

The benefits of joining mixed-species flocks for Greater Racket-tailed Drongos *Dicrurus paradiseus*

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Drongos are well known to participate in mixed-species bird flocks, but it is not clear whether they are mostly commensalists, catching insects that other species disturb, or kleptoparasites, stealing food directly from other species. We studied the foraging ecology of Greater Racket-tailed Drongos *Dicrurus paradiseus* inside and outside mixed-species flocks in seven areas of a lowland rainforest in Sri Lanka. We found that drongos in all seven areas fed at a higher rate when in flocks. Kleptoparasitism was practised at a low rate (4% of observations); more often, drongos captured insects disturbed by other species (41% of observations). To accrue these benefits, drongos adjusted the height at which they perched to match the foraging height of Ashy-headed Laughingthrush *Garrulax cinereifrons*, a species that forages lower than drongos normally do, and those of Orange-billed Babbler *Turdoides rufescens*, a species that forages higher than drongos normally do. We conclude that drongos are better classified as commensalists than as parasites, as they exact only a small cost on other species in flocks; they may even be mutualists, because they make sensitive and reliable alarm calls to which other species react.

INTRODUCTION

The benefits of mixed-species flocking, whether reduced predation risk or increased foraging efficiency, are often analysed as they apply to the flock as a whole (Morse 1977, Terborgh 1990). Different species, however, may benefit from flocking in different ways (Hino 1998). Furthermore, species differ in the benefits they provide to others, with some ‘nuclear’ species being particularly important to flock formation and cohesion (Moynihan 1962, Hutto 1994). A full description of a mixed-flock system would therefore depict the flow of different benefits among a web of species.

The complexity of interspecific relationships within mixed-species flocks is exemplified by the role of drongos Dicruridae, which are frequent members of such flocks in the Old World tropics and Australasia. Drongos may benefit other species by giving alarm calls and serving as flock ‘sentinels’, because their sallying foraging technique makes them particularly vigilant for predators (Munn 1984, Goodale and Kotagama 2005a). Alternatively, they may neutrally affect other species, but accrue benefits themselves, by catching insects disturbed (‘beat-up’) by other species (Swynnerton 1915, Hino 1998). Or they may negatively affect other species through kleptoparasitism (Brockmann and Barnard 1979, King and Rappole 2001). To understand whether drongos are respectively mutualists, commensalists or parasites in a flock system, all possible interactions must be measured.

A mixed-flock system in the rainforests of Sri Lanka provides an opportunity to understand fully the relationship between drongos and other species within a flock. It has previously been argued that Greater Racket-tailed Drongos *Dicrurus paradiseus* play a sentinel, nuclear role in this flock system, because they are sensitive in detecting predators and make reliable alarm calls (Goodale and Kotagama 2005a), and because other birds are attracted to a random sample of their vocalisations (Goodale and Kotagama 2005b). Here, we investigate the benefits gained by drongos from being in such flocks. First, we compare the foraging rate and success of drongos inside and outside flocks. Second, we assess how these foraging benefits arise; specifically whether drongos act as commensalists, capturing insects disturbed by other

species in the flock, or as kleptoparasites, stealing prey items from other flock members. Finally, we examine whether drongos enhance their likelihood of these foraging benefits by increasing their proximity to other flock members. In particular, we investigate whether drongos adjust their perch height to match that of two leaf-gleaning species: Ashy-headed Laughingthrush *Garrulax cinereifrons*, which forages lower than drongos, and Orange-billed Babbler *Turdoides rufescens*, which forages higher than drongos (Kotagama and Goodale 2004). We predicted that the closer drongos were horizontally to these species, the closer they would be vertically.

METHODS

Study site

The study was conducted in the north-western sector of the Sinharaja World Heritage Reserve, a rainforest in Sri Lanka (6°26'N 80°21'E, 400–600 m). Sinharaja is an evergreen lowland rainforest, with the canopy dominated by trees of *Mesua* spp. and *Shorea* spp. (Gunatilleke and Gunatilleke 1981). The mixed-species flocks of the reserve are large (averaging 12 species and 40 individuals), and are characterised by two species that are found in >90% of flocks: Greater Racket-tailed Drongo and Orange-billed Babbler (Kotagama and Goodale 2004).

Data collection

As all observations were made on unmarked birds, flocks were studied at several different sites within the forest to enhance sample independence. A previous radio-telemetry study of Greater Racket-tailed Drongos showed that they had home ranges less than 1.5 km in diameter (Goodale and Kotagama 2006b). We selected seven areas of the forest within walking distance of the Sinharaja Research Station that were each c. 1.5 km in diameter and 1.5 km from each other.

Observations were carried out by SHKS and field assistants. An observation began when a perched drongo was detected and ended when that drongo flew to a perch from where it could not be seen; observations therefore varied in length and so were timed. For each observation, the following were noted: (a) whether a bird was inside a