Journal of Threatened Taxa | www.threatenedtaxa.org | 26 April 2015 | 7(5): 7146–7151

A new species of damselfly, *Protosticta ponmudiensis* (Odonata: Zygoptera: Platystictidae) from Ponmudi Hills in the Western Ghats of India

ISSN 0974-7907 (Online)
ISSN 0974-7893 (Print)

OPEN ACCESS

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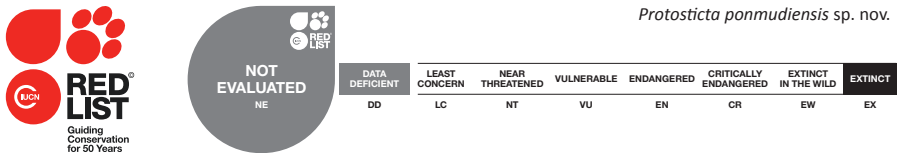
Abstract: The genus *Protosticta* Selys, 1885 has 10 species reported from the Indian region, of which seven are known from the Western Ghats. Here we report a new species, *Protosticta ponmudiensis* from the Ponmudi Hills, Thiruvananthapuram District, Kerala, in the Agasthyamalai region of the southern Western Ghats. The species is distinguished from other *Protosticta* based on its large size, bright green eyes, the broad dorsal stripe on the base of segment 7, and very distinct anal appendages.

Keywords: Biodiversity hotspots, India, Odonata, Platystictidae, *Protosticta,* species description, Western Ghats, Zygoptera.

The genus *Protosticta* Selys, 1885 (Odonata: Zygoptera: Platystictidae) contains small slender damselflies, which are distinguished by the absence of the anal bridge nervure (*ab*) in the wings, which is present in the related genus *Drepanosticta* (Fraser 1933). They are usually confined to small hill-streams in wet forests, fly amongst riparian vegetation that droops into the water, and rest on twigs and dried roots in



Protosticta ponmudiensis sp. nov.

DOI: http://dx.doi.org/10.11609/JoTT.o4145.7146-51 | **ZooBank:** urn:lsid:zoobank.org:pub:F8B0F1C0-98DC-49B1-BDE2-8B3C735BD0B2

Editor: Albert Orr, Griffith University, Nathan, Australia. **Date of publication:** 26 April 2015 (online & print)

Manuscript details: Ms # o4145 | Received 06 September 2014 | Final received 02 April 2015 | Finally accepted 05 April 2015

Citation: Kiran, C.G., S. Kalesh & K. Kunte (2015). A new species of damselfly, *Protosticta ponmudiensis* (Odonata: Zygoptera: Platystictidae) from Ponmudi Hills in the Western Ghats of India. *Journal of Threatened Taxa* 7(5): 7146–7151; http://dx.doi.org/10.11609/JoTT.o4145.7146-51

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Funding: This project was funded by research grants from the Ramanujan Fellowship (Dept. of Science and Technology, Govt. of India) and NCBS/TIFR to Krushnamegh Kunte.

Competing Interest: The authors declare no competing interests.

Acknowledgements: We thank David V. Raju, K. Jayakumar, Ramesh M.B., Charn H., Mitra Satheesh, Kiran M.R., K. Baiju, K.B. Sanjayan and Ajithkumar K., of the Travancore Natural History Society (TNHS), for field assistance. We sincerely thank K.A. Subramanian (ZSI Kolkata) for advice and technical help in describing this species. This research project was permitted by research and voucher specimen collection permits issued by the Kerala Forest and Wildlife Department (WL 10-3781/2012, dated 18/12/2012) and Government of Kerala (GO (RT) No. 376/2012/F&WLD, dated 26/07/2012). The type specimens described here are deposited in the research collections facility of the National Centre for Biological Sciences, Bengaluru.

Table 1. Overview of genus *Protosticta* Selys, 1885 in India

	Species	Distribution	IUCN Red List status
1	*P. gravelyi* Laidlaw, 1915	Western Ghats	Least Concern
2	*P. hearseyi* Fraser, 1922	Uttarakannad, Udupi, Nilgiris, Anamalais and Travancore Hills of Western Ghats	Data Deficient
3	*P. sanguinostigma* Fraser, 1922	Nilgiris, Kodagu (=Coorg), Wayanad and Ponmudi in Agasthyamalai Hills of Western Ghats	Vulnerable
4	*P. mortoni* Fraser, 1924	North of the Palghat Gap, specifically recorded from Kodagu (=Coorg) and the Uttara and Dakshina Kannada Districts (=Kanara) of Western Ghats	Not available
5	*P. antelopoides* Fraser, 1931	Munnar, Idukki and Kozhikode Districts of Western Ghats	Data Deficient
6	*P. davenporti* Fraser, 1931	South of the Palghat Gap, in the Anamalais and Travancore Hills of Western Ghats	Least Concern
7	*P. rufostigma* Kimmins, 1958	Naraikadu, Kalakad-Mundanthurai Tiger Reserve of Western Ghats	Least Concern
8	*P. himalaica* Laidlaw, 1917	Darjeeling (West Bengal), Sikkim and Assam	Data Deficient
9	*P. damacornu* Terzani & Carletti, 1998	Meghalaya	Not available
10	*P. fraseri* Kennedy, 1936	Assam	Data Deficient

shaded forest streams. Early work on *Protosticta* was by Laidlaw (1917) and Fraser (1933), followed by Kimmins (1958), Kennedy (1936) and Terzani & Carletti (1998), with additional work on Platystictidae of the Oriental Region by Zhou (1986), Wilson (1997), Hämäläinen (1999), van Tol (2005, 2008), Bedjanič (2010, 2012), Dow & Orr (2012) and Dijkstra et al. (2013, 2014).

The current taxonomy of Indian *Protosticta* Selys, 1885 is largely dependent on Fraser's work (1933). Based on Schorr-Martin et al. (2014) and considering *P. mortoni* as distinct species (Fraser 1933), there are at least 41 species in the world. The genus is represented in India by 10 species (Subramanian 2014), seven of which occur in the Western Ghats biodiversity hotspot. An overview of Protosticta Selys, 1885 in India, based on Fraser (1933), Kimmins (1958), Terzani & Carletti (1998), Kiran & Raju (2013) and IUCN (2014), is given in Table 1. Here we describe a new *Protosticta* species from the Agasthyamalai region of southern Kerala in southern Western Ghats.

Materials and Methods

The authors have been documenting the Odonata diversity of the Agasthyamalai Hills of southern Western Ghats over the past decade. During a field visit in 2013 a large unidentified male *Protosticta* was observed by the second author on a roadside hill-stream near a tea estate at Ponmudi Hills (8.746^{0}N & 77.127^{0}E), Thiruvananthapuram District, southern Kerala, India (Image 1). It was perched on a dry climber approximately 1.5m above the ground inside the shaded parts of the stream. The specimen was photographed, including its

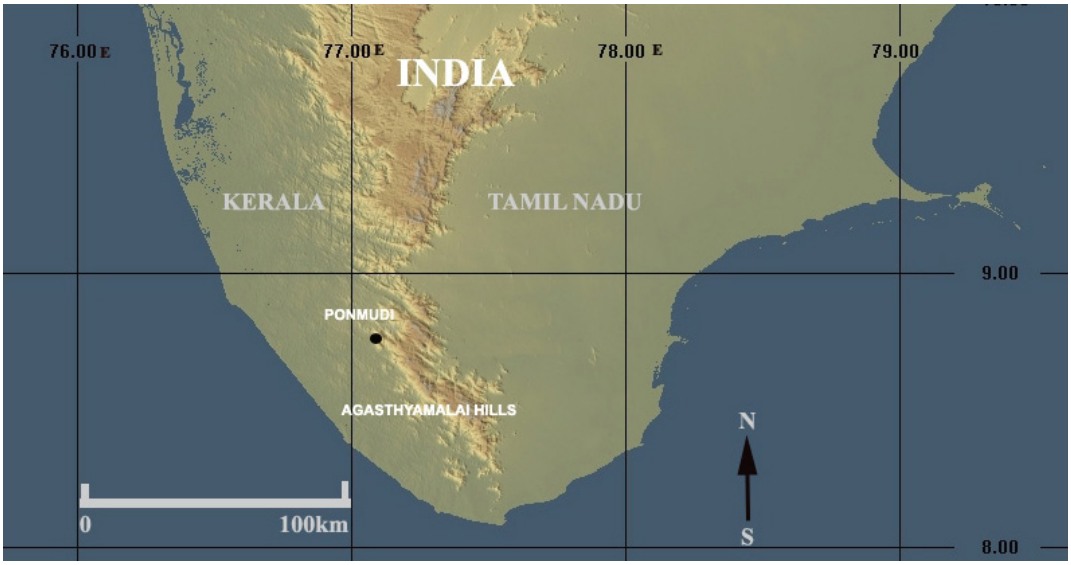

Image 1. Location of the type locality near Thiruvananthapuram, southern Kerala, India *Protosticta ponmudiensis* sp. nov.

anal appendages, but could not be placed as any known species of Indian *Protosticta*. Subsequently, we collected three more male specimens from the same locality in the Ponmudi Hills, two of which were pinned for taxonomic work and one was preserved whole in 100% ethanol for molecular phylogenetic work.

Adult specimens were photographed with a Canon EOS 7D camera body and Canon 100mm 2.8f macro lens, and anal appendages with Canon MPE65 2.8f macro lens. All four type specimens were deposited in a completely climate-controlled research collections facility at the National Centre for Biological Sciences, Tata Institute of Fundamental Research, Bengaluru (=Bangalore), India.

Species Description

***Protosticta ponmudiensis* sp. nov.**
(Images 2–5 and Figs. 1–2)

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Type material

Holotype: NCBS-PW769, mature male, 17.v.2013, roadside hill-stream near a tea estate, Ponmudi Hills, Thiruvananthapuram District, southern Kerala, India (8.746^{0}N & 77.127^{0}E), 800m, coll. by the authors.

Paratype 1: Male, NCBS-PW770, data as holotype.

Paratype 2: Male, NCBS-PW771, data as holotype.

Paratype 3: Male, NCBS-PW772, location and collectors data as holotype, 1.vi.2013. The holotype and first two paratypes are preserved dry, pinned for taxonomic studies, and the third paratype is preserved wet in 100% ethanol for molecular phylogenetic work. All types are deposited in the collections facility at the National Centre for Biological Sciences, Tata Institute of Fundamental Research, Bengaluru, India.

Description of Holotype, male (NCBS-PW769, Images 2,3 & 5)

Head: Labium yellowish-brown; labrum, clypeus and mandibles bluish-white, bordered with sky blue, lower one-third of labrum black and lower half of mandible brown. Frons metallic black, ocelli opalescent, area between the frons, ocelli and antennae brownish with metallic sheen. The rest of the head metallic greenish-black. Antennae translucent amber-brown. Eyes bright pale green. Prothorax: laterally pale yellowish-brown,

Image 2. *Protosticta ponmudiensis* sp. nov. adult male holotype (NCBS-PW769). A - lateral view; B - dorsum of head, prothorax and thorax; C - front view of head with frons; D - lateral view of head and thorax; E - 45^0 view of terminal abdominal segments.

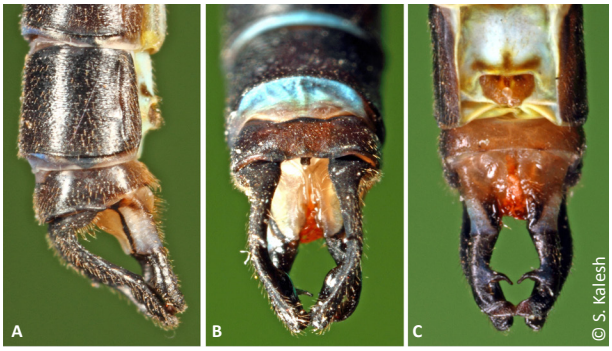

Image 3. *Protosticta ponmudiensis* sp. nov. male holotype anal appendages: A - lateral view, B - dorsal view, and C - ventral view.

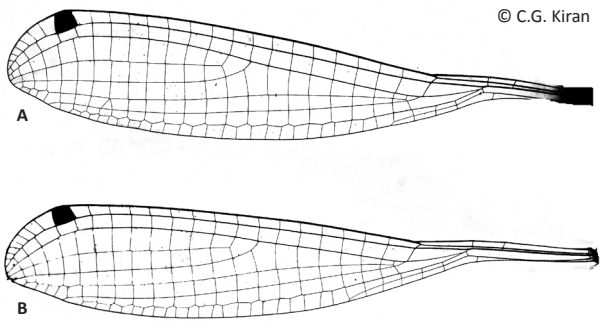

Figure 1. *Protosticta ponmudiensis* sp. nov. male wing venation. A - forewing; B - hindwing.

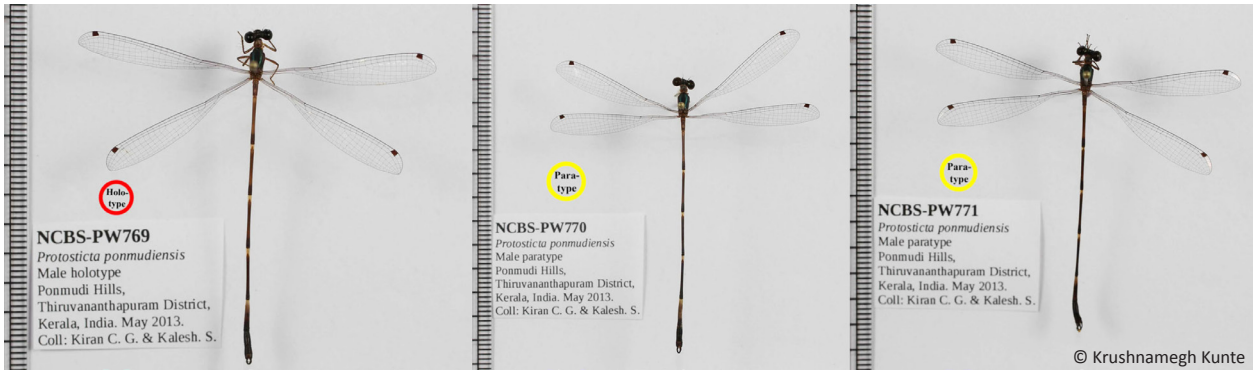

Image 4. *Protosticta ponmudiensis* sp. nov. type specimens photographed in the NCBS research collection, where they are deposited. A - holotype (NCBS-PW769), B - paratype (NCBS-PW770); C - paratype (NCBS-PW771).

dorsum of anterior lobe dirty brownish-white, middle lobe with a pale blue spot and posterior lobe is brown, furnished with a pair of short lateral spine directed posterio-laterally and internal to these there are two medial spines of same length as the lateral pair directed posteriorly (Image 5). Synthorax: dorsum dark metallic green, mesepimeron with superior half metallic green, anteriorly brown; inferior half pale blue, bordered with black near the interpleural suture. Metepimeron is pale bluish but bordered with black near the interpleural suture. The ventral side of thorax is pale, dirty white or yellowish with a greenish tinge. Legs: coxa and trochanter creamy white. Femur brownish, joints darker, flexor surface of tibia bluish-white, tarsus brown and claw reddish-brown. Wings: hyaline, nervure *IA* absent and *Cu2* markedly reduced. Sectors of arc confluent at and for some distance from origin. Nervure *ab* entirely absent (Fig. 1). Forewing with 16 and hindwing with 15 post-nodal nervures. Pterostigma black in colour and trapezoidal in shape (Fig. 1). Abdomen: blackish-brown, paler on the sides. Inferior lateral aspect of segments 1 to 3 pale bluish-white, segments 3 to 6 with

Image 5. *Protosticta ponmudiensis sp. nov.* dorsal view of Prothorax

a pale proximal annulus, narrow on S3, wider on others, continued lower laterally for a distance, less than one fifth of the length of the segment. Segment 7 with a broad bluish annular patch, paler proximally, occupying 3/4th of the dorsum and 1/3rd of the ventrum including the sternite from base. Segment 8 with single narrow bluish-white basal annulus. Anal appendages: superior

Figure 2. Superior anal appendages of Indian species of *Protosticta,* adapted from Fraser (1933).
A - *P. gravelyi*, B - *P. davenporti*, C - *P. antelopoides*, D - *P. sanguinistigma*, E - *P. damacornu* F - *P. rufostigma*, G - *P. mortoni*, H - *P. himalaica*, I - *P. hearseyi*, J - *P. ponmudiensis* sp. nov., K - *P. fraseri.*

Table 2. Morphometric measurements of type specimens of *Protosticta ponmudiensis* sp. nov.

Type	Total length (mm)	Abdomen (mm)	Forewing (mm)	Hindwing (mm)
Holotype (NCBS-PW769)	56	48	30	29
Paratype (NCBS-PW770)	57	50	28	28
Paratype (NCBS-PW771)	54	47	29	29
Paratype (NCBS-PW772)	57	48	30	29

appendages black, inferior appendages proximally dirty white, distally black with a bluish tinge especially on the ventral and proximal half and base of the spine (see below). Superior appendages are slim, gradually curved inwards but spatulate at apex, the medial margin of the spatula bears a small indentation, which is obvious in the superolateral than in the dorsal view. The length of the superior appendage is more than twice the length of segment 10 (Image 3A), and has a short interior dorsal spine directed posterior in the middle (Image 3B).

Table3. Morphometric measurements of males of Indian *Protosticta* Selys, 1885, based on Fraser (1933), Kimmins (1958), Terzani & Carletti (1998), Kiran & Raju (2013).

	Species	Male - abdomen (mm)	Male - hind wing (mm)
1	*P. gravelyi* Laidlaw, 1915	46–49	20–22
2	*P. hearseyi* Fraser, 1922	30–35	18–21
3	*P. sanguinostigma* Fraser, 1922	42–45	22–26
4	*P. mortoni* Fraser, 1924	42–43	20
5	*P. antelopoides* Fraser, 1931	53	30
6	*P. davenporti* Fraser, 1931	43–45	23–24
7	*P. rufostigma* Kimmins, 1958	46	23
8	*P. himalaica* Laidlaw, 1917	40–43	25–26
9	*P. damacornu* Terzani & Carletti, 1998	45	21
10	*P. fraseri* Kennedy, 1936	60	32
11	*P. ponmudiensis* sp. nov.	47–50	28–29

Inferior appendages with a long finger-like spine curved inwards at the junction of its middle and distal third (Image 3C). Apex of the inferior appendages twisted and

curved inwards (Image 3C). Inferior appendages slightly shorter than superior (Image 3A).

Paratype males (NCBS-PW770, NCBS-PW771, and NCBS-PW772) agree with this description of the holotype and also in morphometric measurements (Table 2), and do not display significant variation.

Female: Unknown

Early stages: Unknown.

Distinguishing features

The large size, bright green eyes and broad patch on abdominal segment 7 easily distinguishes this species from other sympatric *Protosticta* (*P. gravelyi* and *P. davenporti*) (Table 3). Further, the characteristic shape of the anal appendages distinguishes it from all known species of *Protosticta* (Fig. 2). The anal appendages have a construction similar to *P. himalaica* but differ in the shape of the superior appendage, which is longer than the inferior appendage and curved in *P. ponmudiensis*, while it is shorter than the inferior appendage and straighter in *P. himalaica.* The spine on the inferior appendage of *P. himalaica* is directed straight and medially, while in *P. ponmudiensis* it is curved inwards medially and directed posteriorly. The prothorax of *P. ponmudiensis* has two pairs of spines on its posterior lobe (medial and lateral pair), both pairs are of equal length in contrast to long medial spines in *P. antelopoides.*

Etymology

Named after the type locality (Ponmudi), a hill station near Thiruvananthapuram, Kerala, where the species was discovered.

Distribution and ecology

Known so far only from the type locality in southern Western Ghats of Kerala. The type specimens were found perched on vegetation overhanging small streams in evergreen forest patches among tea estates in the type locality. They were always found near slow-flowing hill-streams and brooks. This species shares the habitat with other *Protosticta* (*P. gravelyi* and *P. davenporti*), and with other odonates (*Caconeura* spp., *Euphea fraserii, Idionyx saffronata* and *Heliogomphus promelas*).

Remarks

Other specimens observed and photographed from the type locality: (i) a mature male, locality data same as for the holotype, seen on 28 May 2013 but not collected, (ii) a mature male, locality data same as for the holotype, seen on 5 June 2013 but not collected.

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