TAXONOMIC REVIEW

The taxonomy of the Blood-breasted Flowerpecker *Dicaeum sanguinolentum* complex

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Following the publication of Eaton *et al*. (2016) and subsequently del Hoyo & Collar (2016), significant changes in the taxonomy of a number of Indonesian passerines have taken place, with several species complexes separated into individual species-level lineages on the basis of new biological information. Because several of the changes first appeared in the above-mentioned field guide and checklist, the rationale for some of them was not laid out in great detail. The objective of this contribution is to present the case for raising the four taxa/forms which previously made up the Blood-breasted Flowerpecker *Dicaeum sanguinolentum* complex to full species-level status, as advocated by Eaton *et al.* (2016).

The Blood-breasted Flowerpecker complex has traditionally been divided into four subspecies: the nominate form *sanguinolentum* from Java and Bali; the form *rhodopygiale* from Flores; the form *wilhelminae* from Sumba; and *hanieli* from Timor. While this traditional treatment is upheld by many updated sources (e.g. Clements *et al*. 2018, Gill & Donsker 2019), Eaton *et al*. (2016) proposed to elevate all four members to species level based on 'strong differences in vocalisations and plumage'. Subsequently, del Hoyo & Collar (2016) followed this arrangement only partway, recognising Sumba Flowerpecker *D. wilhelminae* and Timor Flowerpecker *D. hanieli* as separate species while maintaining the Flores form *rhodopygiale* within the original Blood-breasted Flowerpecker *D. sanguinolentum*.

In the absence of genetic data, we here revisit each of the four taxa in light of morphological, vocal and ecological information to inform a taxonomic decision on the classification of the Blood-breasted Flowerpecker complex.

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Plate 1. Timor Flowerpecker *Dicaeum hanieli*, Timor, Indonesia, 15 September 2015.

Timor Flowerpecker *Dicaeum hanieli*

Morphology: arguably the most distinctive member of the species complex in terms of plumage, with the blood-like colouration on the breast of the male which led to the name of the group reduced to a tiny spot, accompanied by a reduction in the dimensions of the black central breast stripe underneath the 'bleeding heart' (Plate 1). At the same time, the background colouration of the underparts is a much paler, less warm-coloured tinge than in *D. rhodopygiale* and *D. sanguinolentum*. Based on a small sample size of two male specimens, del Hoyo & Collar (2016) additionally report on longer wings, tail and bill in *D. hanieli* as compared with the other members of the complex.

Vocalisations: our own recordings are of a typical trisyllabic territorial call of a high-pitched, metallic, piercing quality, with one lower-pitched note dividing the higher-pitched initial and terminal notes (Figure 1a).

Ecology: the Timor Flowerpecker is typical of the species complex in its preference for montane forest.

Sumba Flowerpecker *Dicaeum wilhelminae*

Morphology: if Timor Flowerpecker has the most distinctive morphology of the erstwhile Blood-

breasted Flowerpeckers, its cousin from Sumba *D. wilhelminae* is not far behind. However, the male *D. wilhelminae* sports an outsized red breast area, covering the entire lower and upper breast and reaching onto the throat, which—in all the other taxa—is not red (Plate 2). Below this red breast-patch is a vertical black stripe that is perhaps a bit thicker than in all the other taxa, against the background of a cold greyish-white belly and flanks. Therefore, Sumba Flowerpecker is unique within the complex in having a cold-tinged rather than buffy warm-tinged background colour to the underparts. Del Hoyo & Collar (2016) additionally attribute a shorter, deeper bill to this taxon in comparison with the others.

Vocalisations: more vocal material is available for this taxon than for its Timor cousin, including examples of the dawn call series and the territorial call. The dawn call series is characterised by a quick, rising, intensifying succession of 4–7 short metallic notes, whereas the territorial call is trisyllabic, the centre note lower-pitched than the other two, reminiscent of Timor Flowerpecker but more than twice as fast in delivery (Figure 1b).

Ecology: the Sumba Flowerpecker is strikingly different from all other members of the complex in its occurrence at all altitudes on Sumba, common even at sea level. Its use of lower elevations on this arid island is probably coupled with a tolerance for drier conditions. A possible reason for this change in ecological tolerance is the fact that Sumba Flowerpecker is the only *Dicaeum* flowerpecker within its range, allowing it to expand to unoccupied niches at lower altitudes. The other members of the complex are invariably replaced by other *Dicaeum* species in lower, drier parts of their islands.

Flores Flowerpecker *Dicaeum rhodopygiale*

Morphology: this taxon is not as radically different in plumage from the nominate form on Java and Bali as its cousins from Timor and Sumba, which has doubtless led to the reluctance of del Hoyo & Collar (2016) to elevate it to species level. However, close inspection does reveal significant male plumage differences. In contrast to the nominate *sanguinolentum*, the Flores male lacks the bluish-black vest reaching onto the neck sides and upper flanks from the back. Consequently, in comparison with form *sanguinolentum*, its red breast-patch is wider, its underparts perhaps on average buffier, and its vent with a pinkish colouration that always seems to be absent from the nominate (Plate 3).

Vocalisations: again, unfortunately little vocal material exists for this form. Our own recordings are predominantly a collection of dawn songs, characterised by long series of about 14 notes, monotonously repetitive in their up-and-down sequence. In this respect, the Flores Flowerpecker is quite unlike the Sumba Flowerpecker, which

Plate 2. Sumba Flowerpecker *D. wilhelminae*, Sumba, Indonesia, 12 July 2008.

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Plate 3. Flores Flowerpecker *D. rhodopygiale*, Flores, Indonesia, 5 August 2013.

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Figure 1a. Sonogram of the call of Timor Flowerpecker.

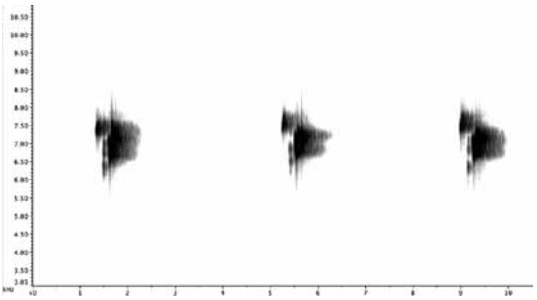


Figure 1b. Sonogram of the call of Sumba Flowerpecker.

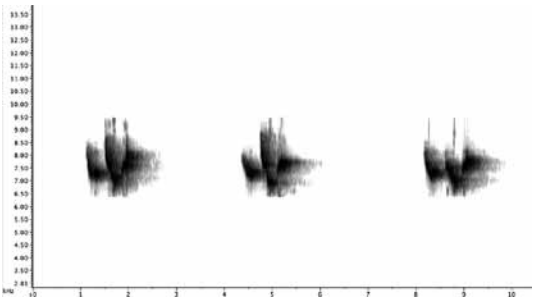


Figure 1c. Sonogram of the call of Flores Flowerpecker.

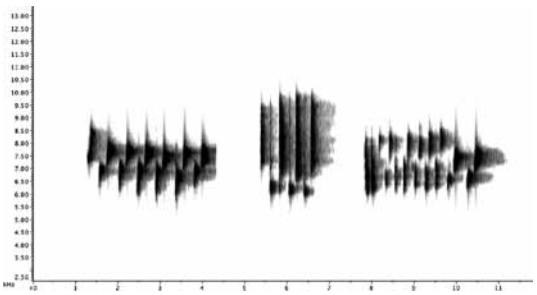
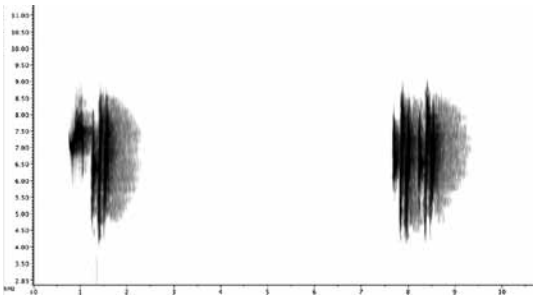


Figure 1d. Sonogram of the call of Javan Flowerpecker.



utters a slightly ascending series that is often much shorter. Our territorial call recordings have most often been of quick and buzzy trisyllabic notes similar in delivery speed to all the taxa except the Sumba Flowerpecker, but uniquely at a level pitch, with the second note not lower-pitched than the other two (Figure 1c).

Ecology: Flores Flowerpecker is a typical member of the complex in requiring more humid higher altitudes, usually above about 800 m. At first sight, it may be puzzling why this species is absent from other large islands with mountains over 1,000 m that have been associated with Flores, such as Alor, Sumbawa and Lombok, during historical periods of lower global sea levels which led to connecting land bridges. Unless future fieldwork on those islands, especially on Sumbawa, uncovers the presence of this species, its absence may be explained by secondary extinction in the face of the pronounced vulcanism in the mountainous parts of the Lesser Sunda chain—Flores Shortwing *Brachypteryx floris* and Flores Scops Owl *Otus alfredi* also show similarly odd distributions.

Javan Flowerpecker *Dicaeum sanguinolentum*

Morphology: the nominate form from Java and Bali (Plate 4) is the baseline against which the other taxa have been assessed. As discussed above, its morphological differences from Timor and Sumba are considerable and, while it is superficially similar to the Flores Flowerpecker, important plumage distinctions stand out.

Vocalisations: the presumed dawn song is a trisyllabic call, which is very similar to that of the Timor Flowerpecker, although it is perhaps marginally lower-pitched and more buzzy in quality (Figure 1d).

Plate 4. Javan Flowerpecker *D. sanguinolentum*, Java, Indonesia, 23 May 2017.

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Ecology: the nominate form is a typical montane forest inhabitant of Java and Bali, replaced at lower altitudes by up to three different *Dicaeum* flowerpecker species.

Taxonomic rationale

In our taxonomic arrangement, we follow the 'yardstick approach' (Mayr & Ashlock 1991). In *Dicaeum* flowerpeckers, this approach allows us to infer species status in taxa comparisons in which differences exceed those of well-known, unequivocal *Dicaeum* species pairs. The following criteria lead us to a four-way division of the Blood-breasted Flowerpecker *D. sanguinolentum* complex:

Timor Flowerpecker *D. hanieli* is larger than the others and is characterised by a unique, unmistakable male plumage. Plumage differences between this form and the other three far exceed those that have been considered as species-level indicators in other traditional flowerpecker classifications, making a continued subspecific arrangement untenable.

Sumba Flowerpecker *D. wilhelminae* is almost equally as distinctive in its male plumage as *D. hanieli*, but additionally utters a much slower version of the trisyllabic territorial call that is almost twice as long in delivery as that of *D. hanieli* and *D. sanguinolentum*. Alone among members of this complex, *D. wilhelminae* tolerates drier, low altitudes, although the taxonomic significance of this trait is questionable as it may simply be a consequence of the absence of lowland competitors on Sumba. However, plumage and vocal characters combined would appear to be sufficient to treat this taxon as a full species.

Flores Flowerpecker *D. rhodopygiale* is the most contentious split within the complex, which was explicitly not followed by the plumage-focused rearrangement of del Hoyo & Collar (2016), presumably because the plumage differences between it and the nominate *sanguinolentum* were perceived as minor. Here we have advocated a species split on the three following bases:

(1) the male plumage of Flores *D. rhodopygiale*, albeit superficially similar to the nominate, has important and consistent variations in specific parts of the body, such as the breast-patch and vent flash, which probably have reproductive and signalling significance to other individuals of the species;

(2) albeit limited, vocal material attests to strong differences in the frequency modulation of the trisyllabic territorial call of *D. rhodopygiale* compared with all the other flowerpeckers in the complex. The Flores Flowerpecker also utters a rising-and-falling dawn song unlike all others in the group, and more akin to the dawn song of the Scarlet-backed Flowerpecker *D. cruentatum*;

(3) if *D. hanieli* and *D. wilhelminae* are split, we fear that retention of Flores Flowerpecker *D. rhodopygiale* with nominate *sanguinolentum* from Java and Bali may lead to an unnatural situation in which two taxa remain united in a species despite not being each other's closest relative. Given the historical connecting land bridge caused by lower global sea levels, a closer relationship among the three Lesser Sundaic taxa (*rhodopygiale, wilhelminae, hanieli*) is conceivable, if not likely, in which case a continued retention of *rhodopygiale* with *sanguinolentum* would create what is known in evolutionary biology as a 'paraphyletic species'.

Javan Flowerpecker *D. sanguinolentum*: with all other taxa removed, the former nominate *sanguinolentum* becomes a monotypic species endemic to Java and Bali. A change in its vernacular name to Javan Flowerpecker is strongly recommended, as continued usage of 'Blood-breasted Flowerpecker' would lead to confusion over which taxonomic treatment is being followed.

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