

Fig. S1. A) Tracings of adult male primary feathers P5 through P10 (outer) of Rufous-sided Broadbill (*Smithornis rufolateralis*) and African Broadbill (*S. capensis*). Rufous-sided Broadbill P8 was lost in the airflow. **B)** left wing of adult male African Broadbill (specimen YPM 143025).

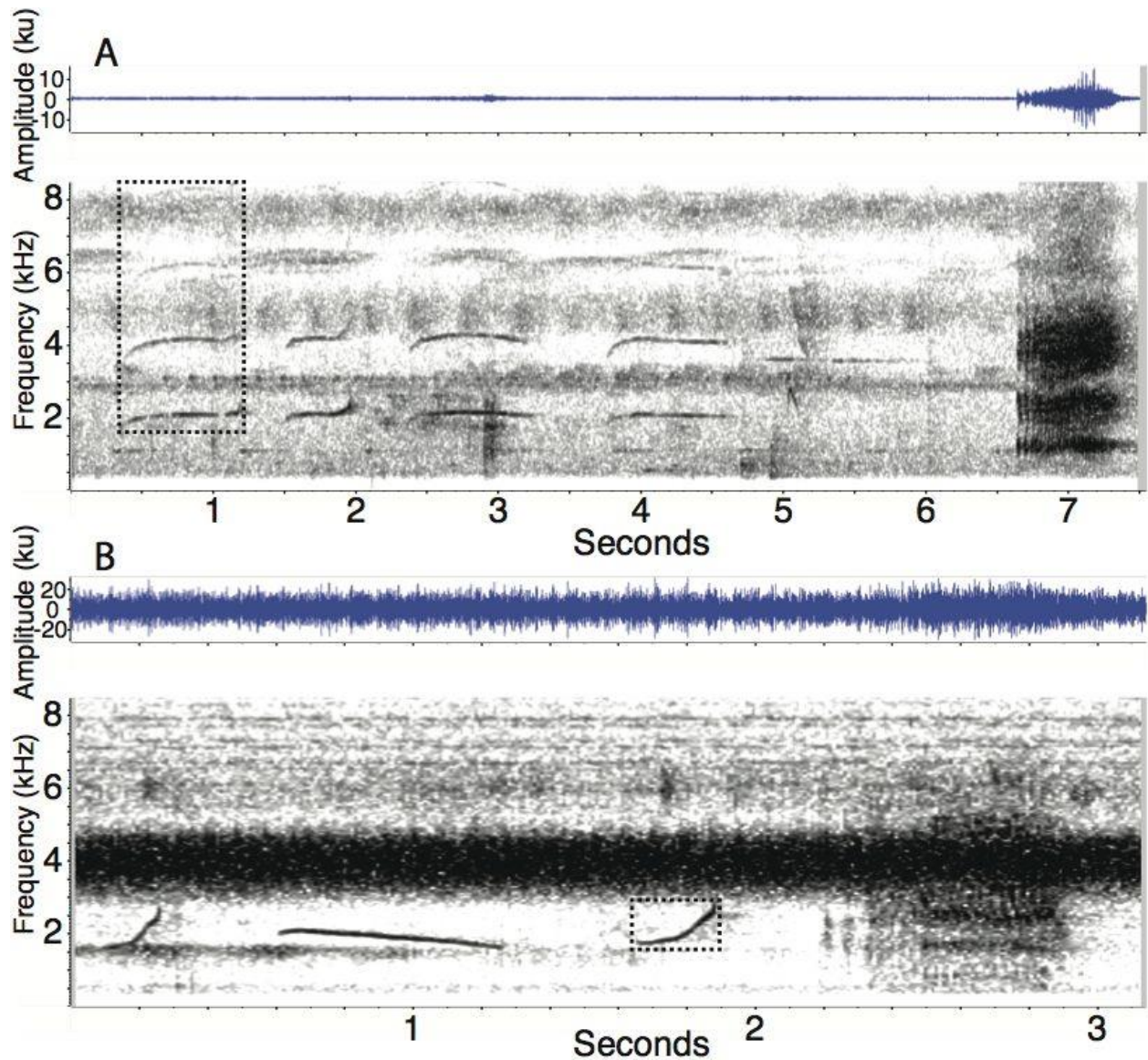


Fig. S2. A) Vocalizations and a display of a Rufous-sided Broadbill at Kakum NP, in Ghana and of B) an African Broadbill at Amani, East Usambara Mts. Tanzania, after P6 and P7 were clipped. Vocalizations are tonal frequency sweeps, as shown in dashed areas (in A with harmonics), that are much lower in amplitude than the display, particularly evident in waveform A), where background noise levels are considerably lower. Hann FFT, 50% overlap, 1024-sample window, high pass filter > 400 Hz (48 kHz sampling frequency).

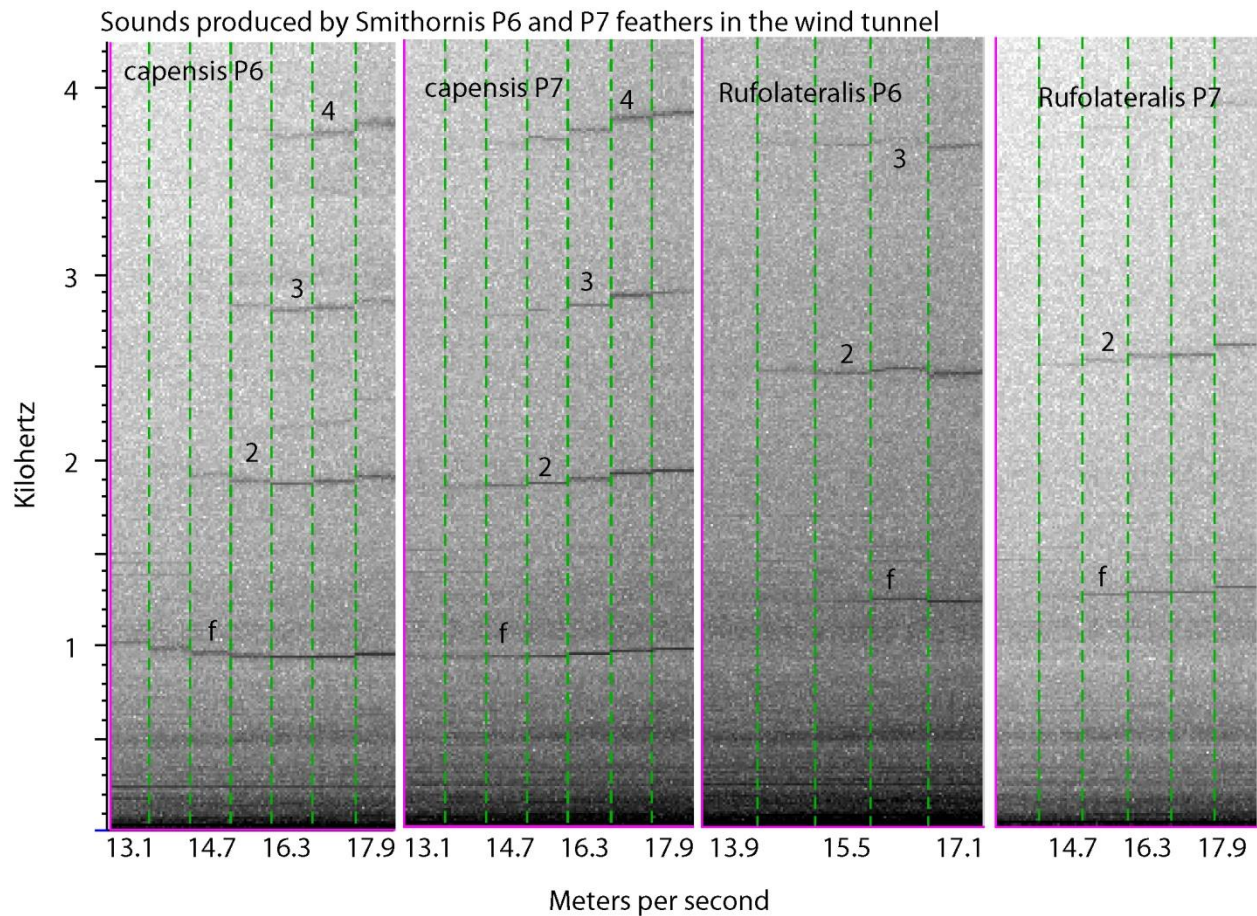


Fig. S3. Sounds produced by Smithornis feathers P6 and P7 in a wind tunnel. Fundamental frequency (f), 2nd-4th harmonics labeled. Measurements were taken at wind tunnel speed intervals of 0.8 m s^{-1} , each interval separated by a green dashed line. The wind tunnel produced a substantial amount of background sound under time-invariant conditions, thus these spectrograms are Hann with a window size of 20,000 to emphasize the frequency domain. For further details about the wind tunnel, see Clark et al. (2013a).

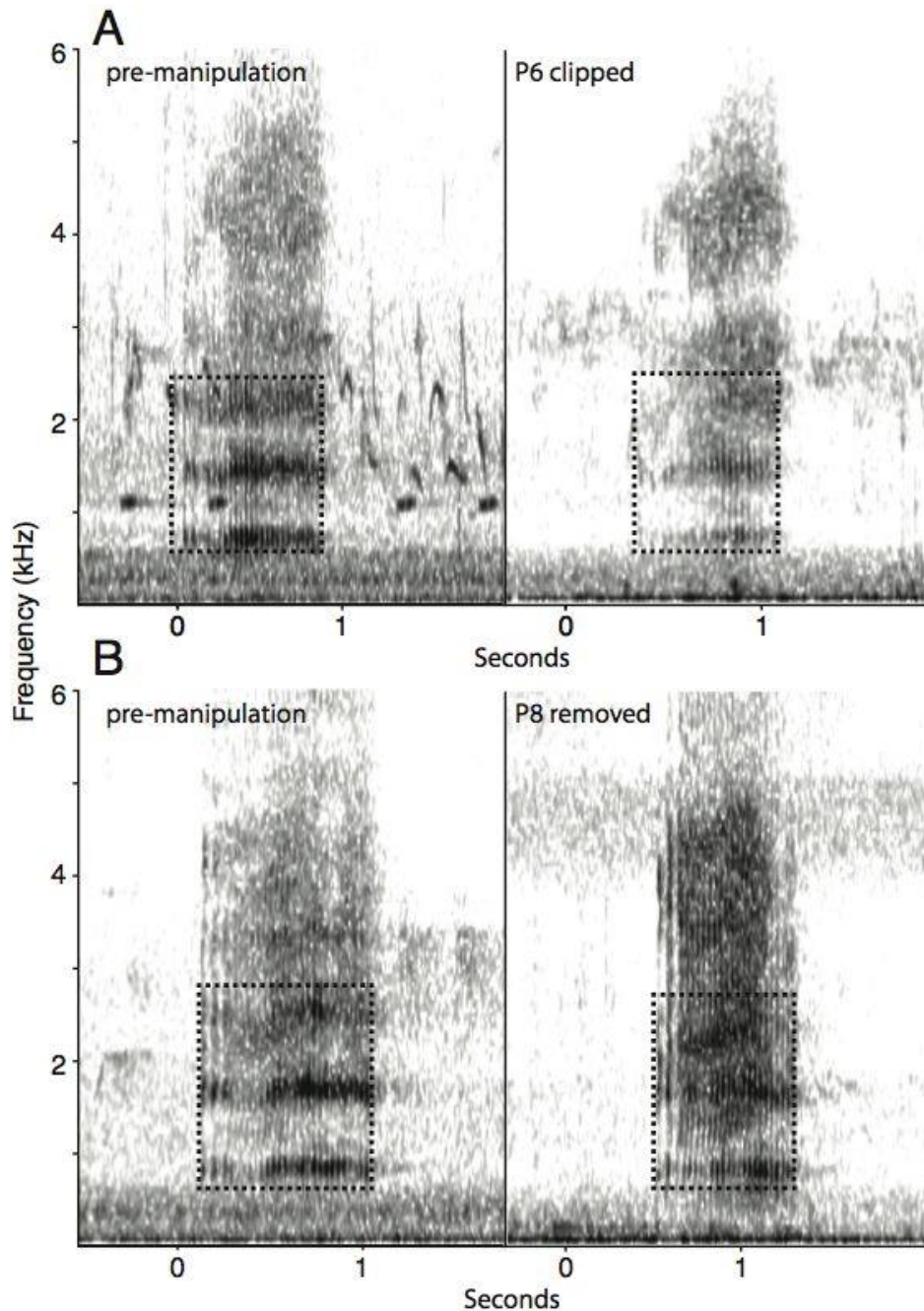


Fig. S4. Spectrograms depicting the effects of experimental removal from both wings of A) of 2cm from the tip of P6 on wing song of an African Broadbill at Amani, Tanzania, and B) of the entire P8 feather on wing song of an African Broadbill at Zaraninge Forest, Tanzania. Tonality decreases in both cases after experimental manipulation, as measured by entropy within the frequency bandwidth of the first three harmonics (dashed area). Hann FFT, 50% overlap, 1024-sample window (48 kHz sampling frequency).

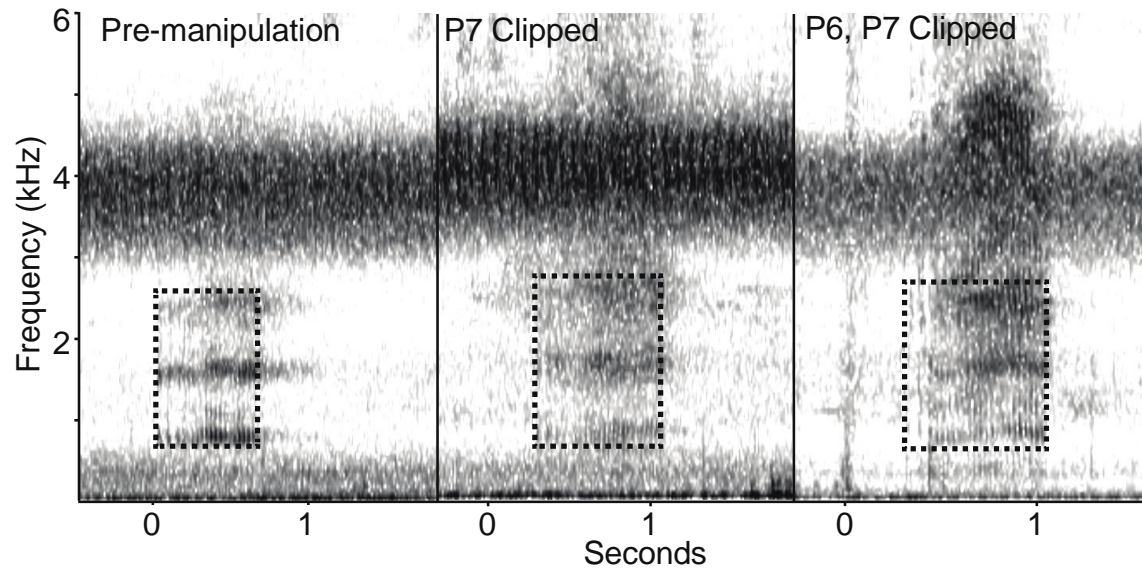
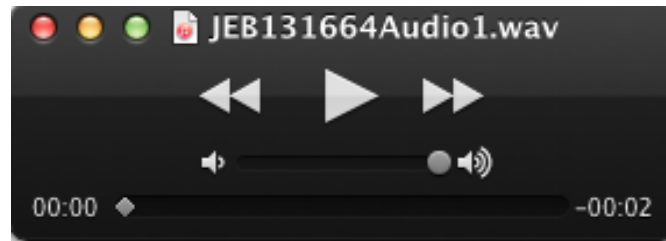


Fig. S5. Spectrograms depicting the effects of experimental removal of P7, followed by removal of both P6 and P7, on wing song of an African Broadbill at Amani, Tanzania. Tonality decreases after experimental manipulation, as measured by entropy within the frequency bandwidth of the first three harmonics (dashed area). Sound recordings from before and after manipulation are provided in the SOM. Hann FFT, 50% overlap, 1024-sample window (48 kHz sampling frequency).

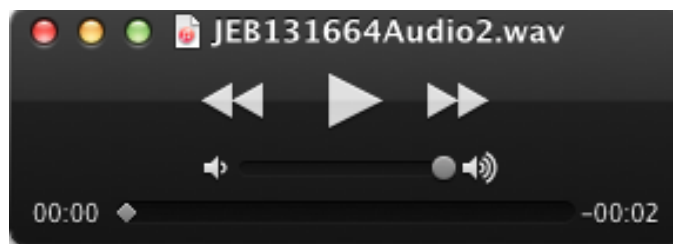
Table S1. Flutter of individual primary feathers (P5 – P10) tested in the wind tunnel. U* is the lowest airspeed at which the feather fluttered and produced sound.

| Feather | African Broadbill | | | | Rufous-sided Broadbill | | | |
|------------|----------------------------|--------------------------|--------------------------------|----------------------------|----------------------------|--------------------------|--------------------------------|----------------------------|
| | U* (m s ⁻¹) | Frequency at U* (kHz) | Flutter easily elicited? | Song frequency (kHz) | U* (m s ⁻¹) | Frequency at U* (kHz) | Flutter easily elicited? | Song frequency (kHz) |
| P10 | 19.6 | 1.5 | No | | 18.0 | 1.8 | No | |
| P9 | 18.0 | 1.2 | No | | 14.8 | 0.89 | No | |
| P8 | 14.0 | 1.2 | No | 0.8 | n/a ¹ | n/a ¹ | No | 1.1 |
| P7 | 12.4 | 0.91 | Yes | | 14.8 | 1.2 | Yes | |
| P6 | 13.2 | 1.0 | Yes | | 14.8 | 1.2 | Yes | |
| P5 | 13.2 | 0.88 | Yes | | 18 | 1.3 | No | |

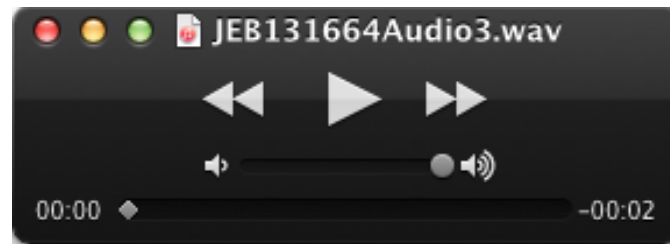
¹ feather lost in wind tunnel



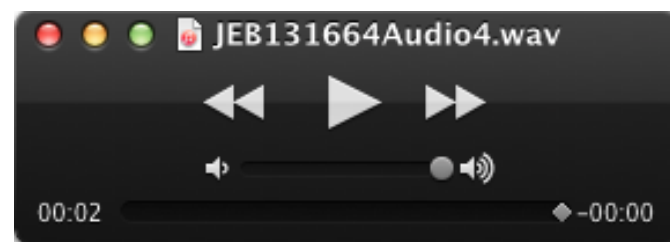
Audio 1. Audio 1–7 are of male *Smithornis capensis* wing song, recorded by Alex Kirschel, at the localities and dates given in the methods. Recording before 1 cm was clipped from the end of wing feather P6; compare with Audio 2.



Audio 2. Recording after 1 cm was clipped from the end of wing feather P6; compare with Audio 1.



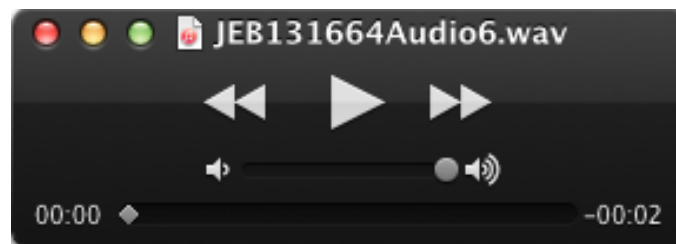
Audio 3. Recording before manipulation; compare with Audio 4 and Audio 5.



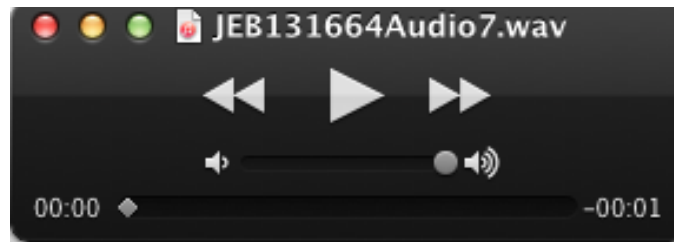
Audio 4. Recording after 1 cm was clipped from the end of wing feather P7, and before a second manipulation; compare with Audio 3 and Audio 5.



Audio 5. Recording after 1 cm was clipped from the end of P7, and also P6. Compare with Audio 3 and Audio 4.



Audio 6. Recording before P8 was removed. Compare with Audio 7.



Audio 7. Recording after P8 was removed. Compare with Audio 6.



Movie 1. Rufous-sided broadbill display. Display flight of rufous-sided broadbill.



Movie 2. Rufous-sided broadbill display in high-speed video. High-speed video of rufous-sided broadbill display, filmed at 1265 fps.



Movie 3. African broadbill wing fluttering in a wind tunnel. Ultra high-speed video (23,121 fps) of a wing of African broadbill in a wind tunnel, recorded at an oblique angle. Air is flowing over the wing towards the viewer. Feathers P10 P9 and P8 have bent upwards in the flow, while P7 and P6 are visibly fluttering and producing sound.