My family and other animals: mixed broods of great and blue tits in the Loch Lomond woodlands

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Every year, University of Glasgow ornithologists monitor breeding birds using the nearly 500 nestboxes installed in the forests surrounding the Scottish Centre for Ecology and the Natural Environment (SCENE, 56º 78 N 4º 36.8 W) (Jarrett *et al*., 2017). This year (2017), we were intrigued to discover two instances of mixed great tit (*Parus major*) and blue tit (*Cyanistes caeruleus*) broods (Fig. 1). To the best of our knowledge, these are the first occurrences of mixed-species broods ever recorded at the site. Each was found in the Cashel area, and consisted of a great tit provisioned nest, occupied by multiple great tit chicks (five and six, respectively), and a single blue tit chick. Mean great tit brood size in Cashel was 6.7±0.4 (mean±S.E.). The two clutches hatched within one week of the population mean hatch date (population mean = 17/05; mixed broods = 19/05, 24/05), suggesting nothing unusual in their phenology. Chick mass on day 13 (hatch date = day 0) approximated the mean values recorded across the SCENE populations (Mixed brood blue tits = 11.2g, 11.7g; SCENE = 11.5±0.1. Mixed brood great tits = 17.9±0.2g, 18.7±0.4g; SCENE = 18.7±0.1). These figures, and the fact that all chicks in both broods fledged successfully, indicate that the burden imposed by an additional nest mate did not exceed the parent's provisioning capacity.

Two potential mechanisms can lead to such mixed species broods – nest takeovers, or interspecific brood parasitism. Nest takeovers are generally instigated by species larger than the current occupants (although blue tits have been known to oust larger pied flycatchers (Samplonius & Both, 2014)). Mixed-species broods can result if eggs from the original residents remain in the nest, and the new occupant lays without adding new nesting material. Alternatively, interspecific brood parasitism involves the dumping of eggs into another species' nest, leaving them to be cared for by the host. Interspecific brood parasitism can be obligate, as with the common cuckoo (*Cuculus canorus*), or facultative, where both parasitic and

Fig. 1. One of two mixed species broods found occupying nest boxes in the Cashel area during the 2017 breeding season. Heads of visible chicks are labelled by species; BT = blue tit, GT = great tit.

non-parasitic breeding strategies may be used, as is the case in blue tits (Lyon & Eadie, 1991). Mixed species broods are sufficiently rare that the conditions necessary to induce either mechanism are not well understood (Barrientos *et al*., 2015). One possible factor, particularly relevant for cavity nesters such as great tits and blue tits, may be breeding density. In one of the few large scale studies to investigate this topic, incidences of great/blue tit mixed broods were found to increase with nest box occupation rate, suggesting that mixed-species broods can be a response to nest site shortage (Barrientos *et al*., 2015). Interestingly, both mechanisms were observed in equal numbers, but only blue tits were associated with egg dumping, usually of a single egg. In 2017, Cashel had a relatively high nest box occupancy (81%), when compared with the two preceding years (2016 = 74%, 2015 = 73%). Also both incidences of mixed-species brood we report contained only one blue tit chick, with no unhatched eggs observed in either nest. As such, it appears quite likely that our first records of mixed-species broods resulted from facultative interspecific brood parasitism, motivated by limited nest site availability.

As a final point, we think it worth noting that mixed-species clutches/broods may be more common than records show. We, at least, and probably others,

could easily have overlooked our blue tit interlopers. We often observe distinctly smaller eggs in great tit nests, which we had assumed were laid by the incubating great tits. Equally, had we only visited the nests before the plumage was sufficiently developed to distinguish the two species, we may also have mistaken the blue tit chicks for great tit runts.

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