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What the pluck? Theft of mammal hair by birds is an overlooked but common behavior with fitness implications

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Avian species across diverse lineages collect and incorporate mammalian hair into their nests (Tóth 2008). This widespread behavior can be adaptive, as hair, fur or wool insulates nests and so enhances nestling survival and recruitment in colder climates (Hilton et al. 2004, Mainwaring et al. 2014, Järvinen and Brommer 2020, Deeming et al. 2020; reviewed in Perez et al. 2020). How birds obtain mammal hair for their nests, however, is an open question. A common assumption is that birds gather mammal hair that has been shed into the environment or from carcasses (e.g. Tóth 2008), although anecdotal accounts exist in the scientific literature of birds plucking hair directly from live mammals. Here, we (H.S.P., Z.S.S. and J.D.B.) document and report our observation of a Tufted Titmouse (*Baeolophus bicolor*) exhibiting a behavior that we are terming "kleptotrichy" (from Greek "klepto-" – to steal + "trich-" – hair), after "kleptoptily" or feather theft described by Whitney (2007). While conducting a bird count for annual Illinois Natural History Survey Spring Bird Count (https://spring-bird-count.inhs.illinois.edu/) on May 9, 2020 at 11:00 AM at Allerton State Park (40° 0' 13" N, 88° 38' 46" W) in Monticello, Illinois, when we observed a titmouse flitting around a raccoon (*Procyon lotor*), sleeping in a tree about 3 m off the ground. The titmouse spent 2-3 minutes gradually getting closer the raccoon (Video S1), and eventually began to extract tufts of hair. The raccoon did not react, and the titmouse spent 3-4 minutes extracting >20 tufts of hair (Fig. 1, Video S2). After the observation, we verified that the raccoon was alive and merely sleeping (H.S.P., pers. obs.). To our knowledge, this is the first account in the peer-reviewed literature of kleptotrichy from a live raccoon.

The encounter piqued our interest – how commonly do birds pluck hair from live mammals, and does antagonizing a potentially dangerous predator present mortality risks? These questions inspired us to conduct a review of kleptotrichy in the scientific and popular literature. Specifically, we searched Google Scholar (scholar.google.com) using the following keywords: *bird* AND *pluck* OR *pull* OR *extraction* OR *gather* OR *collect* AND "*mammal hair*" OR "*mammal fur*" AND *nest* OR "*nest material*". As we were interested in plucking behavior, we only considered observations of hair being collected by birds from mammals and excluded simple descriptions of the presence of mammal hair in nests.

We found only 11 occurrences of kleptotrichy by six bird species in the peer-reviewed literature (Table 1). These reports included six observations of the Tufted Titmouse plucking hair from four mammal species including humans (*Homo sapiens*), three species of honeyeater (family

Meliphagidae) plucking hair from koalas (*Phascolarctos cinereus*) or humans, and two additional observations – a Red-winged Starling (*Onycognathus morio*: Sturnidae) plucking hair from a Klipspringer (*Oreotragus oreotragus*) and an American Crow (*Corvus brachyrhynchos*: Corvidae) plucking hair from a domestic cow (*Bos taurus*). Because (1) more than half of these kleptotrichy observations occurred in the Tufted Titmouse and (2) other species in the same family (Paridae) including tits, titmice and chickadees, are known to regularly incorporate hair into their nests (Ondrušová and Adamik 2013, Harničárová and Adamik 2016), we followed up on our initial search of the scientific literature with a search for plucking behavior among Paridae species on YouTube™ (youtube.com). We used identical keywords as in the initial search, except we replaced *bird* with *tit* OR *titmouse* OR *titmice* OR *chickadee* OR *parid**.

Our search yielded 99 instances of kleptotrichy among three species of Paridae on YouTube, suggesting that it may be a far more common behavior than indicated by the scientific literature. Of these videos, 93% included *B. bicolor* plucking fur/hair from either domestic dogs (*Canis lupus*; 45 out of 99) or humans (47 out of 99). Three other mammal species were documented being plucked by Parids in the remaining seven videos, including domestic cats (*Felis catus*; $n = 3$), Raccoons (*Procyon lotor*; $n = 3$) and North American Porcupine (*Erethizon dorsatum*; $n = 1$). We found videos of kleptotrichy in two other Parid species (i.e. Mountain Chickadee *Poecile gambeli* and Black-crested Titmouse *Baeolophus atricristatus*) that have not previously been documented plucking hair from mammals in the scientific literature. Although the results of our YouTube search included only videos with Parids visibly plucking fur from mammalian hosts, we also discovered hundreds of additional videos of Parids gathering loose fur that had been shed into the environment. These results suggest that kleptotrichy is actually quite well-known among the general public. For example, hair plucking behavior has been featured on multiple popular science websites ranging from specialized ornithological websites such as Cornell Lab of Ornithology (e.g. www.allaboutbirds.org/guide/Tufted_Titmouse/lifehistory#nesting) and the Audubon Society (e.g. www.audubon.org/news/honeyeaters-steal-fur-sleeping-koalas-their-nests) to local newspapers such as https://tulsaworld.com/sportsextra/outdoors/fur-stealing-titmice/article_5d92c49d-c6c0-5fbd-bd55-0efb206edaa8.html). Our findings highlight the value of popular platforms (i.e. platforms not

explicitly designed for citizen science such as eBird.org and wikiaves.com) to advance the scientific knowledge on the natural history of birds (e.g. Hauber et al. 2021).

To further explore the possibility that kleptotrichy may be an overlooked behavior among birds, we conducted a second literature search to determine which species in the family Paridae (n = 63 species) incorporated hair into their nests. Specifically, we used the Cornell Lab of Ornithology's website (birdsoftheworld.org) to characterize nesting material among the Paridae. We found that nests of all species previously recorded exhibiting kleptotrichy contained mammal hair. Furthermore, mammal hairs were found in the nests of 44 of 51 (86%) Parid species for which information on nesting material was available. Of the seven species not recorded incorporating hairs into their nests, the geographic distributions were as follows: subtropical (2/9; 22.2%), tropical (3/7; 42.9%), and temperate (2/23; 8.7%). The lower proportion of species using hair in nests in the tropics, as well as the absence of records of kleptotrichy among tropical species (Table 1), further suggests that this behavior is at least in part associated with climate, being more advantageous in colder climates.

Overall, we show that most species of Paridae incorporate hair in their nests and hair theft has been much more commonly documented in the popular literature than the scientific literature. Our results also suggest that the kleptotrichy is a largely commensal ecological interaction; the mammal species remained inactive or ignored the hair plucking by birds in 10 out of 11 observations from the published literature (Table 1) and were likely unaffected by the loss of a relatively small amount of hair. We speculate that there may be higher search costs associated with gathering patchily distributed hair shed into the environment, in comparison with extracting hair directly from live mammals, since hair is much more concentrated and potentially easier to locate in the latter case. Finally, our geographic analysis, though preliminary, suggests that kleptotrichy may occur more frequently at higher latitudes, supporting the hypothesis that the function of the behavior is to enhance nest insulation in colder climates (Perez et al 2020). Nevertheless, the presence of hair plucking among Parid species from warmer climates indicates that other mechanisms may also be at play. For example, mammalian hair could deter potential predators, as has been found with snakeskin (e.g. Medlin and Risch 2006, Liu and Jiang 2021), or deter parasites, as has been found with certain plant materials (reviewed in Scott-Baumann and Morgan 2015).

The paucity of peer-reviewed studies on kleptotrichy and our report leave many open questions. What are the actual costs and benefits of kleptotrichy, and are there tradeoffs between the risk of plucking hair from a potentially dangerous mammal vs. the reward of obtaining the hair? Is kleptotrichy primarily employed to enhance the thermal benefits of nest insulation, or for alternative reasons such as anti-predator defense? How many species that incorporate hair into their nests do so by kleptotrichy? And is kleptotrichy unique to certain clades (i.e. Paridae, Meliphagidae, Sturnidae and Corvidae) or is it widespread across the avian tree of life? We hope that our observations foment increased attention towards this fascinating and understudied behavior and encourage more systematic studies of kleptotrichy to address some of these unanswered questions.

Supporting Information

Additional supporting information may be found online at: [link to be added in production]

Open Research

Data are available on Zenodo: https://doi.org/10.5281/zenodo.4925146.

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Table 1. References in the scientific literature that described theft of mammal hair (kleptotrichy) by birds.

Bird species	Latitude	Mammal species	Mammal response	Source
Paridae (tits, titmice and chickadees)				
Tufted Titmouse *Baeolophus bicolor*	North temperate	Woodchuck *Marmota monax*	None	Reed 1927
Tufted Titmouse *Baeolophus bicolor*	North temperate	Red Squirrel *Tamasciurus hudsonicus*	None	Bent 1946
Tufted Titmouse *Baeolophus bicolor*	North temperate	Human *Homo sapiens*	None	Bent 1946
Tufted Titmouse *Baeolophus bicolor*	North temperate	Virginia Opossum *Didelphis virginiana*	None	Packard 1949
Tufted Titmouse *Baeolophus bicolor*	North temperate	Human *Homo sapiens*	None	Packard 1949
Tufted Titmouse *Baeolophus bicolor*	North temperate	Virginia Opossum *Didelphis virginiana*	Antagonistic	Goertz 1962

Tufted Titmouse *Baeolophus bicolor*	North temperate	Raccoon *Procyon lotor*	None	This paper
Meliphagidae (honeyeaters)				
Yellow-faced Honeyeater *Caligavis chrysops*	Subtropical	Koala *Phascolarctos cinereus*	None	Cody 1991
Brown-headed Honeyeater *Melithreptus brevirostris*	Subtropical	Human *Homo sapiens*	None	Pascoe and Saxon 1992
Black-chinned Honeyeater *Melithreptus gularis*	Subtropical	Koala *Phascolarctos cinereus*	None	Martin et al. 2003
Sturnidae (starlings)				
Red-winged Starling *Onycognathus morio*	South temperate	Klipspringer *Oreotragus oreotragus*	None	Symes and Hirons 2014
Corvidae (crows and ravens)				

American Crow *Corvus brachyrhynchos*	North temperate	Domestic Cow *Bos taurus*	None	Harris 1946

FIGURE LEGEND

Figure 1. Tufted Titmouse (*Baeolophus bicolor*) plucking hair from a sleeping Raccoon (*Procyon lotor*) at Allerton State Park, Monticello, IL on May 9, 2020. Photo credit: Zachary Sutton © 2020.

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