

Rediscovery of *Libellulosoma minutum* in the littoral forests of southeast Madagascar (Odonata: Corduliidae)

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Abstract. After a period of 109 years without detection, we can here confirm the rediscovery of *Libellulosoma minutum* Martin, 1907, in the southeast of Madagascar. Previously known only from historical collections with vague locality data, five individual males were observed in and around the littoral forest fragments of Sainte Luce between 2016–2017. These observations represent the first reported sightings of this ‘Data Deficient’ (IUCN) species in the wild since René Martin first described it in 1907. Although we cannot be certain Sainte Luce represents the type locality for the species, it must be considered an important area for future monitoring and conservation. A crucial correction is provided regarding the species name.

Further key words. Dragonfly, Anisoptera, Sainte Luce, Data Deficient, conservation, emendation of specific name

Introduction

The genus *Libellulosoma* is represented by a single species, *Libellulosoma minutum*. The species was previously known only from two individual specimens that were collected shortly after the turn of the twentieth century (MARTIN 1907). Both specimens were male and housed within the same collection at the Museum National d’Histoire Naturelle in Paris. Both likely originate from the same expedition to Madagascar, presumably made by René Martin in 1907. The first specimen was described soon after its initial discovery (MARTIN 1907), however the second specimen was not identified within the collection until much later, in 2013. At this point the species received a thorough examination and formal re-description, and evolutionary relationships were discussed (FLECK & LEGRAND 2013). Together these two individuals have provided the only known examples of the species, but unfortunately both were poorly labelled and provided little distributional data, precluding further studies. The first specimen was simply labelled as being collected in »Madagascar«, whereas the second provided the location of »E Madagascar« (presumably East Madagascar). After the initial species description made by MARTIN (1907), FRASER (1956) published an inventory of Odonata in Madagascar and subsequently

PINHEY (1962) provided an updated descriptive catalogue of known African species. However since the two *Libellulosoma* specimens were collected more than 110 years ago, no further information pertaining to the species' natural history, ecology or distribution has been published and the range and type locality of the species has remained a mystery.

Here, we report the rediscovery of *Libellulosoma minutum* in the littoral forests of Sainte Luce, southeastern Madagascar (Fig. 1) and provide the first accurate geo-spatial data for the species. Tentatively we also provide the first evidence for seasonality deduced from the flight window of the imago.

Emendation of the specific name

The species name is corrected from the original spelling *Libellulosoma minuta* [sic] to *Libellulosoma minutum*. Following the Code of the International Commission on Zoological Nomenclature (ICZN) it is a case of correction of incorrect original spelling (Art. 32.4), due to agreement in gender (Art. 31.2). The correction of the original spelling is a justified emendation (Art. 33.2.2.), subject to all regulations according to Art. 32.5.

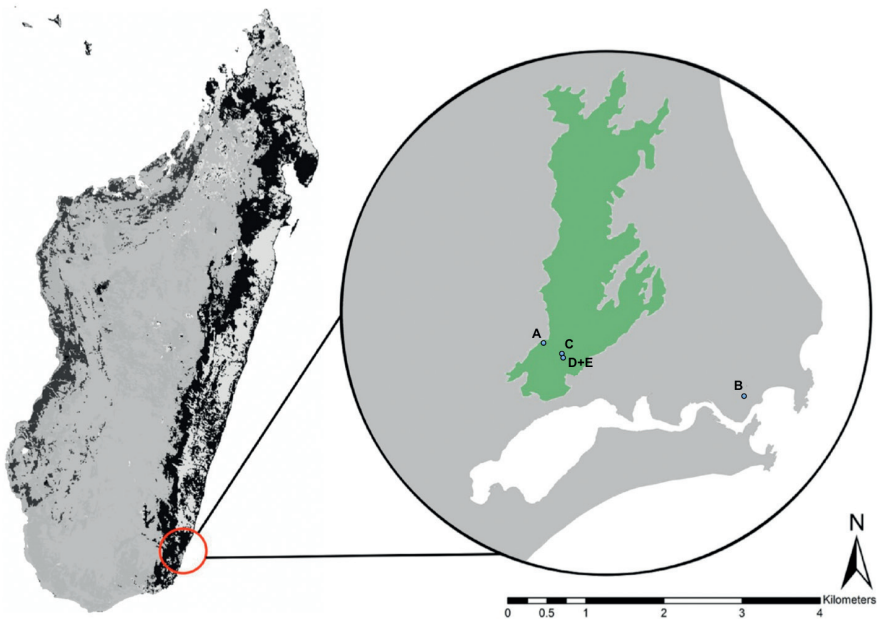


Fig. 1. Map showing the relative position of Sainte Luce in Madagascar and the precise localities of each *Libellulosoma minutum* observation. The forest fragment S9 is represented in green.

However, as Martin gave no etymological explanations and as ‘minuta’ in the sense of ‘the minute’ (time unit) makes definitively no sense here, he surely had the concept of size ‘very small’ in mind. As ‘-soma’ is neuter the correct specific name according to genus agreement should be ‘minutum’ (cf. examples in Art. 30.1.2.).

Study region and methods

All observations were made during a study aimed at expanding upon the known dragonfly species inventory for the Sainte Luce area, first compiled by SCHÜTTE & RAZAFINDRAIBE (2007). All habitat types present in the area (forests, streams, heathland, swamps etc.) were surveyed for Odonata, using 1 hour time constrained searches. The forest fragment S9 (cf. Fig. 1: green shaded area), along with four other remaining patches of littoral forest in Sainte Luce were granted the status of ‘IUCN Category IV Protected Areas’ in 2015. These forests are now managed by the mining company QIT Madagascar Minerals, but are generally considered to be community-protected forests. These protections were granted in light of a proposed mining strategy in Sainte Luce, and are an attempt to offset and protect a few precious intact examples of littoral forest and the rich plant and animal communities they support. The littoral forests of Sainte Luce constitute some of the last few remaining and intact littoral forest habitats in Madagascar and support some of the highest species and floristic diversity on the entire island (RABEVOHITRA et al. 1996; DUMETZ 1999; GANZHORN et al. 2001; BOLLEN & DONATI 2006; TEMPLE et al. 2012). The ‘southern’ littoral forests, once thought to be contiguous with those in northeastern Madagascar, grow along a narrow coastal band of sand and alluvium and exist exclusively between the Vohimena Mountain’s to the west and the Indian ocean to the east (DE GOUVENAIN & SILANDER 2003). Authors KS and KDBD identified all *Libellulosoma minutum* individuals from photographs taken in the field. Photographs of the secondary genitalia and the appendages were taken with a BK Plus Lab System by Dun, Inc.

Results

A total of five male *Libellulosoma minutum* were documented between January 2016 and January 2017. Three of these individuals were subsequently collected, preserved as specimens, and sent for imaging to the Zoological Institute at the University of Hamburg. These observations constitute the first records of this ‘Data Deficient’ (IUCN) species since its initial discovery in 1907, and are the first observations of the species with confirmed geospatial data.

The first specimen (Fig. 1 ‘A’) (cf. Fig. 2), a mature male, was captured on 28-i-2016 in secondary forest, near the forest edge and at the beginning of an established transect (UTM – 719282.82 m E; 7257925.62 m S – Zone 38 J) on the western side of forest fragment S9 (cf. Fig. 4). The individual was photographed and subsequently released. A second adult specimen (cf. Fig. 1. ‘B’) was captured and

photographed on 04-ii-2016, but again not collected. This individual was captured opportunistically (UTM – 721570.88 m E; 7257236.82 m S – Zone 38 J) at the edge of a disused runway (*cf.* Fig. 5) in relatively open ground and some distance away from any notable forest. Then between December 2016 and January 2017 a further three immature specimens were captured and collected as specimens (Fig. 1. ‘C, D+E’). The first of these individuals (*cf.* Fig. 3) was captured on 05-xii-2016 (UTM – 719521.42 m E; 7257811.67 m S – Zone 38 J) along an open canopy path, again inside the forest fragment referred to as S9. The second and third specimens were collected together shortly afterwards on 09-i-2017 (UTM – 719536.86 m E; 7257724.05 m S – Zone 38 J), again in forest S9 and again along a wide forest path. The secondary genitalia and the appendages are shown in Figs 6 & 7.

Discussion

Interestingly the two historic specimens in the collection of René Martin were also male, raising the question as to the outward appearance and habits of female individuals. The larvae similarly remain a mystery. It is possible that a female specimen



Fig. 2. *Libellulosoma minutum* mature male. Sainte Luce Reserve, Anosy Region, Republic of Madagascar (28-i-2016). Photo: Ryan Clark

has merely eluded collection by chance, or it could be that the females of the species occur at lower density and are naturally rarer, as in other well documented species (KOENIG & ALBANO 1978; STOKS 2001; FOSTER & SOLUK 2006). It is also possible that females exhibit hiding habits or may have a different habitat preference to the males, perhaps spending more time in the high canopy.

The majority of *Libellulosoma minutum* observations reported here have been made within a highly localized area of forest named 'S9' (cf. Fig. 1.), with a single observation made some 2 400 m east in an area of cleared ground. Due to the



Fig. 3. *Libellulosoma minutum* immature male. Sainte Luce Reserve, Anosy Region, Republic of Madagascar (05-xii-2016). Photo: LB



Fig. 4. Terrestrial habitat (forest) of *Libellulosoma minutum*. Sainte Luce Reserve (UTM – 719282.82 m E; 7257925.62 m S – Zone 38 J), Anosy Region, Republic of Madagascar (15-ii-2017). Photo: SHR



Fig. 5. Terrestrial habitat (open) of *Libellulosoma minutum*. Sainte Luce Reserve (UTM – 721570.88 m E; 7257236.82 m S – Zone 38 J), Anosy Region, Republic of Madagascar (11-ii-2017). Photo: LB



Fig. 6. Male *Libellulosoma minutum*. Secondary genitalia from lateral (left) and ventral (right) view (scale bar 1 mm). Photos: KS



Fig. 7. Male *Libellulosoma minutum*. Appendages from lateral (left) and dorsal (right) view (scale bar 1 mm). Photos: KS

limited amount of information provided on the early labels of the type specimens, we cannot conclude that Sainte Luce represents the true type locality for the species, and further populations may exist elsewhere along the east coast. In fact KS (unpubl.) reports a possible sighting during an expedition in the area of Ampasy some 22 km north of Sainte Luce in early December 2006 (UTM – 717759 m E; 7279577 m S – Zone 38 J). The specimen was flying during rain but could not be collected. However until further observations are made conclusively elsewhere, and the species wider distributional range is better understood, Sainte Luce must be considered a crucial habitat for this species. As well as all being collected within a very small geographical area, all five individuals were also observed at a similar time of year, within a narrow temporal window, possibly indicating a tendency towards adult seasonality. All individuals were captured during the austral summer, at the onset of the rainy season between the months of December and February.

Conservation

Of the 152 species of Odonata endemic to Madagascar, 88 species (58%) are currently classified as 'Data Deficient' by the IUCN (SCHÜTTE et al. 2018). This emphasizes the considerable lack of knowledge that exists within this taxon. Presently the Sainte Luce littoral forest is severely fragmented, and although some of this fracturing appears to be natural (VIRAH-SAWMY et al. 2009) almost all patches are now heavily degraded as a result of human activities. Charcoal production, commercial logging, increasing pressures for community resources and slash and burn agriculture (tavy) are all exacting a heavy toll on the remaining forests. Undoubtedly however the largest threat to the local environment comes from the proposed mining strategy of RioTinto/QMM, which is anticipated to begin operations in the coming decade (CADOTTE et al. 2002; WATSON et al. 2005; TEMPLE et al. 2012). Based on satellite imagery from 2019 (Google Earth) and the projected mining area proposed by QMM (TEMPLE et al. 2012) there will be an estimated 57% loss of current littoral forest in Sainte Luce, including the total loss of 12 of the 17 existing fragments. Besides the clearance of large swathes of littoral forest, the mining operation is expected to drastically alter the wider Sainte Luce landscape and greatly impact all aquatic habitats within the mining footprint. Increased turbidity, water pollution, siltation and eutrophication of important water bodies from intensive mining operations have recently been identified as the major conservation threat to the Odonata in the southeast by the IUCN Global Species Programme (SCHÜTTE et al. 2018). The same report also highlighted the littoral forest environments of the southeast, as a salient hotspot for Odonata biodiversity, supporting noteworthy species richness as well a high number of threatened and 'Data Deficient' (IUCN) species. It is clear that the littoral forests provide an important habitat for Odonata biodiversity in Madagascar, and a great deal of research work remains to be done. However the long-term survival of this ecosystem is currently uncertain, despite

repeated calls for it to be recognised and properly regarded as an exigent conservation priority.

Given the limited available distributional information for *Libellulosoma minutum*, this rediscovery again highlights the importance of the Sainte Luce littoral forests for the conservation of globally important biodiversity. Any serious future conservation or mining strategy must recognize the inherent value of freshwater bodies for the continual preservation of biodiversity in the area, and include them in long-term monitoring and conservation plans.

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