Notes and records

The habitat preference of four kingfisher species along a branch of the Kilombero River, southern Tanzania

C. Bonnington[1]* , D. Weaver[2] and E. Fanning[2]

[1]*Frontier-Tanzania Savanna Research Programme, PO BOX 9743, Dar es Salaam, Tanzania and* [2]*Society for Environmental Exploration/Frontier, 50-52 Rivington Street, London EC2A 3PQ, U.K.*

Introduction

Several factors have been found to influence kingfisher habitat use, including perch height (Monadjem, Owen-Smith & Kemp, 1994), diet (Woodall, 1991; Libois & Laudelout, 2004), water quality (Douthwaite, 1982), river depth (Monadjem, 1996), river width and river speed (Peris & Rodriguez, 1996).

Comparisons of the habitat preferences of different African kingfisher species have in the past mainly concerned the influence of single habitat variables on kingfisher presence [for example Monadjem *et al.* (1994) compared perch height preferences between Giant kingfisher (*Ceryle maxima*), Half-collared kingfisher (*Alcedo semitorquata*) and Pied kingfisher (*Ceryle rudis*)].

In this study, by regarding multiple habitat variables we compare the habitat preferences of four African species of kingfisher: Giant, Half-collared, Pied and Malachite (*Alcedo cristata*), along the Kilombero River, southern Tanzania.

Riverine habitat of the Kilombero River is cleared for purposes such as agriculture and livestock grazing and this may negatively affect the resident bird community (Baker & Baker, 2002). We aim to highlight those habitat variables that influence kingfisher habitat use, in an area experiencing moderate levels of anthropogenic pressure.

**Correspondence:* Society for Environmental Exploration/Frontier, 50-52 Rivington Street, London EC2A 3PQ, U.K.
Tel.: +44(0) 207 6132422; Fax: +44(0) 207 6132992;
E-mail: development@frontier.ac.uk

Materials and methods

The banks of the Kilombero River are heavily vegetated with shrubs, trees and vines and this habitat holds important bird populations including African Finfoot (*Podica senegalensis*) and Pel's Fishing Owl (*Scotopelia peli*; Baker & Baker, 2002). Much of the watercourse is shaded by extensive tree canopy.

Bird surveys were conducted between August 2005 and February 2006 (ten surveys per month from 07.30 hours to 09.30 hours and from 13.00 hours to 15.00 hours) along a 3-km stretch of the Mafinji River, a branch of the Kilombero River, in the Kilombero Valley (8°34′S. 8° 34′E). The Kilombero River flows south-westerly between the Selous Game Reserve and the Kilombero Game Controlled Area (Fig. 1).

Six experienced observers walked along the river (spanning across the whole river) and opportunistically searched for kingfisher species. Surveys were carried out

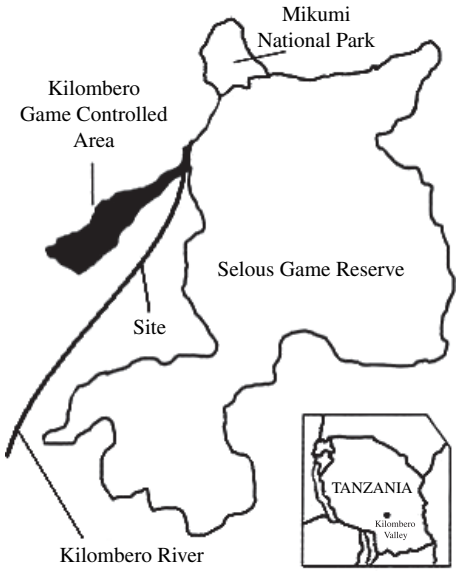

Fig 1 Position of the Kilombero River and the site of our survey, in relation to the Kilombero Game Controlled Area, Mikumi National Park and the Selous Game Reserve (derived from Hinde *et al.*, 2001)

on sunny, calm days, as kingfishers are the most active when visibility is good (Douthwaite, 1976).

During the survey, the following were recorded: (i) kingfisher species, (ii) perch height, measured using a tape measure (m), (iii) an estimate of overhanging branches <3 m in height (as a percentage of the river bank 20 m either side of the perched bird), (iv) an estimate of overhanging branches >3 m in height (as a percentage of the river bank 20 m either side of the perched bird), (v) river width (m), measured using a tape measure, (vi) river depth (m), measured using a plastic tape measure in the central river channel and 1 m from the north and south bank (=average taken of the three), (vii) river speed, a 'poo-stick' method used, in which the time it took a stick to travel 10 m in the water was recorded using a stop clock in the central river channel and 1 m from the north and south banks (=average taken of the three).

One-way analysis of variance was suitable for determining which habitat variables influenced kingfisher habitat preference.

Results

The most frequently observed kingfisher species during this survey were Pied and Malachite kingfishers, with Giant kingfisher being the least observed species (Table 1).

Giant kingfisher was observed significantly more often in wider river stretches and the Malachite kingfisher showed a significant preference for narrower river stretches ($F_{2.40} = 3.91$, $P < 0.01$; Fig. 2a). The Giant and Pied kingfishers utilized higher perches (>3 m) and the Half-collared and Malachite kingfishers preferred lower (<1 m) perch heights ($F_{2.40} = 89.83$, $P < 0.01$) (Fig. 2b).

Malachite and Half-collared kingfishers were found in significantly higher numbers in areas of the river with a high proportion of branches (<3 m within 20 m of observed individuals), compared with the Pied and Giant kingfishers ($F_{2.40} = 2.96$, $P < 0.05$) (Fig. 2c). Giant and Pied kingfishers favoured a greater depth of water than the Half-collared and Malachite kingfishers ($F_{2.40} = 4.55$, $P < 0.01$) (Fig. 2d).

The proportion of branches (>3 m) and river speed did not influence kingfisher habitat preference ($P > 0.05$).

Table 1 The number of individuals of each of the surveyed kingfisher species, the percentage of individuals from each species across all species and the average number of individuals of each species observed per day

Kingfisher species	Number observed	% of all individuals observed	Average number of individuals observed per day (four survey hours)
Malachite	58	32.9	0.828
Pied	67	38.1	0.957
Half-collared	32	18.2	0.457
Giant	19	10.8	0.271
Total	176	100	2.513

The values presented here should not be taken as precise species richness values because the same individual may have been recorded more than once. These values must therefore only be used as frequency estimates.

Discussion

Different habitat preferences between kingfisher species based on their foraging strategies have been documented previously (Fry, Keith & Urban, 1988; Monadjem, 1996). Monadjem *et al.* (1994) found Giant and Pied kingfishers to favour perch-sites 2–4 m high, whilst Half-collared kingfishers favoured perches <2 m in height. Our study supports this earlier research and has found that Malachite kingfishers also prefer lower perch-sites <1 m high.

Half-collared and Malachite kingfishers preferred shallower sections of the river. This may be because Half-collared and Malachite kingfishers perch at lower heights from the water, and therefore the water depth required for full submersion (thus improving the chance of catching prey) is shallower than it would be if they were plunging from a greater height; where as the Giant kingfisher may forage in deeper waters to reduce the chance of injury that could be caused if this large bird plunged into shallow waters.

Although Pied kingfishers have alternative hovering foraging strategies (Douthwaite, 1976), this active searcher strategy was only recorded on two occasions during this survey (C. Bonnington, unpublished observations). The width and depth of this watercourse probably discourage this hovering foraging behaviour. Therefore, we can assume that foraging from a stationary perch is the favoured strategy for the kingfishers in our study.

The destruction of vegetation near the river's edge may cause reduction in suitable perches for Giant and Pied kingfishers (removal of taller flora) and Half-collared and Malachite kingfishers (removal of smaller flora). In addition, species such as the Half-collared kingfisher are particularly sensitive to human disturbance and prefer well-wooded streams (Fry, Fry & Harris, 1992). Therefore,

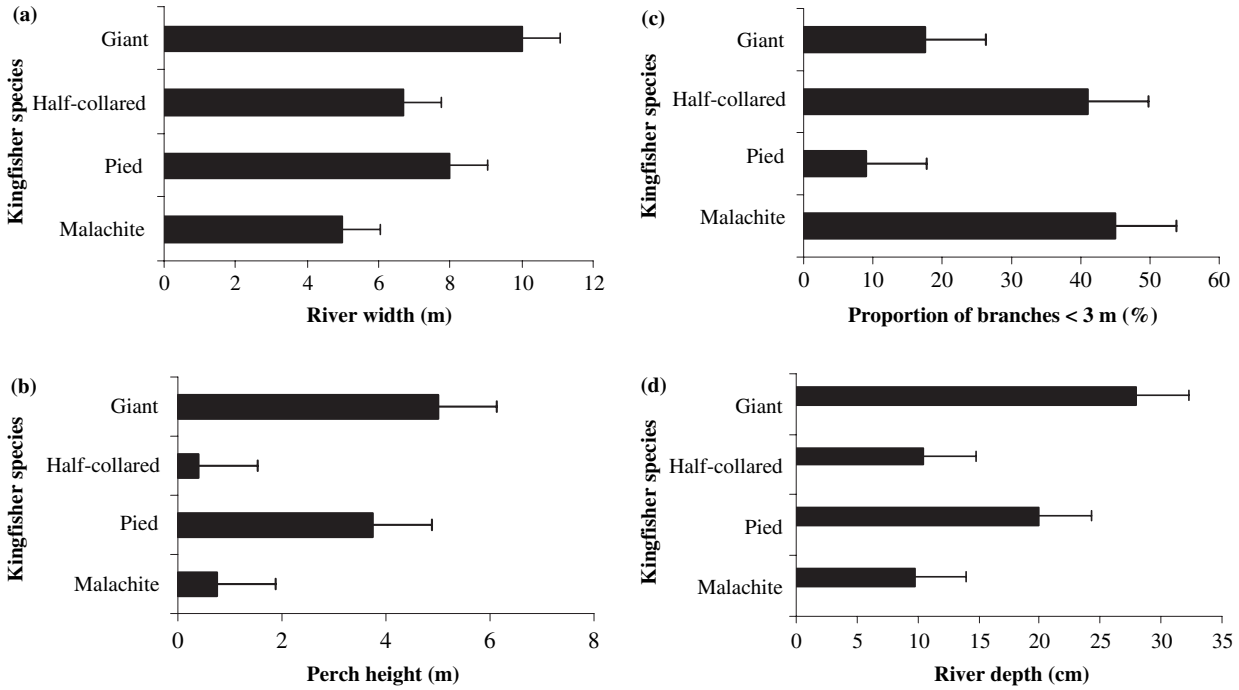

Fig 2 Habitat variables that influenced habitat preference in the surveyed kingfisher species. (a) Average river width in the preferred habitat for each kingfisher species. (b) Average perch height for each observed kingfisher species. (c) Average proportion of branches <3 m (%) in the preferred habitat for each kingfisher species. (d) Average river depth in the preferred habitat for each kingfisher species.

any human activity that opens up the river habitat, would negatively impact this species.

This study has reported habitat niche segregation between (i) Giant and Pied kingfishers and (ii) Half-collared and Malachite kingfishers, with Giant and Pied kingfishers favouring foraging areas with higher perch-sites and deeper and wider river stretches, and Half-collared and Malachite kingfishers preferring lower perch-sites near shallower, narrower river stretches.

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