Camelthorn and blackthorn trees provide important resources for Southern Pied Babblers *Turdoides bicolor* in the Kalahari

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Supplementary Materials

Nest site characteristics

Methods

Southern Pied Babblers nest characterisations (n = 58, initiated by 20 different Southern Pied Babbler groups) were conducted immediately following the end of a breeding attempt due to fledge or failure. Nest characterisations were conducted between October 2016 and March 2017, on clear afternoons, between 14h00 and 16h00, within a maximum of five days of the end of the breeding attempt (Griffith et al. 2016). Data were captured using Cybertracker v3.448 (www.cybertracker.org) installed on a Mobicel TRENDY Android smartphone. For the purpose of the study, the focus was on recording the tree species in which the nest was located.

Additional characteristics that were measured, including nest orientation, height above the ground, distance of the nest from the canopy edge and from the centre of the tree and canopy cover above the nest, are discussed in more detail in the Supplementary Materials. Nest orientation was recorded in degrees from magnetic north (0 – 359◦), using the Android app: Compass 360 Pro, height of the nest above the ground in m, using the Android app: Measure Height v1.4, Deskis OU, and distance of the nest from the canopy edge and from the centre of the tree in cm, using a 50-m tape measure. We used a digital plant canopy imager (LP-80 AccuPAR ceptometer, Decagon Devices, Pulman, WA, USA) placed into the nest cup to record a transmission coefficient directly above each nest (n = 52 as six nests were inaccessible). Transmission coefficient refers to the fraction of sky visible through the canopy and is a measure of sun exposure in the nest.

While recording the availability of nesting and foraging sites via the vegetation survey described in the main methods, we also recorded branch heights available for each tree recorded. The structured vegetation survey was undertaken over 10 consecutive days using a 30 x 30 m grid. At each grid point (*n* = 1,229; mean = 122 ± 46 points per territory, range = 42 to 196), we recorded the presence or absence of plants and the name of the plant species where present. When the point intersected with a large shrub or tree, we used a pole marked at 1 m intervals to record each branch within a 50 cm radius horizontally from the base to the top of the tree.

Statistical analysis

Statistical analyses were conducted in R version 4.0.2 (R Core Team, 2020). Unless otherwise indicated, summary statistics are presented as mean ± one standard deviation and statistical significance taken as *p* < 0.05. We used Ivlev's electivity index (Ei; Ivlev 1964, Strauss 1979, Cunningham *et al.* 2015) to estimate degree of preference or avoidance of different branch

heights by nesting Pied Babblers. The index evaluates choice relative to availability in the environment in the following manner:

$$E_i = (r_i - P_i) / (r_i + P_i)$$

where r_i = proportion of time a particular branch height was used for nesting and P_i = proportion of available branches of each height in the nesting Pied Babbler group's territory. E_i values range from −1 to 1, with positive values indicating preference and negative values indicating avoidance.

We took the mean of individual E_i values for each branch height category per territory and used non-parametric one-sample Wilcoxon rank-sum tests to assess whether these means were significantly different from zero, indicating significant preference for or avoidance of the corresponding branch height.

We calculated the mean nest orientation, expressed in degrees from 0° to 359°, and the value 'r' which indicates the dispersion around the mean orientation, following Inouye et al. (1981), Fisher (1993) and Burton (2006) using the R package '*circular*': r = 1 indicates that all nests were oriented in the same direction, while r = 0 indicates a uniform distribution (no clear tendency to orient in a particular direction). We used Rayleigh's z-test for unimodal patterns (Burton, 2006; Souza & Santos, 2007) and Rao's spacing test for multimodal patterns (Bergin, 1991; Goodenough et al., 2008) to determine whether the orientations of nests differed significantly from uniform distributions. We then used G-Tests of independence on categorical nest orientations [North-East, 0–89.9°; South-East, 90–179.9°; South-West, 180–269.9°; North-West, 270–359.9° following Griffith *et al.* (2016)] to determine whether Pied Babblers avoided particular orientations.

Results

Pied Babblers avoided very high (≥ 7 m) and very low branches (≤ 2 m) for building their nests, and 71.7 % of nests were built on branches at intermediate heights (3 – 6 m above the ground; Table S1, Fig. S1): this usage was proportionate to their availability in the environment, indicating no preference (Table S1, Fig. S1). Nests were located on average 196 ± 197 cm from the tree's main trunk (Fig. S2a), with 81 % of nests located within 300 cm of the main trunk. Nests were also located on average 192 ± 74 cm (Fig. S2b) from the nearest canopy edge. No nests were built at the canopy edge and very few (~9 %) were built within 100 cm of the canopy edge.
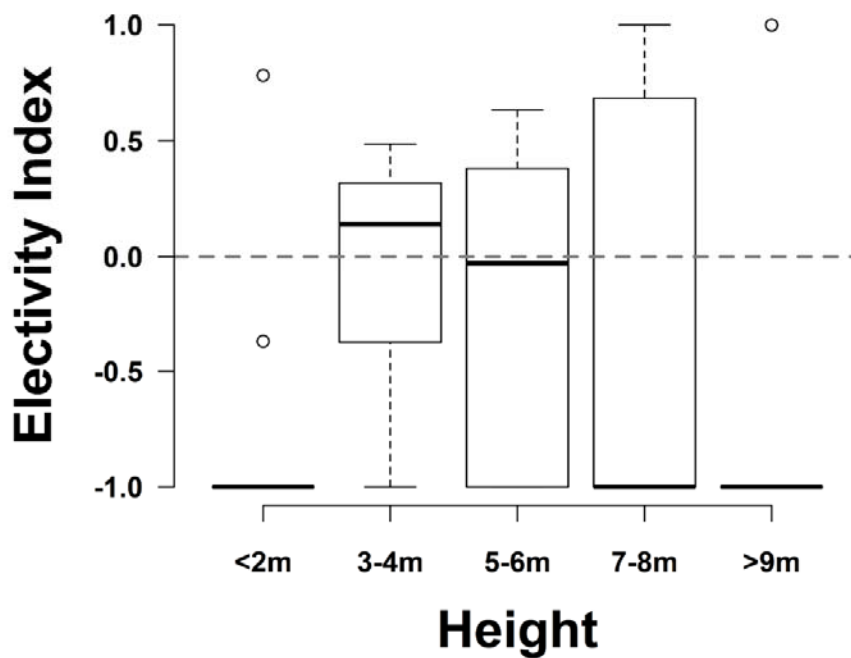

Figure S1: Southern Pied Babblers Turdoides bicolor *used intermediate height branches, avoiding particularly low or particularly high branches.*

Table S1: *Mean Ivlev's electivity index value for selectivity (preference or avoidance) of the different Kalahari branch heights used for nesting by Southern Pied Babblers* Turdoides bicolor. *Positive values indicate tree species that were preferred for nesting in, negative values indicate branch heights that were avoided; * p < 0.05, ** p < 0.01, *** p < 0.001, ns = not significantly different from 0, i.e. neither preferred nor avoided and rather utilised in keeping with their availability in the environment. Significantly preferred sites are shown in bold. Data were collected for 58 nests during one breeding season (September 2016 to March 2017).*

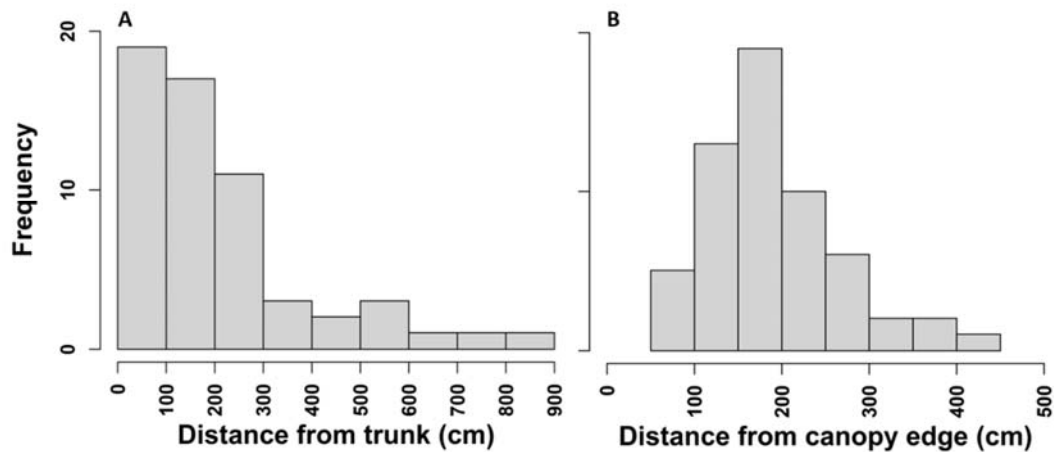| Branch height	Ivlev's electivity index
< 2 m	-0.87 ± 0.44***
3 – 4 m	-0.09 ± 0.54^{ns}
5 – 6 m	-0.25 ± 0.66^{ns}
7 – 8 m	-0.27 ± 0.86*
> 9 m	- 0.67 ± 0.77***

Figure S2: *Southern Pied Babblers* Turdoides bicolor *typically built their nests (a) within ~300 cm of the main tree trunk and (b) away from the canopy edge.*

Pied Babblers built their nests in exposed locations with high transmission coefficients (mean = 0.67 ± 0.17; range: 0.31 to 0.78, Fig. S3a). The two most shaded nests, with transmission coefficients < 0.4, were constructed within disused closed nests of other species, both of which failed due to predation. More nests were south-facing (91 - 270 °, n = 29) than north-facing (271 – 90°, n = 18). The circular mean nest orientation was 146.5 ± 90.7°, a southerly direction. Pied Babblers avoided orienting their nests in a west-northwesterly direction (300-360°, n = 4 nests; G-test for small sample sizes, G = 11.2,

$p = 0.01$, Fig. S3b). None of the four west-northwest facing nests fledged compared to 30% of south-facing nests that fledged (Fig. S3b). We found considerable spread in nest orientations (Fig. S3b) and no evidence of a preferred orientation ($r = 0.502$; Rayleigh test: $Z = 0.214$, $p = 0.112$; Rao's spacing test: $U = 144$, $p = 0.100$). Although not statistically significant, most nests were oriented south-west, consistent with a study by Ferguson & Siegfried (1989) which found that White-browed Sparrow-weavers, another Kalahari passerine, preferred a south-west nest orientation.
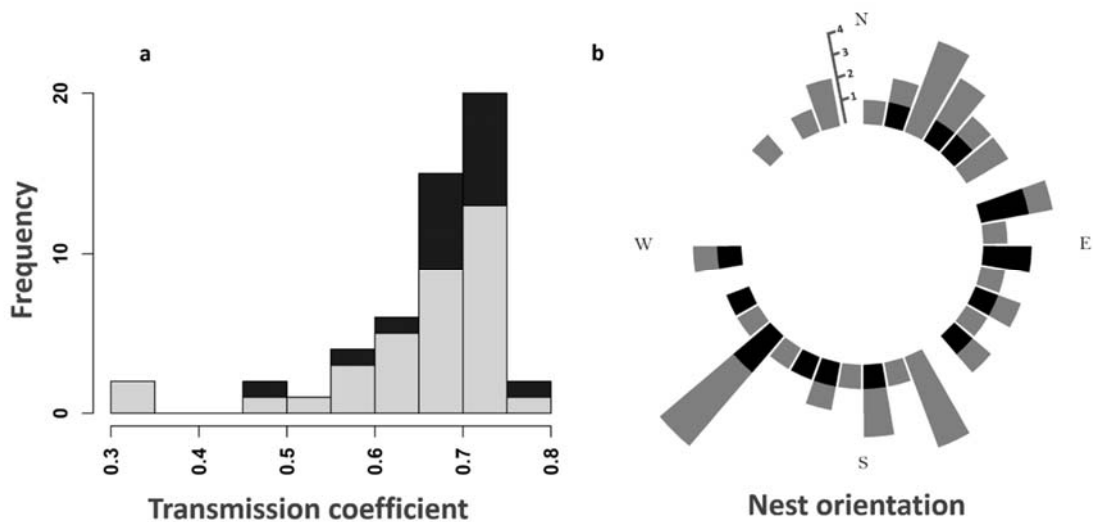

Figure S3: Southern Pied Babblers Turdoides bicolor *nested in exposed locations with high transmission coefficients (a) and avoided building nests with north-westerly orientations (b). Fledged nests are shown in black and failed nests in grey.*

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