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Scientific Note

Southernmost record of the threatened *Platycypha amboniensis* Martin, 1915 (Odonata: Chlorocyphidae), endemic to the highlands of Central Kenya

Anthony Karani[1,2], Laban Njoroge[3]

[1]University of Embu, Embu, Kenya; [2] Centre for Ecosystem Restoration Kenya, Limuru, Kenya; [3] National Museums of Kenya, Nairobi, Kenya.
Corresponding author: akaranigold@gmail.com

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Abstract. Habitat fragmentation poses a significant global challenge to tropical forests, impacting on species, including endemic aquatic insects. Peripheral populations of range-restricted species are particularly vulnerable in rapidly changing landscapes. This study presents the southernmost occurrence of Kenya Jewel (*Platycypha amboniensis* Martin, 1915) (Odonata: Chlorocyphidae) and the first from a restored forest in upland Kenya. This damselfly is globally threatened, extremely rare in the region, and is confined to the montane streams of Central Kenya's highlands. This occurrence is compared with the species' distribution in Central Kenya, with a discussion on conservation measures. This finding not only extends the known range and extent of occurrence of *P. amboniensis* but also provides evidence that the species is persisting in isolated patches outside protected areas, necessitating urgent conservation action.

Keywords: montane streams, conservation, ecosystem restoration, Brackenhurst Botanical Garden.

Dragonflies and damselflies (Odonata) are threatened globally. Among the major causes of population declines include change in land uses, water pollution and degradation of freshwater ecosystems that are essential for their survival (Clausnitzer et al. 2011). In East Africa, habitat loss due to deforestation, agricultural expansion, and urban development poses significant risks to these species (Clausnitzer 1999). Kenya jewel [*Platycypha amboniensis* Martin, 1915 (Odonata: Chlorocyphidae)] is a rare damselfly endemic to the highlands of Central Kenya. This damselfly is one of the four threatened odonates that are also found in the region (Njoroge et al. 2017). These include 1) giant sprite [*Pseudagrion bicoerulans* Martin, 1907 (Odonata: Coenagrionidae)]; 2) Maathai's longleg [*Notogomphus maathaiae* Clausnitzer & Dijkstra, 2005 (Odonata: Gomphidae)]; and 3) intermediate claspertail [*Onychogomphus nigrotibialis* Sjöstedt, 1909 (Odonata: Gomphidae)]. The males of *P. amboniensis* are characterised by black femur and bright orange tibiae that are white anteriorly and slightly flattened (Clausnitzer 1999). The male's abdomen is dorso-laterally flattened, reddish in color with black dorsal carinae, a sky-blue abdomen on the dorsal surface of segments S5-S10, and rufous on segments S2-S4. The tibiae are not enlarged in females, and white colouration on the inner side is absent. The abdomen of the female is rounded, striped and reticulated with black to dull yellow-brown or greenish yellow coloration (Fraser 1950).

There is limited knowledge about the reproductive ecology of *P. amboniensis*, so it has been assumed that the species has biological characteristics similar to closely related species, especially the common dancing-jewel [*Platycypha caligata* (Selys, 1853) (Odonata: Chlorocyphidae], a well-studied species that is widespread in Africa (Martens 2003). Jewels (Chlorocyphidae) rely on well-oxygenated water for reproduction and feeding because the larvae develop in lotic habitats (Dijkstra & Clausnitzer 2014). Fully dependent on montane forest streams, *P. amboniensis* is classified in the IUCN Red List as Critically Endangered (CR B1ab (iii) + 2ab (iii) (*sensu* Clausnitzer 2018)) due to extensive habitat loss as a result of forest clearance (Clausnitzer et al. 2012; Njoroge et al. 2017). The extent of occurrence was reported as below 100 km^2 with an area of occupancy of less than 10 km^2, and from altitudes between 1,600 and 2,000 m above sea level (Clausnitzer 2018).

The degradation of freshwater habitats in the Afro-tropical montane forests due to pollution, water abstraction, and habitat fragmentation is a direct threat to the reproductive success and survival of endemic species. Conservation of *P. amboniensis* is crucial for maintaining biodiversity and ecosystem health because damselflies play key roles in aquatic food webs and serve as bioindicators of environmental quality (Clausnitzer et al. 2011). There is a significant gap in understanding species occurrences, reproductive ecology, and population status of peripheral populations. While much focus is placed on core populations, forest fragments experience different environmental pressures and are often understudied, leaving a significant void in conservation efforts (Simaika & Samways 2018). Peripheral populations of threatened species are particularly vulnerable to landscape changes (Orioli et al. 2021). Here, we confirm the presence of *P. amboniensis* at the southernmost edge of its occurrence in a restored forest and provide an overview of the species' distribution and conservation status in the highlands of Central Kenya.

A single male of *P. amboniensis* was encountered at Brackenhurst Botanical Garden and Forest, located 25 km north of Nairobi, on Mar 21, 2024, and uploaded to iNaturalist and later identified by peers. As this research grade record was unique and isolated, field surveys were undertaken to ascertain the identity of the species, observe reproductive behaviour, and occupancy. These surveys followed an adaptive cluster design as recommended by Henrys et al. (2024). At first, five points with characteristics similar to the site of initial observations were identified and monitored until re-sightings were confirmed. Four out of these turned positive, and a 100 m line transect was set at each of these points. These transects were monitored three times (once a week), and counting was replicated in field surveys that were undertaken in April 2024, September 2024, and February 2025. No research permits were obtained for fieldwork because the sampled localities are private property and not protected.

Sampling of damselflies was standardised to ensure replication following the Odonata sampling protocol (Cezário et al. 2021): 1) Adult

damselflies were recorded at a distance of 5 m (20 intervals) ahead of the observer and a width of 2.5 m for each side; 2) damselflies were captured with a telescopic sweeping net (32 cm diameter, 56 cm deep, and 100 cm handle). Once intercepted, morphological features (body length, wing length, and abdomen length) were measured in the field using a digital callipers (accuracy 0.01 mm) following the guidelines of Novella Fernandez (2024) and immediately released afterwards; 3) using a dipnet, movable stones were scooped or lifted by hand from the water and scanned for the presence of larvae and immediately returned afterwards; 4) after the last sampling of 2025, four specimens (two adult males, one male larvae, and one adult female) (Fig. 1) were collected using the above method and deposited in absolute ethanol at the entomological collection of the National Museums of Kenya. The abundance was calculated by averaging the number of individuals encountered in replicated counts per transect per sampling period. The proportion of occupied sites was predicted using a zero-inflated Poisson model (*sensu* Dénes et al. 2015; Nolan et al. 2022) with abundance as the response variable and sampling season and transect as the predictors.

Data on the species' distribution in the core populations were compiled from unpublished observations and social media posts that were confirmed by experts. Research-grade observations were retrieved from iNaturalist using the 'rinat' package (Barve & Hart 2022), while records with geospatial coordinates were obtained from the Global Biodiversity Information Facility (GBIF 2023) using the 'rgbif' package in R (Chamberlain et al. 2025). Occurrence data were cleaned, duplicate records were removed, and a map of occurrences was plotted using QGIS.

A zero-inflated Poisson model using repeated counts (log-likelihood = -109.6, df=8, AIC=235.26) predicted a site occupancy of 16.7% (13.8 - 18.8). On average, 23 (18 - 28) damselflies were counted every sampling occasion, which translated to a population density of 0.058 sqm^{-1}. These included two middle instar larvae encountered in February 2025. There was a significant difference between the size of males (n=11) and females (n=6) from which measurements were recorded ($p < .001$). The males were larger (total length 33 - 34.5 mm), but the females were shorter (29.5 - 30.5 mm). The wings of the females (25.5 - 26.5mm) were longer than those of the males (24 - 25 mm). The abdomens were longer (20.5 - 22 mm) in males but shorter (18.5 - 19.5 mm) in females.

A total of four reproductive behaviours (patrol flight, perching, territorial display, and tandem) were associated with males (n=59) while three (perching, tandem and oviposition) were associated with females (n=13). The first group of males (11.9%) was observed patrolling the stream banks. This happened when there was direct sunlight in the banks, presumably to inspect the banks for quality oviposition sites before settling on and defending a territory. An additional 49.2% were observed perched on stones and emergent deadwood or, when stones were lacking, on emergent vegetation and tree roots. They left the territory when direct sunlight ceased, returned regularly to these territories and excluded intruders with territorial flights.

Territorial flights were recorded for 22% of the males. In these flights, the resident males made a circular flight whenever an intruder passed by the territory, usually returning to the original perching site in the territory. Whenever an intruder attempted to perch, the resident flew directly towards the intruder. These aggressive interactions did not involve physical contact. The intruder (sometimes two or more) and the resident male faced each other head-to-head. These males were circa 5 cm apart, often made an upward spiral movement, all wings beating, and sometimes raised their abdomens and flashed the orange and white parts of the tibiae. This took 9 (3 - 13) seconds and was followed by a strong ascending flight away from the territory, usually with both males flying in the same direction. The intruders flew away from the territory, in parallel or often chased by the residents. The residents then made a spiral flight back to the territory. This was repeated several times, but in most cases the intruders did not return to the territory immediately after the territorial display. The remaining 16.9% of the males were observed in tandem with females. Tandem was achieved following a brief courtship display, circa 8 seconds, where the male flashed the orange and white tibiae while circling around a female perched within the territory.

Females were observed in tandem with the males (77%). Copulation lasted for 45 seconds (33 - 56) since the beginning of tandem formation for the six timed observations. Copulation was often interrupted by intruders and sun intervals. Following successful copulation, the females were transported in tandem to the oviposition site. Oviposition took place on dead plant material near the water surface. The female laid eggs, often taking low flights to lay them in other high-quality driftwoods in the male's territory while the males

Figure 1. *Platycypha amboniensis* Martin, 1915 (Odonata: Chlorocyphidae): **Upper row:** a male and a female from Mount Kenya; **lower row—**a male and a larva from Brackenhurst Botanical Garden, Tigoni, Kenya. Not to scale.

continuously defended the territory during oviposition (non-contact guarding). When oviposition was interrupted by intruders and sun intervals, females returned to the males' territory and left after laying the eggs. The remaining 23% of the females were observed perching along the stream bank, with no evidence of reproductive activity.

A total of 51 unique records were obtained from verified observations by citizen scientists and experts (Tab. 1, Fig. 2).

Table 1. Observations of *Platycypha amboniensis* Martin, 1915 (Odonata: Chlorocyphidae) from Kenya.

Observations	Source	Number of occurrences	Proportion
Citizen scientists	GBIF	13	25.5%
	iNaturalist	6	11.8%
	Social media	5	9.8%
Experts records	Field surveys	19	37.25%
	Historical records	8	15.7%

It is evident that *P. amboniensis* is a resident species at Brackenhurst Botanical Garden and Forest. The species was encountered throughout the survey period with a reasonable proportion of occupied sites, despite having an extremely low population density for an insect species. The body length, abdomen length, and wing length are comparable to that of core populations (Karani et al. 2025). The observation of reproductive behaviour, including courtship, copulation, oviposition, and the presence of larvae, confirms that this is a breeding population. Despite being larger in body and wing size, *P. amboniensis* compares with the observation of behavior in *P. caligata* in being sexually dimorphic, and males defending territories, courtship displays that involve males waving their legs, females being carried in tandem by the male to the site of oviposition, and eggs being laid on driftwood (Carpenter 1928; Consiglio 1976; Robertson 1982a; 1982b; Rehfeldt 1989; Jennions 1998). It was known that *P. amboniensis* occurs in Mount Kenya and the Aberdare Range, where the type specimen and all hitherto known occurrences were recorded (Clausnitzer et al. 2012; Njoroge et al. 2017; Claisnitzer 2018). With the species being dependent on forested streams, it was thought that the populations outside forested areas had been extirpated by agricultural expansion and deforestation, and therefore this occurrence was most unexpected. Historical evidence shows that the area around Limuru was a forested region connected to the lower parts of the Aberdare Range, but changes in land use transformed the landscape into agricultural lands dominated by tea plantations and human settlements (Ofcansky 1984).

The restored forest at Brackenhurst is surrounded by tea plantations and edges form ecotones with adjoining habitats. In addition, there are research grade records of *P. caligata* a few kilometres south of the current observation, while these two species do not occur syntopically. The newly found population is not only an isolated record but also towards the edge of the species distribution. Research has shown that insects differentially respond to habitat area and the degree of isolation, with rare specialists being susceptible and negatively impacted by fragmentation, while generalists thrive due to altered resource allocation (Steffan-Dewenter & Tscharntke 2000; Dolný et al. 2014). This new population is important because it may act as a source pool, from where these damselflies disperse through corridors to smaller, isolated fragments (sinks) that support lower species diversity (Orioli et al. 2021).

It is not clear whether *P. amboniensis* was always present in Brackenhurst, and it would not be surprising if the species returned recently following ecological restoration. There is evidence that forest-dependent primates such as the Mount Kenya Guereza [*Colobus guereza kikuyuensis* Lönnberg, 1912 (Primatas: Cercopithecidae)] were absent when the forest was dominated with exotic species and returned following ecological restoration (Shaw et al. 2016). There is growing consensus that forest restoration addresses loss of biodiversity, restores natural capital, and uplifts the forest-dependent communities (Beaune & Sellier 2021; Romanelli et al. 2022). Since insects quickly respond to habitat perturbations, they qualify as suitable indicators for ecological changes (Samways et al. 2020; Piczak et al. 2024).

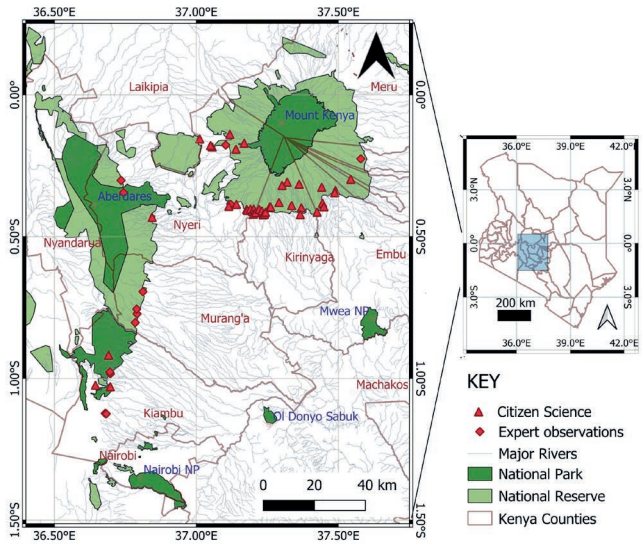

Figure 2. The current distribution records of *Platycypha amboniensis* Martin, 1915 (Odonata: Chlorocyphidae) in Kenya, based on citizen science occurrences (red triangles) and expert observations (red diamonds). The southernmost record is an isolated point located 25 km north of Nairobi.

The habitat of *P. amboniensis* lies in fertile and densely populated areas that are fragmentary in nature. The ecological niche of *P. amboniensis* in Kenya is unknown, with only limited research-grade observations, which makes it difficult to perform species distribution modelling and population viability analysis. In addition, the fate and conservation of peripheral populations remain unknown, and the genetic diversity of this species is yet to be established, especially whether this southernmost population, due to its isolation, exhibits unique genetic characteristics compared to other populations. Research has shown that geographic peripherality and anthropogenic pressures affect genetic diversity in endangered damselfly species (Lévêque et al. 2024). The populations of the sympatric *P. bicoerulans*, for instance, exhibit genetic drift and were subsequently divided into three subspecies occurring in different Afromontane regions of Kenya (Dijkstra et al. 2007). Notably, *P. amboniensis* occurs within protected areas, in habitats shared with *P. bicoerulans* and *N. maathaiae,* while the populations of *O. nigrotibialis* occur in the lowlands between 1,000 and 1,700 m ASL that largely fall outside protected areas.

In conclusion, we present a new observation that not only extends the known range and extent of occurrence of *P. amboniensis* but also provides evidence that the species is persisting in isolated patches outside protected areas, especially those associated with forest restoration. This evidence is important to revise the conservation status of *P. amboniensis* to align with the highlighted emerging challenges. To safeguard this unique species, there is a need for 1) conservation efforts for protection of highland ecosystems, 2) conservation genetics as a tool to understand the diversity of *P. amboniensis* populations, 3) habitat restoration focused on improving water quality and stable streamflow for the survival of *P. amboniensis*, 4) community-based conservation programmes in monitoring and protecting highland streams, and 5) active monitoring programmes along key rivers and streams in protected areas in order to conserve the damselfly and its habitat.

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Author's Contributions

AMK: Conceptualisation, Formal Analysis, Methodology, Investigation, Writing - original draft; Writing - review & editing. LN:

Data and resources, Writing - Review & editing, Validation.

Conflict of Interest Statement

The authors declare that there are no conflicts of interest.

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