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LETTERS

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SYNCHRONOUS TAIL MOLT IN GREAT GRAY OWLS (*STRIX NEBULOSA*)

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Limited information regarding the tail molt sequence of owls suggests that there is variation among and within species in how tail feathers are molted. Some species undergo a gradual tail molt in which rectrices are lost progressively, which may limit loss of tail function or influence energetic constraints (Farner et al. 1972). However, other species molt all rectrices synchronously, or rapidly over a few days, rendering the bird temporarily tailless. This pattern of molting a tail entirely within a short period of time is occasionally referred to as "simultaneous," but "synchronous" is the more accurate term: simultaneous implies that all the rectrices are lost at once, whereas synchronous denotes that feather loss is rapid but also follows an "underlying sequence" (P. Pyle pers. comm.). Occasionally, in some species, an irregular molt occurs in which some tail feathers are molted and the rest of the rectrices are molted later in the year or in a subsequent year.

Although several studies describe the tail molt pattern of various owl species (including a number of *Strix* species), information on the tail molt of Great Gray Owls (*Strix nebulosa)* is lacking. Northern Spotted Owls (*Strix occidentalis*) typically undergo complete tail molts every other year beginning with the third prebasic molt (Forsman 1981), while Tawny Owls (*Strix aluco)* molt their tails completely each year (Cramp and Simmons 1985, Pyle 1997). Mayr and Mayr (1954) suggested that tail molt is gradual in large owl species (*Strix, Bubo,* and *Tyto*) but synchronous in small owls (*Otus, Glaucidium, Athene,* and *Speotyto*). However, Piechocki (1968) reported that Tawny Owls lose their tails synchronously, as do Ural Owls (*Strix uralensis*; Cramp and Simmons 1985). Forsman (1981) noted the prevalence of synchronous tail molt in Northern Spotted Owls in Oregon, although they also exhibited gradual and irregular molt patterns. Conversely, in northern California, synchronous tail molt was rare in Northern Spotted Owls (C. De Juilio pers. comm.). Forsman (1981) also reported that Barred Owls (*Strix varia*) occasionally undergo a "simultaneous" tail molt. Finally, R. Nero observed at least one Great Gray Owl undergoing a synchronous tail molt, although he "doubts that synchronous tail molt is a regular occurrence" in Great Gray Owls (Heinrich and Calaprice 1993). These observations among *Strix* species indicate there is variation in how particular species molt their tails and that synchronous molt may be more widespread among large owls than previously suspected. Little documentation exists on molt patterns of Great Gray Owls in particular, because few year-round studies have been conducted on this species. Although previous researchers noted that Great Gray Owls molt their entire tails annually beginning with the second prebasic molt (e.g., Duncan 1996), there has been no documentation of particular molting patterns.

We investigated the tail molt patterns of Great Gray Owls as part of an extensive field study on the species conducted in montane forests in western Wyoming, U.S.A. We recorded tail condition during weekly relocations of telemetry-marked owls in 2014 and 2015 and observed 20 instances of Great Gray Owls undergoing synchronous tail molt. In 2014, nine breeding owls, one nonbreeding 1-yr-old owl, and two owls with unknown breeding status molted their tails synchronously. In 2015, five breeding Great Gray Owls and three nonbreeding 1-yr-old owls exhibited synchronous tail molt. Rectrices were lost rapidly either in no particular order or centrifugally (from the innermost to outermost), but molt was completed typically within a few days and at the most within 2 wk. We did not observe (either in the hand or through binoculars within 50 m) gradual or irregular tail molt in any owl. Furthermore, every Great Gray Owl banded within our studies ($n = 29$) and all observed unmarked owls had even tail molt (all rectrices from the same generation), indicating that they did not undergo an incomplete molt. Two individuals observed subsequently in 2014 and 2015 molted their tail feathers both years and no captured individual had rectrices that appeared more than 1 yr old during banding operations. For Great Gray Owls in western Wyoming, the mean date on which tail molt began was 17 July in 2014 (range = 24 June–14 August) and 4 July in 2015 (range = 10 June–25 July). Average molt date was 1 July for females ($n = 11$) and 11 July for males ($n = 9$). Our observations indicate that

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Great Gray Owls in this study area typically undergo a complete, synchronous tail molt every year beginning with the second prebasic molt.

The advantages and implications of synchronous tail molt in large owls are not well understood. Great Gray Owls likely can afford a synchronous tail molt because they employ a perch-and-pounce hunting strategy that requires minimal use of their tail for maneuvering (Bull and Duncan 1993). We anecdotally observed no obvious flight impairment by an owl that had molted all of its tail feathers. Forsman (1981) also reported no effect of synchronous tail molt on Northern Spotted Owl flight, whereas Mayr and Mayr (1954) observed only minimal effect on Burrowing Owl maneuverability.

When and how Great Gray Owls replace their rectrices is likely influenced by the energy balance between reproductive output and prey availability. It appears that females molt their tails earlier than males, but more data across years are needed to test this variation. One explanation for a difference in molt timing is that a few weeks after fledglings leave the nest, male Great Gray Owls assume sole responsibility for feeding dependent young (Bull et al. 1989). Therefore, males may delay molt until the young gain more independence and start hunting on their own. Although small sample sizes precluded adequate statistical testing, our data further support this theory because breeding males molted later ($n = 2$, mean = 8 August) than nonbreeding males ($n = 6$, mean = 15 July). Similarly, Forsman (1981) noted that breeding female Northern Spotted Owls molted later than nonbreeding females. Reproduction also had a large effect on the timing and extent of flight feather molt in Ural Owls (*Strix uralensis*; Pietiäinen et al. 1984), and Mayr and Mayr (1954) observed that the majority of breeding Burrowing Owls did not molt their rectrices synchronously, whereas those individuals that had no young or had independent fledglings underwent synchronous tail molt.

Prey availability also likely drives molt patterns. In Wyoming, northern pocket gophers (*Thomomys talpoides*) comprise the majority of Great Gray Owl diet biomass (Franklin 1988) and young pocket gophers make up a high percentage of Great Gray Owl diet because they disperse aboveground and are more easily accessible (Franklin 1988). Pocket gophers typically breed in May–June at high altitudes, have a 19-d gestation period, and start dispersing 6–8 wk after birth (Verts and Carraway 1999). Thus, the dispersal timing of young pocket gophers coincides with the timing of tail molt in Great Gray Owls in western Wyoming. Northern pocket gophers are less cyclic than other prey species such as voles, which may explain why Great Gray Owls in our study area molt their tails synchronously each year. It is possible that Great Gray Owls may molt their tails more gradually or not at all in years of lower food abundance. Inhibited molt in Great Gray Owls has been documented during years of prey shortages (Nero and Copland 1997, Pittaway and Iron 2005).

Although synchronous molt is generally a rare method for tail replacement, we propose that Great Gray Owls can sustain this molt pattern because of the interaction of their distinct hunting style, unusual breeding strategy, and prey availability. One or more of these factors likely precludes most raptors from evolving this molt pattern.

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