Short Communications

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Hail-induced nest mortality and possible fright molting of a passerine bird during the pre-incubation period

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ABSTRACT—Deaths at the nest caused by hailstorms are rarely reported in birds and are usually revealed based on ex post monitoring. As a result, it is often difficult to draw inferences on the behavioral responses of individuals to hailstorms. In this note, I report the death of a female Lesser Whitethroat (*Sylvia curruca*) at its nest during the laying stage during a severe hail event in Poland. I inspected the nest soon after the storm and found traces that allowed me to reconstruct the nesting female's behavior. This observation contributes to the infrequent documentation that hailstorms may have lethal effects on shrubland birds, considered to be relatively resistant to hail-related mortality. It also shows evidence of partial incubation (nest attendance before clutch completion) during an extreme weather event. Finally, the female Lesser Whitethroat of this report lost all of her rectrices and other feathers that were found intact and spread out in the nest. Although feather loss due to hail trauma cannot be ruled out, the most likely explanation was their ejection (known as fright molt), possibly triggered by hail-associated stress. Should this be confirmed, this would be the first case of fright molt associated with a hailstorm reported in wild birds. My report adds further insights into bird responses to increasingly extreme meteorological events. *Received 14 December 2019. Accepted 31 July 2020.*

Key words: animal behavior, breeding failure, climate extremes, Lesser Whitethroat, mortality, natural disturbance, *Sylvia curruca*.

Mortandad en el nido inducida por granizo y posible muda por susto en un ave paserina durante el periodo preincubatorio

RESUMEN (Spanish)—La muerte en el nido causada por tormentas de granizo es raramente reportada en aves y usualmente es revelada de manera posterior a su suceso. Como resultado, frecuentemente es difícil hacer inferencias sobre las respuestas conductuales individuales a las tormentas de granizo. En esta nota, reporto la muerte de una hembra de la curruca *Sylvia curruca* en su nido durante el periodo de puesta a causa de una granizada severa en Polonia. Inspeccioné el nido poco después de la tormenta y encontré pistas que me permitieron reconstruir el comportamiento de la hembra anidando. Esta observación contribuye la documentación poco frecuente del posible efecto letal de las tormentas en aves de zonas arbustivas, consideradas relativamente resistentes a la mortandad relacionada al granizo. También muestra evidencia de incubación parcial (cuidado del nido antes de concluir la puesta) durante un evento meteorológico extremo. Finalmente, la hembra de curruca de este reporte perdió todas las rectrices y otras plumas intactas que fueron encontradas esparcidas por el nido. Si bien la pérdida de plumas por el trauma causado por granizo no puede ser descartada, la explicación más plausible es su eyección (conocida como muda por susto), posiblemente disparada por el estrés asociado al granizo. De ser confirmado, este sería el primer caso de muda por susto asociado con una tormenta de granizo reportada en aves silvestres. Mi reporte agrega otros puntos de vista a las respuestas de las aves al incremento en los eventos meteorológicos extremos.

Palabras clave: comportamiento animal, curruca, extremos meteorológicos, fallo en la anidación, perturbación natural, *Sylvia curruca*.

The biological impact of extreme weather events has attracted much interest in recent years due to their increasing magnitude and confirmed evidence of severe consequences on ecosystems and wildlife populations. Wild animals have developed miscellaneous adaptations to survive inclement weather (van de Pol et al. 2017, Wingfield et al. 2017); however, these adaptive abilities may not be sufficient when confronted with extreme conditions that have never been faced before. Indeed, many species do not seem able to respond to the current magnitude of weather change (as suggested in recent syntheses: Bailey and van de Pol 2016, Vazquez et al. 2017, Sergio et al. 2018), as has been demonstrated by numerous mortality episodes induced by natural disturbances (e.g., Newton 2007, Moreno and Møller 2011, Wuczyński and Jakubiec 2013).

Addressing the selective pressures of extreme climate events and their long-term implications have been set forth as directions for future research (Bailey and van de Pol 2016, Grant et al. 2017). Unfortunately, our understanding of behavioral responses to natural disturbances is very limited (Altwegg et al. 2017), since extreme weather events are, by definition, rare, unexpected, and sometimes also hazardous for people. They are therefore difficult to study, and most information comes from post-factum data. As a result, the

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choices and strategies faced by individuals facing emergencies remain little known.

Our understanding of bird responses to catastrophic hail events, which is the subject of this report, is also insufficient. The best-documented instances of wildlife mortality in response to hailstorms pertain to birds (Hall and Harvey 2007, Saunders et al. 2011, Diehl et al. 2014, Narwade et al. 2014). Indeed, high frequency of hail mortality and nest failure in birds relative to other animal taxa indicate that they are disproportionately vulnerable to hail, possibly because of their physical attributes (small and fragile bodies and eggs) and life history traits (many species breed in open cup nests with weak overhead cover). Although the available data clearly indicate deleterious effects of hail to individuals and avian communities (Hightower et al. 2018, Fiss et al. 2019), the behavioral responses of birds to weather events remain poorly documented. Understanding the circumstances experienced by an individual bird trapped by storms and the decisions taken (e.g., an individual's own safety vs. offspring survival) requires either novel research approaches and equipment, or requires researchers to act quickly before any traces left are erased by hailstones, stormwater, or scavengers.

In the late summer of 2019, I observed the death of an adult Lesser Whitethroat (*Sylvia curruca*) at its nest during a severe localized hailstorm in southwestern Poland. Since I inspected the nest shortly after the storm, I was able to document some traces left that allowed me to make a more thorough description of this event. In this report, I reconstruct the circumstances of the death of a bird, the loss of its clutch, and its activities during the hailstorm, presenting some previously undocumented behavioral responses of this wild bird to an extreme weather disturbance.

Methods

Study site and species

My observations took place in a residential garden (0.25 ha) in the village of Sieniawka (SW Poland, 50°46′37″N, 16°46′11″E; elevation 214 m). Each breeding season, I collect data on the breeding performance of various bird species at this garden, including nest locations and the fate of all nests found.

At the time of the hailstorm, about 20 active bird nests were in the garden, all of them of species with a mass of >24 g, including 1 nest of the Blackbird (*Turdus merula*) at a nestling stage, Collared Dove (*Streptopelia decaocto*) also at a nestling stage, 2 nests of the Tree Sparrow (*Passer montanus*), and about 15 nests of the House Sparrow (*P. domesticus*). Nests of the 2 sparrow species could not be checked after the storm due to their inaccessible locations, but behavior of adult birds indicated that the nests continued forward to other stages of development. Besides these, 1 nest of a smaller species, the Lesser Whitethroat, was active in the garden.

The Lesser Whitethroat is a small (~12 g), secretive, migratory warbler widespread in temperate Europe, mostly in lowlands. This species occupies various habitats that contain well-spaced tall bushes where it breeds at low densities (for example, 1.2 pairs/km^2 in agricultural landscapes neighboring Sieniawka village; Wuczyński 2016). Its nests are usually built in bushes and small trees, especially those with thorns, between mid-April and early July. The Lesser Whitethroat is a single-brooded species, although replacement broods are frequently laid if the first clutch is lost. Broods typically contain 4–6 eggs incubated by both mates, but females contribute more than males. The sexes are similar (all data after Cramp and Simmons 2004).

A single pair of Lesser Whitethroats permanently occupied a territory in the garden until relatively late in the season, into mid-June 2019, indicating a replacement brood. The nest was built between 25 and 29 June, and the first 2 eggs were laid in the mornings of 30 June and 1 July. The nest was built in a common barberry (*Berberis vulgaris*) shrub with a height ~150 cm, part of a larger multispecies group of shrubs (Fig. 1a). The nest cup was placed inside the shrub, ~70 cm from its edge, at a height of 129 cm (i.e., ~20 cm from the tips of the highest shrub shoots).

Characteristics of the storm

On 1 July 2019, after a heat wave, a severe thunderstorm passed over the area between ~1600 and 2100 h CEST. In Sieniawka, the storm began at ~1645 h with a severe hail event that lasted for about 15 min and produced hailstones with a maximum diameter in the range of 5.5–6.0 cm

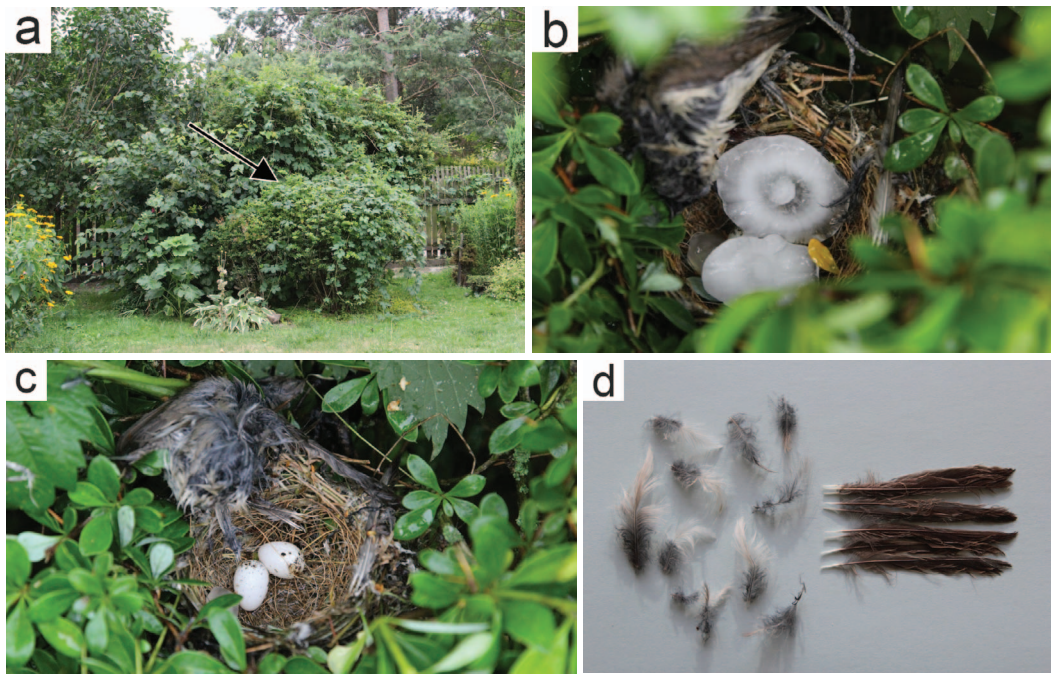

Figure 1. Effects of an extreme hailstorm on 1 July 2019 on the breeding attempt of the Lesser Whitethroat in Sieniawka (southwestern Poland). (a) Group of shrubs with arrow showing the location of the nest in the barberry; (b) dead adult bird (assumed to be a female) and the hailstones in the nest cup; note the size of the biggest stone (~5.5 cm) that was originally placed next to the bird; (c) the original position of the bird lying on the nest edge; also note the location of 9 tail feathers in clusters of 3, 4, and 2 feathers; and (d) the 9 rectrices and other feathers found in the nest.

(Fig. 1b). Hail was accompanied by intense rain and a weak west wind. Intense rainfall interspersed with short phases of torrential rain continued until 2100 h. Although this disturbance was part of a larger system of storms passing over a vast area of southwestern Poland, the hailstorm itself was highly localized, and neighboring villages a few kilometers apart were much less affected than Sieniawka.

This storm produced the largest hailstones that I have ever observed in this area. At ~1720 h I checked nests and the surface under them in order to assess possible failures in breeding birds. I also documented vegetation damage. In the case of the Lesser Whitethroat nest, I recorded detailed notes and photo documentation that allowed me to reconstruct the effects of this hail event in its nest.

Results

I recorded the failure of a Lesser Whitethroat nest due to hail. At the time I checked the nest, a dead adult, 2 intact eggs, and 4 hailstones were present in the nest. The adult bird was lying against the edge of the nest and adjacent branches with its head turned outward (Fig. 1c). No open wounds could be seen, except for a small petechiae on the right hip. However, below the place where the head sat, I noticed fresh traces of blood on a twig, indicating damage to internal organs, but no necropsy was done. The adult bird had a well-developed brood patch, which suggests that it was a female.

In addition, I noticed the adult bird did not have a tail (Fig. 1c). Nine tail feathers (out of 12 rectrices that comprise a complete tail of the Lesser Whitethroat) and a dozen or so finer contour feathers were found in the nest. The rectrices were in 3 clusters: 7 feathers (3+4) were located inside the nest, close to the bird's back, and 2 feathers were found on the opposite side of the nest, lying on its edge, with shafts pointing away from the female. The rectrices were intact, not broken (Fig. 1d).

I found 4 hailstones inside the nest and on its edge. The largest one had the shape of a flattened disk with a diameter of ~5.5 cm (Fig. 1b). It laid next to the bird's head. Three other hailstones were placed in the nest covering the eggs and ranged from 1.5 cm (about the size of this bird's egg) to ~4 cm in diameter. Although the eggs were much smaller and almost invisible under the hailstones, they were not crushed. The nest seemed intact and it remained in the bush during the following weeks. After completing my observations, the adult individual (assumed to be a female) and eggs were frozen. The breeding territory apparently remained occupied after the storm, since a singing Lesser Whitethroat, possibly the dead bird's mate, was observed in the following days in the garden.

No apparent hail damage was observed in or around the nests of the remaining larger species nesting in the garden (i.e., no crushed eggs, dead nestlings, or dead adults that could have been associated with this hailstorm). Nestlings of the Blackbird and Collared Dove survived the storm; they were fed by parents in subsequent days and fledged their nests over time. Beyond that, parents of the 2 sparrow species were observed carrying food. Damage in vegetation was noticed in the orchard and vegetable patches, as well as in parts of the garden covered by woody and herbaceous large-leaved species, including flowerbeds.

Discussion

This note provides evidence that hailstorms have lethal effects on small breeding birds. Hail strike was undoubtedly the cause of death, as indicated by hailstones lying next to the Lesser Whitethroat and fresh traces of blood. The shallow depth of shrub canopy (20 cm) above the nest appeared insufficient to deflect hailstones, although admittedly the canopy was formed mostly by slender and pliant tips of shoots. Nevertheless, this indicates that birds breeding in shrubs are also subject to hail-related mortality.

Hail mortality is believed to be more common among organisms associated with more open habitats such as grassland or water habitats (Higgins and Johnson 1978, Carver et al. 2017, Martin et al. 2017) and rare in woodlands. Recently, Fiss et al. (2019) recorded extensive damage to vegetation and severe nest failures in the Golden-winged Warbler (*Vermivora chrysoptera*) breeding in early-successional forests in response to a localized 15 min hailstorm.

An intriguing part of this observation is the complete loss of the tail by the assumed female adult, and location of rectrices and other feathers in the nest. The simultaneous loss of all rectrices has 2 possible explanations: detachment by trauma or fright molting. It seems unlikely that the tail feathers could, all at once, be separated from the body of this bird by hailstone strikes alone. Under normal circumstances, a substantial and directional force is required to pull out a feather from the bird's skin (Møller et al. 2006). Besides that, the rectrices were not broken and had no visible traces of blood or skin that would be expected to arise during pulling. I found the most likely explanation was fright molting (i.e., the ejection of feathers by the female due to acute hail-associated stress). Fright molt, an equivalent of autotomy in non-avian organisms, is a unique kind of antipredator defense that may allow avian prey to escape during a predation attempt. Feathers from the closest part of the body to a pursuing predator, usually from the tail, rump, and back, can be suddenly shed by the bird to break free when captured (Møller et al. 2006) or to confuse the pursuing predator (Lindström and Nilsson 1988). Expulsion of feathers can also be induced by other stressful situations, such as handling by people (van Nie 2002, Awasthy 2010) and notably, "by violent natural events such as earthquakes and tornados" (Clark 2001).

Although I could not find any support for the last statements in scientific literature, this incident resembles the situation experienced by the Lesser Whitethroat. Should this fright molt event be confirmed, this would be, to the best of my knowledge, the first case of fright molting associated with a hailstorm reported in wild birds.

The assumed female adult's presence at the nest also deserves attention, considering the early stage of the nesting cycle and life hazard caused by intensity of the storm. During early laying, the time spent by parents at the nest is limited and consists of short bouts of nest attendance, mostly at night (Loos and Rohwer 2004, Podlas and Richner 2013). Early nest attendance is defined as partial incubation, occurs in almost 50% of species, and is still little understood (see review by Wang and Beissinger 2011). The possible

primary adaptive function of partial incubation is maintaining egg viability (egg viability declines gradually over time under ambient conditions, such as constant wetting and temperatures near freezing or above 40° C; Morton and Pereyra 1985, Ward 1990). Early nest attendance can thus shelter eggs and is expected to increase during meteorological extremes or in climates prone to these hazards. Unfortunately, there is little evidence to support the association of partial incubation with extreme natural phenomena due to the overall difficulties of observing these behaviors under field conditions (Wang and Beissinger 2011). The observations presented in this paper provide unambiguous evidence of nest attendance of the Lesser Whitethroat during the laying stage, perhaps in order to protect eggs against the effects of an unusual weather event.

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