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Platymeris rhadamanthus Gerstaecker, 1873 (Heteroptera: Reduviidae) – local knowledge and new records from Malawi, with notes on biogeography and taxonomy of the genus *Platymeris*

Short title Assassin bug *Platymeris* in Malawi

Abstract Assassin bugs of the genus *Platymeris* are quite common in Afrotropics. They are important as model organisms, lab pets and potential biological control agents; still, their ecology and behaviour in the native habitat is poorly studied. This paper presents information on local knowledge of *Platymeris rhadamanthus* in Malawi, providing valuable cues on its ecology and biogeography. The findings are evaluated using *Platymeris* specimens from the collection of the Zoological Museum Hamburg as well as records on the citizen science platform iNaturalist.org. Some general notes on the taxonomy and biogeography of the genus *Platymeris* are presented.

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Introduction

Platymeris Laporte, 1833, is an Afrotropical genus of large assassin bugs (Heteroptera: Reduviidae) that includes 13 species according to the world catalogue of the family (Maldonado Capriles 1990). Representatives of the genus, especially *Platymeris biguttatus* (Linnaeus, 1767) and *P. rhadamanthus* Gerstaecker, 1873, are often kept as pets or lab animals (Li et al. 2010). They have been used as model organisms in the studies of reduviid venom (Edwards 1961; Walker et al. 2019; Fischer et al. 2020) and pigment production (Zhang et al. 2019). *Platymeris* species are of potential economic importance as natural enemies of some insect pests as rhinoceros beetles *Oryctes* (Vanderplank 1958; Abd Karim et al. 2019) and cotton stainers *Dysdercus* (Couilloud 1989). Still, as Chłond & Bugaj-Nawrocka (2014) point out for *P. rhadamanthus*, its biology “in the environment, and the habitat where the species occurs is unknown”, which is also true for other representatives of the genus. Thus, observations from the areas of natural occurrence of *Platymeris* and new geographical records are valuable and well worth reporting.

Materials and methods

Observations and photographs of the first author 2017 in Karonga, Malawi, as well as interviews with local residents in 2017 and 2021 provide the data on the local knowledge of *P. rhadamanthus*. The collection of the Zoological Museum of the Center for Natural History Hamburg was browsed for specimens of *P. rhadamanthus* in search of biogeographic and taxonomic cues. Additionally, the citizen science platform iNaturalist.org was browsed for records of *P. rhadamanthus*.

The combination of characters used to identify the specimens from the photos made by the first author and those on iNaturalist is based on the most recent key to the genus, provided by Jeannel (1919). Descriptions of several other *Platymeris* species that appeared after the key was published were also consulted (Distant 1919; Bergroth 1920; Villiers 1944), as was the redescription of *P. rhadamanthus* by Chłond & Bugaj-Nawrocka (2014).

The diagnostic character combination of *P. rhadamanthus* used in the present work is as follows:

- connexivum black (excludes *Platymeris rufipes* Jeannel, 1917; *P. charon* Jeannel, 1917; *P. kavirondo* Jeannel, 1917, *P. swirei* Distant, 1919, *P. flavipes* Bergroth, 1920)
- femora black with red annuli (excludes *Platymeris biguttatus* (Linnaeus, 1758), *P. erebus* Distant, 1902, *P. swirei* Distant, 1919, *P. flavipes* Bergroth, 1920, *P. nigripes* Villiers, 1944)
- humeral angles of the pronotum with distinct spines (excludes *Platymeris guttatipennis* Stål, 1859, *P. nigripes* Villiers, 1944)
- anterior part of the pronotum rugose (excludes *Platymeris laevicollis* Distant, 1919)
- spots on the corium red or orange, not whitish (excludes *P. biguttatus* (Linnaeus, 1758))
- body outline elongated, not oval (excludes *P. biguttatus* (Linnaeus, 1758))

The species *Platymeris pyrrhula* Germar, 1837, and *Platymeris insignis* Germar & Berendt, 1856, do not belong to the genus *Platymeris* in our opinion (s. discussion).

Finally, the difference between the red and the orange form of *P. rhadamanthus* is the colour of the spots on the corium (Chłond & Bugaj-Nawrocka 2014).

Results

The first author encountered two specimens of *Platymeris rhadamanthus* in Karonga, Malawi on 24 and 25 November 2017. (9°55'53.3"S 33°56'33.7"E) The first bug was found in the bathtub, the second was flying around the room the next evening. Both can be identified as the orange form of *P. rhadamanthus* (Fig. 1). The bugs produced loud noise by their

attempts to fly away. The house is surrounded by high trees, the windows were wide open on both days.

A young local woman was in the house on the second day; she immediately recognized the flying bug and became anxious about it "spitting acid"; she refused to come anywhere near it and insisted that it had to be killed or at least taken outside immediately.

Asked about a comment to the first author's report on the encounter with the bugs, other local residents (about 8) in 2017 all reacted with great understanding for the young woman's fears. According to the reports of the locals, the bugs appear regularly in and around settlements, especially nearby artificial lights;

it seemed to be common knowledge 2017 in the area that the bugs can defend themselves by "spitting acid". Asked again in the January 2021, people (5, others than in 2017) from around the locality reported the bugs would "hiss" loudly and should rather be left alone therefore, but they did not mention an ability to "spit acid".

Malawi and neighbouring regions of Zambia and Mozambique are very poor on records of *P. rhadamanthus* (s. the map in Chłond & Bugaj-Nawrocka 2014). This is the first record of the orange form of the species from Malawi. Chłond & Bugaj-Nawrocka (2014, supplement 1) list three records of the red *Platymeris rhadamanthus* for the country – one of them simply gives "Nyassaland" as the location, whereas others name "Port Herald", a town nowadays called Nsanje (Fig. 2). It is in the very south of Malawi; the present record of *P. rhadamanthus* is the first from the north of the country, although there must be some records from Tanzania very close to north Malawian border (Chłond & Bugaj-Nawrocka 2014). The closest occurrences of the orange form published up to date are each almost a thousand kilometers away in the southern Congo, along the Kenyan-Tanzanian border, in the southernmost Mozambique or in the Republic of South Africa.



Fig. 1 A specimen of *P. rhadamanthus* from Karonga, Malawi.



Fig. 2 Records of *P. rhadamanthus* from Malawi. The dot colour indicates the orange or the red form of the species. The record from Karonga is the encounter reported here, the record from Nkhotakota Wildlife Reserve is from iNaturalist.org, the record of the red form in the South is based on the data from Chlond & Bugaj-Nawrocka 2014, supplement 1.



Fig. 3 The specimen of the orange form of *P. rhadamanthus* from the Zoological Museum Hamburg.

A study of online records at the citizen science platform iNaturalist delivered only one record of *P. rhadamanthus* from Malawi, identified using the characters listed above. This is also an orange form of the species, from Nkhotakota (<https://www.inaturalist.org/observations/66606353>), several hundred kilometers to the south from Karonga (Fig. 2).

There is a single specimen of the orange form of *P. rhadamanthus* in the collection of the Zoological Museum of the Center of Natural History in Hamburg (Fig. 3). It is from Northern Tanzania, a region where the orange form is already known (Chłond & Bugaj-Nawrocka 2014). There are also four specimens of the red form of the species in the collection; three of them also from Tanzania (one identified by Gerstaecker himself, the species author) and one without any label.

Discussion

The habit of *Platymeris* spitting venomous salivary gland secretions is known to the scientific community since Edward's description of this behaviour (Edward 1962). It is interesting to note that this habit of the bugs seems to be well known at least to a part of the local community in Northern Malawi, since several people, not specifically trained in entomology, would all recognize the bugs as a potential "acid spitters". In contrast, Tejado & Potes (2019) do indicate that *P. rhadamanthus* is well known to inhabitants of Okavango delta for its dangerousness and painful bite, but do not make any reference to the bugs spitting venom. Thus, species of the genus *Platymeris* may be quite common around human settlements or habitats modified by humans, at least in Malawi, but likely in other parts of Africa. 28 of the 50 total records of the genus *Platymeris* on iNaturalist.org, made throughout the Afrotropics, show the insect on some sort of artificial background, indicating common occurrence of the genus around human habitations. Modelling results by Chłond & Bugaj-Nawrocka (2014) point out that the species might prefer "open areas with small participation of tree vegetation", a description that could fit human-influenced environments like the one in Karonga. Malawi was indicated in the study of Chłond & Bugaj-Nawrocka (2014) as a region with suitable conditions for *P. rhadamanthus*.

There were two more records of *P. rhadamanthus* on iNaturalist.org, both of the orange form. One, labelled as *P. guttatipennis* on the site, is from Tsavo West National Park in Kenya (<https://www.inaturalist.org/observations/5434642>); the orange form of *P. rhadamanthus* is already known from around this area (s. the map in Chłond & Bugaj-Nawrocka 2014).

There is also a record from Northern Botswana, not far from the town of Sepupa (<https://www.inaturalist.org/observations/11012695>), where Tejado & Potes (2019) encountered *P. rhadamanthus*, although in their case this was the red form. The published occurrences of the orange form closest to Malawi (Chłond & Bugaj-Nawrocka 2014) are each almost a thousand kilometers away: in the southern Congo, along the Kenyan-Tanzanian border, in the southernmost Mozambique or in the Republic of South Africa. The present records of the orange form of *P. rhadamanthus* from Malawi fill the gap between these disjunct areas and indicate that this geographical disparity may result from collection bias and that the form is more widespread than previously thought.

Besides *P. rhadamanthus*, another species of the genus, *Platymeris laevicollis* Distant, 1919, is recorded for Malawi ("North Nyasa", Distant 1919). Jeannel (1919) lists two more species – *Platymeris guttatipennis* Stål, 1859, and *P. biguttatus* – occurring in "région du lac Nyassa", which makes their presence in Malawi highly likely. Four species of the 11 *Platymeris* (counted without *P. insignis* and *P. pyrrhula*, s. below) occurring in the country indicate that the local environment is highly suitable for these insects – a conclusion corresponding well with results of Chłond & Bugaj-Nawrocka (2014) and Chłond et al. (2015), whose ecological niche models determined Malawi as highly suitable for both *P. biguttatus* and *P. rhadamanthus*.

Maldonado Capriles (1990) lists 13 species of *Platymeris* in his catalogue; this list or the number of species have been widely reproduced since, e.g. on Wikipedia, but also in scientific literature (e.g. Chłond & Bugaj-Nawrocka 2014). It must be said that two species listed there most likely belong elsewhere. *Platymeris insignis* Germar & Berendt, 1856, is an amber fossil; the text and the illustration (Germar & Berendt 1856) clearly demonstrate many differences from other *Platymeris*. Thus, *P. insignis* is only 13 millimeters long (the body size of other *Platymeris* is never below 30 millimeters), there are differences in coloration and form of the head, the pronotum of *P. insignis* lacks the distinct separation into the anterior and posterior parts as is typical for *Platymeris*, its femora are not incrassated and the apex of scutellum is not produced into spine (both characters are typical for *Platymeris*). It might belong to another genus, if it is a reduviid at all; a study of the holotype would clarify the situation. Another species, *Platymeris pyrrhula* Germar, 1837, described from the Cape of the Good Hope, is also too small for the genus (13 millimeters body length), its colouration as described by the author (four red spots on the thorax, red tegmina with black spots) indicates that it might not be congeneric with other *Platymeris* spp. These might have been the reasons for Jeannel (1919) not to include *P. insignis* and *P. pyrrhula* in his key of the genus; Stål in his *Enumeratio Hemipterorum* (1874) lists *P. pyrrhula* as species incerti generis and does not list *P. insignis* at all. A revision of *Platymeris* Laporte, addressing these issues, seems to be long overdue.

The collection of the Zoological Museum of the Center of Natural History in Hamburg harbours several specimens of different species of *Platymeris*, besides the already mentioned *P. rhadamanthus*. There are four *P. biguttatus* – one from Benin, one from Guinea-Bissau (providing the first record of this species for the country) and two from

Nigeria; there is also one *P. kavirondo* from Tanzania. Five specimens from Cameroon resemble *P. rhadamanthus*, but show some untypical characters making a species assignment premature. In addition, there is a specimen from vicinity of Harar in Ethiopia whose character combination does not fit well with the published species descriptions. These specimens are currently under study and are to be a subject of a subsequent publication.

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References

- Abd Karim, F.N., Zaini, M.R., Rakibe, I., Sani, S., Hazlee, N.F.H. & Mazran, N.S.S. (2019): Status of pest, *Oryctes rhinoceros* and its natural enemies in the independent smallholder treated with different insecticides. *Agriculture, Forestry and Fisheries* 8: 89–94.
- Bergroth, E. (1920): Hemiptera from British East Africa collected by Prof. E. Lönnberg. *Arkiv för Zoologi* 12: 1–30.
- Chlond, D. & Bugaj-Nawrocka, A. (2014): Model of potential distribution of *Platyeris rhadamanthus* Gerstaecker, 1873 with redescription of species. *Zoological Studies* 53: 1–14.
- Chlond, D., Bugaj-Nawrocka, A. & Junkiert, Ł. (2015): Current and potential geographical distribution of *Platyeris biguttatus* (Linnaeus, 1767) with description of nymphs. *Zoological Studies* 54: 1–11.
- Couilloud, R. (1989): Hétéroptères déprédateurs du cotonnier en Afrique et à Madagascar (Pyrrhocoridae, Pentatomidae, Coreidae, Alydidae, Rhopalidae, Lygaeidae). *Cot. Fib. Trop.* 44: 185–226.
- Distant, W.L. (1902): XXVII. – Rhynchotal notes. – XIV. Heteroptera: Families Hydrometridae, Hemicoccephalidae, and Reduviidae (part.). *Annals and Magazine of Natural History: Series 7*, 10:57: 173–194.
- Distant, W.L. (1919): XLVI. – Ethiopian Heteroptera: some new species of Reduviidae belonging to the genera *Psytalla* and *Platyeris*. *Annals and Magazine of Natural History, Series 9*, 3: 17: 466–469.
- Edwards, J.S. (1961): The action and composition of the saliva of an assassin bug, *Platyeris rhadamanthus* Gerst. *Journal of Experimental Biology* 38: 61–77.
- Edwards, J.S. (1962): Spitting as a defensive mechanism in a predatory reduviid. In: *Proc. 11th International Congress of Entomology, Vol. 4, Vienna, 1960*: 259–263.
- Fischer, M.L., Wielsch, N., Heckel, D.G., Vilcinskas, A. & Vogel, H. (2020): Context-dependent venom deployment and protein composition in two assassin bugs. *Ecology and evolution* 10: 9932–9947.
- Germar, E.F. (1837): Hemiptera Heteroptera promontorii bonae spei, nundum descripta, quae collegit C. F. Drège, et proponit E. F. Germar. *Revue Entomologique* 5: 121–192.
- Germar, E.F. & Berendt, G.C. (1856): Die im Bernstein befindlichen Hemipteren und Orthopteren der Vorwelt. In: Berendt, G.C. (Ed.) *Die im Bernstein befindlichen organischen Reste der Vorwelt* 2. Berlin: ii+1–40.
- Jeannel, R. (1919): Hemicoccephalidae et Reduviidae. In: *Voyage de Ch. Alluaud et R. Jeannel en Afrique orientale (1911–12). Résultats scientifiques. Hemiptera, III*: 131–314.
- Li, H., Zhao, G.Y., Cao, L.M., Xu, K. & Cai, W.Z. (2010): Taxonomic and bionomic notes on the white spot assassin bug *Platyeris biguttatus* (Linnaeus) (Hemiptera: Reduviidae: Reduviinae). *Zootaxa* 2644: 47–56.
- Maldonado Capriles, J. (1990): Systematic catalogue of the Reduviidae of the world (Insecta: Heteroptera). *Caribbean Journal of Science, Special Issue. University of Puerto Rico, Mayagüez, Puerto Rico*: 1–694.
- Stål, C. (1874): Enumeratio Hemipterorum Bidrag till en Forteckning ofver alla hittills kända Hemiptera, jemte systematiska meddelanden 4. *Enumeratio reduviidarum Europae, Africae, Asiae et Australiae. Kongl. Svenska Vetenskaps Akademiens Handlingar* 12: 1–97.
- Tejado, C. & Potes, M.E. (2019): Presencia de *Platyeris rhadamanthus* Gerstaecker, 1873, (Hemiptera, Reduviidae) en Botswana. *Munibe Ciencias Naturales* 67: 95–98.
- Vanderplank, F.L. (1958): The assassin bug *Platyeris rhadamanthus* Gerst., a useful predator of the rhinoceros beetles *Oryctes boas* F. and *O. monoceros* (Oliv.). *J. Ent. Soc. S. Africa* 21: 309–314.
- Villiers, A. (1944): Nouveaux Acanthaspidae d'Afrique Orientale (Hem. Reduviidae). *Bulletin du Museum National d'Histoire Naturelle* 16: 122–127.
- Walker, A.A., Robinson, S.D., Undheim, E.A., Jin, J., Han, X., Fry, B.G., Vetter, I. & King, G.F. (2019): Missiles of mass disruption: composition and glandular origin of venom used as a projectile defensive weapon by the assassin bug *Platyeris rhadamanthus*. *Toxins* 11: 673.
- Zhang, Y., Li, H., Du, J., Zhang, J., Shen, J. & Cai, W. (2019): Three melanin pathway genes, TH, yellow, and aaNAT, regulate pigmentation in the Twin-Spotted Assassin Bug, *Platyeris biguttatus* (Linnaeus). *International Journal of Molecular Sciences* 20: 2728.