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A Long-tailed Tit *Aegithalos caudatus* nest constructed from plastic fibres supports the theory of concealment by light reflectance

Running head: Long-tailed Tit nest made of plastic fibres

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Abstract

We document a highly unusual Long-tailed Tit nest in northwest England that is largely constructed from plastic debris, namely synthetic fibres, apparently from a nearby discarded cushion. We describe the nest location, construction and dimensions. The unusual nest material is discussed in relation to the potential insulation properties, and especially its camouflage according to the hypothesis of concealment by light reflection.

Plastic pollution is an epidemic of the modern world that is becoming a widespread component of bird nests. A global review of artificial materials in bird nests by Jagiełło et al. (2019) found that plastic debris was more frequent in the nests of terrestrial species, compared to seabirds, and was more common in regions of increased human impact on the environment. Birds will incorporate plastic debris into nests for a variety of reasons, including as a replacement for natural construction or insulating materials (Antczak et al. 2010, Surgey et al. 2012), or even to deter ectoparasites (Suárez-Rodríguez et al. 2013).

Hansell (1996) has proposed that birds that attach lichen flakes or spider cocoons to their nests, such as Long-tailed Tits *Aegithalos caudatus*, can also use plastic debris for the same purpose, which is to camouflage the nest by breaking up its dark shape with pale reflective materials. Long-tailed Tit nests are oval structures with a side-entrance hole, made of an outer shell composed of moss and plant fibres bound together with spider silk, and an interior lined with approximately 1000-2000 small feathers (Cramp & Perrins 1993). Hansell (1996) found that lichen flakes and spider cocoons were attached to the exterior of all 40 British nests examined, but 35% of nests also had small balls of expanded polystyrene attached (up to 1568 pieces per nest), and 12.5% had small pieces of paper. However, other artificial materials were very rare, with just one nest containing greyish synthetic fibre that was blended into the natural materials of the outer shell.

In this short article we describe a previously unrecorded example of a Long-tailed Tit nest from England with an outer shell composed mostly of plastic debris, namely synthetic fibres, which largely replace the moss and plant fibres of typical nests. We describe the nest in

comparison to usual Long-tailed Tits from England reported by McGowan et al. (2004), and in the context of Hansell's (1996) hypothesis of nest concealment by light reflection.

Nest observations and collection

The nest was discovered on 25 March 2020 during permitted daily exercise amid the England 'lockdown' in response to the COVID-19 pandemic. The nest was situated in a Bramble *Rubus fruticosus* thicket growing up a steel palisade fence alongside a footpath (Fig. 1), between sites known as Turner's Flash and Horrocks Flash (53° 52'N, 2° 61'W), on the southern edge of the Wigan conurbation in northwest England (see Parry & Broughton 2018). The habitat is a mosaic of wetland, grassland and scrub surrounded by dense urbanisation and railway lines. The nest was 1.2 m above the ground with an entrance facing north. Approximately 4 m from the nest, just beyond the Bramble thicket, a damaged cushion had been dumped, and the exposed bright white stuffing material (presumably polyester) appeared to be the source of the plastic fibres in the nest (Fig. 1).

On discovery, the nest appeared complete and ready for eggs, containing a typical dense lining of feathers (see McGowan et al. 2004). Birds were present at the nest on the initial discovery in March, but not engaged in nest-building, although none were seen on weekly checks over the following 40 days, and no eggs were laid. Consequently, the nest was judged to be abandoned and was collected on 5 May.

Nest examination

The nest was air dried and stored at room temperature until 30 June, when it was examined on a day of 70-80% humidity and 18-20°C ambient temperature. Dimensions of the nest were measured in the same way as described by McGowan et al. (2004). Positioning the nest upright, with the entrance hole facing forward, the height from the lowest to the highest point of the nest material was 14.9 cm, width across the nest at the base of the entrance hole was 11.7 cm, and a depth from the base of the entrance hole to the back of the nest (exterior) was 9.4 cm (Fig. 2). Weighing using a Pesola spring balance gave a whole nest

mass of 19.0 g; this was substantially less than the mean 28.6 g for 28 nests examined by McGowan et al. (2004), and at the lower of the range of between 15.4 g and 44.6 g for those nests. Further destructive examination was not possible, such as dissecting the nest and its components, as the nest was required intact to be deposited in the national collection at the Hunterian Museum in Glasgow (item number GLAHM:161995).

The outer shell of the nest was predominantly composed of white plastic (probably polyester) fibres, which were bound with spider silk to small amounts of moss, giving an overall greyish colour, with attached lichen flakes and some small (2-3 mm) buff-coloured wood chips (Figs. 2 and 3). The nest interior was lined with many small feathers (examined by feeling inside and looking with a small torch), as is typical for this species (McGowan et al. 2004), and a few strands of Rabbit *Oryctolagus cuniculus* fur were visible.

Discussion

The Long-tailed Tit nest observed and collected at Wigan is highly unusual in its construction material, and nothing similar has been described for this species in the literature. Whereas the outer shell of typical Long-tailed Tit nests have moss as the major constituent, with lesser amounts of hair or plant fibre (Cramp & Perrins 1993; McGowan et al. 2004), in our nest these materials were almost completely replaced by the plastic fibres. This material was bound with spider silk to make an elastic case for a typical lining of small feathers, and lichen flakes were attached to the exterior, as with standard nests of Long-tailed Tits. More unusually, small buff-coloured wood chips were also attached to the exterior, which does not appear to have been recorded previously on Long-tailed Tit nests.

The use of plastic fibres instead of moss may have been due to limited availability of moss on the site, although this seems highly unlikely due to the damp habitat and commonplace nature of moss in the region. Furthermore, approximately 25 nests of Long-tailed Tits have been discovered annually in recent years on the wider site, and all have been typical nests made of natural materials (pers. obs.). An alternative explanation is the superabundance and easy availability of the plastic fibres, in the form of the abandoned cushion next to the

112 nesting thicket, which may have represented a low-cost choice for the Long-tailed Tits,
113 requiring no searching and little travel to collect large quantities of material. Hebda (2007)
114 reported Long-tailed Tits using material from their depredated nests to build new nests
115 nearby, presumably saving time and effort. In cavity-nesting tits (Paridae), Surgey et al.
116 (2012) found that birds in nestboxes were also opportunistic in using artificial wool-like
117 material for nest lining, although the utilisation varied with species and individuals.
118 Why the birds would select a bright white material instead of the more usual green moss is
119 intriguing. Both materials may provide suitable bulk and flexibility to form the nest shell,
120 although the plastic fibre is likely to contain less absorbed water, and so it would weigh much
121 less than moss. This difference was perhaps indicated by the very low mass of our nest
122 compared to the standard nests examined by McGowan et al. (2004), which were 51%
123 heavier on average. McGowan et al. (2004) suggested that Long-tailed Tits vary the volume
124 and mass of their nest lining (feathers) to adjust the insulation properties of the nest in
125 relation to ambient temperatures, but the mass of the outer structure does not vary.
126 However, if the lightweight polyester used by the birds in the outer structure of our nest had
127 relatively greater insulation properties than moss, this may explain the low overall mass, as
128 the birds may have adjusted construction to reflect the higher insulation properties of the
129 plastic material by using less of it.
130 Hansell's (1996) theory of nest concealment by light reflection may also be a plausible
131 explanation for the choice of white plastic fibres instead of green moss. Bramble has a very
132 open canopy structure that is easily seen through, and so a solid dark nest may be obvious
133 against a light background, such as sky or the surrounding yellowish dead grass in March,
134 when the nest was built. Hansell (1996) proposed that Long-tailed Tits break up the outline
135 and silhouette of typical mossy nests by attaching pieces of pale or whitish material that
136 have a high light reflectance, such as lichen flakes, spider cocoons, or small balls of
137 expanded polystyrene and bits of paper, making the nest appear less solid.
138 The appearance of our nest appears to support Hansell's (1996) hypothesis of concealment
139 by light reflection, as the birds have used a very pale, highly reflective material to construct

the outer shell of the nest. Figure 1 shows that the nest is indeed quite unobtrusive against a background of pale dead grass or bright sky seen through the canopy of the Bramble thicket. In situ, the attached lichen flakes actually create darker spots that break up the nest shape, reversing the usual observation of paler lichen flakes on a dark mossy structure. Intriguingly, Figure 1 shows that the pale nest also blends in somewhat with pale/white plastic litter (plastic bags) caught up in the thicket.

How the synthetic nest material may have influenced breeding success, in terms of the important factors of insulation and humidity on embryo and chick development, remains an open question. The nest was abandoned soon after construction, and no birds were seen thereafter; this may have been due to predation or perhaps voluntary desertion if the birds detected that the microclimate in a synthetic nest was unsuitable after all. The deposition of the intact nest in the Hunterian collection will allow future examination by any interested researchers who may wish to explore such questions.

In summary, this unprecedented Long-tailed Tit nest is consistent with theories of nest camouflage, in line with concealment by light reflection (Hansell 1996), and possibly also with nest construction for insulation properties (McGowan et al. 2004). The close proximity of a superabundant supply of white plastic fibres may have influenced the Long-tailed Tits' decisions on nest materials in a human-modified landscape, as indicated for other species in the review by Jagiełło et al. (2019). However, if the camouflage and/or insulation theories are correct, it is surprising that such 'pale' fibre-built nests have not been recorded before, perhaps composed of sheep's wool, which has long been abundant in Long-tailed Tit habitats across much of Britain. Ultimately, the nest is an additional case study of the increasingly widespread impact of plastic pollution in our landscapes, and its effects on wildlife.

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169 References

170 Antczak, M., Hromada, M., Czechowski, P., Tabor, J., Zablocki, P., Grzybek, J. &
171 Tryjanowski, P. (2010) A new material for old solutions-the case of plastic string used in
172 Great Grey Shrike nests. Acta Ethologica 13: 87e91.
173 Cramp, S. & Perrins, C.M. (1993) *The Birds of the Western Palearctic: Vol. VII Flycatchers to*
174 *Shrikes*. Oxford University Press, Oxford.
175 Hansell, M. (1996) The function of lichen flakes and white spider cocoons on the outer
176 surface of birds' nests, Journal of Natural History 30: 303-311.
177 Hebda, G. (2007) Utilizing material from old nests – a way to time-saving in species with a
178 short breeding season? The case of the Long-tailed Tit *Aegithalos caudatus*. Vertebrate
179 Zoology 57: 79-82.
180 Jagiełło, Z., Dylewski, Ł., Tobolka, M. & Aguirre, J.I. (2019) Life in a polluted world: A global
181 review of anthropogenic materials in bird nests. Environmental Pollution 251: 717-722.
182 McGowan, A., Sharp S.P. & Hatchwell, B.J. (2004) The structure and function of nests of
183 Long-tailed Tits *Aegithalos caudatus*. Functional Ecology 18: 578-583.
184 Parry, W. & Broughton, R.K. (2018) Nesting behaviour and breeding success of Willow Tits
185 *Poecile montana* in north-west England. Ringing & Migration. 33: 75-85.
186 Suárez-Rodríguez, M., López-Rull, I. & Garcia, C.M. (2013) Incorporation of cigarette butts
187 into nests reduces nest ectoparasite load in urban birds: new ingredients for an old recipe?
188 Biology Letters 9: 20120931.
189 Surgey, J., Feu, C.R.D. & Deeming, D.C. (2012) Opportunistic use of a wool- like artificial
190 material as lining of Tit (Paridae) nests. The Condor 114: 385e392

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Figures

Figure 1. Long-tailed Tit nest (left) with an outer structure composed of plastic fibres (probably polyester), in situ in a Bramble thicket on 13 April 2020, approximately two weeks after completion and activity had ceased. The likely source of the synthetic fibres (right) was the stuffing from a cushion, which was illegally dumped 4 m from the nest, at the edge of the thicket.

Figure 2. Long-tailed Tit nest after collection on 5 May 2020, photographed on 30 June, showing (left) front view, and (right) side view, with a ruler showing the scale in cm on the right edge and inches on the left. The overall greyish colouring is due to the majority of the outer structure being composed of plastic fibres (presumably polyster), bound with spider silk to smaller amounts of green moss, with greyish flakes of lichen and some small buff-coloured wood chips attached to the exterior.

Figure 3. Detail of the construction and materials of the outer structure of the Long-tailed Tit nest, showing the major composition of white plastic (presumably polyester) fibres. The plastic fibres are bound with spider silk to small amounts of moss (yellowish-green) and greyish flakes of lichen.