the preformative (also called postjuvenile)—inserted within the first annual cycle of the bird's life (Howell et al. 2003). Among North American passerines, plumage replacement in the preformative molt is most commonly partial, including all the head and body feathers, a variable number of wing coverts, and occasionally the tertials (Pyle 1997). Less commonly, species may follow an eccentric preformative molt in which the outer primaries and inner secondaries are also replaced (Pyle 1997).

The Dark-eyed Junco (*Junco hyemalis*) is a well-studied species with a broad range across North America (Nolan et al. 2002). Its preformative molt is partial (Pyle 1997). Here, I present evidence of an incomplete preformative molt following an eccentric pattern in an Oregon Dark-eyed Junco (*oreganus* group, likely *J. h. pinosus*) captured at my landbird-banding station along Los Trancos Creek at Stanford University, Santa Clara Co., California. I have operated an array of seven mist nets at this site approximately once weekly since 2019. Across the four years of banding, I have captured 73 individual Dark-eyed Juncos in their first plumage cycle.

Following convention, I number the primaries from innermost (p1) to outermost (p9) and the secondaries from outermost (s1) to innermost (s9). On 22 November 2022, I recaptured a first-cycle Dark-eyed Junco whose plumage was consistent with an eccentric preformative molt, which has not been previously documented in this species. Primaries 1–3 were contrastingly duller brown (in base and shaft color) and had more wear at the tips than p4–9 and s1–9 (Figure 1A–B). Additionally, the outer six primary coverts on the left wing (Figure 1C) and outer five on the right wing (Figure 1D) were contrastingly darker (in base and shaft color) and had less wear than the inner primary coverts. These observations suggest that during its preformative molt this individual replaced all its plumage except p1–3 and a few inner primary coverts. It was first captured and banded on 12 July 2022 in juvenile plumage with an incompletely (<1/3) pneumatized skull. Interestingly, there appears to be leucism in s9 on both wings (Figure 1A–B): the outer barbs are depigmented and whitish in a splotchy pattern. My observations of the population of the Dark-eyed Junco at and near Stanford University suggest that individuals with leucism are not uncommon and should be captured annually.

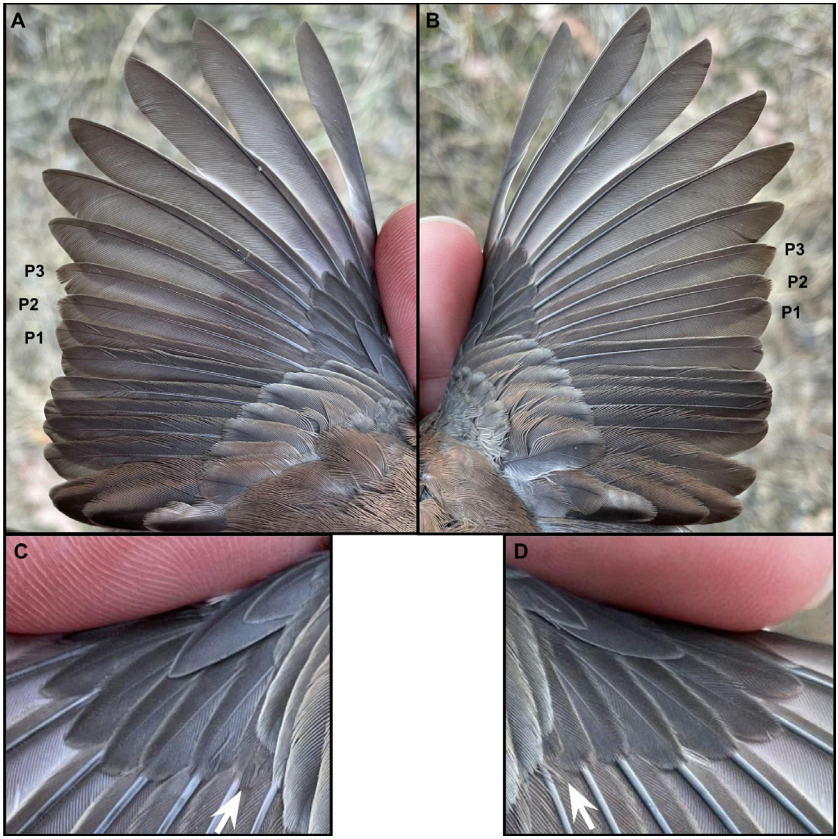

FIGURE 1. Wings (A, left; B, right) of a first-cycle Dark-eyed Junco (*Junco hyemalis*) that followed an eccentric pattern in its preformative molt. Primaries 1–3 are contrastingly more worn and duller brown than p4–9 and all secondaries. Unusual for species with eccentric molt, this bird partially replaced its primary coverts (C, left; D, right); the white arrows point to the inner coverts retained from the juvenile plumage. There appears to be leucism (partial depigmentation) in s9 on both wings.

Photos by D. Julian Tattoni

While eccentric preformative molt appears scarce within this population (1/73), the plasticity in molt it represents may have important implications. Historically, the junco's breeding habitat near Stanford was limited to coniferous forests at higher elevations, but the species expanded into the low-elevation urban areas of the Santa Clara Valley beginning in the 1990s (Bousman 2007). Similar expansions have been described elsewhere in coastal California around the same time (e.g., Yeh and Price 2004). This change in habitat has likely exposed populations to novel selective pressures, some of which may act on molt. For example, life in scrubby, sun-exposed habitats is thought to be an ecological driver of the evolution of eccentric preformative molt (Pyle 1998, Pyle et al. 2004, Guallar et al. 2021). Urban Dark-eyed

Juncos almost certainly experience greater sun exposure than their coniferous forest counterparts, suggesting an eccentric preformative molt could be adaptive in this novel environment. It is unclear whether the molt of the individual I captured reflects phenotypic plasticity that all individuals possess or a difference in genotype. If this molt pattern enhances fitness and is heritable, we may expect eccentric molt to increase in frequency among first-cycle birds in urban areas.

Among the stages of the avian life cycle, molt has received the least attention by professional researchers and community-based scientists alike (Bridge 2011, Kiat 2023). A survey of ornithologists, birdwatchers, and bird banders found that <40% of respondents understood plumage-based molt terminology (Kiat 2023). Broadly, among those who study birds in the field there is a clear imbalance of knowledge with respect to breeding, migration, and molt, and this may foster a sense that molt is static rather than a dynamic life stage that continues to evolve as populations experience changing selective pressures. Although many bird banders have documented and published evidence of considerable plasticity in patterns of preformative molt (e.g., Elrod et al. 2011, Small et al. 2013), I advocate for increased research on molt in the context of ecology, evolution, and global change. Because molt is a critical stage in the lives of birds (Holmgren and Hedenström 1995, Dawson 2015), the expectation should not be that molt is fixed—even if most individuals follow similar patterns—but rather that variation will emerge since variation is a prerequisite for natural selection.

With this framing, anomalous molt patterns become more interesting as they raise key questions on the nature of molt and evolution: to what extent are molt patterns driven by genetic versus environmental factors? Is an eccentric molt pattern a heritable trait that may be passed down to our study individual's offspring? How often does this trait appear in a population? Does this trait improve a bird's fitness? As interest in researching molt increases, these questions will be important areas of investigation.

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