Vocalisation of Mountain Imperial Pigeon *Ducula badia* and its taxonomic implications

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The Mountain Imperial Pigeon *Ducula badia* is a forest pigeon that occupies a wide range in the Oriental Region—from the Western Ghats in the west to south-eastern China and Borneo in the east (del Hoyo et al. 2020). It comprises four subspecies: the nominate occurs in southern Tenasserim, through Borneo and western Java; *griseicapilla* occurs from Nagaland up to south-eastern China, Laos, Vietnam, and Cambodia; *insignis* occurs from central Nepal to Meghalaya and Arunachal Pradesh; and the disjunct *cuprea* occurs in the Western Ghats roughly southwards of Goa (del Hoyo et al. 2020). HBW/BirdLife International (BirdLife International 2014) split *cuprea* from the other three on the basis of morphological and plumage differences; a stand not accepted yet by any other taxonomy (Dickinson & Remsen 2013; Clements et al. 2019; Gill et al. 2021). However, del Hoyo et al. (2020) and Rasmussen & Anderton (2012) stated that the vocalisation of *cuprea* is poorly documented and it is unclear whether there are any unambiguous differences from the rest of the *badia* group.

Avian taxonomy is moving strongly towards the concept of integrative taxonomy, where multiple lines of evidence including genetic, acoustic, morphological, and plumage are used to delineate species (Cicero et al. 2021). While there was a lack of acoustic data a decade ago, databases of Xeno-Canto and the Macaulay Library now have a fairly comprehensive representation of vocalisations for all subspecies. We used these data sources to analyze the vocalisation of this species complex.

**Methods**

We downloaded all sound recordings of the Mountain Imperial Pigeon from www.xeno-canto.org and www.macaulaylibrary.org. The most common vocalisation is the low-pitched, three-noted *uk-ook ook*, each note being upwardly inflected towards the end, subsequently referred to as the call (Fig. 1). Aurally, we categorised the recordings by quality: High, Medium, or Low. To avoid any particular individual influencing the analysis, we selected one call within each recording that we classified as High or Medium in quality. Thus we had 13 *cuprea*, 6 *insignis*, 16 *griseicapilla*, and 8 *badia* samples—all assigned geographically, and hence sampling a good spread of recordings from all geographies within their ranges. We analysed the call in RavenLite with a spectrogram window size of 2048 (as frequency variations were slight and we needed higher fidelity) with brightness and contrast set appropriately to obtain the sharpest sonograms. Since we used a higher contrast for the measurements, the faint onset of every note may have been missed in a few medium quality recordings, but these have hardly influenced the relative values of the measurements. A single observer (NC) manually measured the maximum/minimum frequencies and start/end time of each of the three notes. From these values, we calculated values for eight measures: Maximum and minimum frequency of the entire call, total call duration, duration of each note (three values), and interval duration between the three notes (2 interval values) (Table 1). We applied Principal Component Analysis (PCA) to identify the clusters using an R Script (prcomp function in stats package) and verified the results by listening to the recordings.

**Results & Discussion**

We found that a majority of *cuprea* vocalisations could be unambiguously assigned by checking the length of the interval between the second and third note (Interval2; Fig. 1), with this interval falling in a range of 0.45–0.81s, while the rest of the subspecies ranged from 0.24 to 0.59s. The total duration of *cuprea* calls fell in the range 1.52–1.86s while the range for the other three subspecies was 1.13–1.53s. Hence, the call of *cuprea* is audibly less hurried than that of the other three subspecies (Fig. 2; Table 1). The PCA plot (Fig. 3) clearly shows *cuprea* calls clustering differently than those of the other three taxa—with the first principal component explaining 33% of the total variation (loading on total duration), and second principal component explaining 24% (loading on Interval2). As the first two components of PCA only explain 57% of the variation, we investigated PC3 (15% loading on Note1 duration) and PC4 (12% loading on Interval2 again), but they did not provide any different clustering for *cuprea*.  

![Fig. 1. Typical Mountain Imperial Pigeon three-noted uk-ook ook call (ML154167051), and interval 2 measure (duration of the interval between second and third note). Recordist: Sharad Apte](image-url)
Fig. 2. From top to bottom: *badia* (ML36353), *griseicapilla* (ML183047), *insignis* (ML241888971), and *cuprea* (ML154167051). Recordists: Arnoud van den Berg, Roger McNeill, Sharad Apte (2) respectively.

Fig. 3. PCA showing *cuprea* clustering differently from other races.

Fig. 4A,B. Box plot for total duration (A), and the second interval duration (B).

The key morphological differences of *cuprea* are dark (vs pale) iris and narrower tail band. Apart from this, *cuprea* also has a slightly shorter wing and longer bill length, on an average, than the nearest subspecies *insignis*. The morphological differences are significant and consistent, positively supporting a split of *cuprea* from the *badia* group of subspecies (del Hoyo et al. 2019). The vocal analysis shows that there is a modest,
but consistent, difference between the call of *cuprea* and the other races, which are much more similar to one another. This may have taxonomic implications. The calls of pigeons are considered innate, and vocal differences have been used as a strong argument to elevate taxa in this family to species level (Ng et al. 2016). Species rank was given to the congeneric Nicobar Imperial Pigeon *D. nicobarica* based on similar evidences (Collar et al. 2020). A phylogenetic study would provide further insight in the taxonomic status of *cuprea*, but these morphological and vocal differences would point towards a likely genetic divergence of this allopatric taxon. While awaiting such results, we believe that *cuprea* can be accorded a species status.

We recommend the English name ‘Malabar Imperial Pigeon’ for *cuprea*, as against ‘Nilgiri Imperial Pigeon’ used by BirdLife International, as the taxon is decidedly rare in the upper Nilgiri Plateau (Zarri & Rahmani 2005; Zari et al. 2009) compared to other wetter forests in the Western Ghats.

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References


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