

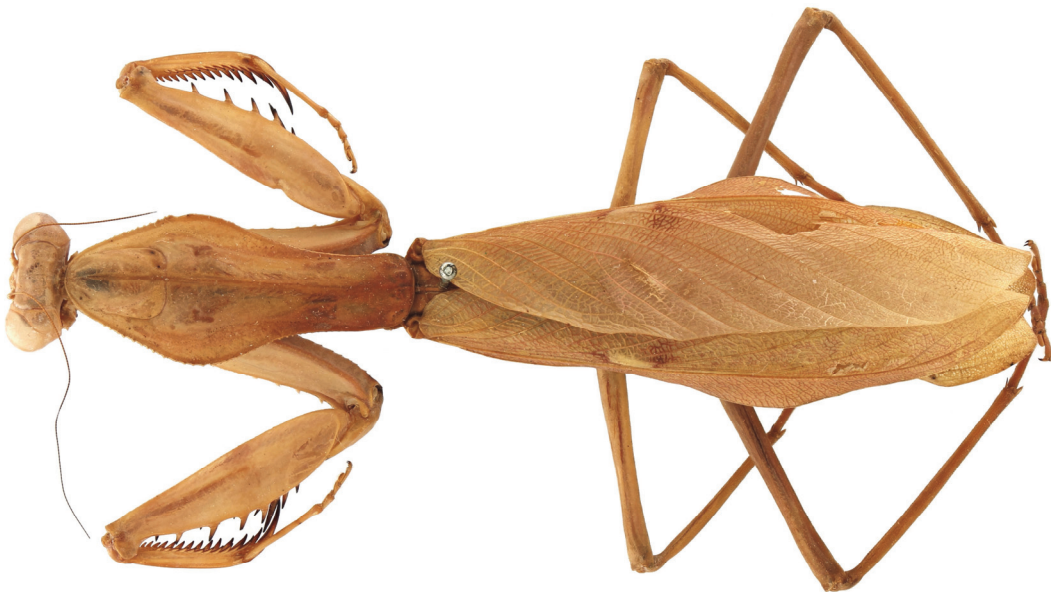
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Update on the poorly known praying mantis *Tamolanica leopoldi* (Werner, 1930) with description of the previously unknown male

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Front cover: The holotype of *Tamolanica leopoldi* (Werner, 1930). Photo taken by Florence Trus (RBINS).

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Abstract

Tamolanica leopoldi (Werner, 1930) is a large species of praying mantis endemic to the Aru Islands, a group of low-lying islands located in the Maluku province of eastern Indonesia. Until recently the species was only known from two adult females (holotype and paratype) that were collected by King Leopold III of Belgium during his nature exploration expedition to the Aru Islands in 1929. The acquisition of additional specimens recently collected on the Aru Islands allows us now, 90 years after the initial discovery of the species, to provide an important update on this very poorly known praying mantis, to discuss intraspecific variability and to finally describe the previously unknown male.

Keywords: Mantodea, Mantidae, Aru Islands, Indonesia, Endemism

Introduction

The genus *Tamolanica* Werner, 1923 was originally created as a sub-genus of *Hierodula* Burmeister, 1838 and served to accommodate some species of praying mantises previously included in *Parhierodula* Giglio-Tos, 1912, which was at that time another sub-genus of *Hierodula*. *Tamolanica* currently contains ten species of which one has two sub-species (OTTE *et al.*, Mantodea Speciesfile Online), but a critical revision of the genus is necessary to confirm species validity and to facilitate future research on praying mantis species diversity in the Oriental and Australasian region.

Tamolanica leopoldi (Werner, 1930) was originally described as *Parhierodula leopoldi* by WERNER (1930), then transferred without further explanation to the sub-genus *Tamolanica* as *Hierodula (Tamolanica) leopoldi* in BEIER (1935). Beier also provided for the first time a comprehensive diagnosis for *Tamolanica* (then still a sub-genus) and described it as follows: “Forehead between the eyes and the antenna without a tubercle. Pronotum with strongly lamellar broadened supracoxal extension, broadening not extending to the base, but ending rather abruptly in the middle of the metazone. Claw groove of the forefemora located proximally of the middle femur. Genicular lobes of the middle and hind legs rounded, with an apical spur.” *Tamolanica* was elevated to the generic rank almost 70 years later by EHRMANN (2002).

Tamolanica leopoldi was until now only known from two adult females that were collected on the Aru Islands by Leopold III of Belgium during his exploratory travels across South-East Asia and the Australasian region from 1928 to 1929. During these travels he visited many Islands that are now part of Indonesia, including the Aru Islands. New specimens of *Tamolanica leopoldi* allow us now to extend our knowledge on this elusive species, and to provide a detailed redescription of the females, and a first description of the males.

Material and methods

ILLUSTRATIONS

Photographs were taken with a Canon EOS 700D DSLR camera mounted with a Sigma AF 50mm f/2.8 EX DG macro lens and two Yongnuo Speedlite YN 460-II off-camera flashes. The photographs were processed in Adobe® Photoshop CS 5.5 to adjust levels and to perform image alignment and stacking. The stacked images were then optimized using Adobe® Photoshop Lightroom 6 to adjust exposure and sharpness.

DESCRIPTIVE CONVENTIONS AND MORPHOLOGICAL CHARACTERS

The morphological nomenclature follows BRANNOCH *et al.* (2017), SCHWARZ & ROY (2019) and VERMEERSCH (2018). Measurements were taken as detailed and illustrated in VERMEERSCH (2018). The formula to express the spine count of the raptorial legs follows BRANNOCH *et al.* (2017). Spine numbering is always performed from the proximal end towards the distal end. Profemoral spine size arrangement is represented using the letter “I” in a font size relative to the spine size within the arrangement and given from the proximal to the distal end.

OBSERVATIONS AND MEASUREMENTS

Observations were done using a Leica EZ4-W stereo-microscope. The description of the colouration is based on dry pinned specimens. All measurements are in millimetres and were taken using an electronic calliper. For paired appendages the given value represents the mean of both measurements with exception of the tegmina where only the overlapping tegmen is taken into account. Twenty-three measurements were recorded (Table 1).

SPECIMEN REPOSITORIES

The holotype and paratype of *Tamolanica leopoldi* are stored in the King Leopold III sub-collection of the Entomological collections of RBINS. The additional specimens (AS1–3) used for this publication were acquired via an online insect trader and are stored in the first author’s personal entomological collection (XVPC).

Abbreviations:

AS = additional specimen

AvS = anteroventral spine

DS = discoidal spine

PvS = posteroventral spine

Collection acronyms:

RBINS = Royal Belgian Institute of Natural Sciences, Brussels, Belgium

XVPC = Xavier Vermeersch Personal Collection



Fig. 1. *Tamolanica leopoldi* (Werner, 1930). Paratype ♀. A, habitus, dorsal view. B, habitus, ventral view. C, head, frontal view. D, left anterior leg, anterior view. C, D not to scale. © Xavier Vermeersch.

Taxonomy

Order **Mantodea**, Burmeister, 1838

Family **Mantidae** Burmeister, 1838

Genus ***Tamolanica*** Werner, 1923

Tamolanica leopoldi (Werner, 1930)

Figs 1–6

DIAGNOSIS.

Large and robust species. Head triangular with large eyes, without any projections or horns. Antennae filiform. Pronotum medium long with lateral lamellar dilatations in both sexes that abruptly end before the middle of the metazone. Procoxa completely darkened, blackish in colour on their inner side. Profemora with 4 discoidal spines, 14–15 anteroventral spines and 4 posteroventral spines. Protibiae with 14–15 anteroventral spines and 11–12 posteroventral spines. Spinal formula: F=4DS/14-15AvS/4PvS; T=14-15AvS/11-12PvS. Ratios ♀: MzL/PzL: 1.2; TgL/PL: 1.8. Ratios ♂: MzL/PzL: 2.8; TgL/PL: 2.3. Female macropterous, tegmina cover the abdomen, but incapable of flight. Male macropterous, tegmina extending further than tip of abdomen, flight capable.

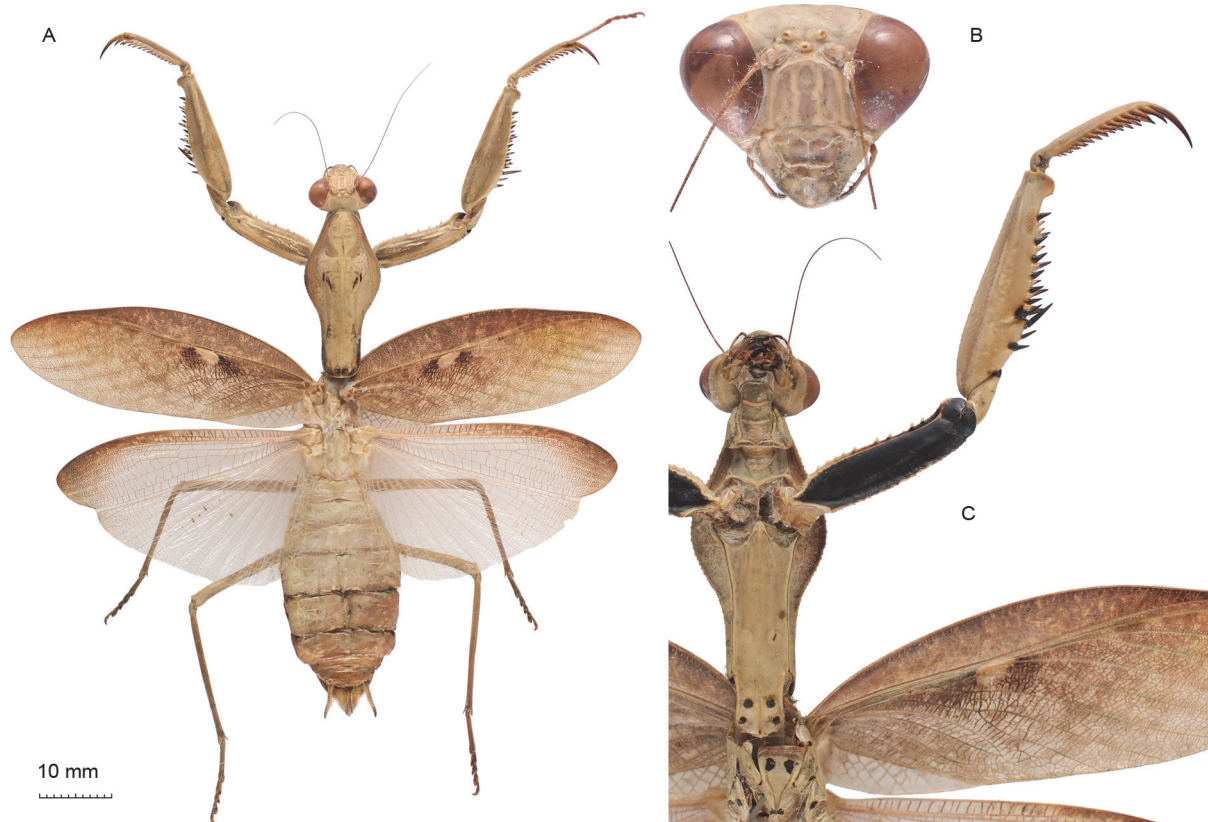


Fig. 2. *Tamolanica leopoldi* (Werner, 1930). ♀. A, habitus, dorsal view. B, head, frontal view. C, ventral view of pronotum and left anterior leg. B, C not to scale. © Xavier Vermeersch.

ETYMOLOGY. The species was named in honour of King Léopold III of Belgium (1901–1981) who collected the type specimens on the Aru Islands in March of 1929 during one of his nature exploration travels.

TYPE MATERIAL STUDIED. Holotype ♀: S. Manoembai [= Env. of Manoembai river], I. Aroe [= Aru Islands], 25.III.1929, Leg. Prince Léopold. (RBINS); Paratype ♀ (Fig. 1): same label data as holotype.

ADDITIONAL SPECIMENS. ♀ (Fig. 2): Indonesia, SE Molukkas, Aru Is., N Coast of Kobror I. Algang vill. env., 0-20m. 20-28.XII.2014. local collector leg. (XVPC); 2♂ (Figs 3–4): Indonesia, SE Molukkas, Aru Is., S. coast of Wokam I., 10-15 km NEE of Wakua vill., 0-50m. 21-30.I.2015, St. Jakl leg. (XVPC)

REDESCRIPTION

The following redescription of *Tamolanica leopoldi* (Werner, 1930) is based on the types and three additional specimens (one female and two males).


FEMALE: (Figs 1–2).

Measurements: Table 1.

Head (Figs 1–2). Triangular, only slightly wider than long with large, rounded compound eyes that does not exceed the profile of the head. Vertex flat. Ocelli big, all in same shape and size, ocellar tubercle without ridges connecting the ocelli. Lower frons transverse, with two noticeable vertical ridges internally dividing it in three equal parts. Clypeus smooth.

Thorax (Figs 1–2). Pronotum long, straight with lateral expansion. Dorsal surface smooth. Anterior margin rounded, then expanding laterally towards widest point in faintly concave

line, reaching the widest point before the middle, then narrowing down again in a strongly concave curve until margins run parallel to each other towards in posterior third of pronotum. Small denticulations along lateral margins, more prominent in lateral dilatation, nearly indistinguishable in anterior and posterior end. In some specimens four dark markings can be present, two on each side of dorsal ridge placed at maximal pronotum width, and two more, one on each side placed where the lateral dilatation ends. Posterior lateral margins and two slightly protruding tubercles at posterior margin of pronotum sometimes darkened. Narrowest width located after middle of pronotum. Cervix with two large ventral cervical sclerites of equal size and shape and strongly sclerotized lateral and intercervical sclerites, merged in the middle. Postcervical plate and furcasternite concolour and entirely smooth.

Prothoracic legs (Figs 1–2). Coxa shorter than pronotum, with about nine spinules of unequal size, irregularly implanted. Dorsal and ventral coxal lobes rounded, adjacent, dorsal lobe slightly longer, without a space between them. Femur straight, gently curved dorsally on proximal end; surface entirely smooth. Femoral brush elongated. Genicular lobes large and rounded, with very small darkened genicular spur pointing ventrally, with darkened tip. Very faint brownish transverse band situated proximally from middle. Tibial spine groove proximally placed from middle of femur. AvS unequal in size and arranged as follows: . AvS 1, 2, 4, 6, 8, 10, 12 and 15 deep black; AvS 1 and 2 with black spot at the base that connects both spines, slightly extending on anterior surface of femur; AvS 3, 5, 7, 9, 11, 13 and 14 concolour to femur and only apically infuscate; AvS 12 and 15 large but with two much smaller spines of equal size between them. Large and medium spines alternate between AvS 1 and 12, first spine being a medium one. PvS about equal in size, PvS 4 smallest, all apically infuscate. DS with different size arrangement as PvS; DS1 completely black, about same size as DS4, DS2 apically infuscate, DS3 completely black on posterior side, apically infuscate on anterior side. DS4 apically infuscate but also darkened on proximal side throughout its length. Protibiae smooth with longitudinal groove across entire length of posterior side. Tibial AvS gradually elongated towards tibial spur, AvS only apically infuscate. PvS also only apically infuscate. Tibial spur darkened apically. Protarsi not darkened; first tarsomere longer than others combined. Spinal formula: F=4DS/14-15AvS/4PvS; T=14-15AvS/11-12PvS.

Meso- and metathoracic legs (Figs 1–2). Long and slender. Femora with rounded oval shaped genicular lobes, but with a very short genicular spur only on the metathoracic femora. Tibiae with two short apical spurs. Tarsi 5-segmented. First tarsomere of mesotarsus shorter than remaining segments combined, first tarsomere of metatarsus about as long as remaining segments combined.

Tegmina and alae (Figs 1–2). Tegmina uniformly coloured or with a slightly mottled pattern, cover the abdomen completely. Stigma whitish, large and elongated, situated proximally from middle of tegmen length, with well delineated blackish spots proximally and distally from stigma.

ABDOMEN (Figs 1–2). Typical for Mantidae, gently broadening until fifth coxosternite. Tergite 10 broad, very short and rounded. Cerci densely setose, not flattened.

Table 1. Measurements and spine counts for examined material of *T. leopoldi* (Werner, 1930).


Measurements	HT (♀)	PT (♀)	AS1 (♀)	AS2 (♂)	AS3 (♂)
Total Length	78.6	71.7	77	82.6	80
Head width	10.9	10.4	10.8	9.3	4.6
Head height	10	9.7	9.3	7.1	3.4
Pronotum length	26.7	23.8	26.2	22.7	21.7
Pronotum width	11.9	10.7	11.9	9.5	9.4
Pronotum narrow width	6.1	5.7	6.1	5.2	4.8
Prozone length	7.6	6.9	7.5	6.5	6
Metazone length	19.1	16.9	18.7	16.2	15.7
Tegmen length	48.4	42.6	48.9	56.8	55.8
Ala Length	-	38.1	42.5	49.5	49.3
Procoxa length	17.9	16.9	18	15.5	14.8
Profemur length	20.8	19.3	20.6	17.5	17.6
Protibia length	14.6	12.5	14	11.2	11.5
Protarsus length	11.3	11.8	13.4	11.4	10.7
Mesofemur length	18.5	17.6	17.8	16.1	15.5
Mesotibia length	16.1	13.5	14.9	15.3	11.5
Mesotarsus length	8.8	8.5	10.2	9.3	8.6
Metafemur length	22	20.9	21.7	19.2	18.4
Metatibia length	21.7	19.7	22.6	17.9	18.2
Metatarsus length	11.9	11.6	13.5	11.4	12.2
Anteroventral femoral spine count	15/14	15/15	15/15	15/15	15/15
Anteroventral tibial spine count	14/14	14/15	14/14	14/14	13/13
Posteroventral tibial spine count	11/12	11/12	11/11	11/12	11/11

MALE: (Figs 3–4).

Measurements: Table 1.

Head (Fig. 3). Triangular, broader than high, rounded compound eyes that do not exceed the profile of the head. Vertex flat. Ocelli big, ovaloid, all in same shape and size, ocellar tubercle without ridges connecting the ocelli. Lower frons transverse, only very slightly higher than broad, with two very faint vertical ridges internally dividing it in three equal parts. Clypeus smooth.

Thorax (Fig. 3). Pronotum as in female but with less pronounced lateral dilatation. Dorsal surface smooth. Anterior margin rounded, then expanding laterally towards widest point in faintly concave line, reaching the widest point before the middle, then narrowing down again in a strongly concave curve until margins run parallel to each other towards in posterior third of pronotum. Small denticulations along lateral margins nearly indistinguishable. Cervix with two large ventral cervical sclerites of equal size and shape and strongly sclerotized lateral and intercervical sclerites, merged in the middle. Postcervical plate and furcasternite concolour and entirely smooth.

Prothoracic legs (Fig. 3). Coxa shorter than pronotum, with about eight to nine small spinules, more or less regularly implanted, growing gradually bigger towards distal end; . Dorsal and ventral coxal lobes rounded, adjacent, dorsal lobe slightly longer, without a space between them. Femur straight, gently curved dorsally on proximal end; surface entirely smooth. Femoral brush elongated. Genicular lobes large and rounded, with very small darkened genicular spur pointing ventrally, with darkened tip. Very faint brownish transverse band situated just proximally from middle. Tibial spine groove proximally placed from middle of femur. AvS unequal in size and arranged as follows: . AvS 1, 2, 4, 6, 8, 10, 12 and 15 deep black; AvS 1 and 2 with darkened spot at the base that connects both spines as in females, but not always as visible in preserved specimens; AvS 3, 5, 7, 9, 11, 13 and 14 concolour to femur and only apically infuscate; AvS 12 and 15 large but with two much

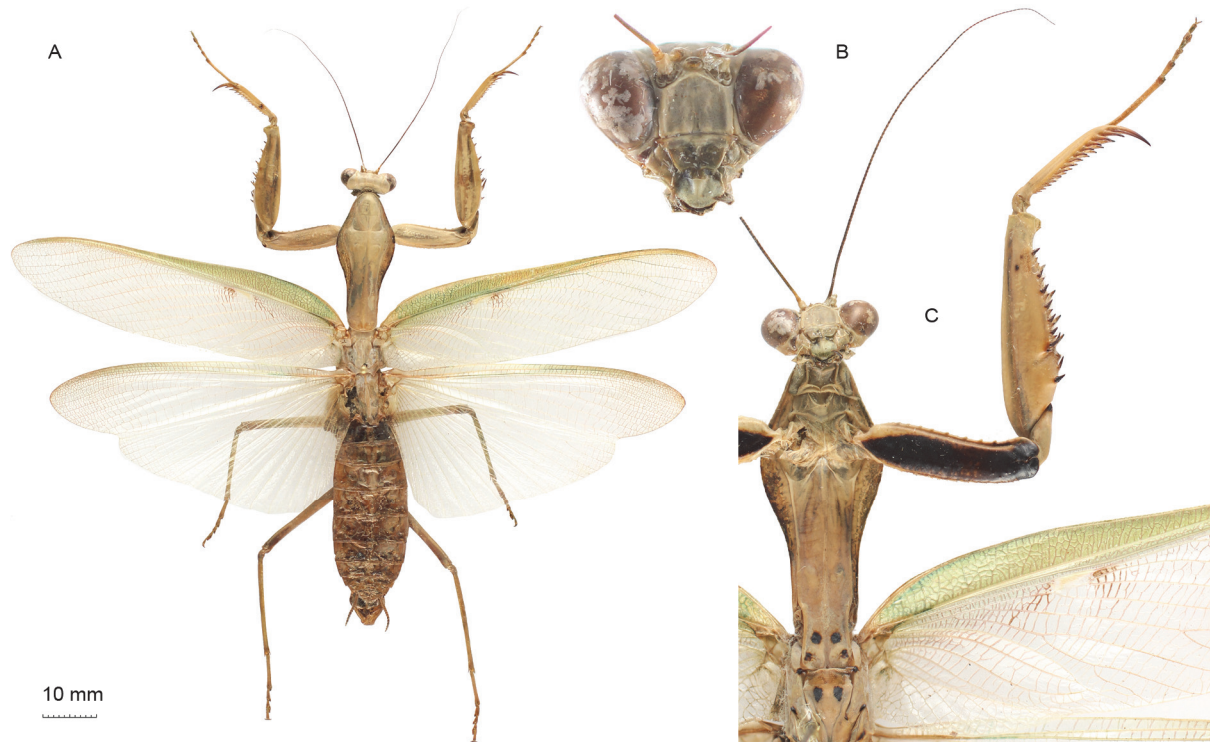


Fig. 3. *Tamolanica leopoldi* (Werner, 1930). ♂. A, habitus, dorsal view. B, head, frontal view. C, ventral view of pronotum and left anterior leg. B, C not to scale. © Xavier Vermeersch.

smaller spines of equal size between them. Large and medium spines alternate between AvS 1 and 12, first spine being a medium one. PvS about equal in size, PvS 4 smallest, all apically infuscate. DS with different size arrangement as PvS; DS1 completely black, about same size as DS4, DS2 apically infuscate, DS3 completely black only on posterior side, apically infuscate on anterior side. DS4 apically infuscate but also darkened on proximal side throughout its length. Protibiae smooth with longitudinal groove across entire length of posterior side. Tibial AvS gradually elongated towards tibial spur, AvS only apically infuscate. PvS also only apically infuscate. Tibial spur darkened apically. Protarsi not darkened; first tarsomere longer than others combined. Spinal formula: F=4DS/15AvS/4PvS; T=13-14AvS/11-12PvS.

Meso- and metathoracic legs (Fig. 3). Long and slender. Femora with rounded oval shaped genicular lobes, but with a very short genicular spur only on the metathoracic femora. Tibiae with two short apical spurs. Tarsi 5-segmented. First tarsomere of mesotarsus shorter than remaining segments combined, first tarsomere of metatarsus about as long as remaining segments combined.

Tegmina and alae (Fig. 3). Tegmina coloured only in costal area, hyaline in discoidal area. Tegmina longer than the abdomen at rest. Stigma whitish, large and elongated, situated proximally from middle of tegmen length.

Abdomen (FIGS. 3–4). Typical for Mantidae, fusiform and elongated. Tergite 10 broad and rounded. Cerci densely setose with short setae, not flattened.

Male genitalia (Fig. 4): Ventral phallomere slightly elongated, tapered towards the anterior side, with strongly developed basal lobe (bl) and one distal bifurcated process (sdp) sclerotized by sclerite L4A, with a long weakly sinusoidal shaped lateral process (sdpl) and a short almost straight median process (sdpm). Sclerite L4B very broad at its base. Apical process paa long, its apex sharply curved. Left part of sclerite L1A more or less straight. Sclerite L1 sclerotizes phalloid apophysis afa. Anterior lobe of afa (aafa) small, pointing

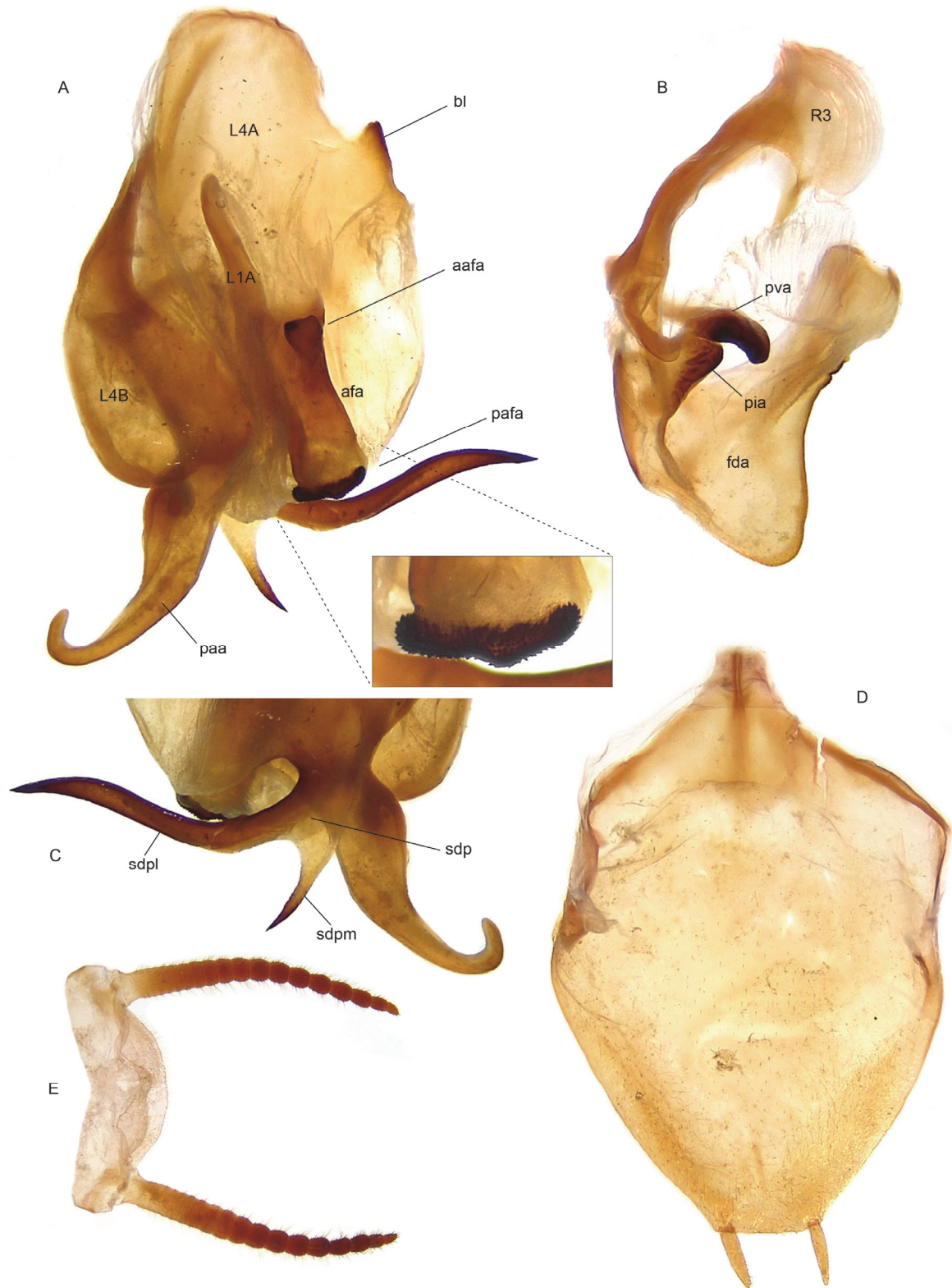


Fig. 4. *Tamolanica leopoldi* (Werner, 1930). Male genitalia, preparation GEN1904 by Xavier Vermeersch. A, left phallic complex, dorsal view. B, right phallic complex, ventral view. C, detail of distal process pda, ventral view. D, Coxosternite IX (subgenital plate), ventral view. E, Tergite X (supra-anal plate) and cerci, dorsal view. C, D, E not to scale. © Xavier Vermeersch.

dorsally with sclerotised tip. Posterior lobe of afa (pafa) large, with broad and more or less flat extremity, covered by multiple short, but strongly sclerotised spines. Main lobe fda of the right phallomere sclerotized dorsally by sclerite R1A. Sclerite R1A more or less triangular. Sclerite R3 shovel-shaped. Sclerite R1B sclerotizes pia; the latter short, the sclerotized part is transverse, with weak creases. Process pva sclerotized by R1D, finger-shaped, with very weak creases.

INTRASPECIFIC VARIABILITY

All recent specimens are uniformly brownish in coloration except for one male which was clearly green during life. The type specimens are of a lighter beige tone, with beige-brownish wings. The beige coloration of the types might be a result of the long conservation period and the effects of preservatives used in the collections, whereas more recent specimens may have better retained their natural coloration. The greenish male illustrates that both brown and green colour forms can occur in the wild, but brown seems to be the dominant colour. Although the anterior side of the coxa is entirely black in both sexes, in some specimens the black coloration does not cover the full area of the coxa, a small margin along the edges on both sides occasionally has the same colour as the remainder of the legs. This is usually more pronounced in the proximal part of the coxa.

DISTRIBUTION (Fig. 5).

Tamolanica leopoldi is an endemic species of the Aru Islands Regency (In Indonesian: Kabupaten Kepulauan Aru) which is a group of low-laying islands located in the eastern Indonesian Maluku province, covering a land area of about 8500 square kilometres. *Tamolanica leopoldi* is likely to be distributed across suitable forested habitats on several of the islands that make up the archipelago. The current status of the species in the wild is not documented, however, as an endemic species with a limited distribution it is highly vulnerable for disturbance by human activities and loss of natural habitats.

Conclusion

The many superficial species descriptions and poorly supported taxonomic rearrangements and aggregations in some Oriental praying mantis genera such as *Hierodula* Burmeister, 1838, *Rhombodera* Burmeister, 1838 and *Tamolanica* Werner, 1930 are causing much confusion in the current taxonomy of praying mantises and remain an ongoing and largely unresolved issue for taxonomists today. The taxonomic validity and phylogenetic placement of many species belonging to these genera is in urgent need of in-depth taxonomic investigation and revision. The rarity of praying mantises in scientific collections, the scarceness of recent collecting events along with the worldwide loss of biodiversity and natural habitats, the global taxonomic impediment, and the insufficient attention that praying mantises receive from the international research community all contribute to immense knowledge gaps. This lack of knowledge is well illustrated with the case of *Tamolanica leopoldi*, which was previously known from only two female specimens. After nine decades this enigmatic species is finally re-examined with representatives of both sexes, providing clear illustrations and detailed (re)descriptions. We hope that this species update will help to further stimulate much needed research on the taxonomy of praying mantises, and to bring us one small step closer to fully understand and appreciate the beauty and diversity of life on earth.

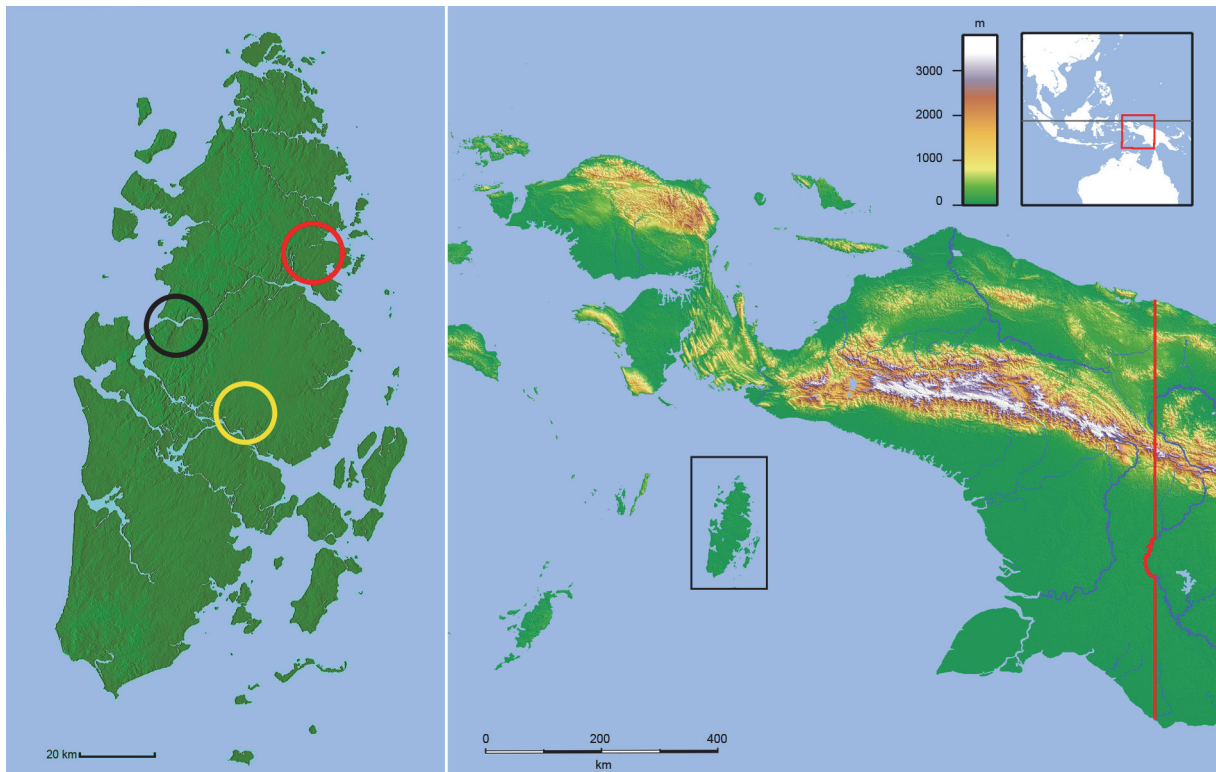


Fig. 5. Distribution map of *Tamolanica leopoldi* (Werner, 1930) with indication of the collecting localities (estimation) based on label data. Black circle, type specimens collected by Léopold III. Yellow circle, additional specimen, 1♀. Red circle, additional specimens, 2♂.



Fig. 6. View of the vegetation and forest floor, South of the Manoembai river. Photographs taken by Leopold III of Belgium during his expedition on the Aru Islands [from: VAN STRAELEN V., 1939, Plate LIX, Figs 1-2].

Acknowledgments

We are immensely grateful to Dr Yves Samyn (RBINS) for his assistance in consulting original printed reports on the expeditions of King Leopold III of Belgium and to provide high resolution scans of photographs made by King Leopold III of Belgium near the collecting site of the types. We also wish to express our sincere gratitude to Dr Wouter Dekoninck, Prof Dr Frederik Hendrickx, Jérôme Constant and Joachim Bresseel at RBINS for their valued friendship and permanent moral support of our taxonomic research. This paper is the result of the authors voluntary endeavours to perform taxonomic investigations on poorly studied taxa and received no funding.

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